Terrestrial Ecological Systems of the United States and Canada

12 July 2013

Descriptions by NatureServe

About this document

This document contains brief definitions of the NatureServe terrestrial ecological systems currently identified as occurring in the United States and Canada. This ecological systems classification has been developed in consultation with many individuals and agencies and incorporates information from a variety of publications and other classifications. This report download was made possible by funding from LANDFIRE. Comments and suggestions regarding the contents of this subset may be directed to Mary J. Russo, Central Ecology Data Manager, Durham, NC, <mary_russo@natureserve.org>.

NatureServe

A Network Connecting Science With Conservation

NatureServe is a non-profit organization
dedicated to providing the scientific knowledge
that forms the basis for effective conservation.

Citation:
The following citation should be used to reference this document and in any published materials which reference ecological system and/or International Vegetation Classification (IVC) and association data:

NatureServe. 2013. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA, U.S.A. Data current as of 12 July 2013.

NatureServe
4600 N Fairfax Dr., 7th Floor
Arlington, VA 22203
703-908-1800
www.natureserve.org

TABLE OF CONTENTS

FOREST AND WOODLAND

ACADIAN LOW-ELEVATION SPRUCE-FIR-HARDWOOD FOREST (CES201.565)

CLASSIFIERS

Classification Status: Standard

Primary Division: Laurentian-Acadian (201)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch, Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland; Forest and Woodland (Treed); Mesotrophic Soil; Oligotrophic Soil; Picea (glauca, mariana, rubens) - Abies
Non-Diagnostic Classifiers: Moderate (100-500 yrs) Persistence; Sideslope; Toeslope/Valley Bottom; Glaciated; Acidic Soil; Mineral: W/ A-Horizon >10 cm; Loam Soil Texture; Sand Soil Texture; Udic; Long Disturbance Interval; W-Patch/Medium Intensity; Needle-Leaved Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Mixed evergreen-deciduous closed tree canopy
National Mapping Codes: EVT 2373; ESLF 4316; ESP 1373

CONCEPT

Summary: This system represents the Acadian and northern Appalachian red spruce-fir forest that extends to the southern boreal region of southeastern Canada. The low- to mid-elevation forests are dominated by *Picea rubens* and *Abies balsamea*. *Picea mariana* and *Picea glauca* may be present. *Betula alleghaniensis* is the most common codominant, and *Acer rubrum*, *Acer saccharum*, and *Fagus grandifolia* are sometimes present. The upland soils are acidic and usually rocky, mostly well- to moderately well-drained but with some somewhat poorly drained patches at the slope bottoms. This is the matrix forest type in the lower-elevation northern portions of this division. This system may include earlier successional patches in which *Populus* spp. and *Betula* spp. are dominant or mixed with *Picea* and *Abies* that will develop into spruce-fir forests. Blowdowns with subsequent gap regeneration are the most frequent form of natural disturbance, with large-scale fires important at longer return intervals.
Classification Comments: Differences between this and the seasonally flooded Acadian Sub-boreal Spruce Flat (CES201.562) are not well-defined; data from Canada may help to resolve this.
Similar Ecological Systems:
- Acadian Sub-boreal Spruce Flat (CES201.562)--more poorly drained and with a very well-developed bryoid layer, although the two systems can grade into one another.
- Laurentian-Acadian Northern Hardwood Forest (CES201.564)
- Laurentian-Acadian Sub-boreal Aspen-Birch Forest (CES103.020)

Related Concepts:
- Aspen - Birch Woodland/Forest Complex (Gawler and Cutko 2010) Finer
- Balsam Fir: 5 (Eyre 1980) Finer
- Black Spruce (eastern type): 12 (Eyre 1980) Finer
- Maritime Spruce - Fir Forest (Gawler and Cutko 2010) Finer
- Paper Birch - Red Spruce - Balsam Fir: 35 (Eyre 1980) Finer
- Red Spruce - Balsam Fir: 33 (Eyre 1980) Finer
- Red Spruce: 32 (Eyre 1980) Finer
- Spruce - Fir - Broom-Moss Forest (Gawler and Cutko 2010) Finer
- Spruce - Northern Hardwoods Forest (Gawler and Cutko 2010) Finer
- White Spruce: 107 (Eyre 1980) Finer

Component Associations:
- *Picea mariana - Picea rubens / Pleurozium schreberi* Forest (CEGL006361, GNR)
- *Picea mariana / Kalmia angustifolia* Woodland (CEGL006292, G4?)
- *Picea rubens - Abies balsamea - Betula papyrifera* Forest (CEGL006273, GNR)
- *Picea rubens - Abies balsamea - Betula* spp. - *Acer rubrum* Forest (CEGL006505, GNR)
- *Picea rubens - Picea glauca* Forest (CEGL006151, G4G5)

SPATIAL CHARACTERISTICS

Spatial Summary: More southerly occurrences of this system can be large patch (or even small patch) rather than matrix systems.
Adjacent Ecological Systems:
- Acadian-Appalachian Montane Spruce-Fir Forest (CES201.566)

DISTRIBUTION

Range: This system is found in northern New England, northern New York and adjacent Canada and is occasional southwards.
Divisions: 201:C; 202:C
Nations: CA, US

Subnations: ME, NB, NH, NY, PA, QC?, VT
Map Zones: 64:C, 65:C, 66:C
USFS Ecomap Regions: 211A:CC, 211B:CC, 211C:CC, 211D:CC, 211F:CC, 211I:CC, 221A:CC, M211D:CC, M221B:CC, M221C:CC
TNC Ecoregions: 60:C, 61:C, 63:C

SOURCES

References: Comer et al. 2003, Lorimer 1977
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723039#references
Description Author: S.C. Gawler
Version: 20 Aug 2007 **Stakeholders:** Canada, East, Midwest
Concept Author: S.C. Gawler **ClassifResp:** East

ACADIAN-APPALACHIAN MONTANE SPRUCE-FIR FOREST (CES201.566)

CLASSIFIERS

Classification Status: Standard

Primary Division: Laurentian-Acadian (201)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane; Forest and Woodland (Treed); Ridge/Summit/Upper Slope; Picea (glauca, mariana, rubens) - Abies
Non-Diagnostic Classifiers: Moderate (100-500 yrs) Persistence; Glaciated; Mesotrophic Soil; Oligotrophic Soil; Acidic Soil; Mineral: W/ A-Horizon >10 cm; Loam Soil Texture; Udic; Long Disturbance Interval; W-Patch/Medium Intensity; Needle-Leaved Tree; Broad-Leaved Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Mixed evergreen-deciduous closed tree canopy
National Mapping Codes: EVT 2374; ESLF 4317; ESP 1374

CONCEPT

Summary: This is the matrix forest system in the montane spruce-fir region of the northern Appalachian Mountains, extending east through the Canadian Maritimes. It occurs mostly upwards of 457 m (1500 feet) elevation and is restricted to progressively higher elevations southward. Northward, it is often contiguous with Acadian Low-Elevation Spruce-Fir-Hardwood Forest (CES201.565). This system often forms a mosaic of strongly coniferous patches and mixed patches, with occasional smaller inclusions of northern hardwoods, but is overall more than 50% coniferous. *Picea rubens* and *Abies balsamea* are the dominant conifers. Gaps formed by wind, snow, ice, and harvesting are the major replacement agents; fires may be important but only over a long return interval.
Classification Comments: This system can occupy an intermediate elevation position between Acadian Low-Elevation Spruce-Fir-Hardwood Forest (CES201.565) and Acadian-Appalachian Subalpine Woodland and Heath-Krummholz (CES201.568), and it could arguably be combined with one of those, probably the former. However, in the southern part of its range, it often occurs without either of these other systems. It is distinguished, in concept, from Acadian Low-Elevation Spruce-Fir-Hardwood Forest (CES201.565) by the presence or greater abundance of montane species such as *Sorbus americana* or *Sorbus decora, Dryopteris campyloptera, Oxalis montana*, etc., and by occurring at higher positions in the toposequence. It is generally above northern hardwood forests, while Acadian Low-Elevation Spruce-Fir-Hardwood Forest (CES201.565) is generally below (or at similar elevations to) northern hardwood forests. More careful review is needed to determine if it should remain a separate system.
Similar Ecological Systems:
- Acadian-Appalachian Subalpine Woodland and Heath-Krummholz (CES201.568)
- Central and Southern Appalachian Spruce-Fir Forest (CES202.028)

Related Concepts:
- Balsam Fir: 5 (Eyre 1980) Finer
- Fir - Heart-Leaved Birch Subalpine Forest (Gawler and Cutko 2010) Finer
- Paper Birch - Red Spruce - Balsam Fir: 35 (Eyre 1980) Finer
- Paper Birch:18 (Eyre 1980) Finer
- Red Spruce - Balsam Fir: 33 (Eyre 1980) Finer
- Red Spruce - Yellow Birch: 30 (Eyre 1980) Finer
- Red Spruce: 32 (Eyre 1980) Finer
- Spruce - Fir - Wood-sorrel - Feather-moss Forest (Gawler and Cutko 2010) Finer
- Spruce - Northern Hardwoods Forest (Gawler and Cutko 2010) Finer

Component Associations:
- *Abies balsamea - (Betula papyrifera var. cordifolia)* Forest (CEGL006112, GNR)
- *Betula alleghaniensis - Picea rubens / Dryopteris campyloptera* Forest (CEGL006267, GNR)
- *Picea rubens - Abies balsamea - Betula* spp. *- Acer rubrum* Forest (CEGL006505, GNR)
- *Picea rubens - Abies balsamea / Sorbus americana* Forest (CEGL006128, G3G5)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Acadian Low-Elevation Spruce-Fir-Hardwood Forest (CES201.565)
- Acadian-Appalachian Subalpine Woodland and Heath-Krummholz (CES201.568)

Adjacent Ecological System Comments: Northward, it is often contiguous with Acadian Low-Elevation Spruce-Fir-Hardwood Forest (CES201.565). At higher elevations it can transition to Acadian-Appalachian Subalpine Woodland and Heath-Krummholz (CES201.568).

DISTRIBUTION

Range: This system is found at higher elevations of northern New England and the Adirondacks, extending north along the mountains and higher hills into Canada and occurring southward in the Catskills.
Divisions: 201:C; 202:C

Nations: US
Subnations: MA, ME, NH, NY, VT
Map Zones: 64:C, 65:C, 66:C
USFS Ecomap Regions: 211Ia:CCC, 221A:CC, M211A:CC, M211Df:CCC, M221B:CC, M221C:CC
TNC Ecoregions: 60:C, 61:C, 63:C

SOURCES

References: Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723038#references
Description Author: S.C. Gawler
Version: 20 Aug 2007
Concept Author: S.C. Gawler
Stakeholders: East
ClassifResp: East

ALASKA SUB-BOREAL MOUNTAIN HEMLOCK-WHITE SPRUCE FOREST (CES105.103)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Montane]; Forest and Woodland (Treed); Sideslope; Boreal [Boreal Oceanic]; Picea X lutzii; Tsuga mertensiana
Non-Diagnostic Classifiers: Very Long Disturbance Interval; F-Landscape/High Intensity
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2678; ESLF 4282; ESP 1678

CONCEPT

Summary: This ecological system occurs on sideslopes and rolling terrain on the inland side of the Kenai and Chugach mountains and represents a transition from maritime forests to south-central boreal forests. Soils are mesic and derived from colluvium, glacial deposits, or residual bedrock. Permafrost is rare. *Picea X lutzii* is the dominant spruce and *Tsuga mertensiana* is codominant in the canopy and has at least 15% cover. The major disturbance processes include fungal pathogens, human disturbance, fire, blowdown, and insect infestations.
Classification Comments: This system is known as Boreal Transition Mountain Hemlock - White Spruce by the Alaska Natural Heritage Program.
Similar Ecological Systems:
- Alaska Sub-boreal White-Lutz Spruce Forest and Woodland (CES105.102)
- Alaskan Pacific Maritime Mountain Hemlock Forest (CES204.142)
- Alaskan Pacific Maritime Subalpine Mountain Hemlock Woodland (CES204.143)
- Western North American Boreal Mesic Birch-Aspen Forest (CES105.108)

Related Concepts:
- I.A.1.f - Mountain hemlock (closed) (Viereck et al. 1992) Intersecting. no white spruce-mt hemlock in AKVC
- I.A.2.c - Mountain hemlock (open) (Viereck et al. 1992) Intersecting. no white spruce-mt hemlock in AKVC

DESCRIPTION

Environment: This system occurs on sideslopes and rolling terrain on the inland side of the Kenai and Chugach mountains and represents a transition from maritime forests to south-central boreal forests. Soils are mesic and derived from colluvium, glacial deposits, or residual bedrock. Permafrost is rare.
Vegetation: *Picea X lutzii* and *Tsuga mertensiana* are the dominant conifers, and *Tsuga mertensiana* has at least 15% cover. Other tree species that may be present include *Betula papyrifera* and *Populus balsamifera*. Common shrubs include *Menziesia ferruginea*, *Alnus viridis ssp. sinuata*, *Vaccinium ovalifolium*, *Oplopanax horridus*, *Vaccinium vitis-idaea*, and *Linnaea borealis*. Common herbaceous species include *Rubus pedatus*, *Cornus canadensis*, *Dryopteris expansa*, *Gymnocarpium dryopteris*, and *Equisetum arvense*. Common mosses include *Hylocomium splendens* and *Pleurozium schreberi*. Plant communities in this system are described by DeVelice et al. (1999).
Dynamics: The major disturbance processes are fire, human disturbance, blowdown, avalanches (on steeper slopes), and insect infestations. Although lightning and natural fires have historically been infrequent, wildfire plays an important role in the disturbance regime of this system. Under the natural fire regime, fires were infrequent but large. Estimates of the mean fire-return interval range from 600-800 years (Potkin 1997, Berg and Anderson 2006).

Spruce beetle (*Dendroctonus rufipennis*) infestations are a major natural disturbance of spruce forest in south-central Alaska. Forests of the Kenai Peninsula have experienced periodic beetle infestations which occasionally rise to epidemic proportions. The most recent infestation, which began in 1987, impacted 429,000 ha on the Kenai Peninsula (USFS 2004, Rude unpubl. data) out of 772,000 ha of total forested area (van Hees and Larson 1991).

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Alaska Sub-boreal White-Lutz Spruce Forest and Woodland (CES105.102)
- Alaskan Pacific Maritime Mountain Hemlock Forest (CES204.142)

Adjacent Ecological System Comments: Within the Kenai Mountains, this system occurs above Alaska Sub-boreal White-Lutz Spruce Forest and Woodland (CES105.102) and below Alaskan Pacific Maritime Mountain Hemlock Forest (CES204.142).

DISTRIBUTION

Range: This system occurs primarily in the Kenai and Chugach mountains of Alaska.
Divisions: 105:C; 204:C
Nations: US
Subnations: AK

Map Zones: 73:C, 74:C, 75:C, 77:?
TNC Ecoregions: 70:C, 71:C

SOURCES

References: Berg and Anderson 2006, DeVelice et al. 1999, Potkin 1997, Rude unpubl. data, USFS 2004, van Hees and Larson 1991, Western Ecology Working Group n.d.

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817363#references

Description Author: T. Boucher

Version: 17 Dec 2008 **Stakeholders:** West

Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKA SUB-BOREAL WHITE SPRUCE-HARDWOOD FOREST (CES105.136)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Montane]; Forest and Woodland (Treed); Sideslope; Boreal [Boreal Oceanic]; Picea glauca
Non-Diagnostic Classifiers: Very Long Disturbance Interval; F-Landscape/High Intensity
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Mixed evergreen-deciduous closed tree canopy
National Mapping Codes: EVT 2679; ESLF 4334; ESP 1679

CONCEPT

Summary: This ecological system is widespread in south-central Alaska on well-drained upland terrain. *Picea glauca* and *Betula papyrifera* are typically codominant in an open canopy.
Classification Comments: This system is known as Boreal Transition White Spruce Hardwood by the Alaska Natural Heritage Program.
Similar Ecological Systems:
- Alaska Sub-boreal White-Lutz Spruce Forest and Woodland (CES105.102)
- Western North American Boreal Mesic Birch-Aspen Forest (CES105.108)
- Western North American Boreal White Spruce Forest (CES105.104)

Related Concepts:
- I.B.1.d - Paper birch (closed) (Viereck et al. 1992) Intersecting. seral
- I.B.1.f - Paper birch-quaking aspen (Viereck et al. 1992) Intersecting. seral
- I.B.2.a - Paper birch (open) (Viereck et al. 1992) Intersecting. seral
- I.C.1.b - White spruce-paper birch-balsam poplar (black cottonwood) (Viereck et al. 1992) Intersecting
- I.C.2.a - Spruce-paper birch (open) (Viereck et al. 1992) Intersecting
- I.C.2.c - Paper birch-balsam poplar-spruce (Viereck et al. 1992) Intersecting
- II.B.1.b - Alder (closed) (Viereck et al. 1992) Intersecting. seral
- II.B.2.b - Alder (open) (Viereck et al. 1992) Intersecting. sera
- III.A.2.a - Bluejoint meadow (Viereck et al. 1992) Intersecting. seral
- III.A.2.b - Bluejoint-herb (Viereck et al. 1992) Intersecting. seral
- III.B.2.b - Fireweed (Viereck et al. 1992) Intersecting. seral

DESCRIPTION

Environment: This system typically occurs on well-drained upland terrain. Soils generally develop on surficial deposits including glacial till, colluvium, and loess. Permafrost is rare.
Vegetation: *Picea glauca* and *Betula papyrifera* are typically codominant in an open canopy. *Populus tremuloides* and *Populus balsamifera* are common canopy trees and *Picea mariana* may also be present. Common understory shrubs include *Alnus viridis ssp. sinuata, Viburnum edule, Rosa acicularis, Ribes triste, Vaccinium vitis-idaea,* and *Linnaea borealis*. Common herbaceous species include *Calamagrostis canadensis, Chamerion angustifolium, Gymnocarpium dryopteris,* and *Cornus canadensis*.
Dynamics: Although lightning strikes and natural fires are rare in the region, wildfires play an infrequent but important role in the disturbance regime of the Coastal Boreal Transition Forest PNV (Potkin 1997). Under the natural fire regime of this PNV, fires were infrequent but large (USFS 2002). Estimates of mean fire-return interval (MFI) include: (1) 800 years (Berg 2004); (2) 600 years (FRCC experts' workshop March 2004 pers. comm.); and (3) 600 years (570-3010 year range) (Potkin 1997) (5 locations in the Kenai Mountains).

Spruce beetle (*Dendroctonus rufipennis*) infestations are a major natural disturbance of spruce forests in the boreal transition region. Spruce beetles typically attack larger, slow-growing spruce, but infestations periodically escalate to epidemic levels when forest and climatic conditions are favorable for beetle expansion. During epidemic-level infestations, beetles are less selective and may attack and kill a wider range of spruce trees. Beetle outbreaks that thin stands and produce a growth release in surviving trees occur on average every 50 years in white and Lutz spruce forests on the Kenai Peninsula (Berg 2004). Spruce beetle outbreaks that produce a more substantial thinning occur at longer intervals, with the last two severe infestations occurring in the 1870s-1880s and 1987-present (Berg 2004). The beetle outbreak that began in 1987 on the Kenai Peninsula has killed over 1.3 million acres of spruce (USFS 2002). Berg (2004) found no association between spruce beetle mortality and fire in the past.

When the canopy of these forests is thinned by spruce beetle mortality, *Calamagrostis canadensis* may proliferate rapidly from its predisturbance-level network of rhizomatous roots and develop into a think sod that limits spruce regeneration within a few years (Berg 2004). Boucher (2003) found that rapid spread of *Calamagrostis canadensis* occurs primarily on sites with deep, loamy soils.

Other natural disturbances include wind, avalanche and landslides. Windthrow gap disturbances are important in both spruce and hemlock recruitment in these forests (Potkin 1997).

DISTRIBUTION

Range: This system occurs in the boreal transition region of Alaska.
Divisions: 105:C; 204:C
Nations: US
Subnations: AK
Map Zones: 73:C, 74:C, 75:C, 76:C, 77:?
TNC Ecoregions: 70:C, 71:C, 74:C, 76:C, 77:C

SOURCES

References: Berg 2004, Boucher 2003, Foote 1983, FRCC pers. comm. 2004, Potkin 1997, Rowe 1972, USFS 2002a, Western Ecology Working Group n.d., Witten 2004, Yarie 1981, Yarie 1983
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817469#references
Description Author: T. Boucher after Witten (2004)
Version: 11 Aug 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKA SUB-BOREAL WHITE-LUTZ SPRUCE FOREST AND WOODLAND (CES105.102)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane; Forest and Woodland (Treed); Boreal [Boreal Oceanic]; Very Long Disturbance Interval; Picea X lutzii
Non-Diagnostic Classifiers: Lowland; Sideslope; Toeslope/Valley Bottom; Picea glauca
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2677; ESLF 4273; ESP 1677

CONCEPT

Summary: This system occurs in the boreal transition of Alaska on well-drained upland terrain. *Picea glauca* or *Picea X lutzii* are the dominant conifers, although *Betula papyrifera, Populus balsamifera*, and *Populus tremuloides* are often present. Common shrubs include *Menziesia ferruginea, Alnus viridis ssp. sinuata, Vaccinium ovalifolium, Oplopanax horridus, Vaccinium vitis-idaea*, and *Linnaea borealis*. Common herbaceous species include *Calamagrostis canadensis, Equisetum arvense, Dryopteris expansa*, and *Gymnocarpium dryopteris*. The major disturbance processes include fire, human disturbance, blowdown and insect infestations.
Classification Comments: This system is known as Boreal Transition White Spruce by the Alaska Natural Heritage Program. Same model for Alaska Sub-boreal White Spruce-Hardwood Forest (CES105.136) and Western North American Boreal Mesic Birch-Aspen Forest (CES105.108).
Similar Ecological Systems:
- Alaska Sub-boreal Mountain Hemlock-White Spruce Forest (CES105.103)
- Alaska Sub-boreal White Spruce-Hardwood Forest (CES105.136)
- Western North American Boreal Mesic Birch-Aspen Forest (CES105.108)
- Western North American Boreal White Spruce Forest (CES105.104)
- Western North American Boreal White Spruce-Hardwood Forest (CES105.106)

Related Concepts:
- I.A.1.j - White spruce (closed) (Viereck et al. 1992) Intersecting
- I.A.2.e - White spruce (open) (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: This system occurs on well-drained soils on sideslopes, toeslopes, and inactive terraces. Permafrost is rare. Within the Kenai Mountains, it occurs at lower elevations than white spruce-mountain hemlock and mountain hemlock systems.
Vegetation: *Picea glauca* or *Picea X lutzii* are the dominant conifers. Other tree species include *Betula papyrifera, Populus balsamifera*, and *Populus tremuloides*. Common shrubs include *Menziesia ferruginea, Alnus viridis ssp. sinuata, Vaccinium ovalifolium, Oplopanax horridus, Vaccinium vitis-idaea*, and *Linnaea borealis*. Common herbaceous species include *Calamagrostis canadensis, Equisetum arvense, Dryopteris expansa*, and *Gymnocarpium dryopteris*. Common mosses include *Hylocomium splendens* and *Pleurozium schreberi* (DeVelice et al. 1999).
Dynamics: The major disturbance processes are fire, human disturbance, blowdown, and insect infestations. Although lightning and natural fires have historically been infrequent, wildfire plays an important role in the disturbance regime of this system. Under the natural fire regime, fires were infrequent but large. Estimates of the mean fire-return interval range from 600-800 years (Potkin 1997, Berg and Anderson 2006).

Spruce beetle (*Dendroctonus rufipennis*) infestations are a major natural disturbance of spruce forests in the boreal transition region. Spruce beetles typically attack larger, slow-growing spruce, but infestations periodically escalate to epidemic levels when forest and climatic conditions are favorable for beetle expansion. During epidemic-level infestations, beetles are less selective and may attack and kill a wider range of spruce trees. Beetle outbreaks that thin stands and produce a growth release in surviving trees occur on average every 50 years in white and Lutz spruce forests on the Kenai Peninsula (Berg 2004). Spruce beetle outbreaks that produce a more substantial thinning occur at longer intervals, with the last two severe infestations occurring in the 1870s-1880s and 1987-present (Berg 2004). The beetle outbreak that began in 1987 on the Kenai Peninsula has killed over 1.3 million acres of spruce (USFS 2004). Berg (2004) found no association between spruce beetle mortality and fire in the past.

When the canopy of these forests is thinned by spruce beetle mortality, *Calamagrostis canadensis* may proliferate rapidly from its predisturbance-level network of rhizomatous roots and develop into a think sod that limits spruce regeneration within a few years (Berg 2004). Boucher (2003) found that rapid spread of *Calamagrostis canadensis* occurs primarily on sites with deep, loamy soils.

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Alaska Sub-boreal Mountain Hemlock-White Spruce Forest (CES105.103)

DISTRIBUTION

Range: This system occurs in the boreal transition region of Alaska.
Divisions: 105:C; 204:C
Nations: US
Subnations: AK
Map Zones: 73:C, 74:C, 75:C, 77:?
TNC Ecoregions: 70:C, 71:C

SOURCES

References: Banner et al. 1993, Berg 2004, Berg and Anderson 2006, Boucher 2003, DeVelice et al. 1999, Kartesz 1999, Pojar and MacKinnon 1994, Potkin 1997, Rude unpubl. data, USFS 2004, van Hees and Larson 1991, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817360#references
Description Author: T. Boucher
Version: 07 Aug 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKAN PACIFIC MARITIME MOUNTAIN HEMLOCK FOREST (CES204.142)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Sideslope; Temperate [Temperate Oceanic]; Tsuga mertensiana
Non-Diagnostic Classifiers: Montane; Boreal [Boreal Oceanic]; Picea sitchensis
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2648; ESLF 4277; ESP 1648

CONCEPT

Summary: This ecological system occurs along the Gulf of Alaska Coast and Pacific Coast from Kenai Fjords through southeastern Alaska. It occurs primarily in the maritime region, but also occurs in the sub-boreal transition on the inland side of the Kenai and Chugach mountains. This system occurs on relatively stable sideslopes and benches, and soils are generally well-drained. The lower and upper elevational limits of this system decrease from south to north and from east to west. The climate is generally characterized by short, cool summers, rainy autumns and long, cool, wet winters with heavy snow cover for 5-9 months. Fire is very rare in the sub-boreal portion of the distribution and absent from the rest of the range. *Tsuga mertensiana* is the dominant conifer with at least 15% cover, but associated canopy trees vary by region. In the northern portion of its range (from Kenai Fjords to Yakutat), the system occurs from sea level to upper forest elevations.. *Picea sitchensis* or *Tsuga heterophylla* may be codominant. In the sub-boreal region, *Picea X lutzii* may be present in the canopy, but cover is less than 15%. In southeast Alaska, this system is the predominant forest of upper elevations. It occurs above the western hemlock, western hemlock - red-cedar, and western hemlock - yellow-cedar systems and below the subalpine mountain memlock dwarf-tree system. Elevations generally range from 300 to 1000 m. *Tsuga mertensiana* is the dominant tree species. *Picea sitchensis, Chamaecyparis nootkatensis* (northern limit is Prince William Sound), or *Tsuga heterophylla* may be present but are less abundant than *Tsuga mertensiana*. Throughout the entire range of the system, the dominant understory shrub is typically *Vaccinium ovalifolium*; other common shrubs include *Menziesia ferruginea, Elliottia pyroliflorus, Vaccinium vitis-idaea*, and *Empetrum nigrum*. Common herbaceous species include *Rubus pedatus, Cornus canadensis, Gymnocarpium dryopteris, Blechnum spicant*, and *Listera cordata*. Major disturbance processes include avalanche, fungal pathogens, and blowdown. Parklands (open woodlands or sparse trees with dwarf-shrub or herbaceous vegetation) are not part of this system but of North Pacific Maritime Mesic Subalpine Parkland (CES204.837) or Alaskan Pacific Maritime Subalpine Mountain Hemlock Woodland (CES204.143).
Classification Comments: This system combines those known as Boreal Transition Mountain Hemlock, Maritime Mountain Hemlock (North), and Maritime Mountain Hemlock (SE) by the Alaska Natural Heritage Program. It is similar to Alaska Sub-boreal Mountain Hemlock-White Spruce Forest (CES105.103) but has less than 15% cover *Picea glauca* and typically occurs in the elevational zone above it. It also includes the Maritime Mountain Hemlock-Sitka Spruce of Alaska Natural Heritage's classification.
Similar Ecological Systems:
- Alaska Sub-boreal Mountain Hemlock-White Spruce Forest (CES105.103)
- Alaskan Pacific Maritime Subalpine Mountain Hemlock Woodland (CES204.143)
- North Pacific Mountain Hemlock Forest (CES204.838)

Related Concepts:
- *Tsuga mertensiana / Harrimanella stelleriana* (Boggs et al. 2008b) Finer
- *Tsuga mertensiana / Hylocomium splendens* (DeVelice et al. 1999) Finer
- *Tsuga mertensiana / Vaccinium ovalifolium - Elliottia pyroliflora* (DeVelice et al. 1999) Finer
- *Tsuga mertensiana / Vaccinium ovalifolium - Oplopanax horridus* (Boggs et al. 2008b) Finer
- *Tsuga mertensiana / Vaccinium ovalifolium - Oplopanax horridus* (DeVelice et al. 1999) Finer
- *Tsuga mertensiana / Vaccinium ovalifolium-Elliottia pyroliflora* (Boggs et al. 2008b) Finer
- *Tsuga mertensiana / Menziesia ferruginea - Vaccinium vitis-idaea* (DeVelice et al. 1999) Finer
- *Tsuga mertensiana / Menziesia ferruginea* (DeVelice et al. 1999) Finer
- I.A.1.f - Mountain hemlock (closed) (Viereck et al. 1992) Intersecting
- I.A.2.c - Mountain hemlock (open) (Viereck et al. 1992) Intersecting
- Mountain Hemlock: 205 (Eyre 1980) Broader

DESCRIPTION

Environment: This system occurs on mountain sideslopes, shoulders, and benches. Soils are typically well-drained, shallow and are derived from glacial and colluvial deposits, as well as residual bedrock. Within the Kenai, Chugach, and St. Elias mountains, the elevation range is from 0 to 600 m. In southeastern Alaska, the elevation range is 300 to 1000 m. This system is common on north-facing slopes and uncommon on south-facing slopes.
Vegetation: *Tsuga mertensiana* is the dominant tree with at least 15% cover. *Picea sitchensis* or *Tsuga heterophylla* may be codominant in the maritime region. In the sub-boreal region, *Picea glauca* or *Picea X lutzii* may be present but have less than 15%

canopy cover. Common shrubs include *Alnus viridis ssp. sinuata*, *Vaccinium ovalifolium*, *Oplopanax horridus*, and *Menziesia ferruginea*. Common herbaceous species include *Cornus canadensis*, *Rubus pedatus*, *Dryopteris expansa*, and *Gymnocarpium dryopteris*. Common mosses include *Hylocomium splendens* and *Pleurozium schreberi*. *Sphagnum* spp. may be abundant on some sites. Plant communities in this system are described by DeVelice et al. (1999).

Dynamics: The major disturbance processes are soil creep, snow avalanche, and fungal pathogens such as red ring rot (*Phellinus pini*). Fire is absent in the maritime region, however, fire does occur infrequently in the sub-boreal region. The fire regime has not been defined for this type, but estimates of the mean fire-return interval for adjacent vegetation range from 600 to greater then 1500 years (Lertzman and Krebs 1991, Potkin 1997).

Component Associations:

- *Tsuga mertensiana - Tsuga heterophylla / Alnus viridis ssp. sinuata* Forest (CEGL003217, GNR)
- *Tsuga mertensiana - Tsuga heterophylla / Vaccinium ovalifolium - Menziesia ferruginea* Forest (CEGL003219, GNR)
- *Tsuga mertensiana - Tsuga heterophylla / Vaccinium ovalifolium* Forest (CEGL003218, G5)
- *Tsuga mertensiana / Alnus viridis ssp. sinuata* Forest (CEGL003243, GNR)
- *Tsuga mertensiana / Elliottia pyroliflorus* Woodland (CEGL003248, G4G5)
- *Tsuga mertensiana / Vaccinium ovalifolium / Caltha leptosepala ssp. howellii* Woodland (CEGL003247, G5)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:

- Alaska Sub-boreal Mountain Hemlock-White Spruce Forest (CES105.103)
- Alaskan Pacific Maritime Sitka Spruce Forest (CES204.151)

DISTRIBUTION

Range: This system occurs from Kenai Fjords through southeastern Alaska.
Divisions: 204:C
Nations: US
Subnations: AK
Map Zones: 73:C, 75:C, 77:C, 78:?
TNC Ecoregions: 69:C, 70:C, 71:C

SOURCES

References: Boggs et al. 2008b, DeMeo et al. 1992, DeVelice et al. 1999, Eyre 1980, Lertzman and Krebs 1991, Potkin 1997, Viereck et al. 1992, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817486#references
Description Author: T. Boucher
Version: 10 Dec 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKAN PACIFIC MARITIME PERIGLACIAL WOODLAND AND SHRUBLAND (CES204.311)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Glaciated plains; Temperate [Temperate Oceanic]; Very Shallow Soil; Unconsolidated; Picea sitchensis; Populus balsamifera
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2650; ESLF 4284; ESP 1650

CONCEPT

Summary: This ecological system occurs as an early-successional sere on landscapes recently exposed through deglaciation since the end of the Little Ice Age (especially common in Glacier Bay and Kenai Fjords). This is not a riverine system, and glacial outwash systems are also not included. Soils are derived from glacial till, residuum and colluvium and are shallow, stony, and well-drained to excessively well-drained. Soil profile development is lacking or minimal. Early-seral stages of forested systems with low cover of *Picea sitchensis* and *Populus balsamifera ssp. trichocarpa* occur on older landscapes at low elevations near the maximum glacial extent. Depending on time since ice has receded, some sites may have woodlands of either *Populus balsamifera* or a mix of *Populus balsamifera* and *Picea sitchensis*. On other sites *Alnus viridis ssp. sinuata* often dominates the species composition, although *Salix sitchensis, Salix alaxensis,* or *Salix barclayi* may also be abundant. *Salix* spp. and *Alnus viridis ssp. sinuata* are commonly mixed with the trees on wooded sites as well. *Rubus spectabilis* is uncommon in this system. Common herbaceous species include *Calamagrostis canadensis, Chamerion angustifolium, Chamerion latifolium, Heracleum maximum, Lupinus nootkatensis, Equisetum arvense, Athyrium filix-femina, Dryopteris expansa, Phegopteris connectilis, Streptopus amplexifolius, Pyrola* spp., *Carex mertensii,* and *Epilobium* spp. Mosses and lichens may be abundant on some sites; common early-seral nonvascular species include *Racomitrium canescens, Pohlia nutans, Drepanocladus aduncus, Stereocaulon tomentosum, Cladonia crispata*, and *Cladina portentosa*.
Classification Comments: This system is known as Upland Cottonwood-Sitka Spruce by the Alaska Natural Heritage Program. Does this include Kodiak (spruce invading shrublands)? This system is very difficult to distinguish in the sequence table. For mapping purposes, the best will be to obtain a spatial layer from Keith Boggs showing maximum glacial extent and overlay that on areas mapped as Sitka spruce or cottonwood forest, or alder shrublands (as opposed to being mapped as current snow/ice). Any areas that were covered by glaciers that are now Sitka spruce-, alder-, or cottonwood-dominated are part of this periglacial system. This system is likely to be most of the Sitka spruce on Kodiak Island (K. Boggs pers. comm.).
Related Concepts:
- I.B.2.c - Balsam poplar (black cottonwood) (Viereck et al. 1992) Intersecting. no periglacial cottonwood in Viereck
- II.B.1.a - Willow (closed) (Viereck et al. 1992) Intersecting. seral
- II.B.1.b - Alder (closed) (Viereck et al. 1992) Intersecting. seral
- II.B.1.d - Alder-willow (closed) (Viereck et al. 1992) Intersecting. seral
- II.B.2.a - Willow (open) (Viereck et al. 1992) Intersecting. seral
- II.B.2.b - Alder (open) (Viereck et al. 1992) Intersecting. seral
- II.B.2.d - Alder-willow (open) (Viereck et al. 1992) Intersecting. seral

DESCRIPTION

Dynamics: Primary succession on recently deglaciated terrain (glacial till or bedrock shields) usually begins with colonization of bare rock and soil by lichens and mosses, followed by grasses and forbs, then by shrub species such as *Alnus viridis ssp. sinuata* and *Salix* spp. In Glacier Bay, *Shepherdia canadensis* and *Dryas drummondii* are also early colonizers. The rate and direction of succession are influenced by the type of substrate. On glacial till substrates, *Alnus viridis ssp. sinuata* and/or *Salix* spp. dominate the site within about 20 years. On bedrock substrates, mosses and herbaceous species may persist longer due to the lack of microsites for shrub establishment. Disturbance-prone sites may remain dominated by *Alnus viridis ssp. sinuata*. In mid-seral stages that are transitional to forested systems, *Populus balsamifera ssp. trichocarpa* and *Picea sitchensis* emerge through the tall-shrub canopy within 50 years. *Picea sitchensis* eventually gains dominance in the canopy through competitive exclusion. This transition to a hemlock-spruce forest is evident at Glacier Bay where bark beetles killed some of the even-aged Sitka spruce approximately 140 years after colonization, yielding a multi-aged forest favoring more western hemlock. Succession on bedrock shields will likely proceed to sloping peatlands over long time scales.

Component Associations:
- *Picea sitchensis - Populus balsamifera ssp. trichocarpa / Alnus viridis ssp. sinuata* Woodland (CEGL003277, G4)

DISTRIBUTION

Range: This system occurs from Kodiak Island to southeastern Alaska.
Divisions: 204:C
Nations: US

Subnations: AK
Map Zones: 76:C, 77:C, 78:C
TNC Ecoregions: 69:C, 70:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818674#references
Description Author: T. Boucher
Version: 10 Dec 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKAN PACIFIC MARITIME SITKA SPRUCE BEACH RIDGE (CES204.153)

CLASSIFIERS

Conf.: 3 - Weak **Classification Status:** Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Temperate [Temperate Oceanic]; Beach ridge; Picea sitchensis
Non-Diagnostic Classifiers: Raised beach; Beach (Landform)
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2654; ESLF 4285; ESP 1654

CONCEPT

Summary: This ecological system includes productive forests on beach ridges and occurs along the Alaska Gulf Coast in the following areas: Copper River Delta, Cape Yakataga, Yakutat Forelands, and outer coast of Glacier Bay National Park. *Picea sitchensis* is usually dominant in the canopy, but *Tsuga heterophylla* can be codominant especially on older sites. *Oplopanax horridus* is usually the most abundant understory shrub; other common shrubs include *Vaccinium ovalifolium* and *Rubus spectabilis*. Understory species include *Circaea alpina, Rubus pedatus, Streptopus amplexifolius, Tiarella trifoliata, Athyrium filix-femina, Dryopteris expansa*, and *Gymnocarpium dryopteris*. Mature forests usually have very little downed wood or snags. Beach ridges form and become removed from direct contact with saltwater through long-shore sediment transport coupled with isostatic rebound. Coastal beach communities are often dominated by *Leymus mollis* and brackish meadows. *Picea sitchensis* seedlings establish in the brackish meadows, but often do not survive, probably due to excessive salt spray. Further inland, *Picea sitchensis* seedlings establish and survive in these meadows, and the meadow transitions to forest. *Picea sitchensis* establishes about 130 years after beach ridge formation and may succeed to *Tsuga heterophylla* forest.
Classification Comments: This system is known as Sitka Spruce Beach Ridge by the Alaska Natural Heritage Program.
Related Concepts:
- I.A.1.a - Sitka spruce (closed) (Viereck et al. 1992) Intersecting
- I.A.1.c - Sitka spruce-western hemlock (Viereck et al. 1992) Intersecting
- I.A.2.a - Sitka spruce (open) (Viereck et al. 1992) Intersecting
- I.A.2.b - Western hemlock-Sitka spruce (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: This system includes productive forests on beach ridges and occurs along the Alaska Gulf Coast in the following areas: Copper River Delta, Cape Yakataga, Yakutat Forelands, and outer coast of Glacier Bay National Park. Beach ridges form and become removed from direct contact with salt water through long-shore sediment transport coupled with isostatic rebound (Shephard 1993).
Vegetation: *Picea sitchensis* is usually dominant in the canopy, but *Tsuga heterophylla* can be codominant especially on older sites (Shephard 1993). *Oplopanax horridus* is usually the most abundant understory shrub; other common shrubs include *Vaccinium ovalifolium* and *Rubus spectabilis*. Understory species include *Circaea alpina, Rubus pedatus, Streptopus amplexifolius, Tiarella trifoliata, Athyrium filix-femina, Dryopteris expansa*, and *Gymnocarpium dryopteris* (Shephard 1993). Mature forests usually have very little downed wood or snags. Coastal beach communities are often dominated *Leymus mollis* and brackish meadows. *Picea sitchensis* seedlings establish in the brackish meadows, but often do not survive, probably due to excessive salt spray. Further inland, *Picea sitchensis* seedlings establish and survive in these meadows, and the meadow transitions to forest.
Dynamics: *Picea sitchensis* establishes about 130 years after beach ridge formation and may succeed to *Tsuga heterophylla* forest (Shephard 1995).

Component Associations:
- *Picea sitchensis / Athyrium filix-femina* Forest (CEGL003273, GNR)
- *Picea sitchensis / Oplopanax horridus - Rubus spectabilis* Forest (CEGL003256, G4)
- *Picea sitchensis / Oplopanax horridus / Circaea alpina* Forest (CEGL003260, G2)
- *Picea sitchensis / Oplopanax horridus* Temporarily Flooded Forest (CEGL003258, G5)
- *Picea sitchensis / Vaccinium ovalifolium - Oplopanax horridus* Forest (CEGL003262, G5)

DISTRIBUTION

Range: This system occurs from the Copper River Delta to Glacier Bay in Alaska. It also occurs on Kodiak Island.
Divisions: 204:C
Nations: US
Subnations: AK
Map Zones: 76:C, 77:C, 78:P
TNC Ecoregions: 69:C, 70:C

SOURCES

References: Shephard 1993a, Shephard 1995, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817696#references
Description Author: T. Boucher
Version: 10 Dec 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKAN PACIFIC MARITIME SITKA SPRUCE FOREST (CES204.151)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland; Forest and Woodland (Treed); Temperate [Temperate Hyperoceanic]; Picea sitchensis
Non-Diagnostic Classifiers: Sideslope; Toeslope/Valley Bottom; Salt Spray
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2644; ESLF 4286; ESP 1644

CONCEPT

Summary: This productive ecological system occurs on well-drained sideslopes and footslopes along the Gulf Coast of Alaska and the North Pacific, in the perhumid and subpolar rainforest zones. Sites dominated by *Picea sitchensis* are usually tied to disturbance such as slope instability, water movement (either downhill through the soil or in open streams), exposure to salt spray, or windthrow. *Picea sitchensis* is the dominant tree species, although *Tsuga mertensiana* or *Tsuga heterophylla* may be minor canopy associates. In southeastern Alaska, *Alnus rubra* may be an associated understory tree species, especially in upland alluvial fans. Common species in the shrub layer include *Alnus viridis ssp. sinuata*, *Oplopanax horridus*, *Rubus spectabilis*, and *Vaccinium ovalifolium*. Common herbaceous species include *Maianthemum dilatatum*, *Tiarella trifoliata*, *Dryopteris expansa*, and *Gymnocarpium dryopteris*. *Calamagrostis nutkaensis* may be common on exposed sites near the coast. In the northern portion of the temperate rainforest (Kodiak Island, Kenai Fjords, and Prince William Sound), *Picea sitchensis* is frequently the dominant canopy tree from sea level to treeline on productive sites, and it is the only conifer that occurs on Afognak and Kodiak islands, where its range is actively expanding. In the southern portion of the Alaskan rainforest, *Picea sitchensis* is linked more closely with disturbance (e.g., very steep sites, recently deglaciated landscapes, outer coast headlands, upland alluvial fans, ancient landslides) and karst substrates. It also occurs commonly at upper elevations just below the mountain hemlock zone.
Classification Comments: This system is known as Sitka Spruce by the Alaska Natural Heritage Program. It is being split from North Pacific Seasonal Sitka Spruce Forest (CES204.841). Sitka spruce, western hemlock, and mountain hemlock dominate the subpolar zone (Gulf of Alaska); Sitka spruce, western red-cedar, and western hemlock characterize the perhumid zone (southeastern Alaska). Associated canopy species in southeast: red alder (south), western hemlock (to Prince William Sound), mountain hemlock (in upper elevations in south to sea level in north). Alluvial fans often support Sitka spruce forests, included in this system; DeMeo et al. (1992) classified these as Sitka spruce / red alder; Sitka spruce / salmonberry; Sitka spruce / devil's club-salmonberry; and Sitka spruce / blueberry.
Similar Ecological Systems:
- North Pacific Mountain Hemlock Forest (CES204.838)

Related Concepts:
- *Picea sitchensis / Alnus viridis ssp. sinuata - Oplopanax horridus* (Martin et al. 1995) Finer
- *Picea sitchensis / Alnus viridis ssp. sinuata - Oplopanax horridus* (DeVelice et al. 1999) Finer
- *Picea sitchensis / Vaccinium ovalifolium / Calamagrostis nutkaensis* (DeVelice et al. 1999) Finer
- *Picea sitchensis / Vaccinium ovalifolium / Calamagrostis nutkaensis* (Martin et al. 1995) Finer
- I.A.1.a - Sitka spruce (closed) (Viereck et al. 1992) Intersecting
- I.A.2.a - Sitka spruce (open) (Viereck et al. 1992) Intersecting
- Sitka spruce/ salmonberry (DeMeo et al. 1992) Finer
- Sitka spruce/blueberry (DeMeo et al. 1992) Finer
- Sitka spruce/devils' club-salmonberry (DeMeo et al. 1992) Finer
- Sitka spruce/red alder (DeMeo et al. 1992) Finer
- Sitka Spruce: 223 (Eyre 1980) Finer. (80% spruce)
- Western Hemlock - Sitka Spruce: 225 (Eyre 1980) Finer. (equal cover hemlock and spruce)

DESCRIPTION

Environment: This productive ecological system occurs on well-drained sideslopes and footslopes along the Gulf Coast of Alaska and the North Pacific, in the perhumid and subpolar rainforest zones. Sites dominated by *Picea sitchensis* are usually tied to disturbance such as slope instability, water movement (either downhill through the soil or in open streams), exposure to salt spray, or windthrow (DeMeo et al. 1992, Martin et al. 1995).
Vegetation: *Picea sitchensis* is the dominant tree species, although *Tsuga mertensiana* or *Tsuga heterophylla* may be minor canopy associates. In southeastern Alaska, *Alnus rubra* may be an associated understory tree species, especially in upland alluvial fans. Common species in the shrub layer include *Alnus viridis ssp. sinuata, Oplopanax horridus, Rubus spectabilis*, and *Vaccinium ovalifolium* (DeMeo et al. 1992, Martin et al. 1995, DeVelice et al. 1999). Common herbaceous species include *Maianthemum dilatatum, Tiarella trifoliata, Dryopteris expansa*, and *Gymnocarpium dryopteris*. *Calamagrostis nutkaensis* may be common on exposed sites near the coast. In the northern portion of the temperate rainforest (Kodiak Island, Kenai Fjords, and Prince William

Sound), *Picea sitchensis* is frequently the dominant canopy tree from sea level to treeline on productive sites, and it is the only conifer that occurs on Afognak and Kodiak islands, where its range is actively expanding. In the southern portion of the Alaskan rainforest, *Picea sitchensis* is linked more closely with disturbance (e.g., very steep sites, recently deglaciated landscapes, outer coast headlands, upland alluvial fans, ancient landslides) and karst substrates. It also occurs commonly at upper elevations just below the mountain hemlock zone.

Component Associations:
- *Picea sitchensis - Tsuga mertensiana / Vaccinium ovalifolium - Oplopanax horridus* Woodland (CEGL003276, G4)
- *Picea sitchensis - Tsuga mertensiana / Vaccinium ovalifolium / Caltha leptosepala ssp. howellii* Woodland (CEGL003275, GNR)
- *Picea sitchensis / Alnus viridis ssp. sinuata* Woodland (CEGL003254, G5)
- *Picea sitchensis / Athyrium filix-femina* Forest (CEGL003273, GNR)
- *Picea sitchensis* / Bryophyte Forest (CEGL003268, G4)
- *Picea sitchensis / Calamagrostis canadensis* Woodland (CEGL003267, G5)
- *Picea sitchensis / Dryopteris campyloptera* Forest (CEGL003272, GNR)
- *Picea sitchensis / Empetrum nigrum* Forest (CEGL003269, GNR)
- *Picea sitchensis / Lysichiton americanus* Forest (CEGL003271, G3)
- *Picea sitchensis / Oplopanax horridus - Rubus spectabilis* Forest (CEGL003256, G4)
- *Picea sitchensis / Oplopanax horridus / Circaea alpina* Forest (CEGL003260, G2)
- *Picea sitchensis / Oplopanax horridus / Dryopteris campyloptera* Forest (CEGL003259, G5)
- *Picea sitchensis / Oplopanax horridus / Lysichiton americanus* Forest (CEGL003257, G4)
- *Picea sitchensis / Rubus spectabilis* Woodland (CEGL003255, G3G4)
- *Picea sitchensis / Vaccinium ovalifolium - Oplopanax horridus* Forest (CEGL003262, G5)
- *Picea sitchensis / Vaccinium ovalifolium / Athyrium filix-femina* Forest (CEGL003263, G3)
- *Picea sitchensis / Vaccinium ovalifolium / Dryopteris expansa* Forest (CEGL003264, GNR)
- *Picea sitchensis / Vaccinium ovalifolium / Lysichiton americanus* Forest (CEGL003265, G5)
- *Picea sitchensis / Vaccinium ovalifolium* Forest (CEGL003261, G5)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Alaskan Pacific Maritime Mountain Hemlock Forest (CES204.142)
- Alaskan Pacific Maritime Western Hemlock Forest (CES204.840)
- North Pacific Hypermaritime Western Red-cedar-Western Hemlock Forest (CES204.842)

DISTRIBUTION

Range: This system occurs as a narrow band along the Gulf of Alaska coast and extends from the northern portion of Kodiak Island through southeast Alaska and into coastal British Columbia. The range coincides roughly with the subpolar and perhumid rainforest zones defined by Alaback (1991, 1995). The southern boundary is just north of Vancouver Island, British Columbia.
Divisions: 204:C
Nations: CA, US
Subnations: AK, BC
Map Zones: 76:C, 77:C, 78:C
TNC Ecoregions: 69:C, 70:C

SOURCES

References: Alaback 1991, Alaback 1995, Banner et al. 1993, DeMeo et al. 1992, DeVelice et al. 1999, Eyre 1980, Martin et al. 1995, Shephard 1995, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817688#references
Description Author: T. Boucher
Version: 29 Aug 2008 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKAN PACIFIC MARITIME SUBALPINE MOUNTAIN HEMLOCK WOODLAND (CES204.143)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Upper Montane]; Forest and Woodland (Treed); Ridge/Summit/Upper Slope; Temperate [Temperate Oceanic]; Tsuga mertensiana
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2649; ESLF 4299; ESP 1649

CONCEPT

Summary: This subalpine ecological system occurs in the upper slopes of mountain ranges along the Gulf Coast of Alaska, including the Kenai, Chugach, St. Elias, Fairweather, and Coast mountains. It is dominated by mountain hemlock forests and parkland growing near elevational treeline. *Tsuga mertensiana* is the dominant tree and often grows with a stunted growth form (krummholz). Patches of forest interspersed with alpine heath or tall shrub characterize this system. Treeline forests often grow as small patches at the lower elevation of alpine tundra and forb meadow systems. Common understory species include *Phyllodoce aleutica* (or *Phyllodoce glanduliflora*), *Harrimanella stelleriana, Luetkea pectinata, Empetrum nigrum, Nephrophyllidium crista-galli,* and *Geum calthifolium.* The major disturbance processes include avalanche, fungal pathogens, and blowdown.
Classification Comments: This system combines those known as Boreal Transition Treeline Mountain Hemlock and Maritime Mountain Hemlock Treeline by the Alaska Natural Heritage Program. It is similar to Alaskan Pacific Maritime Mountain Hemlock Forest (CES204.142), but it occurs at treeline just below alpine tundra or forb meadows.
Similar Ecological Systems:
- Alaska Sub-boreal Mountain Hemlock-White Spruce Forest (CES105.103)
- Alaskan Pacific Maritime Mountain Hemlock Forest (CES204.142)
- North Pacific Mountain Hemlock Forest (CES204.838)

Related Concepts:
- *Tsuga mertensiana / Harrimanella stelleriana* (DeVelice et al. 1999) Finer
- *Tsuga mertensiana / Phyllodoce aleutica* (DeVelice et al. 1999) Finer
- *Tsuga mertensiana* / Krummholz (Boggs et al. 2008a) Finer
- I.A.2.c - Mountain hemlock (open) (Viereck et al. 1992) Intersecting
- II.A.1.a - Mountain hemlock (closed) scrub (Viereck et al. 1992) Finer
- II.A.2.b - Mountain hemlock (open) scrub (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: This system occurs on upper mountain sideslopes, shoulders, and bedrock outcrops from 500 to 800 m elevation. Soils are typically shallow and are derived from glacial and colluvial deposits as well as residual bedrock. Treeline Mountain Hemlock is common on north-facing slopes with late-lying snow, but also occurs on east and west aspects. This system is uncommon on south-facing slopes.
Vegetation: *Tsuga mertensiana* is the dominant tree species and has a stunted growth form (krummholz). Common shrubs include *Menziesia ferruginea, Alnus viridis ssp. sinuata, Vaccinium ovalifolium, Oplopanax horridus, Harrimanella stelleriana (= Cassiope stelleriana),* and *Empetrum nigrum.* Common herbaceous species include *Cornus canadensis, Rubus pedatus, Dryopteris expansa,* and *Gymnocarpium dryopteris.* Common mosses include *Hylocomium splendens* and *Pleurozium schreberi*. *Sphagnum* spp. may be abundant on sites with restricted drainage. Plant communities in this system are described by DeVelice et al. (1999).
Dynamics: The major disturbance processes are soil creep, blowdown, snow avalanche, and fungal pathogens. Fire is infrequent in this system and the fire regime has not been defined, but estimates of the mean fire-return interval for lower elevation mountain hemlock zones range from 600 to greater then 1500 years (Lertzman and Krebs 1991, Potkin 1997). Treeline appears to be advancing upward in some areas; with young stems further up the hill from older ones (P. Hennon pers. obs.).

Component Associations:
- *Tsuga mertensiana / Cassiope mertensiana / Nephrophyllidium crista-galli* Woodland (CEGL003252, G5)
- *Tsuga mertensiana / Cassiope mertensiana* Woodland (CEGL003251, G5)
- *Tsuga mertensiana / Elliottia pyroliflorus* Woodland (CEGL003248, G4G5)
- *Tsuga mertensiana / Phyllodoce aleutica / Nephrophyllidium crista-galli* Woodland (CEGL003250, GNR)
- *Tsuga mertensiana / Vaccinium ovalifolium - Harrimanella stelleriana* Woodland (CEGL003246, G5)

DISTRIBUTION

Range: This system occurs primarily at the elevational limit of tree growth in the mountain ranges along the Gulf Coast of Alaska, including the Kenai, Chugach, St. Elias, Fairweather, and Coast mountains. It occurs from the Kenai Fjords to southeastern Alaska and British Columbia.

Divisions: 204:C
Nations: CA, US
Subnations: AK, BC
Map Zones: 74:?, 75:C, 77:C, 78:C
TNC Ecoregions: 69:C, 70:C

SOURCES

References: DeVelice et al. 1999, Hennon pers. comm., Lertzman and Krebs 1991, Potkin 1997, Western Ecology Working Group n.d.

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817489#references

Description Author: T. Boucher
Version: 10 Dec 2008
Concept Author: Western Ecology Group and Alaska Natural Heritage Program
Stakeholders: Canada, West
ClassifResp: West

ALASKAN PACIFIC MARITIME WESTERN HEMLOCK FOREST (CES204.840)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland; Forest and Woodland (Treed); Temperate [Temperate Oceanic]
Non-Diagnostic Classifiers: Montane [Montane]; Montane [Lower Montane]; Very Long Disturbance Interval; Needle-Leaved Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2646; ESLF 4276; ESP 1646

CONCEPT

Summary: This forested ecological system is the dominant *Tsuga heterophylla* forest system along the northern portions of the Pacific Northwest Coast. It occurs from coastal British Columbia (north of the northern limit of *Pseudotsuga menziesii*) through southeast Alaska to Prince William Sound (the northwest limit of *Tsuga heterophylla*). This system ranges from sea level to about 610 m (0-2000 feet) elevation. The climate is wet with heavy snow and rainfall, but sites occupied are typically well-drained. The dominant upper canopy species is *Tsuga heterophylla* or a mix of *Picea sitchensis* and *Tsuga heterophylla*. In the northern portion of the region (Yakutat through Prince William Sound), *Tsuga mertensiana* may also be present in the canopy. *Chamaecyparis nootkatensis* may be present in the canopy in southeastern Alaska (Glacier Bay to British Columbia?) but is rare in this system in Prince William Sound (the northwestern limit of *Chamaecyparis nootkatensis*). The shrub layer is often dominated by *Vaccinium ovalifolium*, with *Menziesia ferruginea* usually present; *Rubus spectabilis* and *Oplopanax horridus* are also common. *Lysichiton americanus* occurs in poorly drained depressions. Other common forbs include *Rubus pedatus, Streptopus amplexifolius, Cornus canadensis*, and *Tiarella trifoliata*. *Dryopteris expansa* is common in well-drained, relatively nutrient-rich sites. Other common ferns include *Gymnocarpium dryopteris, Blechnum spicant*, and *Dryopteris expansa*. Disturbed sites, such as V-notches, can have abundant *Rubus spectabilis* or *Oplopanax horridus* dominating the undergrowth. Sites may receive very infrequent catastrophic disturbance leading to large older trees and multiple canopy layers where western hemlock regeneration is favored. Diseases including dwarf mistletoe and heart rot fungi perpetuate the hemlock-dominated old-growth condition. On other sites, wind disturbance yields forests approaching an even-aged condition dominated by *Tsuga heterophylla* but with a component of *Picea sitchensis*.
Classification Comments: This includes Western Hemlock - Sitka Spruce Forest initially identified for the Alaska Maritime systems classification. Wetter sites with open canopies are classified as Alaskan Pacific Maritime Poorly Drained Conifer Woodland (CES204.315). At lower elevations, these forests occur at sea level or adjacent to hypermaritime forests dominated by *Picea sitchensis*. At higher elevations in southeastern Alaska, associations can be dominated by *Chamaecyparis nootkatensis* with some *Tsuga heterophylla* forming North Pacific Mesic Western Hemlock-Yellow-cedar Forest (CES204.843), which can be considered transitional into North Pacific Mountain Hemlock Forest (CES204.838) further south in British Columbia and Washington. In southeastern Alaska, this system occurs on slightly more productive sites than North Pacific Hypermaritime Western Red-cedar-Western Hemlock Forest (CES204.842). Throughout its northern extent (Prince William Sound), this system occurs adjacent to Alaskan Pacific Maritime Mountain Hemlock Forest (CES204.142), which occurs in lower as well as higher elevation sites.
Similar Ecological Systems:
- North Pacific Dry-Mesic Silver Fir-Western Hemlock-Douglas-fir Forest (CES204.098)
- North Pacific Mesic Western Hemlock-Silver Fir Forest (CES204.097)
- North Pacific Mesic Western Hemlock-Yellow-cedar Forest (CES204.843)

Related Concepts:
- I.A.1.b - Western hemlock (Viereck et al. 1992) Finer
- I.A.1.c - Sitka spruce-western hemlock (Viereck et al. 1992) Intersecting
- I.A.1.d - Western hemlock-Sitka spruce-(western redcedar) (Viereck et al. 1992) Finer
- I.A.1.e - Western hemlock-Alaska-cedar (Viereck et al. 1992) Intersecting
- I.A.2.b - Western hemlock-Sitka spruce (Viereck et al. 1992) Intersecting
- Western Hemlock: 224 (Eyre 1980) Broader. 80% W. Hemlock

DESCRIPTION

Environment: This system ranges from sea level to about 610 m (0-2000 feet) elevation. The climate is wet with heavy snow and rainfall, but sites occupied are typically well-drained.
Vegetation: The dominant upper canopy species is *Tsuga heterophylla* or a mix of *Picea sitchensis* and *Tsuga heterophylla*. In the northern portion of the region (Yakutat through Prince William Sound), *Tsuga mertensiana* may also be present in the canopy. *Chamaecyparis nootkatensis* may be present in the canopy in southeastern Alaska (Glacier Bay to British Columbia?) but is rare in this system in Prince William Sound (the northwestern limit of *Chamaecyparis nootkatensis*). The shrub layer is often dominated by *Vaccinium ovalifolium*, with *Menziesia ferruginea* usually present; *Rubus spectabilis* and *Oplopanax horridus* are also common. *Lysichiton americanus* occurs in poorly drained depressions. Other common forbs include *Rubus pedatus, Streptopus amplexifolius,*

Cornus canadensis, and *Tiarella trifoliata*. *Dryopteris expansa* is common in well-drained, relatively nutrient-rich sites. Other common ferns include *Gymnocarpium dryopteris*, *Blechnum spicant*, and *Dryopteris expansa*. Disturbed sites, such as V-notches, can have abundant *Rubus spectabilis* or *Oplopanax horridus* dominating the undergrowth.
Dynamics: Sites may receive very infrequent catastrophic disturbance leading to large older trees and multiple canopy layers where western hemlock regeneration is favored. Diseases including dwarf mistletoe and heart rot fungi perpetuate the hemlock-dominated old-growth condition (Hennon and McClellan 2003). On other sites, wind disturbance yields forests approaching an even-aged condition dominated by *Tsuga heterophylla* but with a component of *Picea sitchensis*.

Component Associations:
- *Tsuga heterophylla* / Moss Forest (CEGL003238, G4G5)
- *Tsuga heterophylla / Oplopanax horridus - Gymnocarpium dryopteris* Forest (CEGL003234, G5)
- *Tsuga heterophylla / Oplopanax horridus - Rubus spectabilis* Forest (CEGL003233, G4Q)
- *Tsuga heterophylla / Oplopanax horridus / Lysichiton americanus* Forest (CEGL003235, G4G5)
- *Tsuga heterophylla / Vaccinium ovalifolium - Menziesia ferruginea* Forest (CEGL003236, G4)
- *Tsuga heterophylla / Vaccinium ovalifolium - Oplopanax horridus* Forest (CEGL003232, G5)
- *Tsuga heterophylla / Vaccinium ovalifolium - Rubus pedatus* Forest (CEGL003229, G5)
- *Tsuga heterophylla / Vaccinium ovalifolium / Dryopteris expansa* Forest (CEGL003230, G5)
- *Tsuga heterophylla / Vaccinium ovalifolium / Lysichiton americanus* Woodland (CEGL003231, G5)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Alaskan Pacific Maritime Sitka Spruce Forest (CES204.151)
- North Pacific Mesic Western Hemlock-Silver Fir Forest (CES204.097)
- North Pacific Mesic Western Hemlock-Yellow-cedar Forest (CES204.843)

DISTRIBUTION

Range: This system is found along the Pacific Northwest Coast, occupying much of the elevations in the Coast and Cascade mountains of British Columbia and southeastern Alaska (south of Prince William Sound, the northwestern limit of *Tsuga heterophylla*), from sea level to about 610 m (0-2000 feet) elevation.
Divisions: 204:C
Nations: CA, US
Subnations: AK, BC
Map Zones: 75:C, 77:C, 78:C
TNC Ecoregions: 1:C, 69:C, 70:C

SOURCES

References: Comer et al. 2003, DeMeo et al. 1992, DeVelice et al. 1999, Eyre 1980, Hennon and McClellan 2003, Martin et al. 1995
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722834#references
Description Author: G. Kittel, mod. M.S. Reid and T. Boucher
Version: 10 Dec 2008 **Stakeholders:** Canada, West
Concept Author: G. Kittel **ClassifResp:** West

ALEUTIAN KENAI BIRCH-COTTONWOOD-POPLAR FOREST (CES105.146)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland [Lowland]; Forest and Woodland (Treed); Populus balsamifera
Non-Diagnostic Classifiers: Moraine; Slope; Terrace
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: EVT 2642; ESLF 4161; ESP 1642

CONCEPT

Summary: These hardwood-dominated forests are common on the eastern Alaska Peninsula and on Kodiak Island. This system occurs at low elevations and also at the upper elevational limit of broad-leaved trees. At low elevations it is found predominantly on well-drained, gentle lower hillslopes, large moraines, and old riparian terraces, although floodplain stands of cottonwood are not included in this system. Patch size is typically small to large. Total hardwood tree species cover is >25% and dominated by *Betula papyrifera var. kenaica, Betula papyrifera, Populus balsamifera ssp. trichocarpa*, or *Populus balsamifera*. Tree height ranges from 6 to 21 m. Understory shrubs include *Alnus viridis ssp. sinuata, Salix barclayi, Rubus spectabilis*, and *Sambucus racemosa*. Herbaceous species may also dominate the understory, such as *Athyrium filix-femina, Calamagrostis canadensis, Calamagrostis lapponica, Chamerion angustifolium ssp. angustifolium, Equisetum* spp., *Gymnocarpium dryopteris*, and *Heracleum maximum.*
Classification Comments: This system combines those known as Kenai Birch Forest and Black Cottonwood-Balsam Poplar Forest by the Alaska Natural Heritage Program. Floristics in plots from the Alaska Peninsula suggest two proposed systems should be merged. This concept includes both the Aleutian Kenai Birch and Aleutian Black Cottonwood-Balsam Poplar Forest types. However, it may also be appropriate to combine this with hardwood forests from the boreal transition region into a new "Alaska Sub-boreal Hardwood Forest" system, that includes Kenai birch, balsam poplar and black cottonwood, along with aspen. More review is needed to resolve this; for now, this Aleutian hardwood system remains a distinct type, and the boreal transition hardwood system stays combined with Western North American Boreal Mesic Birch-Aspen Forest (CES105.108).
Related Concepts:
- *Betula papyrifera var. kenaica - Populus balsamifera ssp. trichocarpa / Salix barclayi* (Boggs et al. 2003) Finer
- *Betula papyrifera var. kenaica - Populus balsamifera ssp. trichocarpa* (Boggs et al. 2003) Finer
- *Betula papyrifera var. kenaica - Populus balsamifera* (Boggs et al. 2003) Finer
- *Betula papyrifera var. kenaica / Alnus viridis ssp. sinuata / Calamagrostis canadensis* (Boggs et al. 2003) Finer
- *Betula papyrifera var. kenaica / Alnus incana ssp. tenuifolia / Calamagrostis canadensis* (Boggs et al. 2003) Finer
- *Betula papyrifera var. kenaica / Betula nana - Vaccinium uliginosum* (Boggs et al. 2003) Finer
- *Betula papyrifera var. kenaica / Calamagrostis canadensis* (Boggs et al. 2003) Finer
- *Betula papyrifera var. kenaica / Equisetum silvaticum* (Boggs et al. 2003) Finer
- *Betula papyrifera var. kenaica / Salix barclayi* (Boggs et al. 2003) Finer
- *Populus balsamifera / Alnus viridis ssp. sinuata / Calamagrostis canadensis* (Boggs et al. 2003) Finer
- *Populus balsamifera / Calamagrostis* spp. (Boggs et al. 2003) Finer
- *Populus balsamifera ssp. trichocarpa / Alnus viridis ssp. sinuata / Calamagrostis canadensis* (Boggs et al. 2003) Finer
- *Populus balsamifera ssp. trichocarpa / Alnus viridis ssp. sinuata* / Herbaceous (Boggs et al. 2003) Finer
- *Populus balsamifera ssp. trichocarpa* / Herbaceous (Boggs et al. 2003) Finer
- I.B.1.b - Black cottonwood (Viereck et al. 1992) Intersecting
- I.B.1.c - Balsam poplar (forest) (Viereck et al. 1992) Intersecting
- I.B.1.d - Paper birch (closed) (Viereck et al. 1992) Intersecting
- I.B.2.a - Paper birch (open) (Viereck et al. 1992) Intersecting
- I.B.2.c - Balsam poplar (black cottonwood) (Viereck et al. 1992) Intersecting
- I.B.3.b - Balsam poplar (woodland) (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: These hardwood-dominated forests are common on the eastern Alaska Peninsula and on Kodiak Island. This system occurs at low elevations and also at the upper elevational limit of broad-leaved trees. At low elevations it is found predominantly on well-drained, gentle lower hillslopes, large moraines, and old riparian terraces, although floodplain stands of cottonwood are not included in this system. Patch size is typically small to large.
Vegetation: Total hardwood tree species cover is >25% and dominated by *Betula papyrifera var. kenaica, Betula papyrifera, Populus balsamifera ssp. trichocarpa*, or *Populus balsamifera*. Tree height ranges from 6 to 21 m. Understory shrubs include *Alnus viridis ssp. sinuata, Salix barclayi, Rubus spectabilis*, and *Sambucus racemosa*. Herbaceous species may also dominate the understory, such as *Athyrium filix-femina, Calamagrostis canadensis, Calamagrostis lapponica, Chamerion angustifolium ssp. angustifolium, Equisetum* spp., *Gymnocarpium dryopteris*, and *Heracleum maximum.*

DISTRIBUTION

Range: This hardwood-dominated system is common on the eastern Alaska Peninsula and on Kodiak Island.
Divisions: 102:C; 105:C
Nations: US
Subnations: AK
Map Zones: 76:C
TNC Ecoregions: 70:C, 72:C

SOURCES

References: Boggs et al. 2003, Fleming and Spencer 2007, Viereck et al. 1992, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818537#references
Description Author: K. Boggs
Version: 09 Dec 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALLEGHENY-CUMBERLAND DRY OAK FOREST AND WOODLAND (CES202.359)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Acidic Soil; Broad-Leaved Tree
Non-Diagnostic Classifiers: Lowland; Forest and Woodland (Treed)
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: EVT 2317; ESLF 4123; ESP 1317

CONCEPT

Summary: This system encompasses dry hardwood forests on predominately acidic substrates in the Allegheny and Cumberland plateaus, and ridges in the southern Ridge and Valley. Its range is more or less consistent with the "Mixed Mesophytic Forest Region" of Braun (1950) and Greller (1988), although it is not a mesic forest type. These forests are typically dominated by *Quercus alba, Quercus falcata, Quercus prinus, Quercus coccinea*, with lesser amounts of *Acer rubrum*, *Carya glabra*, and *Carya alba*. Small inclusions of *Pinus echinata* and/or *Pinus virginiana* may occur, particularly adjacent to escarpments or following fire. In addition, *Pinus strobus* may be prominent in some stands in the absence of fire. It occurs in a variety of situations, including on nutrient-poor or acidic soils. Sprouts of *Castanea dentata* can often be found where it was formerly a common tree.
Classification Comments: Related forests on more base-rich substrates may be classified as examples of Southern Ridge and Valley / Cumberland Dry Calcareous Forest (CES202.457), where this distinction may be made. Eastward and northward, this system transitions into Central Appalachian Dry Oak-Pine Forest (CES202.591). The dividing line between them is the Allegheny Front.
Similar Ecological Systems:
- Central Appalachian Dry Oak-Pine Forest (CES202.591)--occurs to the east of this system's range.
- Northeastern Interior Dry-Mesic Oak Forest (CES202.592)
- Southern Appalachian Low-Elevation Pine Forest (CES202.332)
- Southern Appalachian Oak Forest (CES202.886)--is a related broader and overlapping concept (conceptually and geographically).
- Southern Interior Low Plateau Dry-Mesic Oak Forest (CES202.898)
- Southern Ridge and Valley / Cumberland Dry Calcareous Forest (CES202.457)--is found in some similar landscapes but on more base-rich substrates, which usually correspond to different landform positions.

Related Concepts:
- Chestnut Oak: 44 (Eyre 1980) Finer
- Post Oak - Blackjack Oak: 40 (Eyre 1980) Finer
- Virginia Pine: 79 (Eyre 1980) Finer
- White Oak - Black Oak - Northern Red Oak: 52 (Eyre 1980) Finer
- White Oak: 53 (Eyre 1980) Finer
- White Pine - Chestnut Oak: 51 (Eyre 1980) Finer
- White Pine - Northern Red Oak - Red Maple: 20 (Eyre 1980) Finer
- Xeric Acidic Forest (Evans 1991) Broader

DESCRIPTION

Environment: This system is most likely found on predominantly nutrient-poor or acidic substrates in the Allegheny and Cumberland plateaus, and ridges in the southern Ridge and Valley.
Vegetation: These forests are typically dominated by *Quercus alba, Quercus falcata, Quercus prinus, Quercus coccinea, Acer rubrum, Carya glabra*, and *Carya alba*. These occur in a variety of situations, most likely on nutrient-poor or acidic soils and, to a much lesser extent, on circumneutral soils. Sprouts of *Castanea dentata* can often be found where it was formerly a common tree. Small inclusions of *Pinus echinata* and/or *Pinus virginiana* may occur, particularly adjacent to escarpments or following fire. In addition, *Pinus strobus* may be prominent in some stands in the absence of fire.

Component Associations:
- *Pinus rigida - Quercus coccinea / Vaccinium angustifolium* Woodland (CEGL006557, G4Q)
- *Pinus strobus - Quercus (coccinea, prinus) / (Gaylussacia ursina, Vaccinium stamineum)* Forest (CEGL007519, G4)
- *Pinus strobus - Quercus alba - (Carya alba) / Gaylussacia ursina* Forest (CEGL007517, G3G4)
- *Pinus virginiana - Pinus (rigida, echinata) - (Quercus prinus) / Vaccinium pallidum* Forest (CEGL007119, G3)
- *Quercus alba - (Quercus prinus) / (Hydrangea quercifolia) - Viburnum acerifolium / Carex picta - Piptochaetium avenaceum* Forest (CEGL008430, G3G4)
- *Quercus alba - Carya alba - (Quercus velutina) / Desmodium nudiflorum - (Carex picta)* Forest (CEGL007795, G4)
- *Quercus alba - Quercus (coccinea, velutina, prinus) / Gaylussacia baccata* Forest (CEGL008521, G5)
- *Quercus alba - Quercus falcata / Vaccinium (arboreum, hirsutum, pallidum)* Forest (CEGL008567, G3G4)
- *Quercus alba - Quercus rubra - Carya ovata / Cercis canadensis - Juniperus virginiana var. virginiana* Forest (CEGL007240, G4)

- *Quercus alba - Quercus stellata / Ostrya virginiana - Acer barbatum / Chasmanthium sessiliflorum* Forest (CEGL008443, G3G4)
- *Quercus alba - Quercus velutina - Carya (ovata, alba, glabra) - Pinus* sp. Forest (CEGL007231, G4G5)
- *Quercus falcata - Quercus (coccinea, stellata) / Vaccinium (pallidum, stamineum)* Forest (CEGL007247, G4)
- *Quercus falcata - Quercus alba - Carya alba / Oxydendrum arboreum / Vaccinium stamineum* Forest (CEGL007244, G4G5)
- *Quercus prinus - (Quercus coccinea) / Carya pallida / Vaccinium arboreum - Vaccinium pallidum* Forest (CEGL008431, G4G5)
- *Quercus prinus - Carya (alba, glabra, ovata) / Juniperus virginiana var. virginiana* Forest (CEGL004786, G2G3)
- *Quercus prinus - Carya* spp. *- Quercus velutina / Vaccinium arboreum / Iris verna var. smalliana* Forest (CEGL007261, G3G4)
- *Quercus prinus - Quercus (alba, coccinea, velutina) / Viburnum acerifolium - (Kalmia latifolia)* Forest (CEGL005023, G4?)
- *Quercus prinus - Quercus rubra - Carya (ovata, glabra) - Pinus virginiana* Forest (CEGL007269, G4?)
- *Quercus prinus - Quercus* spp. / *Vaccinium arboreum - (Kalmia latifolia, Styrax grandifolius)* Forest (CEGL007700, G4)
- *Quercus stellata - Pinus virginiana / (Schizachyrium scoparium, Piptochaetium avenaceum)* Woodland (CEGL008406, G2?)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- South-Central Interior Mesophytic Forest (CES202.887)

Adjacent Ecological System Comments: The somewhat more mesic and/or more base-rich forests of the lower slopes of the Cumberlands and the lower slopes and valleys in the Ridge and Valley are covered by South-Central Interior Mesophytic Forest (CES202.887).

DISTRIBUTION

Range: This system is centered on the Allegheny and Cumberland plateaus from northern Alabama north to Ohio, West Virginia, and possibly western Pennsylvania.
Divisions: 202:C
Nations: US
Subnations: AL, GA, KY, OH, PA?, TN, VA, WV
Map Zones: 48:C, 53:C, 57:C, 61:C, 62:C
USFS Ecomap Regions: 221E:CC, 221H:CC, 221J:CC, 231C:CC, 231D:CC, M221A:CC, M221Ba:CCC, M221Bb:CCC, M221Bc:CCC, M221Be:CCC, M221C:CC
TNC Ecoregions: 49:C, 50:C

SOURCES

References: Braun 1950, Comer et al. 2003, Greller 1988
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723154#references
Description Author: R. Evans, M. Pyne, C. Nordman, mod. J. Teague and S. Gawler
Version: 05 May 2008 **Stakeholders:** East, Midwest, Southeast
Concept Author: R. Evans, M. Pyne, C. Nordman **ClassifResp:** Southeast

APPALACHIAN (HEMLOCK)-NORTHERN HARDWOOD FOREST (CES202.593)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Mesotrophic Soil; Needle-Leaved Tree; Broad-Leaved Deciduous Tree; Pinus spp. - Tsuga canadensis
Non-Diagnostic Classifiers: Moderate (100-500 yrs) Persistence; Lowland; Forest and Woodland (Treed); Sideslope; Toeslope/Valley Bottom; Temperate; Acidic Soil; Shallow Soil; Deep Soil; Mineral: W/ A-Horizon >10 cm; Ustic; Long Disturbance Interval
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Mixed evergreen-deciduous closed tree canopy
National Mapping Codes: EVT 2370; ESLF 4313; ESP 1370

CONCEPT

Summary: This forested system of the eastern U.S. ranges from central New England west to Lake Erie and south to the higher elevations of Virginia and West Virginia. It is one of the matrix forest types in the northern part of the Central Interior and Appalachian Division. Northern hardwoods such as *Acer saccharum, Betula alleghaniensis,* and *Fagus grandifolia* are characteristic, either forming a deciduous canopy or mixed with *Tsuga canadensis* (or in some cases *Pinus strobus*). Other common and sometimes dominant trees include *Quercus* spp. (most commonly *Quercus rubra*), *Liriodendron tulipifera, Prunus serotina, Acer rubrum*, and *Betula lenta*. It is of more limited extent and more ecologically constrained in the southern part of its range in northern parts of Virginia and West Virginia.
Classification Comments: Northward this system is replaced by Laurentian-Acadian Pine-Hemlock-Hardwood Forest (CES201.563) and Laurentian-Acadian Northern Hardwood Forest (CES201.564), but the systems overlap on the Allegheny Plateau and in central New England. USFS ecological province lines provide a general delimiter, with areas in Provinces 211 and M211 mostly falling into the Laurentian-Acadian systems, and areas in Provinces 221 and M221 falling into this Appalachian system. The range of *Liriodendron tulipifera* is a good approximator for the northern limit of this system's range.
Similar Ecological Systems:
- Laurentian-Acadian Northern Hardwood Forest (CES201.564)
- Laurentian-Acadian Pine-Hemlock-Hardwood Forest (CES201.563)--found to the north and northeast of this system.
- North-Central Interior Beech-Maple Forest (CES202.693)
- South-Central Interior Mesophytic Forest (CES202.887)
- Southern and Central Appalachian Cove Forest (CES202.373)
- Southern Appalachian Northern Hardwood Forest (CES202.029)

Related Concepts:
- Acidic Cove Forests (Fleming et al. 2005) Intersecting
- Beech - Birch - Maple Forest (Gawler and Cutko 2010) Finer
- Beech - Sugar Maple: 60 (Eyre 1980) Finer
- Black Cherry - Maple: 28 (Eyre 1980) Finer
- Central Appalachian Northern Hardwood Forests (Fleming et al. 2005) Intersecting
- Eastern Hemlock - Hardwood Forests (Fleming et al. 2005) Intersecting
- Eastern Hemlock: 23 (Eyre 1980) Finer
- Eastern White Pine: 21 (Eyre 1980) Finer
- Hardwood Seepage Forest (Gawler and Cutko 2010) Finer
- Hemlock - Yellow Birch: 24 (Eyre 1980) Finer
- Hemlock Forest (Gawler and Cutko 2010) Finer
- Maple - Basswood - Ash Forest (Gawler and Cutko 2010) Finer
- Northern Red Oak: 55 (Eyre 1980) Finer
- Semi-rich Northern Hardwood Forest (Gawler and Cutko 2010) Finer
- Sugar Maple - Basswood: 26 (Eyre 1980) Finer
- Sugar Maple - Beech - Yellow Birch: 25 (Eyre 1980) Finer
- Sugar Maple: 27 (Eyre 1980) Finer
- White Pine - Hemlock: 22 (Eyre 1980) Finer
- White Pine - Northern Red Oak - Red Maple: 20 (Eyre 1980) Finer
- Yellow-Poplar - Eastern Hemlock: 58 (Eyre 1980) Finer
- Yellow-Poplar - White Oak - Northern Red Oak: 59 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs predominantly on mesic sites over a broad range of topographic conditions, such as protected low and midslopes and valley bottoms, at elevations from 305 to 1360 m. Soils are usually acidic and retain some moisture except during

severe droughts. They are moderately well-drained to well-drained loamy or silty soils, and are rocky and usually deep in depressions among boulders. Forests in this system are also associated with high-elevation periglacial boulderfields. In the Central Appalachian center of its range, its ecological amplitude is somewhat broader, and it becomes the matrix forest in some areas of Pennsylvania, Maryland, West Virginia. At Shenandoah National Park, this system spans a broad range of environmental settings from steep west-facing slopes to south-facing gentle slopes.

Vegetation: The canopy is characterized and often usually dominated by northern hardwoods (e.g., *Fagus grandifolia* and *Acer saccharum*), often with *Tsuga canadensis*, but may also contain large amounts of *Pinus strobus* and *Quercus* spp. *Tsuga canadensis* can dominate the canopy on cool/moist sites at higher elevations and in shaded coves, valley bottoms and riparian areas. Bottomlands and toeslopes may also contain *Fraxinus americana*, as well as *Platanus occidentalis* (Whitney 1990). Other common associates may include *Acer rubrum, Prunus serotina, Betula lenta, Tilia americana, Pinus strobus, Liriodendron tulipifera, Quercus* spp., and *Magnolia acuminata*. The subcanopy and shrub layers are usually well-developed and may include *Viburnum lantanoides (= Viburnum alnifolium), Viburnum acerifolium, Hamamelis virginiana*, and *Cornus alternifolia*. A dense, low to high shrub layer of *Rhododendron maximum* and sometimes *Kalmia latifolia* is sometimes present. Common herbaceous species include *Maianthemum canadense, Onoclea sensibilis, Huperzia lucidula (= Lycopodium lucidulum), Dryopteris carthusiana (= Dryopteris spinulosa), Oxalis montana*, and *Mitchella repens* (Lutz 1930, Braun 1950).

Dynamics: In general, this system is dominated by long-lived, mesophytic species that form multi-layered uneven-aged forests. Canopy dynamics are dominated by single and multiple disturbances encouraging gap phase regeneration (Abrams and Orwig 1996). Larger disturbances include windthrow, insect attack and ice storms. Although stand-replacing wind events are rare, small to medium blowdown events are more common and occur at greater frequency on the plateau and exposed sideslopes (Ruffner and Abrams 2003).This system is currently being devastated in large parts of its range by the hemlock woolly adelgid (*Adelges tsugae*). This sucking insect is continuing to cause close to 100% mortality in some areas as it spreads from the north into the southern United States. The insect will most likely cause canopy hemlocks to be replaced by other canopy trees. Historically, this system was probably only subject to occasional fires. Fires that did occur may have been catastrophic and may have led to even-aged stands of pine and hemlock. Fire suppression appears to have increased the extent of this system at the expense of oak-pine systems.

Fire Regime Description (from Landfire 2007a): Historically, this system was probably only subject to occasional fires. Fires that did occur may have been catastrophic and may have led to even-aged stands of pine and hemlock. Due to the predominance of cool, moist site conditions, surface and replacement fires are extremely rare, occurring at 700- to 1000-year intervals. Most protected sites are essentially fire-free. The principal cause of fuel formation leading to fire in northern hardwood ecosystems is broad-scale, storm-driven windthrow of catastrophic proportions (Hough 1936, Runkle 1982). The importance of red maple, sweet birch, northern red oak, and especially black cherry in contemporary Central Appalachian examples of this community group reflects secondary succession following catastrophic logging and fire disturbances in the early part of the twentieth century. Sugar maple and beech, both abundant in understory layers and locally codominant in the overstory, appear positioned to assume dominance as current secondary stands mature. However, beech bark disease and excessive deer browsing are serious threats to the future viability of the largest stands on Allegheny Mountain (VDNH 2007).

Component Associations:

- *Acer saccharum - (Fraxinus americana) / Arisaema triphyllum* Forest (CEGL006211, G4)
- *Acer saccharum - Betula alleghaniensis - Fagus grandifolia / Viburnum lantanoides* Forest (CEGL006252, G5)
- *Acer saccharum - Betula alleghaniensis - Prunus serotina* Forest (CEGL006045, G4)
- *Acer saccharum - Fraxinus americana - Juglans cinerea / Staphylea trifolia / Adlumia fungosa* Forest (CEGL006577, GNR)
- *Acer saccharum - Pinus strobus / Acer pensylvanicum* Forest (CEGL005005, GNR)
- *Acer saccharum - Quercus rubra / Hepatica nobilis var. obtusa* Forest (CEGL006046, GNR)
- *Betula alleghaniensis - (Tsuga canadensis) / Rhododendron maximum / (Leucothoe fontanesiana)* Forest (CEGL007861, G3)
- *Betula alleghaniensis - Quercus rubra / Acer (pensylvanicum, spicatum) / Dryopteris intermedia - Oclemena acuminata* Forest (CEGL008502, G3G4)
- *Betula alleghaniensis / Sorbus americana - Acer spicatum / Polypodium appalachianum* Forest (CEGL008504, G2)
- *Carex scabrata - Viola cucullata / Plagiomnium ciliare* Herbaceous Vegetation (CEGL006597, G3)
- *Chrysosplenium americanum* Herbaceous Vegetation (CEGL006193, G3G5)
- *Fagus grandifolia - Betula lenta - Liriodendron tulipifera - Acer saccharum* Forest (CEGL006296, GNR)
- *Picea rubens - Tsuga canadensis - Fagus grandifolia / Dryopteris intermedia* Forest (CEGL006029, G3)
- *Pinus strobus - Tsuga canadensis / Acer pensylvanicum / Polystichum acrostichoides* Forest (CEGL006019, G4?)
- *Pinus strobus - Tsuga canadensis* Lower New England / Northern Piedmont Forest (CEGL006328, G5)
- *Quercus (rubra, velutina, alba) - Betula lenta - (Pinus strobus)* Forest (CEGL006454, G4G5)
- *Quercus bicolor / Vaccinium corymbosum / Carex stipata* Forest (CEGL006241, GNR)
- *Quercus rubra - Acer saccharum - Fagus grandifolia / Viburnum acerifolium* Forest (CEGL006173, G4G5)
- *Quercus rubra - Acer saccharum - Liriodendron tulipifera* Forest (CEGL006125, G4?)
- *Quercus rubra - Tsuga canadensis - Liriodendron tulipifera / Hamamelis virginiana* Forest (CEGL006566, G4?)
- *Rhododendron maximum* Upland Shrubland (CEGL003819, G3?Q)
- *Thuja occidentalis - Pinus strobus - Tsuga canadensis / Carex eburnea* Woodland (CEGL008426, G1G2)
- *Tsuga canadensis - (Betula alleghaniensis, Quercus rubra) / Ilex montana / Rhododendron catawbiense* Forest (CEGL008513, G1?)
- *Tsuga canadensis - Betula alleghaniensis - Acer saccharum / Dryopteris intermedia* Forest (CEGL006109, G4?)

- *Tsuga canadensis - Betula alleghaniensis - Prunus serotina / Rhododendron maximum* Forest (CEGL006206, G4?)
- *Tsuga canadensis - Betula alleghaniensis / Veratrum viride - Carex scabrata - Oclemena acuminata* Forest (CEGL008533, G2)
- *Tsuga canadensis - Fagus grandifolia - Acer saccharum / (Hamamelis virginiana, Kalmia latifolia)* Forest (CEGL005043, G3?)
- *Tsuga canadensis - Fagus grandifolia - Quercus (prinus, alba)* Forest (CEGL006474, G2G3)
- *Tsuga canadensis - Fagus grandifolia - Quercus rubra* Forest (CEGL006088, G4G5)

Spatial Characteristics

Spatial Summary: Matrix in the northern portion of its range to large patch on the southern end of its range in Virginia and West Virginia.
Size: Some examples may be more than 1000 acres, but smaller in the southern part of the range.
Adjacent Ecological Systems:
- High Allegheny Wetland (CES202.069)
- Northeastern Interior Dry-Mesic Oak Forest (CES202.592)

Adjacent Ecological System Comments: The concept of this system was revised in April 2007 to remove areas south and west of Virginia and West Virginia from its range; hemlock and mixed coves in that southern range are now within Southern and Central Appalachian Cove Forest (CES202.373), and small areas of non-cove hemlock are to be considered patches within the surrounding forest matrix system. The Region 8 National Forests and other Federal lands, as well as ecoregions and mapzones related to this area were also removed.

Distribution

Range: This system is found from southern New Hampshire south to Virginia and West Virginia, and possibly in adjacent Kentucky.
Divisions: 202:C
Nations: US
Subnations: CT, KY?, MA, MD, NH, NJ, NY, OH?, PA, VA, WV
Map Zones: 53:C, 60:C, 61:C, 62:C, 63:C, 64:C, 65:C, 66:C
USFS Ecomap Regions: 211E:CC, 211Fc:CCC, 211Fd:CCC, 211G:CC, 221Aa:CCC, 221B:CC, 221D:CC, 221E:CC, 221F:CC, 222I:CC, M221A:CC, M221B:CC, M221C:CC, M221D:CC
TNC Ecoregions: 48:C, 49:C, 52:C, 59:C, 60:C, 61:C

Sources

References: Abrams and Orwig 1996, Braun 1950, Braun 2001, Comer et al. 2003, Connolly et al. 2007, Delcourt and Delcourt 1988, Ellison et al. 2005, Eyre 1980, Fike 1999, Fleming and Patterson 2013, Fleming et al. 2005, Fleming et al. 2013, Gawler and Cutko 2010, Hough 1936, Hough 1963, Ison 2000, Landfire 2007a, Litvaitis 2003, Lorimer and Frelich 1994, Lutz 1930, NYNHP 2013b, Orwig and Foster 1998, Orwig et al. 2012, Paradis et al. 2007, PNHP 2002, Ruffner and Abrams 2003, Runkle 1981, Runkle 1982, Runkle 1985, Spies 2004, Swain and Kearsley 2011, VDNH 2007, Whitney 1990a, Whitney 1990b
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723013#references
Description Author: S.C. Gawler, R. White, R. Evans, M. Pyne, mod. L.A. Sneddon
Version: 14 Jan 2014 **Stakeholders:** East, Midwest, Southeast
Concept Author: S.C. Gawler, R. White, R. Evans, M. Pyne **ClassifResp:** East

APPALACHIAN SHALE BARRENS (CES202.598)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Sideslope; Talus (Substrate); Unglaciated; Unconsolidated
Non-Diagnostic Classifiers: Lowland; Ridge/Summit/Upper Slope; Temperate; Acidic Soil; Very Shallow Soil; Ustic; Landslide
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Deciduous open tree canopy
National Mapping Codes: EVT 2340; ESLF 4147; ESP 1340

CONCEPT

Summary: This system encompasses the distinctive shale barrens of the central and southern Appalachians at low to mid elevations. The exposure and lack of soil create extreme conditions for plant growth. Vegetation is mostly classified as woodland, overall, but may include large open areas of sparse vegetation. Dominant trees are primarily *Quercus prinus* and *Pinus virginiana*, although on higher-pH substrates the common trees include *Juniperus virginiana* and *Fraxinus americana*. Shale barren endemics are diagnostic in the herb layer. The substrate includes areas of solid rock as well as unstable areas of shale scree, usually steeply sloped. The fully exposed areas are extremely dry. These barrens are high in endemic species.
Classification Comments: Examples of related barrens in the "Knobs" region of Kentucky are included in Central Interior Highlands Dry Acidic Glade and Barrens (CES202.692), not here. The southern range limit is not completely clear. "Central Appalachian Shale Barrens" (sensu VDNH) are the "core" concept. The bluestone shale barrens of West Virginia are placed in this system even though many of the endemics are not present there; the same is true at the northern periphery of this system in Pennsylvania.
Similar Ecological Systems:
- Central Appalachian Pine-Oak Rocky Woodland (CES202.600)
- Central Interior Highlands Dry Acidic Glade and Barrens (CES202.692)
- Southern and Central Appalachian Mafic Glade and Barrens (CES202.348)
- Southern Appalachian Montane Cliff and Talus (CES202.330)

Related Concepts:
- Central Appalachian Shale Barrens (Fleming et al. 2004) Finer
- Chestnut Oak: 44 (Eyre 1980) Finer
- Virginia Pine: 79 (Eyre 1980) Finer

DESCRIPTION

Environment: This system is found at low to mid elevations in the central and southern Appalachians. Most shale barrens occur between 305 and 610 m (1000-2000 feet) elevation and have a generally southern exposure. Slopes are steep and often undercut by a stream at the base. Soils are thin, with a layer weathered rock fragments covering the surface. The exposure and lack of soil create extreme conditions for plant growth. The chemistry and pH vary somewhat from site to site, and this variability may be reflected in the vegetation. The substrate includes areas of solid rock as well as unstable areas of shale scree, usually steeply sloped.
Vegetation: Although stunted trees of several species such as *Quercus prinus, Pinus virginiana*, and *Carya glabra* are common, Central Appalachian Shale Barrens are strongly characterized by their open physiognomy and by a suite of uncommon and rare plants found almost exclusively in these habitats (Fleming et al. 2004). Endemic or near-endemic shale barren species include shale-barren rock-cress (*Arabis serotina*), white-haired leatherflower (*Clematis albicoma*), Millboro leatherflower (*Clematis viticaulis*; also endemic to Virginia), shale-barren wild buckwheat (*Eriogonum allenii*), shale-barren evening-primrose (*Oenothera argillicola*), shale-barren ragwort (*Packera antennariifolia*), and Kate's Mountain clover (*Trifolium virginicum*). Other more-or-less widespread and characteristic herbaceous species of Virginia shale barrens include Pennsylvania sedge (*Carex pensylvanica*), little bluestem (*Schizachyrium scoparium*), poverty oatgrass (*Danthonia spicata*), wavy hairgrass (*Deschampsia flexuosa var. flexuosa*), moss phlox (*Phlox subulata*), mountain nailwort (*Paronychia montana*), rock spike-moss (*Selaginella rupestris*), shale-barren pussytoes (*Antennaria virginica*), Canada cinquefoil (*Potentilla canadensis*), smooth sunflower (*Helianthus laevigatus*), false boneset (*Brickellia eupatorioides var. eupatorioides*), hairy woodmint (*Blephilia ciliata*), and western wallflower (*Erysimum capitatum var. capitatum*; Bath and Alleghany counties).

Component Associations:
- *(Pinus virginiana, Juniperus virginiana) / Schizachyrium scoparium - Eriogonum allenii* Wooded Herbaceous Vegetation (CEGL008530, G2)
- *Juniperus virginiana - Fraxinus americana / Carex pensylvanica - Cheilanthes lanosa* Wooded Herbaceous Vegetation (CEGL006037, G2)
- *Pinus virginiana - Juniperus virginiana - Quercus rubra / Solidago arguta var. harrisii - Opuntia humifusa* Woodland (CEGL006288, G3)
- *Pinus virginiana - Quercus prinus / Packera antennariifolia - Phlox subulata* Woodland (CEGL006562, G3G4)
- *Pinus virginiana - Quercus prinus / Quercus ilicifolia / (Hieracium greenii, Viola pedata)* Woodland (CEGL008525, G3)

- *Pinus virginiana / Vaccinium pallidum / Schizachyrium scoparium - Carex pensylvanica* Woodland (CEGL003624, G2)
- *Quercus prinus - Juniperus virginiana - (Pinus virginiana) / Philadelphus hirsutus - Celtis occidentalis* Woodland (CEGL007720, G2)
- *Quercus prinus / Quercus ilicifolia / Danthonia spicata* Woodland (CEGL008526, G3?)

DISTRIBUTION

Range: This system is found from southern Pennsylvania south to Virginia and extreme eastern Tennessee. Application of the concept south of Virginia is uncertain. It is not attributed to Kentucky.
Divisions: 202:C
Nations: US
Subnations: MD, NC?, PA, TN, VA, WV
Map Zones: 57:C, 61:C
USFS Ecomap Regions: M221Ac:CCC, M221Be:CCC
TNC Ecoregions: 50:P, 51:P, 59:C

SOURCES

References: Comer et al. 2003, Fleming et al. 2004, Keener 1970, Platt 1951
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723010#references
Description Author: S.C. Gawler, mod. M. Pyne
Version: 05 May 2008 **Stakeholders:** East, Southeast
Concept Author: S.C. Gawler **ClassifResp:** East

ATLANTIC BOREAL BALSAM FIR WET FOREST (CES103.433)

CLASSIFIERS

Classification Status: Standard

Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
National Mapping Codes: ESLF 4406

CONCEPT

Summary: This ecological system represents the climatically wet boreal forests of Atlantic Canada, found in southern Newfoundland and coastal areas of Labrador. The low-elevation forests are dominated by *Abies balsamea*, with *Picea glauca, Picea mariana*, and *Betula papyrifera var. cordifolia (= Betula cordifolia)* present. Trees are relatively short-statured, rarely exceeding 15 m. With increasing age, the fir-dominated forests may develop a high diversity and biomass of lichens, along with epiphytic mosses. The ground moss layer ranges from discontinuous to continuous. Because of the wet conditions, these forests have little to no history of fire. Insects, fungal diseases, and wind are the main natural disturbance factors, leading to the formation of patchy, multi-aged stands.
Classification Comments: The separation of these Atlantic boreal forests from other eastern Canadian boreal forests has been proposed by the Canadian NVC Technical Committee (K. Baldwin pers. comm. 2012), at either the macrogroup or group level. These forests differ from Eastern Boreal Balsam Fir - White Spruce - White Birch Forest Group (G638), in that they have a wet climate, fire is essentially absent, trees are short-statured, and strongly dominated by *Abies balsamea*, and epiphytic lichen cover is high. Other distinctive aspects of their flora are under review by the Canadian NVC Technical Committee (K. Baldwin pers. comm. 2012). These forests have recently been referred to as "boreal rainforests" and, more technically, as "perhumid boreal forests" (Clayden et al. 2011). The authors provide an extended summary of the climatic characteristics of these forests. They also discuss the potential for recognition of "perhumid hemi-boreal forests" of eastern Canada, including the red spruce-northern hardwoods, and even eastern hemlock types, but they note that these perhumid stands occur in an eastern humid climate, and it is not clear whether they warrant a distinctly "perhumid sector." Those "hemi-boreal" forests are included within Northern Mesic Hardwood & Conifer Forest Macrogroup (M014), belonging to either Sub-Boreal Mesic Fir - Yellow Birch - Hardwoods Forest Group (G629), Northern Appalachian & Acadian Red Spruce - Fir - Hardwoods Forest Group (G024), or Northern Hemlock - White Pine - Hardwoods Forest Group (G163).

A separate aspen-birch system is not recognized in this region; and this system is directly comparable to the group concept (G674).
Similar Ecological Systems:
- Eastern Boreal Balsam Fir-White Spruce-Paper Birch Forest (CES103.421)--contains the more continental eastern boreal forests where balsam fir is also a dominant.
- Laurentian-Acadian Sub-boreal Mesic Balsam Fir-Spruce Forest (CES103.426)--Extension of this hemi-boreal system into Newfoundland is under review.

Related Concepts:
- Balsam Fir: 5 (Eyre 1980) Finer
- Perhumid Boreal Forests of Eastern Canada (Clayden et al. 2011) Undetermined

DESCRIPTION

Environment: The climate is wet, resulting from a combination of humid continental air masses interacting with coastal oceanic conditions and relatively low air temperatures. Clayden et al. (2011) describe the climate as "perhumid" (based on Thornthwaite (1948) categories); that is, a climate in which precipitation much exceeds evaporation and plant transpiration, resulting in year-round wetness. Perhumid areas may undergo short periods during an average year when water losses exceed water gains, but these are offset by abundant moisture in adjacent months. Thornthwaite index values in this region are greater than 100 (Clayden et al. 2011, cf. Rowe 1972, p. 155). In eastern Canada, annual precipitation is mostly in the range of 1000 to 1600 mm, though locally some areas receive between 1600 and 1800 mm annually. The wetness is a consequence of major airstreams and oceanic currents along the coast. In the coastal areas, over 85% of the precipitation falls as rain; in higher elevation areas, snow may account for half of the precipitation. Fog also contributes to the wet conditions, increasing the precipitation levels and decreasing evapotranspiration. Temperate conditions are cool, with a mean annual temperate of 1-4 degrees C. Because continental airflows dominate the region, seasonal temperature variations are higher than in western North America, but moderated by the ocean.
Vegetation: The low-elevation forests are dominated by *Abies balsamea*, with *Picea glauca, Picea mariana, Betula papyrifera, Betula papyrifera var. cordifolia (= Betula cordifolia)*, and *Populus tremuloides* present. Trees are relatively short-statured, rarely exceeding 15 m. *Abies balsamea* also typically dominates the shrub layer. Common herbs include *Coptis trifolia (= Coptis groenlandica), Epigea repens, Goodyera repens, Listera cordata*, and *Streptopus lanceolatus (= Streptopus roseus)*, especially in old-growth stands. With increasing age, the fir-dominated forests may develop a high diversity and biomass of lichens, along with epiphytic mosses. The lichen composition is reflective of wet conditions, with analogues to oceanic wet sites in other boreal regions (Clayden et al. 2011). One of the common epiphytic mosses of West Coast rainforests, *Antitrichia curtipendula*, has its only known eastern North American occurrence in the wet forests of southern Newfoundland. Ground moss layer ranges from discontinuous to continuous, and is dominated by *Pleurozium schreberi, Hylocomium splendens*, and *Sphagnum* spp. (Thompson et al. 2003). *Rhytidiadelphus loreus* (lanky moss) is a common and distinctive moss, not found in balsam fir forests of more continental areas

(Clayden et al. 2011).
Dynamics: Because of the wet conditions, these forests have little to no history of fire, with fire intervals exceeding 500 to 1000 years (Thompson et al. 2003, Bouchard et al. 2008). Insects, fungal diseases, and wind are the main natural disturbance factors. Average gap size and stand age-class structure vary, depending on the frequency of such disturbances. Small disturbances are the most common, creating patchy, multi-aged stands across the landscape. Large disturbances may be created by hurricane storms in late summer or fall. *Abies balsamea* is capable of persisting as suppressed saplings in the understory of mature stands, and they can quickly dominate recently disturbed sites. Old-growth characteristics include high volume of snags and coarse woody debris, and high lichen loads, among others. These forests are now considerably altered from the natural patch structure, with large gaps and young stands created by clear-cut logging (Thompson et al. 2003).

DISTRIBUTION

Range: This system is found in eastern Canada, on Newfoundland and Labrador.
Nations: CA
Subnations: LB, NF

SOURCES

References: Bouchard et al. 2008, Clayden et al. 2011, Eyre 1980, Faber-Langendoen et al. 2013a, NatureServe n.d., Rowe 1972, Thompson et al. 2003, Thornthwaite 1948
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.878464#references
Description Author: D. Faber-Langendoen
Version: 24 Aug 2012 **Stakeholders:** Canada
Concept Author: K. Baldwin and Canadian NVC Committee (2012), in Faber-Langendoen et al. (2012) **ClassifResp:** Central

ATLANTIC COASTAL PLAIN FALL-LINE SANDHILLS LONGLEAF PINE WOODLAND (CES203.254)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Very Short Disturbance Interval; Needle-Leaved Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2346; ESLF 4249; ESP 1346

CONCEPT

Summary: This system occurs in the Fall-line Sandhills region of central North Carolina south and west into central Georgia. It is the predominant system in its range, covering most of the natural landscape of the region. It occurs on upland sites ranging from gently rolling, broad ridgetops to steeper sideslopes, as well as locally in mesic swales and terraces. Most soils are well-drained to excessively-drained. The vegetation is naturally dominated by *Pinus palustris*. Most associations have an understory of scrub oaks (*Quercus laevis*, *Quercus marilandica*, *Quercus incana*, and *Quercus margarettiae*). The herb layer is generally well-developed and dominated by grasses. Wiregrasses (*Aristida stricta* in the north, *Aristida beyrichiana* in the south) dominate in most of the range, but other grasses dominate where these are absent. Forbs, including many legumes and composites, are also abundant. Frequent, low-intensity fire is the dominant natural ecological force.
Classification Comments: This system is distinguished from Atlantic Coastal Plain Upland Longleaf Pine Woodland (CES203.281) based on differences in landscape patterns, prevailing associations, and some floristic differences. Dissected topography with much higher relief, predominance of interbedded sands and clays, and interspersion with seepage wetlands all characterize the Fall-line Sandhills, in contrast to the low relief, pure sands or loams, and mosaics containing other wetland types in the rest of the Coastal Plain. Some matrix associations in the Fall-line Sandhills, such as *Pinus palustris / Quercus marilandica / Gaylussacia dumosa / Aristida stricta* Woodland (CEGL003595) are nearly absent in the rest of the Coastal Plain. The abundance of legumes in most Sandhills region associations and their scarcity in most Outer Coastal Plain associations is striking, and is probably related to the differences in prevailing soil texture. This system does not have a biogeographic break in southern South Carolina, as the Outer Coastal Plain systems do. It includes areas with both *Aristida stricta* and *Aristida beyrichiana*. Gopher tortoises (*Gopherus polyphemus*), used as a break in the Outer Coastal Plain systems because of their keystone species role, are not present in the Fall-line Sandhills. This system is distinguished from Central Atlantic Coastal Plain Wet Longleaf Pine Savanna and Flatwoods (CES203.265) because of the ecological role of saturated wetland conditions in the latter.
Similar Ecological Systems:
- Atlantic Coastal Plain Upland Longleaf Pine Woodland (CES203.281)
- Central Atlantic Coastal Plain Wet Longleaf Pine Savanna and Flatwoods (CES203.265)

Related Concepts:
- Longleaf Pine - Scrub Oak: 71 (Eyre 1980) Finer
- Longleaf Pine: 70 (Eyre 1980) Finer
- Pine / Scrub Oak Sandhill (Schafale and Weakley 1990) Finer. in major part.
- Southern Scrub Oak: 72 (Eyre 1980) Finer
- Xeric Sandhill Scrub (Schafale and Weakley 1990) Finer

DESCRIPTION

Environment: This system occurs on upland sites in the Fall-line Sandhills region (Ecoregion 65c of EPA (2004); 232Bq of Keys et al. (1995)). It covers the gently rolling, ancient eolian sands and the steeper side slopes in older formations that make up most of the dissected landscape in this region. Shallow swales, drier stream terraces, and rock outcrops also may support this system. Substrates include interbedded sands and clays, deep sands, and occasional loamy sediments. Soils are generally well- to excessively drained and infertile, though local richer, mesic sites occur. All soil types are underlain by a thick clay layer that impedes drainage and creates innumerable headwater creeks; the depth from the surface to this clay layer is very variable. Non-wetland conditions and frequent fire unify this system within the Fall-line Sandhills region. Soil texture appears to be the most important driver of differences among associations within the system, with biogeography also important.
Vegetation: Vegetation is a set of associations naturally dominated by longleaf pine (*Pinus palustris*). Scrub oaks (*Quercus laevis*, *Quercus marilandica*, *Quercus incana*, and *Quercus margarettiae*) form an understory in most associations, all but the mesic ones. Low shrubs, most ericaceous, may be abundant. In most of the range, wiregrass (*Aristida stricta* or in the south *Aristida beyrichiana*) is the dominant herb. In central South Carolina both species are absent and various other grass species dominate. Most associations have abundant legumes, as well as composites and other forbs. The abundance of legumes distinguishes this system from Atlantic Coastal Plain Upland Longleaf Pine Woodland (CES203.281), where most associations have few legumes. Many associations have moderate to high species richness, with most of the species in the herb layer. Some mesic associations have among the highest species richness values measured at the 1/10-hectare scale. Associations on deep, coarse sands may have low species richness but have a distinct set of xerophytic herbs and dwarf-shrubs.

Dynamics: Frequent fire is the predominant natural disturbance in this system. Component communities naturally burned every few years, many averaging as often as every 3 years. Fires are naturally low to moderate in intensity. They burn above-ground parts of herbs and shrubs, but have little effect on the fire-tolerant trees. Vegetation recovers very quickly from fires, with live herbaceous biomass often restored in just a few weeks. Many plants have their flowering triggered by burning. Fire is important in creating the structure of the vegetation. In the absence of fire, less fire-tolerant species increase and others invade the system. The scrub oaks and shrubs, kept to low density and mostly reduced to shrub size, become tall and dense and can suppress tree regeneration. Herb layer density and diversity decline. Only on the most excessively drained coarse sands does the vegetation not undergo substantial structural alteration and reduction in species richness after just a few years without burning. The often patchy nature of natural fires (and controlled burns) results in part from the abundance of streamheads that lace the Sandhills region and which tend to restrict fires from sweeping across large acreages.

Canopies are believed to naturally be multi-aged, consisting of a fine mosaic of small even-aged groves driven by gap-phase regeneration. *Pinus palustris* is shade-intolerant and slow to reach reproductive age, but is very long-lived. Most plants in these systems appear to be conservative, living a long time and only rarely sexually reproducing or colonizing new sites. Similar conservatism is shown by some of the vertebrates, such as Red-cockaded woodpecker (*Picoides borealis)*. Different dynamics occur in many insect populations, whose individuals are not resilient to fire and must recolonize burned areas from nearby unburned patches.

Component Associations:
- *Pinus palustris - (Pinus taeda) / Schizachyrium scoparium - Rhynchosia reniformis* Woodland (CEGL007738, G1)
- *Pinus palustris - Pinus (echinata, taeda) - Quercus (incana, margarettiae, falcata, laevis)* Woodland (CEGL007511, G4)
- *Pinus palustris / Aristida stricta - Sorghastrum nutans - Anthaenantia villosa* Woodland (CEGL003570, G2G3)
- *Pinus palustris / Quercus incana - Quercus marilandica / Aristida beyrichiana - Nolina georgiana* Woodland (CEGL007842, G2G3)
- *Pinus palustris / Quercus incana / Aristida stricta - Sorghastrum nutans - Anthaenantia villosa* Woodland (CEGL003578, G2G3)
- *Pinus palustris / Quercus laevis - (Quercus incana) / Vaccinium tenellum / Schizachyrium scoparium - Eriogonum tomentosum* Woodland (CEGL003593, G2)
- *Pinus palustris / Quercus laevis - Quercus (incana, margarettiae) / Gaylussacia dumosa / Aristida stricta* Woodland (CEGL003591, G3?)
- *Pinus palustris / Quercus laevis - Quercus incana / Aristida beyrichiana - Baptisia perfoliata* Woodland (CEGL007844, G2G3)
- *Pinus palustris / Quercus laevis / Aristida purpurascens - Stipulicida setacea - (Rhynchospora megalocarpa, Selaginella acanthonota)* Woodland (CEGL003590, G2)
- *Pinus palustris / Quercus laevis / Aristida stricta / Cladonia* spp. Woodland (CEGL003584, G2G3)
- *Pinus palustris / Quercus laevis / Gaylussacia dumosa / Aristida stricta* Woodland (CEGL003586, G3?)
- *Pinus palustris / Quercus laevis / Leiophyllum buxifolium - Cyrilla racemiflora - Clethra alnifolia* Woodland (CEGL007767, G1)
- *Pinus palustris / Quercus marilandica / Gaylussacia dumosa / Aristida stricta* Woodland (CEGL003595, G2G3)
- *Pinus palustris / Quercus marilandica / Vaccinium crassifolium / Aristida stricta* Woodland (CEGL003599, G2?)
- *Pinus palustris / Vaccinium elliottii - Clethra alnifolia / Aristida stricta - Panicum virgatum* Woodland (CEGL003573, G1)

SPATIAL CHARACTERISTICS

Spatial Summary: This system is naturally a matrix system, covering most of the landscape in its range. Most occurrences now are artificially bounded remnants or naturally small islands. Extensive occurrences usually have embedded wetland systems, especially Atlantic Coastal Plain Streamhead Seepage Swamp, Pocosin, and Baygall (CES203.252).
Size: Natural patches once would have been contiguous over hundreds of square miles, covering most of the landscape in the region and broken only by river systems. Most occurrences are now artificially bounded remnants of small to fairly large size. A few landscape matrix areas of thousands of acres remain.
Adjacent Ecological Systems:
- Atlantic Coastal Plain Sandhill Seep (CES203.253)
- Atlantic Coastal Plain Small Blackwater River Floodplain Forest (CES203.249)
- Atlantic Coastal Plain Streamhead Seepage Swamp, Pocosin and Baygall (CES203.252)

Adjacent Ecological System Comments: Streamhead pocosins are the most frequently associated system, with Sandhill seeps and Atlantic Coastal Plain Small Blackwater River Floodplain Forest (CES203.249) also frequent associates.

DISTRIBUTION

Range: This system ranges from central North Carolina to central Georgia, in the Fall-line Sandhills region (Ecoregion 65c of EPA (2004); 232Bq of Keys et al. (1995)).
Divisions: 203:C
Nations: US
Subnations: GA, NC, SC
Map Zones: 55:C, 58:C
USFS Ecomap Regions: 232J:CC
TNC Ecoregions: 56:C, 57:C

SOURCES

References: Brewer 2008, Comer et al. 2003, EPA 2004, Eyre 1980, Keys et al. 1995, NatureServe 2011, Nordman 2012, Oswalt et al. 2012, Schafale and Weakley 1990, Wahlenberg 1946

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723231#references
Description Author: M. Schafale and R. Evans, mod. C. Nordman
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: M. Schafale and R. Evans **ClassifResp:** Southeast

ATLANTIC COASTAL PLAIN UPLAND LONGLEAF PINE WOODLAND (CES203.281)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Very Short Disturbance Interval; Needle-Leaved Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2347; ESLF 4250; ESP 1347

CONCEPT

Summary: This system of upland *Pinus palustris*-dominated vegetation is found in the Atlantic Coastal Plain of the United States, where it ranges from southern Virginia (where it is nearly extirpated and of very limited extent) to northeastern Florida. This system does not include *Pinus palustris* stands found in the Fall-line Sandhills, which are accommodated by another ecological system. Examples and associations share the common feature of upland (non-wetland) moisture regimes and natural exposure to frequent fire. They occur on a variety of well- to excessively drained soils, and on the higher parts of upland-wetland mosaics. The vegetation is naturally dominated by *Pinus palustris*. Most associations have an understory of scrub oaks. The herb layer is generally well-developed and dominated by grasses, with legumes and composites. *Aristida stricta* primarily dominates in the northern part of its range, and *Aristida beyrichiana* in the southern part. Frequent, low-intensity fire is the dominant natural ecological force.
Classification Comments: This system is distinguished from Central Atlantic Coastal Plain Wet Longleaf Pine Savanna and Flatwoods (CES203.265) because of the ecological role of saturated wetland conditions in the latter. The two systems have much in common, including frequent fire and the same primary dominant tree and herb species. They often occur in the same landscapes. However, floristic differences are well marked, and no associations are shared. This system is distinguished from Atlantic Coastal Plain Fall-line Sandhills Longleaf Pine Woodland (CES203.254) based on the differences in landscape patterns and prevailing associations in the two regions. Dissected topography with much higher relief, predominance of interbedded sands and clays, and interspersion with seepage wetlands all characterize the Fall-line Sandhills, in contrast to the low relief, pure sands or loams, and mosaics containing other wetland types in the rest of the Coastal Plain. Some matrix associations in the Fall-line Sandhills, such as *Pinus palustris / Quercus marilandica / Gaylussacia dumosa / Aristida stricta* Woodland (CEGL003595) are nearly absent in the rest of the Coastal Plain, and there are systematic floristic differences. If this were to be split into a northern and southern component, the distinction would be justified based on differences in climate, flora, and some differences in ecological dynamics. Gopher tortoises (*Gopherus polyphemus*) are an important keystone species in the southern portion of the range. The dominant grass also changes at this approximate point, with *Aristida beyrichiana* dominating herb layers to the south.
Similar Ecological Systems:
- Atlantic Coastal Plain Fall-line Sandhills Longleaf Pine Woodland (CES203.254)
- Central Atlantic Coastal Plain Wet Longleaf Pine Savanna and Flatwoods (CES203.265)

Related Concepts:
- Coastal Fringe Sandhill (Schafale and Weakley 1990) Finer
- Longleaf Pine - Scrub Oak: 71 (Eyre 1980) Finer
- Longleaf Pine - Slash Pine: 83 (Eyre 1980) Finer
- Longleaf Pine: 70 (Eyre 1980) Finer
- Mesic Pine Flatwoods (Schafale and Weakley 1990) Finer
- Pine / Scrub Oak Sandhill (Schafale and Weakley 1990) Finer. in minor part.
- Sandhill (FNAI 1990) Intersecting
- Xeric Sandhill Scrub (Schafale and Weakley 1990) Finer
- Xeric Sandhill Scrub (Bennett and Nelson 1991) Finer

DESCRIPTION

Environment: This system occurs on upland sites of the Middle to Outer Atlantic Coastal Plain, on landforms that include loamy to sandy flats, relict beach system deposits, eolian sand deposits, Carolina bay rims (Bennett and Nelson 1991), and occasional low rolling hills. Soils range from mesic to xeric and from sandy to loamy or occasionally clayey. Most natural remnants are on coarse sands, but most examples probably once occurred on loamy soils but have subsequently been converted to agricultural uses since the time of European settlement. Soils are largely acidic and infertile, and the coarsest sands are excessively drained and sterile. The unifying feature of this system is non-wetland sites that naturally supported frequent fire. As such, it once covered much of the landscape of the Coastal Plain. Variations in soil texture and drainage appear to be a primary driver of differences between associations within the system, with biogeography also important as there is considerable floristic turnover along a northeast-to-southwest gradient paralleling the coast. In addition, soil texture varies dramatically along this gradient with finer-textured soils predominating north of the Neuse River (in North Carolina), and again south of the Great Pee Dee River and north of the Savanna River (in South Carolina).
Vegetation: Vegetation is a set of associations that are most naturally woodlands or savannas dominated by *Pinus palustris* and

having a well-developed grassy herb layer. A few associations have sparse herb layers due to excessively drained soils, and a few are dominated by scrub oaks. Other pine species may sometimes be present. Scrub oaks (*Quercus laevis, Quercus incana, Quercus margarettiae, Quercus hemisphaerica*, and others) form an understory in most associations, all but the mesic ones. Low shrubs, most ericaceous, are often an important component. In most of the range, *Aristida stricta* is the dominant herb. In the southern and northern parts of the range, it is absent, and various other grass species dominate. Forbs, especially composites, are usually also an important herb component, and lichens are abundant in some associations. Many associations have moderate species richness, with most of the species in the herb layer. Some mesic associations have very high species richness, among the highest values ever measured at the 1/10-hectare scale. Associations on deep, coarse sands may have low species richness but have a distinct set of xerophytic herbs and dwarf-shrubs.

Dynamics: Frequent fire is the predominant natural disturbance in this ecological system, except on the most excessively drained coarse sands, where the sparse ground cover vegetation limits low intensity fire. Component communities naturally burned every few years, many averaging as often as every 3 years. Fires are naturally low to moderate in intensity. They burn above-ground parts of herbs and shrubs but have little effect on the fire-tolerant trees. Vegetation recovers very quickly from fire, with live herbaceous biomass often restored in just a few weeks. Many plants have their flowering triggered by burning. In the absence of fire, less fire-tolerant species increase and others invade the system. The scrub oaks and shrubs, kept to low density and mostly reduced to shrub size by fire, become tall and dense and can suppress *Pinus palustris* regeneration as well as dramatically reducing the herbaceous layer. Only on the most excessively drained coarse sands does the vegetation not undergo substantial structural alteration and reduction in species richness after just a few years without burning.

Canopies are believed to naturally be multi-aged, consisting of a fine mosaic of small even-aged patches driven by gap-phase regeneration. *Pinus palustris* is shade-intolerant and slow to reach reproductive age but is very long-lived.

Component Associations:

- *(Pinus palustris) / Bigelowia nuttallii - Talinum teretifolium - Allium cuthbertii - Penstemon dissectus* Altamaha Grit Herbaceous Vegetation (CEGL004783, G1G2)
- *Pinus palustris - (Pinus taeda) / Schizachyrium scoparium - Rhynchosia reniformis* Woodland (CEGL007738, G1)
- *Pinus palustris - Pinus (echinata, taeda) - Quercus (incana, margarettiae, falcata, laevis)* Woodland (CEGL007511, G4)
- *Pinus palustris - Pinus taeda - Pinus serotina / Quercus marilandica / (Quercus pumila) / Aristida stricta* Woodland (CEGL003664, G1)
- *Pinus palustris - Pinus taeda / Quercus geminata - Quercus hemisphaerica - Osmanthus americanus var. americanus / Aristida stricta* Woodland (CEGL003577, G2)
- *Pinus palustris / Amorpha herbacea var. herbacea / Aristida stricta - Sorghastrum nutans* Woodland (CEGL003569, G2G3)
- *Pinus palustris / Aristida stricta - Sorghastrum nutans - Anthaenantia villosa* Woodland (CEGL003570, G2G3)
- *Pinus palustris / Quercus incana - Quercus marilandica / Aristida beyrichiana - Nolina georgiana* Woodland (CEGL007842, G2G3)
- *Pinus palustris / Quercus incana - Quercus stellata / Aristida beyrichiana - Sporobolus junceus - Nolina georgiana* Woodland (CEGL004487, G2G3)
- *Pinus palustris / Quercus incana / Aristida stricta - Sorghastrum nutans - Anthaenantia villosa* Woodland (CEGL003578, G2G3)
- *Pinus palustris / Quercus laevis - (Quercus incana) / Vaccinium tenellum / Schizachyrium scoparium - Eriogonum tomentosum* Woodland (CEGL003593, G2)
- *Pinus palustris / Quercus laevis - Quercus (incana, margarettiae) / Gaylussacia dumosa / Aristida stricta* Woodland (CEGL003591, G3?)
- *Pinus palustris / Quercus laevis - Quercus geminata / Vaccinium tenellum / Aristida stricta* Woodland (CEGL003589, G2?)
- *Pinus palustris / Quercus laevis - Quercus incana - Quercus margarettiae / Licania michauxii / Aristida beyrichiana* Woodland (CEGL004492, G3)
- *Pinus palustris / Quercus laevis - Quercus incana / Aristida beyrichiana - Baptisia perfoliata* Woodland (CEGL007844, G2G3)
- *Pinus palustris / Quercus laevis - Quercus incana / Gaylussacia dumosa - Gaylussacia (baccata, frondosa)* Woodland (CEGL003592, G1)
- *Pinus palustris / Quercus laevis / Aristida purpurascens - Stipulicida setacea - (Rhynchospora megalocarpa, Selaginella acanthonota)* Woodland (CEGL003590, G2)
- *Pinus palustris / Quercus laevis / Aristida stricta / Cladonia* spp. Woodland (CEGL003584, G2G3)
- *Pinus palustris / Quercus laevis / Gaylussacia dumosa / Aristida beyrichiana - Helianthus atrorubens* Woodland (CEGL004488, G2G3)
- *Pinus palustris / Quercus laevis / Gaylussacia dumosa / Aristida stricta* Woodland (CEGL003586, G3?)
- *Pinus palustris / Quercus laevis / Serenoa repens - Vaccinium stamineum / Aristida beyrichiana* Woodland (CEGL004490, G2G3)
- *Pinus palustris / Quercus margarettiae - Quercus incana / Schizachyrium scoparium* Atlantic Woodland (CEGL004083, G2?)
- *Pinus palustris / Quercus marilandica - Quercus laevis / Aristida beyrichiana - Nolina georgiana* Woodland (CEGL004489, G2)
- *Pinus palustris / Quercus marilandica / Gaylussacia dumosa / Aristida stricta* Woodland (CEGL003595, G2G3)
- *Pinus palustris / Quercus pumila - Gaylussacia dumosa / Schizachyrium scoparium* Woodland (CEGL004084, G2?)

SPATIAL CHARACTERISTICS

Spatial Summary: This system is naturally a matrix system, probably once the most extensive system in its range. Most occurrences now are artificially bounded remnants or naturally small islands. Occurrences often form mosaics with Atlantic Coastal Plain Northern Wet Longleaf Pine Savanna and Flatwoods (CES203.265) or Atlantic Coastal Plain Peatland Pocosin (CES203.267) and may have

small-patch systems embedded in them.
Size: Once the most abundant system over large parts of the Coastal Plain, forming the matrix in which most other systems occurred, most occurrences are now naturally small islands or are artificially bounded remnants of small to fairly large size. A few landscape matrix areas of several thousand acres remain.
Adjacent Ecological Systems:
- Atlantic Coastal Plain Clay-Based Carolina Bay Wetland (CES203.245)
- Atlantic Coastal Plain Peatland Pocosin and Canebrake (CES203.267)
- Central Atlantic Coastal Plain Wet Longleaf Pine Savanna and Flatwoods (CES203.265)
- Southern Atlantic Coastal Plain Depression Pond (CES203.262)

Adjacent Ecological System Comments: Central Atlantic Coastal Plain Wet Longleaf Pine Savanna and Flatwoods (CES203.265) or Atlantic Coastal Plain Peatland Pocosin and Canebrake (CES203.267) are the most commonly associated systems, often forming mosaics. Southern Atlantic Coastal Plain Depression Pondshore (CES203.262) and small floodplain systems may be embedded in matrices of this system.

DISTRIBUTION

Range: This system is found in the Atlantic Coastal Plain (exclusive of the Fall-line Sandhills) from southern Virginia to northeastern Florida.
Divisions: 203:C
Nations: US
Subnations: FL, GA, NC, SC, VA
Map Zones: 55:C, 58:C, 60:C
USFS Ecomap Regions: 232C:CC, 232H:CC, 232I:CC, 232J:CC
TNC Ecoregions: 56:C, 57:C

SOURCES

References: Bennett and Nelson 1991, Brewer 2008, Capinera et al. 2004, Comer et al. 2003, Dakin and Hays 1970, Eyre 1980, FNAI 1990, NatureServe 2011, Oswalt et al. 2012, Rehn and Hebard 1916, Schafale and Weakley 1990, Schafale pers. comm., Schuster 1974, Squitier and Capinera 2002, Wahlenberg 1946
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723206#references
Description Author: R. Evans, mod. M. Pyne and C. Nordman
Version: 14 Jan 2014 **Stakeholders:** East, Southeast
Concept Author: R. Evans **ClassifResp:** Southeast

BASTROP LOST PINES FOREST AND WOODLAND (CES205.896)

CLASSIFIERS

Classification Status: Standard

Primary Division: Eastern Great Plains (205)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Needle-Leaved Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2358; ESLF 4261; ESP 1358

CONCEPT

Summary: This system, dominated by *Pinus taeda*, is endemic to central Texas. Locally this is known as the "Bastrop Pines." Examples may share similarities, in terms of the vegetation, with Coastal Plain pine-hardwood systems to the east (in TNC Ecoregions 40 and 41) but differ in the fact that this system contains only loblolly pine which is generally considered successional in the more eastern systems. The vegetation includes a range of communities (that have yet to be defined) that range from very dry to xeric uplands to dry and even mesic areas with different suites of hardwood associates. The *Pinus taeda* of this region is genetically different than strains to the east; it has much greater drought tolerance. It is possible that this area was one of the epicenters of early southern pine colonization of the Coastal Plain based on fossil pollen evidence.
Classification Comments: No associations have currently been described in the NVC for this system. More information is needed.
Related Concepts:

- Bastrop Lost Pines: Hardwood Slope Forest (124) [CES205.896.16] (Elliott 2011) Finer
- Bastrop Lost Pines: Loblolly Pine / Oak Forest (103) [CES205.896.3] (Elliott 2011) Finer
- Bastrop Lost Pines: Loblolly Pine / Oak Slope Forest (123) [CES205.896.14] (Elliott 2011) Finer
- Bastrop Lost Pines: Loblolly Pine Forest (101) [CES205.896.1] (Elliott 2011) Finer
- Bastrop Lost Pines: Loblolly Pine Slope Forest (121) [CES205.896.11] (Elliott 2011) Finer

DESCRIPTION

Environment: Stands of this system occur on dissected uplands. Sandy soils characterize this system with typical Ecological Sites being deep sand, sandy, and sandy loam. It may also occupy gravelly sites associated with more recent geologic strata. Sandy Eocene formations such as Carrizo, Sparta, and Queen City formations are most frequently associated with this system, though it may also occur on the Reklaw (another Eocene) Formation (Elliott 2010).
Vegetation: This system is dominated by *Pinus taeda*, often with *Quercus stellata* and *Quercus marilandica* present to codominant. *Quercus incana, Quercus margarettiae, Carya texana, Ulmus crassifolia, Celtis* spp., and *Juniperus virginiana* may also be present. *Vaccinium arboreum* is a frequent shrub component. Other shrub and woody vine species that may be present include *Sideroxylon lanuginosum, Callicarpa americana, Ilex vomitoria, Toxicodendron* spp., *Rhus aromatica, Smilax bona-nox, Parthenocissus quinquefolia,* and *Vitis* spp. A grassy herbaceous layer may be present with *Schizachyrium scoparium* commonly encountered, but other species include *Andropogon gerardii, Nassella leucotricha, Sporobolus junceus, Paspalum plicatulum, Paspalum setaceum, Aristida* spp., *Sporobolus clandestinus, Digitaria cognata, Dichanthelium oligosanthes var. scribnerianum*, and *Dichanthelium oligosanthes*. Forbs are conspicuous and include *Heterotheca subaxillaris, Euphorbia corollata, Monarda citriodora, Galactia volubilis, Liatris aspera, Brazoria truncata, Diodia teres*, and many others (Elliott 2011).
Dynamics: Local accumulations of pine needles result in a patchy distribution of herbaceous cover. This system bears some resemblance to pine woodlands and forests farther to the east and may represent a western, more xeric outlier of these similar systems.

DISTRIBUTION

Range: This system is endemic to central Texas.
Divisions: 205:C
Nations: US
Subnations: TX
Map Zones: 32:?, 35:?, 36:C, 37:P
USFS Ecomap Regions: 255C:CC
TNC Ecoregions: 32:C

SOURCES

References: Comer et al. 2003, Diamond pers. comm., Elliott 2011
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722785#references
Description Author: R. Evans and M. Pyne, mod. L. Elliott
Version: 17 Feb 2011
Concept Author: R. Evans and M. Pyne
Stakeholders: Southeast
ClassifResp: Southeast

CALIFORNIA COASTAL CLOSED-CONE CONIFER FOREST AND WOODLAND (CES206.922)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Marine Sedimentary; Cupressus macrocarpa, C. goveniana, C. abramsiana
Non-Diagnostic Classifiers: Montane [Lower Montane]; Sideslope; Acidic Soil
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2177; ESLF 4268; ESP 1177

CONCEPT

Summary: Small occurrences of this system may be found in scattered locations along California's entire coastline and onto the Channel Islands. They are found on marine sedimentary, non-metamorphosed features, often with podsols on sterile sandstone. These forests and woodlands are limited to coastal areas with moderate maritime climate and likely receive more annual precipitation than nearby coastal chaparral. Highly localized endemic tree species include *Cupressus macrocarpa, Cupressus goveniana*, and *Cupressus abramsiana* in scattered groves along coastal Mendocino, San Mateo, Santa Cruz, and Monterey counties. *Pinus contorta var. contorta, Pinus contorta var. bolanderi, Pinus muricata, Pinus torreyana*, and *Pinus radiata* are dominant or codominant in these and other occurrences. These occurrences can also include pygmy woodland expressions where nearly lateritic subsoil underlies acidic sands (ancient marine terraces). Stunted and twisted *Pinus contorta var. contorta* stands along the Oregon coast (often called pygmy forests) are also part of this system. Other associated plant species include *Arctostaphylos nummularia, Ledum groenlandicum, Vaccinium ovatum, Gaultheria shallon, Rhododendron macrophyllum*, and *Morella californica (= Myrica californica)*. The lichen and moss component of this system is very diverse, includes *Cladonia* spp., and can be abundant in these communities.
Related Concepts:
- Knobcone Pine: 248 (Eyre 1980) Broader. includes Santa Cruz cypress, Baker cypress, McNab cypress and Sargent cypress.
- Lodgepole Pine: 218 (Eyre 1980) Intersecting. *Pinus contorta ssp. contorta* stands are a minor component of this ecological system.

DESCRIPTION

Environment: These woodlands occur in fire-prone, seasonally dry and nutritionally poor locations, in areas with a Mediterranean climate (Barbour 2007). Found in scattered locations along California's entire coastline and onto the Channel Islands, as well as along the southern Oregon coast and on two small Islands off the coast of Baja California, Mexico. These forests and woodlands are limited to coastal areas with moderate maritime climate and likely receive more annual precipitation than nearby coastal chaparral; fog drip can be an important source of moisture in some stands. They are found on marine sedimentary, non-metamorphosed features, often with Podsols on sterile sandstone. These occurrences can also include pygmy woodland expressions where nearly lateritic subsoil underlies acidic sands (ancient marine terraces). The soils are excessively well-drained in most cases, but stands of *Pinus contorta var. bolanderi* occur on poorly drained Spodosols.
Dynamics: These woodlands typically are found in sharply demarcated localized groves with a single-aged and monospecific overstory (Barbour 2007). The dominant trees are mostly serotinous in fire response (Davis and Borchert 2006), requiring heat to open the closed cones. Degree of serotiny varies widely across these species, along a continuum of conditions, but all are serotinous to some degree (Keeley and Zedler 1998, Barbour 2007). *Pinus torreyana* is reported to shed seeds from third-year cones and continuously from those cones for several years (Lanner 1999). The seeds are wingless and large, suggesting they are animal dispersed and cached in the ground which protects them from fires. Most of the closed-cone conifers are killed in crown fires because they grow in or near highly flammable chaparral (Barbour 2007). Moreover, they self-prune poorly, typically retaining lower limbs to within a meter of the ground surface (Barbour 2007) so fire easily carries into the canopy. Because they often grow in dense thickets of small-stemmed individuals, they may burn intensely even in the absence of chaparral. Basically, the fire regime of many closed-cone conifers is the same as that of the surrounding shrublands and particularly characterizes *Cupressus sargentii, Cupressus forbesii, Cupressus arizonica ssp. stephensonii (= Cupressus stephensonii), Pinus coulteri*, and *Pinus attenuata* (Landfire 2007a). The typical fire regime for most adjacent communities is known to have a return interval of less than 50 years (Barbour 2007).

Postfire regeneration of these species is closely linked to the frequency of fire relative to cone bank accumulation. For example, *Cupressus sargentii* needs at least 20 years between fires to accumulate a cone bank sufficient to regenerate the stand. *Pinus coulteri* likely needs at least 25 years and preferably 30 years to develop an adequate cone bank. Fires that kill a stand before an adequate cone bank is in place will disappear (immaturity risk) as has been observed in *Cupressus forbesii* and *Cupressus sargentii*. Fire opens closed cones but not all stands necessarily burn in crown fires. Some may burn in ground and surface fires (Landfire 2007). Severe drought can cause mortality of the trees without triggering seed dispersal; some *Cupressus* species are susceptible to cypress canker, a fungus (*Coryneum cardinale*) (Barbour 2007).

Component Associations:
- *Cupressus goveniana ssp. pygmaea* Scrub (CEGL003042, G2?)
- *Pinus muricata - Arbutus menziesii / Vaccinium ovatum* Forest (CEGL003164, G2)

- *Pinus radiata* Forest (CEGL003076, G1)

Spatial Characteristics

Size: Some occurrences of this system are large enough to map, especially those dominated by the pines; however, *Cupressus* is always too small to map. Todd Keeler-Wolf (pers. comm. 2005) and Julie Evens (pers. comm. 2005) recommend that Landfire should attempt to map where possible.

Adjacent Ecological Systems:

- California Maritime Chaparral (CES206.929)
- North Pacific Seasonal Sitka Spruce Forest (CES204.841)

Distribution

Range: This system is found in scattered locations along California's entire coastline and onto the Channel Islands and possibly just into southern Oregon in southern Coos and Curry counties.

Divisions: 206:C
Nations: MX, US
Subnations: CA, MXBC(MX), OR?
Map Zones: 2:C, 3:C, 4:C
USFS Ecomap Regions: 261B:CC, 263A:CC
TNC Ecoregions: 14:C, 15:C, 16:C

Sources

References: Barbour 2007, Barbour and Major 1988, Barbour et al. 2007, Borchert 1985, Comer et al. 2003, Davis and Borchert 2006, Eyre 1980, Holland and Keil 1995, Keeley and Zedler 1998, Landfire 2007a, Lanner 2007, Ne'eman et al. 1999, PRBO Conservation Science 2011, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722759#references

Description Author: P. Comer and T. Keeler-Wolf, mod. M.S. Reid, G. Kittel
Version: 14 Jan 2014 **Stakeholders:** Latin America, West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

CALIFORNIA COASTAL REDWOOD FOREST (CES206.921)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Long (>500 yrs) Persistence; Forest and Woodland (Treed); Toeslope/Valley Bottom; Mediterranean [Mediterranean Pluviseasonal-Oceanic]; Intermediate Disturbance Interval; F-Patch/Low Intensity; Needle-Leaved Tree; Sequoia sempervirens
Non-Diagnostic Classifiers: Montane [Lower Montane]; Lowland [Foothill]; Lowland [Lowland]; Sideslope; Marine Sedimentary; Ustic
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2015; ESLF 4202; ESP 1015

CONCEPT

Summary: This system occurs from the Klamath Mountains south to Monterey Bay, California. The coastal redwood forest generally can be found in areas of within the fog belt. In the northern portion, it occurs on upland slopes and in riparian zones and on riverine terraces that are flooded approximately every 50-100 years. In the southern portion of the range, annual precipitation may be as little as 500 mm, and the system is limited to coves and ravines. It is commonly found on moderately well-drained marine sediments (non-metamorphosed siltstones, sandstones, etc.). This system forms the tallest forests in North America, with individuals reaching 100 m high (tallest being 106-110 m [350-360 feet]). Typically, mature stands of *Sequoia sempervirens* produce a deep shade, so understories can be limited, but coarse woody debris from past disturbance can be quite large. *Pseudotsuga menziesii* is the common associate among the large trees. *Tsuga heterophylla* is found in old-growth stands in northern sections, and *Lithocarpus densiflorus* occurs as a subcanopy in almost all stands (possibly as a result of fire suppression). *Sequoia sempervirens* mixes with *Arbutus menziesii, Lithocarpus densiflorus, Pseudotsuga menziesii* and *Umbellularia californica*. The moist, coastal *Chamaecyparis lawsoniana* stands from southwestern Oregon and northwestern California, often mixed with *Sequoia sempervirens, Pseudotsuga menziesii*, or *Tsuga heterophylla*, are included in this system, as ecologically they function in the same way and have a similar overall floristic composition. Shade-tolerant understory species include *Rubus parviflorus, Oxalis oregana, Aralia californica, Mahonia nervosa (= Berberis nervosa), Gaultheria shallon*, and many ferns, such as *Blechnum spicant, Polystichum* spp., and *Polypodium* spp. Historically, surface fires likely exposed mineral soil for redwood seed germination. Less frequent disturbance can result in increases in *Tsuga heterophylla* in northern occurrences, as it is sensitive to fire and is a decreaser with fire and flood. Fire suppression has tended to result in increasing abundance of *Lithocarpus densiflorus, Umbellularia californica, Alnus rubra, Arbutus menziesii*, and *Acer macrophyllum*; all respond favorably to fire, flood, wind and slides, becoming more abundant in areas of frequent disturbance.
Classification Comments: Stands dominated or codominated with *Chamaecyparis lawsoniana* that are within 25 km (15 miles) of the coast are part of either California Coastal Redwood Forest (CES206.921) (extreme southern Oregon and northern California) or North Pacific Seasonal Sitka Spruce Forest (CES204.841) (central and northern coastal Oregon). Stands in these areas may or may not have redwood or Sitka spruce present. Stands away for the coast and not on serpentine soils are considered part of North Pacific Maritime Mesic-Wet Douglas-Fir-Western Hemlock Forest (CES204.002).
Related Concepts:
- Port Orford-Cedar: 231 (Eyre 1980) Intersecting. Coastal Port Orford-cedar stands occur in this system.
- Redwood: 232 (Eyre 1980) Equivalent

DESCRIPTION

Environment: Climate is wet, mild maritime. Forests along the immediate coast experience uniformly wet and mild climate, where precipitation averages 2000-3000 mm/year (500 mm for some of the driest redwood occurrences) with frequent fog and low clouds during warmer months; additional moisture from fog-drip can be significant. The coastal redwood system generally can be found in areas of lower rainfall than other coastal rainforests in this macrogroup, but still within the fog belt. In the northern portion, it occurs on upland slopes and in riparian zones and on riverine terraces that are flooded approximately every 50-100 years. In the southern portion of the range, annual precipitation may be as little as 500 mm, and the system is limited to coves and ravines. It is commonly found on moderately well-drained marine sediments (non-metamorphosed siltstones, sandstones, etc.). Redwood forests are limited to the north by ultramafic soils of the Klamath Mountains (Sawyer 2007).
Dynamics: Historically, surface fires likely exposed mineral soil for redwood seed germination. Less frequent disturbance can result in increases in *Tsuga heterophylla* in northern occurrences, as it is sensitive to fire and is a decreaser with fire and flood. Landfire (2007a) model: Redwood forests typically burned in the summer and early fall in low- to moderate-intensity surface fires that consumed irregular patches of surface fuel and understory vegetation. The great height of the canopy and separation of surface and crown fuels resulted in a pattern where fire rarely resulted in canopy tree mortality. Fire intervals ranged from less than 10 years in interior and upland locations to 100 years or more along the coast in the fog belt. More recent research funded by Save the Redwoods League suggests that fire has been historically quite variable with much lower frequencies in the extreme north coastal portion of redwood range (as low as 1 every 500 years) and very high in the southern end where ravine redwood stands occur adjacent to

California chaparral and grasslands (T. Keeler-Wolf pers. comm. 2013). Native Americans are thought to have contributed to the ignitions (perhaps as much as every 5-8 years) since lightning is relatively infrequent in the area, especially in the fog belt. Flooding events that undermine trees may be a significant disturbance, but it's not known for certain this is the case.

Component Associations:
- *Abies concolor - Chamaecyparis lawsoniana - Pseudotsuga menziesii / (Mahonia nervosa) / Achlys triphylla* Forest (CEGL000041, G2)
- *Abies grandis - Picea sitchensis / Gaultheria shallon / Polystichum munitum* Forest (CEGL000053, G1)
- *Chamaecyparis lawsoniana - Tsuga heterophylla / Gaultheria shallon - Rhododendron macrophyllum* Forest (CEGL000045, G1)
- *Chamaecyparis lawsoniana - Tsuga heterophylla / Polystichum munitum* Forest (CEGL000046, G1)
- *Chamaecyparis lawsoniana / Vaccinium ovatum* Forest (CEGL000048, G1)
- *Pseudotsuga menziesii - Sequoia sempervirens / Rhododendron macrophyllum / Vaccinium ovatum* Forest (CEGL000082, G2)
- *Sequoia sempervirens - Pseudotsuga menziesii* Forest (CEGL003173, GNR)
- *Sequoia sempervirens / Lithocarpus densiflorus / Vaccinium ovatum* Forest (CEGL003172, G3?)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- North Pacific Seasonal Sitka Spruce Forest (CES204.841)

DISTRIBUTION

Range: This system occurs from the Klamath Mountains south to Monterey Bay, California.
Divisions: 206:C
Nations: US
Subnations: CA
Map Zones: 2:C, 3:C, 4:C
USFS Ecomap Regions: 263A:CC, M242A:PP, M261A:CP, M261B:CC
TNC Ecoregions: 14:C, 15:C

SOURCES

References: Barbour and Billings 2000, Barbour and Major 1988, CNRA 2009, Comer et al. 2003, Eyre 1980, Faber-Langendoen et al. 2008b, Holland and Keil 1995, Keeler-Wolf pers. comm., Landfire 2007a, PRBO Conservation Science 2011, Save the Redwoods League 2013, Sawyer 2007, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Sillett and Bailey 2003, Sillett and Van Pelt 2000, WNHP 2011
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722760#references
Description Author: P. Comer and T. Keeler-Wolf, mod. M.S. Reid and G. Kittel
Version: 14 Jan 2014 **Stakeholders:** West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

CALIFORNIA MONTANE JEFFREY PINE-(PONDEROSA PINE) WOODLAND (CES206.918)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Shrubland (Shrub-dominated); Mediterranean [Mediterranean Xeric-Oceanic]; F-Patch/Low Intensity; Needle-Leaved Tree; Broad-Leaved Evergreen Shrub; Pinus jeffreyi
Non-Diagnostic Classifiers: Montane [Montane]; Montane [Lower Montane]; Acidic Soil; F-Patch/Medium Intensity; Graminoid
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2031; ESLF 4218; ESP 1031

CONCEPT

Summary: These forests are found on relatively xeric sites in mountains and plateaus from southern Oregon (600-1830 m [1800-5000 feet] elevation) south into the Sierra Nevada, throughout the Transverse Ranges of California, and into northern Baja California (1200-2740 m [4000-8300 feet]), Mexico. While the two dominant pines tend to segregate by soil fertility and temperature regimes, they may co-occur in certain areas (e.g., Modoc Plateau). These stands are more common on the east side of the Sierra Nevada, although they do occur on the west side. Stands are pure *Pinus jeffreyi, Pinus ponderosa*, or a mix of the two. Ponderosa pine and/or Jeffrey pine on the west slope of the Sierras with other conifer species are part of Mediterranean California Dry-Mesic Mixed Conifer Forest and Woodland (CES206.916). This system includes sites where *Pinus ponderosa* and/or *Pinus jeffreyi* are the predominant conifers and other tree species do not occur in high abundance, if at all. The exception to this is in southern California on the edges of the Mojave Desert where *Pinus monophylla* or *Juniperus californica* might occur in a subcanopy under *Pinus ponderosa* or *Pinus jeffreyi*. *Pinus jeffreyi* is more tolerant of colder, drier and poorer sites and replaces *Pinus ponderosa* as the dominant at higher elevations. In the north, *Pinus jeffreyi* may be replaced by *Pinus washoensis* (Carson Range and Warner Mountains). Throughout California, pure stands of ponderosa pine are relatively uncommon. Only on the Modoc Plateau do these pines co-occur in mixed stands. *Juniperus occidentalis* (both *var. australis* [in the south] and *var. occidentalis*) can co-occur in these stands but typically is not dominant. On moister and cooler sites, *Abies concolor* can be present in some stands. There can be well-developed shrub understories with strong Great Basin affinities; species can include *Artemisia tridentata, Purshia tridentata, Symphoricarpos rotundifolius var. parishii (= Symphoricarpos parishii), Arctostaphylos patula, Ceanothus cordulatus, Ceanothus prostratus, Ceanothus integerrimus, Chrysolepis sempervirens, Eriogonum wrightii, Quercus vacciniifolia,* and *Lupinus elatus*. *Cercocarpus ledifolius* is common on steeper slopes throughout the range. Historically, frequent localized ground fires maintained these systems. Stands of ponderosa pine on the east side of the Cascades transition into East Cascades Oak-Ponderosa Pine Forest and Woodland (CES204.085), or Northern Rocky Mountain Ponderosa Pine Woodland and Savanna (CES306.030) north of the Warm Springs Reservation of central Oregon.
Classification Comments: *Pinus ponderosa* forests with *Calocedrus decurrens* found on the west side of the Sierra Nevada and in the Klamath Mountains are accommodated in Mediterranean California Dry-Mesic Mixed Conifer Forest and Woodland (CES206.916).
Related Concepts:
- Bitterbrush (210) (Shiflet 1994) Intersecting. SRM type includes stands of open *P. jeffreyi* over *Purshia tridentata*.
- Interior Ponderosa Pine: 237 (Eyre 1980) Intersecting. This ecological system includes Ponderosa pine in the Sierra Nevada of California.
- Jeffrey Pine: 247 (Eyre 1980) Broader
- Pacific Ponderosa Pine: 245 (Eyre 1980) Intersecting. Ponderosa pine stands in the Sierras and Klamaths are included in this ecological system.

Component Associations:
- *Pinus jeffreyi - Abies concolor / Symphoricarpos rotundifolius / Elymus elymoides* Woodland (CEGL008631, G3?)
- *Pinus jeffreyi - Pinus monophylla* Woodland (CEGL008629, GNR)
- *Pinus jeffreyi - Quercus chrysolepis / Arctostaphylos viscida* Woodland (CEGL003156, GNR)
- *Pinus jeffreyi / Arctostaphylos patula* Woodland (CEGL008627, G4?)
- *Pinus jeffreyi / Ceanothus cordulatus* Woodland (CEGL008628, G3?)
- *Pinus jeffreyi / Cercocarpus ledifolius* Woodland (CEGL008626, GNR)
- *Pinus jeffreyi / Chrysolepis sempervirens* Woodland (CEGL008625, G3?)
- *Pinus jeffreyi / Purshia tridentata* Woodland (CEGL008624, G3G4)
- *Pinus jeffreyi / Quercus vacciniifolia* Sierra Nevada Woodland (CEGL008714, GNR)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- East Cascades Oak-Ponderosa Pine Forest and Woodland (CES204.085)
- Northern Rocky Mountain Ponderosa Pine Woodland and Savanna (CES306.030)

Adjacent Ecological System Comments: Stands of ponderosa pine on the east side of the Cascades transition into East Cascades Oak-Ponderosa Pine Forest and Woodland (CES204.085), or Northern Rocky Mountain Ponderosa Pine Woodland and Savanna (CES306.030) north of the Warm Springs Reservation of central Oregon.

DISTRIBUTION

Range: This system occurs in foothills and mountains from southern Oregon south into the Sierra Nevada, throughout the Transverse Ranges of California and into northern Baja California, Mexico.
Divisions: 206:C
Nations: MX, US
Subnations: CA, MXBC(MX), NV, OR
Map Zones: 2:C, 3:P, 4:C, 5:P, 6:C, 7:C, 12:C, 13:?
USFS Ecomap Regions: 263A:CC, 341D:CC, 342B:CC, M242A:PP, M242B:PP, M242C:PP, M261A:CC, M261B:CC, M261C:CP, M261D:CC, M261E:CC, M261F:CC, M261G:CC
TNC Ecoregions: 5:C, 12:C, 14:C, 15:C, 16:C

SOURCES

References: Barbour and Billings 2000, Barbour and Major 1988, Comer et al. 2003, Eyre 1980, Holland and Keil 1995, Jenkinson 1990, Sawyer and Keeler-Wolf 1995
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722763#references
Description Author: P. Comer, T. Keeler-Wolf, mod. G. Kittel
Version: 12 Jan 2012 **Stakeholders:** Latin America, West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

CENTRAL AND SOUTH TEXAS COASTAL FRINGE FOREST AND WOODLAND (CES203.464)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed)
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Deciduous open tree canopy
National Mapping Codes: EVT 2338; ESLF 4144; ESP 1338

CONCEPT

Summary: This system includes oak-dominated forests woodlands, shrublands and savannas occurring on deep sands of the Pleistocene-aged Ingleside barrier-strandplain of the central Texas coast and the Holocene-aged eolian sand deposits of the South Texas Sand Sheet. Topography varies from larger dunes to smaller ridges and swales. Vegetation of this physiognomically variable and dynamic system primarily includes patches (mottes) of forests, woodlands and shrublands dominated by *Quercus fusiformis*. Associated species vary in a north/south manner across the range of this system. Some examples contain dense shrublands dominated (almost to the exclusion of other species) by running clones of *Quercus fusiformis*. Other canopy species in the vicinity of Aransas National Wildlife Refuge, at the northern end of the range, include *Quercus marilandica, Quercus hemisphaerica, Persea borbonia,* and *Celtis laevigata*. In this area, understory species include *Ilex vomitoria, Smilax bona-nox, Vitis mustangensis,* and/or *Morella cerifera*. Other canopy species on the South Texas Sand Sheet, at the southern end of the range, include *Prosopis glandulosa var. glandulosa, Zanthoxylum hirsutum, Condalia hookeri, Lantana urticoides (= Lantana horrida), Ziziphus obtusifolia var. obtusifolia,* and a very few other species. Many of the species found in the northern parts of the range of this system are absent in the southern occurrences. *Quercus fusiformis - Prosopis glandulosa var. glandulosa / Malvaviscus arboreus var. drummondii* Forest (CEGL007785) can be referred to the southern expression, while *Quercus fusiformis - Persea borbonia* Forest (CEGL002117) represents the northern expression. A characteristic component of the sparse ground cover within the mottes and forests across the entire range is *Malvaviscus arboreus var. drummondii*. Canopy openings are similar in composition to surrounding grasslands. In addition to *Schizachyrium littorale*, other herbaceous species common in canopy openings across the range of this system include *Paspalum plicatulum, Paspalum monostachyum, Andropogon gerardii, Sorghastrum nutans, Muhlenbergia capillaris, Helianthemum georgianum, Croton argyranthemus,* and *Froelichia floridana*. Minor changes in drainage can cause major differences in species composition. On the Ingleside barrier-strandplain, while *Paspalum monostachyum* may dominate slightly lower areas, deeper swales are typically dominated by *Panicum virgatum, Spartina patens, Fimbristylis* spp., *Hydrocotyle bonariensis, Rhynchospora* spp., *Fuirena* spp., *Eleocharis* spp., and *Cyperus* spp.
Classification Comments: More data are needed to better define the boundary and distinction between this system and the surrounding grassland systems. The wooded component of this landscape is considered separately here due to its apparent long-term stability (>100 years) on the landscape, but some of the factors controlling its occurrence are not known. Live oak taxonomy follows that suggested by Nixon and Muller (1997), where all live oaks of coastal Texas southwest of the Brazos are considered *Quercus fusiformis*, likely introgressed with *Quercus virginiana* and/or the Mexican species *Quercus oleoides*. Though *Quercus fusiformis* is the dominant species across the range of this system, associated species vary in a north/south manner. There are probably more associations to be developed for this system.
Similar Ecological Systems:
- Texas Coast Dune and Coastal Grassland (CES203.465)

Related Concepts:
- Coastal and Sandsheet: Deep Sand Live Oak / Mesquite Woodland (6403) [CES203.464.3] (Elliott 2011) Finer
- Coastal and Sandsheet: Deep Sand Live Oak Forest and Woodland (6402) [CES203.464.2] (Elliott 2011) Finer
- Coastal and Sandsheet: Deep Sand Live Oak Shrubland (6405) [CES203.464.5] (Elliott 2011) Finer
- Coastal and Sandsheet: Deep Sand Live Oak Swale Marsh (6407) [CES203.464.7] (Elliott 2011) Finer
- Mesquite (southern type): 68 (Eyre 1980) Intersecting

DESCRIPTION

Environment: This system occurs on deep sands of the Pleistocene-aged Ingleside barrier-strandplain and the Holocene- and Pleistocene-aged eolian sand deposits of the South Texas Sand Sheet. Ridge and swale topography characterizes these sites, with some large (up to 15 m tall) vegetated dunes present. Topography varies from larger dunes to smaller ridges and swales.
Vegetation: Vegetation of this physiognomically variable and dynamic system is dominated by *Quercus fusiformis*. Stands primarily consist of patches (mottes) of forest, woodland and shrubland in a matrix of more open savannas and grasslands. Closed canopy mottes typically occur within a grassland matrix but may become more extensive forests. In the northern range of this system, other canopy components may include *Quercus marilandica, Quercus hemisphaerica, Persea borbonia,* and *Celtis laevigata*. In this area, understory species include *Callicarpa americana, Ilex vomitoria, Smilax bona-nox, Vitis mustangensis,* and *Morella cerifera*. Characteristic components of the sparse ground cover within the mottes and forests include *Malvaviscus arboreus var. drummondii, Scleria triglomerata,* and *Erythrina herbacea*. A shrubland component of this system is also present in some areas and is sometimes

extensive, consisting of a rhizomatous expression of sprouting live oaks referred to locally as "running live oak." This shrubland often appears to be a monoculture of shrubby *Quercus fusiformis* (1.5-6 m tall), but other species of the oak motte are also found here, including larger *Quercus fusiformis* trees, *Quercus hemisphaerica, Persea borbonia, Morella cerifera* (usually in swales), *Toxicodendron pubescens, Callicarpa americana, Vitis mustangensis, Ilex vomitoria, Erythrina herbacea,* and scattered *Quercus marilandica*. Small openings with *Sorghastrum nutans* hint at what is thought to have been the historical condition of these areas. These "running-live oak" thickets are thought to be a modified community that is the result of years of fire suppression and severe grazing pressures. Once this shrubland is established, it is difficult to restore the grassland community to these areas. Canopy openings are similar in composition to surrounding grasslands. In addition to *Schizachyrium littorale* and *Paspalum monostachyum,* common components include *Heteropogon contortus, Paspalum plicatulum, Trichoneura elegans, Andropogon gerardii, Sorghastrum nutans, Bothriochloa saccharoides, Muhlenbergia capillaris, Dichanthelium* spp., *Elionurus tripsacoides, Eriogonum multiflorum, Stylosanthes viscosa, Helianthemum georgianum, Croton glandulosus, Paspalum setaceum, Tradescantia humilis, Physalis cinerascens var. spathulifolia, Palafoxia hookeriana, Scleria triglomerata, Thelesperma nuecense, Lechea mucronata, Liatris elegans var. carizzana,* and *Froelichia floridana*. The oak mottes may have expanded at the expense of the oak savanna phase and become more dense in the absence of fire. A maritime component occurs on stabilized dunes composed of deep sand that stretch along San Antonio Bay. This component is characterized by a relatively tall forest (8-12 m) dominated by *Quercus fusiformis*. Other trees that reach the canopy include *Persea borbonia* and *Quercus hemisphaerica*. The midcanopy is dominated by *Persea borbonia* and *Quercus hemisphaerica* with *Celtis laevigata* and *Quercus marilandica* occurring as occasional associates. The understory includes *Ilex vomitoria* and *Callicarpa americana*. A characteristic member of the sparse ground layer is *Scleria triglomerata*. [continued in Other Comments]

Dynamics: Fire, climate, and edaphic factors all likely played a role historically in maintaining a more open structure in this vegetation. Historically, fire likely limited the development of woody cover. Likewise, edaphic conditions limited this system to deep sandy soils. Loss of these natural processes often results in a shift toward a more closed canopy and decrease in native grass cover. Threats to this system include fire suppression, coastal development, invasive exotics, and damage by vehicles.

Component Associations:

- *Fuirena scirpoidea - Fuirena longa - Rhynchospora microcarpa - Rhynchospora divergens* Herbaceous Vegetation (CEGL004952, G2)
- *Prosopis glandulosa var. glandulosa - Acacia greggii - Celtis pallida / Paspalum setaceum - Urochloa ciliatissima* Woodland (CEGL007786, G5)
- *Prosopis glandulosa var. glandulosa / Colubrina texensis - Monarda fruticulosa - Waltheria indica* Woodland (CEGL007788, G3?)
- *Quercus fusiformis - Persea borbonia* Forest (CEGL002117, G2?)
- *Quercus fusiformis - Prosopis glandulosa var. glandulosa / Malvaviscus arboreus var. drummondii* Forest (CEGL007785, G3)
- *Schizachyrium littorale - Paspalum monostachyum* Herbaceous Vegetation (CEGL002207, G3?)
- *Schizachyrium littorale - Paspalum plicatulum* Texas Sand Sheet Herbaceous Vegetation (CEGL007821, GNR)
- *Spartina patens - Fimbristylis (caroliniana, castanea) - (Panicum virgatum)* Herbaceous Vegetation (CEGL007836, G2G3)

SPATIAL CHARACTERISTICS

Spatial Summary: This system occurs in patches (mottes) or as linear occurrences on sand ridges and dunes.

Adjacent Ecological Systems:

- Tamaulipan Closed Depression Wetland (CES301.197)
- Texas Coast Dune and Coastal Grassland (CES203.465)

DISTRIBUTION

Range: This system is endemic to Texas. It is found within 10 km of the coast on deep sands of ancient Pleistocene strandplains (the Ingleside barrier-strandplain) at its northern extent and within a much greater distance from the coast (100 km) on the Holocene-aged eolian sand deposits of the South Texas Sand Sheet (primarily Kenedy and Brooks counties but extending into adjacent Jim Hogg, Hidalgo, and Willacy counties) at its southern extent.

Divisions: 203:C; 301:C
Nations: US
Subnations: TX
Map Zones: 36:C
USFS Ecomap Regions: 255D:CC
TNC Ecoregions: 30:C, 31:C

SOURCES

References: Comer et al. 2003, Elliott 2011, Nixon and Muller 1997

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723122#references

Description Author: J. Teague and M. Pyne
Version: 14 Feb 2011
Concept Author: J. Teague, mod. J. Teague, L. Elliott, M. Pyne
Stakeholders: Southeast
ClassifResp: Southeast

CENTRAL AND SOUTHERN APPALACHIAN MONTANE OAK FOREST (CES202.596)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane; Forest and Woodland (Treed); Ridge/Summit/Upper Slope; Unglaciated; Broad-Leaved Deciduous Tree; Quercus - Carya
Non-Diagnostic Classifiers: Temperate; Oligotrophic Soil; Acidic Soil; Shallow Soil; Mineral: W/ A-Horizon <10 cm; Ustic; Consolidated; W-Landscape/Medium Intensity
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: EVT 2320; ESLF 4126; ESP 1320

CONCEPT

Summary: This generally oak-dominated system is found in the central and southern Appalachian Mountains. These high-elevation deciduous forests occur on exposed sites, including ridgecrests and south- to west-facing slopes, mostly between 915 and 1372 m (3000-4500 feet) elevation, less commonly ranging up to 1680 m (5500 feet). In most associations attributed to this system, the soils are thin, weathered, nutrient-poor, low in organic matter, and acidic. The forests are dominated by *Quercus* spp. (most commonly *Quercus rubra* and *Quercus alba*), with the individuals often stunted or wind-flagged. *Castanea dentata* sprouts are also common, but the importance of chestnut in these forests has been dramatically altered by chestnut blight. *Ilex montana* and *Rhododendron prinophyllum* are characteristic shrubs.
Classification Comments: This system may be interfingered with the non-oak-dominated Southern Appalachian Northern Hardwood Forest (CES202.029), particularly between 1220 and 1525 m (4000-5000 feet) elevation. Above 1372 m (4500 feet) elevation and below spruce-fir communities, this system may be replaced on certain aspects by Southern Appalachian Northern Hardwood Forest (CES202.029).
Similar Ecological Systems:
- Southern Appalachian Low-Elevation Pine Forest (CES202.332)
- Southern Appalachian Northern Hardwood Forest (CES202.029)--generally occupies more protected and moister aspects and becomes more prominent at upper elevations.
- Southern Appalachian Oak Forest (CES202.886)--occurs at lower elevations.

Related Concepts:
- Chestnut Oak: 44 (Eyre 1980) Finer
- Cumberlands Highlands Forest (Evans 1991) Finer
- Northern Red Oak: 55 (Eyre 1980) Finer
- Red Oak - Chestnut Forest (Whittaker 1956) Equivalent
- Sugar Maple - Beech - Yellow Birch: 25 (Eyre 1980) Finer
- White Oak - Black Oak - Northern Red Oak: 52 (Eyre 1980) Finer
- White Oak: 53 (Eyre 1980) Finer

DESCRIPTION

Environment: The habitat for this system includes high ridgelines and exposed upper slopes, primarily on south- to west-facing aspects, mostly between 915 and 1372 m (3000-4500 feet) elevation, and less commonly ranging up to 1680 m (5500 feet).It generally occurs as a transition between Southern Appalachian Oak Forest (CES202.886) and more mesic Southern Appalachian Northern Hardwood Forest (CES202.029) that occurs on less-exposed ridgetops and cooler, moister upper slopes (e.g., north- and east-facing aspects). At high elevations (e.g., above 1372 m [4500 feet]), this system is generally less common than Southern Appalachian Northern Hardwood Forest (CES202.029), since the habitat on most slopes at this elevation tends to favor those species adapted to a more mesic environment. Rockslides occur periodically due to the steep slopes, and severe rockslides can cause stand replacement. Ice storms occur frequently and cause extensive damage to older dwarfed trees. Fire occurs at moderate frequency and probably needed in the long run to promote growth of fire tolerant *Quercus* and maintain their dominance. Some rare examples may be too rocky to burn, and even these have mostly closed canopies and produce a substantial leaf litter layer in most places (M. Schafale pers. comm. 2013).
Vegetation: This system is dominated by *Quercus rubra* and, more rarely, *Quercus alba*. Often the trees are stunted or at least not as tall as they would be in other systems farther downslope. Species richness is low to moderate. Tree associates include *Prunus serotina, Acer rubrum, Betula lenta,* and *Betula alleghaniensis*. Typical small trees and shrubs include *Ilex montana, Hamamelis virginiana, Acer pensylvanicum, Menziesia pilosa, Rhododendron prinophyllum, Vaccinium pallidum, Corylus cornuta var. cornuta,* and sprouts of *Castanea dentata*. The understory is usually dominated by ericaceous shrubs, but some communities are dominated by graminoid species or ferns. *Dennstaedtia punctilobula*, *Carex pensylvanica*, and *Deschampsia flexuosa* are common. Only rarely are the communities dominated by other herbs.
Dynamics: The communities of this system occur on exposed high ridges in the Appalachians, and they are subject to frequent ice and wind storms in the summer and high winds throughout the year. This system exists naturally predominantly as old-growth forest,

with trees reproducing in small to medium-sized canopy gaps created by the death of individual or small groups of trees. Wind and ice storms are the main cause of tree mortality. Breakage of trees and of branches by ice storms can additionally produce partial canopy opening over large areas (M. Schafale pers. comm.). In addition, lightning-caused fires may create surface fires that change the understory composition and inhibit some ericaceous shrub species in some areas. Fire is naturally at moderate or low frequency, but appears to be important in structuring the vegetation. In many locations, fire exclusion and competing understory vegetation are factors in poor oak regeneration, with replacement by more mesophytic species such as *Acer saccharum* (Fleming et al. 2005). Fire likely was crucial for reducing the competitive advantage of these species. Presettlement forests are likely to have experienced lightning-caused fires every 40-60 years (Fleming et al. 2005). Fires likely were more frequent than this farther south. Rockslides cause severe disturbance in occasional locations, initiating a primary succession that may last many years. Despite the high elevation, *Castanea dentata* had been a fairly substantial component of this system and can still be seen as rotting stumps in the forest.

Component Associations:
- *Betula alleghaniensis - Quercus rubra / Acer (pensylvanicum, spicatum) / Dryopteris intermedia - Oclemena acuminata* Forest (CEGL008502, G3G4)
- *Betula alleghaniensis / Sorbus americana - Acer spicatum / Polypodium appalachianum* Forest (CEGL008504, G2)
- *Quercus alba - Quercus (rubra, prinus) / Rhododendron calendulaceum - Kalmia latifolia - (Gaylussacia ursina)* Forest (CEGL007230, G4G5)
- *Quercus alba / Kalmia latifolia* Forest (CEGL007295, G2Q)
- *Quercus rubra - (Quercus alba) / Ilex montana / Dennstaedtia punctilobula - Lysimachia quadrifolia* Forest (CEGL008506, G3G4)
- *Quercus rubra - (Quercus prinus) / Vaccinium* spp. / *Deschampsia flexuosa* Woodland (CEGL006134, G4)
- *Quercus rubra - Carya (ovata, ovalis) - Fraxinus americana / Actaea racemosa - Hydrophyllum virginianum* Forest (CEGL008518, G3G4)
- *Quercus rubra - Fraxinus americana - Acer saccharum / Actaea racemosa - Caulophyllum thalictroides - Collinsonia canadensis* Forest (CEGL004256, G2)
- *Quercus rubra / (Kalmia latifolia, Rhododendron catawbiense, Rhododendron maximum) / Galax urceolata* Forest (CEGL007299, G4)
- *Quercus rubra / (Vaccinium simulatum, Rhododendron calendulaceum) / (Dennstaedtia punctilobula, Thelypteris noveboracensis)* Forest (CEGL007300, G4)
- *Quercus rubra / Carex pensylvanica - Ageratina altissima var. roanensis* Forest (CEGL007298, G2)
- *Tilia americana - Fraxinus americana / Acer pensylvanicum - Ostrya virginiana / Parthenocissus quinquefolia - Impatiens pallida* Woodland (CEGL008528, G3)

Spatial Characteristics

Spatial Summary: Large patches that may be interfingered with Southern Appalachian Northern Hardwood Forest (CES202.029). Southern Appalachian Oak Forest (CES202.886) may occur downslope.
Size: Usually smaller than 10 acres but can be larger if the slope is broadly convex on the upper exposed slopes.
Adjacent Ecological Systems:
- Southern Appalachian Northern Hardwood Forest (CES202.029)
- Southern Appalachian Oak Forest (CES202.886)

Adjacent Ecological System Comments: This system often grades into Southern Appalachian Northern Hardwood Forest (CES202.029) as one proceeds upslope or around slope to less exposed areas. Below 915-1220 m (3000-4000 feet) this system can grade into Southern Appalachian Oak Forest (CES202.886).

Distribution

Range: This system is found at higher elevations of the central and southern Appalachian Mountains, Virginia and West Virginia to Georgia. In Kentucky, this system is restricted to the Cumberland Mountains in the extreme southeastern corner of that state. In West Virginia, this system is found in the Ridge and Valley.
Divisions: 202:C
Nations: US
Subnations: GA, KY, MD?, NC, SC, TN, VA, WV
Map Zones: 53:P, 57:C, 61:C
USFS Ecomap Regions: M221A:CC, M221B:CP, M221C:CC, M221D:CC
TNC Ecoregions: 50:C, 51:C, 59:C

Sources

References: Comer et al. 2003, Evans 1991, Eyre 1980, Fleming et al. 2005, Greenberg et al. 2011, Landfire 2007a, Schafale pers. comm., Southern Group of State Foresters 2013, Whittaker 1956, Woods et al. 2002
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723012#references
Description Author: R. White, M. Pyne, R. Evans, M. Schafale, S.C. Gawler, mod. L.A. Sneddon
Version: 14 Jan 2014 **Stakeholders:** East, Southeast
Concept Author: R. White, M. Pyne, R. Evans, M. Schafale, S.C. Gawler **ClassifResp:** Southeast

CENTRAL AND SOUTHERN APPALACHIAN SPRUCE-FIR FOREST (CES202.028)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane; Forest and Woodland (Treed); Needle-Leaved Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2350; ESLF 4253; ESP 1350

CONCEPT

Summary: This system consists of forests in the highest elevation zone of the Blue Ridge and parts of the Central Appalachians, generally dominated by *Picea rubens, Abies fraseri*, or by a mixture of spruce and fir. *Abies fraseri* is the constituent fir from Mount Rogers in Virginia southward. Examples occur above 1676 m (5500 feet) in the Southern Blue Ridge, but as low as 975 m (3200 feet) at the northern range in West Virginia, and may range up to the highest peaks. Elevation and orographic effects make the climate cool and wet, with heavy moisture input from fog as well as high rainfall. Strong winds, extreme cold, rime ice, and other extreme weather are periodically important.

Classification Comments: The border of this system with adjacent systems is often gradational. The non-forested systems that occur in the same elevational zone may have transition zones of open woody vegetation, though some have sharp borders. The transition to Southern Appalachian Northern Hardwood Forest (CES202.029) or other systems that adjoin at lower elevations is marked by a gradual shift in canopy dominance from conifers to hardwoods. In relatively undisturbed stands, the canopy composition and structure are the best way to determine the boundary of this system.

This system is similar to the spruce-fir systems of the northern Appalachians and the boreal forests but differs in having less frequent natural fire, having southern seasonal dynamics (shorter winters, less extreme cold temperatures, lack of long summer days), lacking a history of glaciation, and in a flora and fauna that has southern Appalachian endemics and lacks some characteristic northern species. High-elevation spruce-fir in West Virginia is placed in this system because its location well below the glacial boundary and presence of species of more southern affinity (e.g., *Rhododendron maximum* and *Vaccinium erythrocarpum*) differentiate it from the northern Appalachian system.

Similar Ecological Systems:
- Acadian-Appalachian Montane Spruce-Fir Forest (CES201.566)--occurs on the higher elevations of the northern Appalachians, mostly from New York northward but with a few disjunct patches in Pennsylvania.

Related Concepts:
- Red Spruce - Fraser Fir: 34 (Eyre 1980) Finer
- Red Spruce - Yellow Birch: 30 (Eyre 1980) Finer
- Red Spruce: 32 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs at elevations typically above about 1300 m (4300 feet), up to the highest peaks. Species distribution follows an elevational gradient, with *Picea rubens*-dominated stands occurring between 1370 and 1675 m, mixed stands between 1675 and 1890 m, and *Abies fraseri* stands above 1890 m (Whittaker 1956 cited in Nicholas and Zedaker 1989). Examples occur on most of the landforms that are present in this elevational range; most sites are strongly exposed and convex in shape. Elevation and orographic effects make the climate cool and wet, with heavy moisture input from fog as well as high rainfall. Strong winds, extreme cold, rime ice, and other extreme weather are periodically important factors in the structure and dynamics of this vegetation. Concentration of air pollutants has been implicated as an important anthropogenic stress in recent years. In recent decades, the balsam woolly adelgid (*Adelges piceae*), an introduced insect, has killed almost all of the mature *Abies fraseri*. The saplings are not susceptible, resulting in many dense stands of young trees. Soils are generally very rocky, with the matrix ranging from well-weathered parent material to organic deposits over boulders. Soils may be saturated for long periods from a combination of precipitation and seepage. Any kind of bedrock may be present, but most sites have erosion-resistant felsic igneous or metamorphic rocks (White et al. 1993).

Vegetation: Vegetation consists primarily of forests dominated by *Picea rubens, Abies fraseri*, or occasionally by *Sorbus americana*. *Betula alleghaniensis, Tsuga canadensis*, and *Quercus rubra* are the only other locally common canopy species. *Acer rubrum, Betula lenta, Magnolia acuminata*, and *Magnolia fraseri* may occur. Lower strata are most typically dominated by mosses, ferns or forbs, but a few associations have dense shrub layers of *Rhododendron catawbiense, Rhododendron maximum*, or *Vaccinium erythrocarpum*.

Dynamics: This system is naturally dominated by stable, uneven-aged forests, with canopy dynamics dominated by gap-phase regeneration on a fine scale, as well as larger disturbances resulting primarily from ice storms (Nicholas and Zedaker 1989). Despite the extreme climate, *Picea rubens* is long-lived (300-400 or more years) (White et al. 1993). Both *Picea* and *Abies* seedlings are shade-tolerant, and advanced regeneration is important in stand dynamics. Natural disturbances are primarily wind and ice storms, but may include debris avalanches or very rarely lightning fires (White 1984b, Nicholas and Zedaker 1989, White et al. 1993). Occasional extreme wind events disturb larger patches on the most exposed slopes. Fire is a very rare event under natural conditions, due to the

wetness and limited flammability of the undergrowth (Korstian 1937 cited in White et al. 1993), and return intervals have been estimated between 500 and 1000 years or more. If fires do occur, they are likely to be catastrophic, because few of the species are at all fire-tolerant. Anthropogenic fires fueled by logging slash were extremely destructive, turning large expanses of this system into grass-shrub-hardwood scrub (e.g., Dolly Sods, Graveyard Fields) that has not recovered to conifer dominance after 100 years.

Estimates of the loss in extent of the Southern Appalachian spruce-fir forest range from 50% (White 1984c) to 90% (Korstian 1937 cited in Nicholas and Zedaker 1989). The primary disturbances are weather-related, including ice storms and windthrow, occurring at intervals of 100 to 200 years. There have been multiple events of wind and ice damage in single- and multiple-tree patches that have cumulatively damaged a lot of the canopy in spruce forests (M. Schafale pers. comm. 2013). Rare extreme weather events are also important large-scale disturbances. In contrast to northern stands of *Picea-Abies* vegetation, insect outbreaks are not important disturbances (M. Schafale pers. comm. 2013). Windthrow produces dense *Abies* seedlings if overstory is mature (Eyre 1980). In general, fire is extremely rare in Southern Appalachian *Picea-Abies* vegetation, and fire is not a primary factor in its successional dynamics.

Component Associations:
- *Abies fraseri / (Rhododendron catawbiense, Rhododendron carolinianum)* Forest (CEGL006308, G1)
- *Abies fraseri / Viburnum lantanoides / Dryopteris campyloptera - Oxalis montana / Hylocomium splendens* Forest (CEGL006049, G1)
- *Carex scabrata - Viola cucullata / Plagiomnium ciliare* Herbaceous Vegetation (CEGL006597, G3)
- *Chrysosplenium americanum* Herbaceous Vegetation (CEGL006193, G3G5)
- *Picea rubens - (Abies fraseri) / (Rhododendron catawbiense, Rhododendron maximum)* Forest (CEGL007130, G1)
- *Picea rubens - (Abies fraseri) / Vaccinium erythrocarpum / Oxalis montana - Dryopteris campyloptera / Hylocomium splendens* Forest (CEGL007131, G2)
- *Picea rubens - (Betula alleghaniensis, Aesculus flava) / Rhododendron (maximum, catawbiense)* Forest (CEGL004983, G1?)
- *Picea rubens - (Betula alleghaniensis, Aesculus flava) / Viburnum lantanoides / Oxalis montana - Solidago glomerata* Forest (CEGL006256, G2)
- *Picea rubens - (Tsuga canadensis) / Rhododendron maximum* Forest (CEGL006152, G2G3)
- *Picea rubens - Tsuga canadensis - Fagus grandifolia / Dryopteris intermedia* Forest (CEGL006029, G3)
- *Picea rubens / Betula alleghaniensis / Bazzania trilobata* Forest (CEGL008501, G2)
- *Picea rubens / Kalmia latifolia - Menziesia pilosa* Woodland (CEGL006254, G2)
- *Picea rubens / Ribes glandulosum* Forest (CEGL007128, G1)

SPATIAL CHARACTERISTICS

Spatial Summary: Large-patch to matrix system, dominating the highest mountain areas. Small patches may occur especially due to logging of the matrix/large-patch forest. Small-patch systems may be embedded.
Size: Generally covers most of the landscape in the limited areas at the tops of the highest mountain ranges. Natural patches range from hundreds to thousands of acres. A couple remnant patches of thousands of acres remain, while other intact patches are dozens of acres embedded in landscapes of degraded spruce-fir systems.
Adjacent Ecological Systems:
- High Allegheny Wetland (CES202.069)
- Southern Appalachian Grass and Shrub Bald (CES202.294)
- Southern Appalachian Northern Hardwood Forest (CES202.029)
- Southern Appalachian Rocky Summit (CES202.327)

Adjacent Ecological System Comments: Bordered by Southern Appalachian Northern Hardwood Forest (CES202.029) or Appalachian (Hemlock)-Northern Hardwood Forest (CES202.593) at lower elevation. It may contain embedded small patches of Southern Appalachian Rocky Summit (CES202.327) and Southern Appalachian Grass and Shrub Bald (CES202.294). In addition, high-elevation wetlands may be present.

DISTRIBUTION

Range: This system ranges from the Balsam Mountains and Great Smoky Mountains of North Carolina and Tennessee northward to the mountains of western Virginia and eastern West Virginia.
Divisions: 202:C
Nations: US
Subnations: NC, TN, VA, WV
Map Zones: 57:C, 61:C
USFS Ecomap Regions: M221A:CC, M221B:CC, M221C:CC, M221D:CC
TNC Ecoregions: 51:C, 59:C

SOURCES

References: Comer et al. 2003, Eyre 1980, Fleming et al. 2005, Korstian 1937, Lohman and Watson 1943, Nicholas and Zedaker 1989, Pyle and Schafale 1985, Schafale pers. comm., USFS 1973, USFS 1997, White 1984b, White and Cogbill 1992, White et al. 1993, Whittaker 1956
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722677#references
Description Author: M. Schafale and R. Evans, mod. S.C. Gawler and M. Pyne

Version: 14 Jan 2014
Concept Author: M. Schafale and R. Evans

Stakeholders: East, Southeast
ClassifResp: Southeast

CENTRAL AND SOUTHERN CALIFORNIA MIXED EVERGREEN WOODLAND (CES206.920)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Mediterranean [Mediterranean Xeric-Oceanic]; Xeric; Broad-Leaved Evergreen Tree
Non-Diagnostic Classifiers: Montane [Montane]; Montane [Lower Montane]; Sideslope; F-Patch/Medium Intensity
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2014; ESLF 4201; ESP 1014

CONCEPT

Summary: This system occurs from Monterey, California, south across the outer Central Coast Ranges to crests of Peninsular Ranges. It can occur on metasediments and granitics. In much of this area, conifers are relatively infrequent, *Pinus coulteri* occurs in scattered stands and *Pseudotsuga macrocarpa* picks up in Transverse Ranges south to Mexico. Characteristic tree species include *Quercus chrysolepis, Quercus agrifolia, Quercus kelloggii, Umbellularia californica, Acer macrophyllum,* and *Arbutus menziesii*. Historic fire frequency was likely higher in this system than in similar systems to the north.
Related Concepts:
- California Coast Live Oak: 255 (Eyre 1980) Intersecting
- Canyon Live Oak: 249 (Eyre 1980) Intersecting

Component Associations:
- *Pseudotsuga macrocarpa* Forest (CEGL003084, G3?)

DISTRIBUTION

Range: Occurs from Monterey, California, south across the outer Central Coast Ranges to crests of Peninsular Ranges, and in Transverse Ranges south to Mexico.
Divisions: 206:C
Nations: MX, US
Subnations: CA, MXBC(MX)
Map Zones: 4:C, 5:?
USFS Ecomap Regions: 261B:CC, 262A:PP, 322A:PP
TNC Ecoregions: 15:C, 16:C

SOURCES

References: Barbour and Billings 2000, Barbour and Major 1988, Comer et al. 2003, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722761#references
Description Author: P. Comer, T. Keeler-Wolf
Version: 17 Mar 2003 **Stakeholders:** Latin America, West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

CENTRAL APPALACHIAN DRY OAK-PINE FOREST (CES202.591)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Ridge/Summit/Upper Slope; Acidic Soil; Pinus (strobus, rigida, echinata, virginiana) - Quercus prinus
Non-Diagnostic Classifiers: Lowland; Sideslope; Oligotrophic Soil; Mineral: W/ A-Horizon <10 cm; Loam Soil Texture; Sand Soil Texture; Ustic; F-Patch/Medium Intensity; W-Patch/Low Intensity; Needle-Leaved Tree; Broad-Leaved Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Mixed evergreen-deciduous closed tree canopy
National Mapping Codes: EVT 2369; ESLF 4312; ESP 1369

CONCEPT

Summary: These oak and oak-pine forests cover large areas in the low- to mid-elevation Central Appalachians and middle Piedmont. The topography and landscape position range from rolling hills to steep slopes, with occasional occurrences on more level, ancient alluvial fans. In the highly dissected fall zone of Maryland and the District of Columbia, where the Piedmont and Coastal Plain meet, it is also found on dry knolls capped with Pleistocene- and Tertiary-aged fluvial cobble and gravel terrace deposits. Soils are typically coarse and infertile; they may be deep (on glacial deposits in the northern and terrace deposits in the southern parts of the system's range), or more commonly shallow, on rocky slopes of acidic rock (shale, sandstone, other acidic igneous or metamorphic rock). The well-drained soils and exposure create dry conditions. The forest is mostly closed-canopy but can include patches of more open woodlands. It is dominated by a variable mixture of dry-site oak and pine species, most typically *Quercus prinus*, *Pinus virginiana*, and *Pinus strobus*, but sometimes *Quercus alba* and/or *Quercus coccinea*. The system may include areas of oak forest, pine forest (usually small), and mixed oak-pine forest. Heath shrubs such as *Vaccinium pallidum*, *Gaylussacia baccata*, and *Kalmia latifolia* are common in the understory and often form a dense layer. Embedded submesic ravines and concave landforms support slightly more diverse forests characterized by mixtures of oaks, several hickories, *Cornus florida*, and sometimes *Liriodendron tulipifera*. Small hillslope pockets with impeded drainage may support small isolated wetlands with *Acer rubrum* and *Nyssa sylvatica* characteristic. Disturbance agents include fire, windthrow, and ice damage. Increased site disturbance generally leads to secondary forest vegetation with a greater proportion of *Pinus virginiana* and weedy hardwoods such as *Acer rubrum*.
Classification Comments: This system occurs in drier settings than the other matrix oak forest system of the division, Northeastern Interior Dry-Mesic Oak Forest (CES202.592), except in New York and New England, which are mostly out of the range of CES202.592. In that system, *Quercus rubra*, *Quercus alba*, *Quercus velutina*, and/or *Quercus coccinea* and *Carya* spp. are the typical dominants rather than *Quercus prinus*. It includes the system formerly segregated as Southern Piedmont Dry Oak-Heath Forest (CES202.023). Its analog from central Virginia south is Southern Piedmont Dry Oak-(Pine) Forest (CES202.339), which has somewhat more southern floristics, for example, the typical presence of *Pinus taeda*.
Similar Ecological Systems:
- Allegheny-Cumberland Dry Oak Forest and Woodland (CES202.359)--occurs to the west of this system (e.g., Allegheny Plateau), with the Allegheny Front as the dividing line.
- Central Appalachian Pine-Oak Rocky Woodland (CES202.600)
- Laurentian-Acadian Northern Pine-(Oak) Forest (CES201.719)--occurs to the north.
- Northeastern Interior Dry-Mesic Oak Forest (CES202.592)--more mesic.
- Northern Atlantic Coastal Plain Hardwood Forest (CES203.475)
- Southern Appalachian Oak Forest (CES202.886)--found south of Roanoke River in central Virginia (Blue Ridge/southern Appalachians only).
- Southern Piedmont Dry Oak-(Pine) Forest (CES202.339)--occurs to the south; its northern limit overlaps slightly with the southern limit of this system but is farther out on the Coastal Plain.

Related Concepts:
- Chestnut Oak: 44 (Eyre 1980) Finer
- Eastern White Pine: 21 (Eyre 1980) Finer
- Northern Red Oak: 55 (Eyre 1980) Finer
- Oak - Hickory Forest (Gawler and Cutko 2010) Finer
- Oak - Pine Forest (Gawler and Cutko 2010) Finer
- Virginia Pine: 79 (Eyre 1980) Finer
- White Oak - Black Oak - Northern Red Oak: 52 (Eyre 1980) Finer
- White Oak - Red Oak Forest (Gawler and Cutko 2010) Finer
- White Oak: 53 (Eyre 1980) Finer
- White Pine - Chestnut Oak: 51 (Eyre 1980) Finer
- White Pine - Northern Red Oak - Red Maple: 20 (Eyre 1980) Finer

DESCRIPTION

Environment: These oak and oak-pine forests cover large areas in the low- to mid-elevation central Appalachians and middle Piedmont. The topography and landscape position range from rolling hills to steep slopes, with occasional occurrences on more level, ancient alluvial fans. The soils are coarse and infertile; they may be deep (on glacial deposits in the northern part of the system's range), or more commonly shallow, on rocky slopes of acidic rock (shale, sandstone, other acidic igneous or metamorphic rock). The well-drained soils and exposure create dry conditions. In the highly dissected fall zone of Maryland and the District of Columbia, where the Piedmont and Coastal Plain meet, it is also found on dry knolls capped with Pleistocene- and Tertiary-aged fluvial cobble and gravel terrace deposits.

Vegetation: Stands of this forest system are mostly closed-canopied but can include more open woodlands. They are dominated by a variable mixture of dry-site oak and pine species, including *Quercus prinus, Pinus virginiana*, and *Pinus strobus*. The system may include areas of pine forest and mixed oak-pine forest. Heath shrubs such as *Vaccinium pallidum, Gaylussacia baccata*, and *Kalmia latifolia* are common in the understory. Within these forests, hillslope pockets with impeded drainage may support small isolated wetlands with *Acer rubrum* and *Nyssa sylvatica* characteristic.

Dynamics: Disturbance agents include fire, windthrow, and ice damage.

Component Associations:

- *Acer saccharum - Quercus muehlenbergii / Carex platyphylla* Forest (CEGL006162, GNR)
- *Fagus grandifolia - Betula lenta - Quercus (alba, rubra) / Carpinus caroliniana* Forest (CEGL006921, GNR)
- *Pinus (pungens, rigida) - Quercus prinus / (Quercus ilicifolia) / Gaylussacia baccata* Woodland (CEGL004996, G4)
- *Pinus rigida - Quercus (velutina, prinus)* Forest (CEGL006290, GNR)
- *Pinus strobus - Pinus resinosa - Pinus rigida* Forest (CEGL006259, G4G5)
- *Pinus strobus - Quercus (rubra, velutina) - Fagus grandifolia* Forest (CEGL006293, G5)
- *Pinus strobus - Quercus alba - Quercus prinus / Vaccinium stamineum* Forest (CEGL008539, G4)
- *Pinus virginiana - Pinus (rigida, echinata) - (Quercus prinus) / Vaccinium pallidum* Forest (CEGL007119, G3)
- *Quercus (alba, rubra, velutina) - Carya* spp. / *Viburnum acerifolium* Forest (CEGL006336, G4G5)
- *Quercus (rubra, velutina, alba) - Betula lenta - (Pinus strobus)* Forest (CEGL006454, G4G5)
- *Quercus (velutina, alba) / Vaccinium pallidum* High Allegheny Plateau, Western Allegheny Plateau Forest (CEGL006018, GNR)
- *Quercus alba - Quercus (coccinea, velutina, prinus) / Gaylussacia baccata* Forest (CEGL008521, G5)
- *Quercus alba - Quercus prinus - Carya glabra / Cornus florida / Vaccinium pallidum* Forest (CEGL008515, G4)
- *Quercus prinus - (Quercus coccinea, Quercus rubra) / Kalmia latifolia / Vaccinium pallidum* Forest (CEGL006299, G5)
- *Quercus prinus - Quercus (rubra, velutina) / Vaccinium (angustifolium, pallidum*) Forest (CEGL006282, G5)
- *Quercus prinus - Quercus rubra / Vaccinium pallidum - (Rhododendron periclymenoides)* Forest (CEGL008523, G3G4)
- *Quercus prinus / Rhododendron catawbiense - Kalmia latifolia* Forest (CEGL008524, G4)
- *Tsuga canadensis - Quercus prinus - Betula lenta* Forest (CEGL006923, G3)

SPATIAL CHARACTERISTICS

Spatial Summary: Large-patch (at outer range) to matrix (in center of range) system that may cover extensive hillslopes and low ridges.

Adjacent Ecological Systems:

- Northeastern Interior Dry-Mesic Oak Forest (CES202.592)
- Southern and Central Appalachian Cove Forest (CES202.373)
- Southern Atlantic Coastal Plain Mesic Hardwood Forest (CES203.242)

DISTRIBUTION

Range: This system is found from central New England through Pennsylvania and south to the Roanoke River in southern Virginia. It is primarily Appalachian but overlaps slightly into the upper Piedmont and fall zone in Virginia, Maryland and the District of Columbia.

Divisions: 202:C

Nations: US

Subnations: CT, DC, MA, MD, ME, NH, NJ, NY, OH, PA, RI, VA, VT, WV

Map Zones: 57:P, 60:C, 61:C, 63:C, 64:C, 65:C, 66:C

USFS Ecomap Regions: 211E:CC, 211F:CC, 211G:CC, 211I:CC, 221A:CC, 221B:CC, 221D:CC, 232A:CC, M221A:CC, M221Ba:CCC, M221Bb:CCC, M221Bd:CCC, M221Bf:CCC, M221Da:CCC

TNC Ecoregions: 52:C, 58:C, 59:C, 60:C, 61:C

SOURCES

References: Comer et al. 2003, Eyre 1980, Gawler and Cutko 2010, Landfire 2007a

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723015#references

Description Author: S.C. Gawler, mod. J. Teague and L.A. Sneddon

Version: 23 Jan 2012 **Stakeholders:** East, Southeast

Concept Author: S.C. Gawler **ClassifResp:** East

CENTRAL APPALACHIAN PINE-OAK ROCKY WOODLAND (CES202.600)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Shrubland (Shrub-dominated); Woody-Herbaceous; Ridge/Summit/Upper Slope; Acidic Soil; Pinus (strobus, rigida, echinata, virginiana) - Quercus prinus
Non-Diagnostic Classifiers: Moderate (100-500 yrs) Persistence; Lowland; Temperate; Oligotrophic Soil; Shallow Soil; Ustic; Consolidated; F-Patch/Medium Intensity; Needle-Leaved Tree; Broad-Leaved Deciduous Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Mixed evergreen-deciduous open tree canopy
National Mapping Codes: EVT 2377; ESLF 4320; ESP 1377

CONCEPT

Summary: This system encompasses open or patchily wooded hilltops and outcrops or rocky slopes in the Central Appalachians, High Allegheny Plateau, and Lower New England / Northern Piedmont. It occurs mostly at lower elevations, but occasionally up to 1220 m (4000 feet) in West Virginia. The substrate rock is generally granitic or of other acidic lithology, although near the northern limit of its range in New England, examples can also occur on intermediate, base-rich, or mafic bedrock including traprock. The vegetation is patchy, with woodland as well as open portions. *Pinus rigida* (and within its range *Pinus virginiana*) is diagnostic and often mixed with xerophytic *Quercus* spp. and sprouts of *Castanea dentata*. In New England, some examples lack pine and feature *Juniperus virginiana* or *Ostrya virginiana* as important codominants with oak. Some areas have a fairly well-developed heath shrub layer, others a graminoid layer, the latter particularly common under oaks or other deciduous trees. Conditions are dry and for the most part nutrient-poor, and at many, if not most, sites, a history of fire is evident. In the Central Appalachians ecoregion, this system is rarely found on sandy soils rather than rock.
Classification Comments: The northern extent of this system in central New England may overlap with Northern Appalachian-Acadian Rocky Heath Outcrop (CES201.571), which has *Picea* spp. prominent. The southern extent overlaps with Southern Appalachian Montane Pine Forest and Woodland (CES202.331), which is characterized by *Pinus pungens*. The present type may have some *Pinus pungens* (from southern Pennsylvania south) but generally has other pines as well. This type is differentiated from the similar Central Appalachian Dry Oak-Pine Forest (CES202.591) by its mosaic nature of wooded and open patches, as opposed to being merely a "thin forest." New England dry-rich forest/woodlands (e.g., those on traprock ridges) are also housed here, expanding the concept beyond pitch pine diagnostics. Pike Knob, West Virginia, with its disjunct red pine woodlands, is put into this system.
Similar Ecological Systems:
- Appalachian Shale Barrens (CES202.598)
- Central Appalachian Dry Oak-Pine Forest (CES202.591)
- Northern Appalachian-Acadian Rocky Heath Outcrop (CES201.571)
- Southern Appalachian Montane Pine Forest and Woodland (CES202.331)--is a restricted type characterized by the dominance (not just incidental occurrence) of *Pinus pungens*.

Related Concepts:
- Appalachian oak rocky ridge system (Sperduto 2005) Finer
- Bear Oak: 43 (Eyre 1980) Finer
- Chestnut Oak Woodland (Gawler and Cutko 2010) Finer
- Chestnut Oak: 44 (Eyre 1980) Finer
- Eastern redcedar / Poverty oatgrass community (Metzler and Barrett 2006) Finer
- Eastern Redcedar: 46 (Eyre 1980) Finer
- Ironwood - Oak - Ash Woodland (Gawler and Cutko 2010) Finer
- Low-Elevation Acidic Outcrop Barrens (Fleming et al. 2005) Finer. This system in the southern portion of its range appears similar to Virginia's Low-Elevation Acidic Outcrop Barrens, which are noted to occur in the western Piedmont, Blue Ridge, Cumberland Mountains, and Ridge and Valley.
- Northern Red Oak: 55 (Eyre 1980) Finer
- Oak - Pine Woodland (Gawler and Cutko 2010) Intersecting
- Pitch pine / Bear oak community (Metzler and Barrett 2006) Intersecting
- Pitch Pine Rocky Woodland (Gawler and Cutko 2010) Finer
- Pitch Pine: 45 (Eyre 1980) Finer
- Red Pine: 15 (Eyre 1980) Finer
- Virginia Pine: 79 (Eyre 1980) Finer
- White Oak - Black Oak - Northern Red Oak: 52 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs mostly at lower elevations, but occasionally up to 1220 m (4000 feet) in West Virginia. The substrate rock is generally granitic or of other acidic lithology, although near the northern limit of its range in New England, examples can also occur on intermediate, base-rich, or mafic bedrock including traprock.

This system contains species-poor, fire-influenced, mixed woodlands of xeric, exposed montane habitats. They are typically located on convex, south to west facets of steep spur ridges, narrow rocky crests, and cliff tops. Pine - oak / heath woodlands are widespread throughout both the Ridge and Valley and Blue Ridge provinces in western Virginia. They occur at elevations from below 305 m (1000 feet) to more than 1220m (4000 feet) on various substrates, but most commonly on acidic, sedimentary and metasedimentary substrates, e.g., sandstone, quartzite, and shale. A few stands occur on Piedmont monadnocks and foothills. Soils are very infertile, shallow, and droughty (VDNH 2007).

The type is restricted to poor, dry sites which have been disturbed in the recent past by heavy cutting, fire, or both. It is found on thin, rocky soils in the mountainous areas. Soils are strongly acidic and devoid of nutrients. Precipitation is low in the shale barrens of eastern West Virginia and adjacent states (Eyre 1980).
Vegetation: Short-statured *Pinus pungens* and *Pinus rigida* are usually the dominants forming an open overstory, often with codominant *Quercus prinus (= Quercus montana)*. Less important tree associates include *Quercus coccinea, Pinus virginiana*, and *Sassafras albidum*. Except in the Piedmont, *Quercus ilicifolia* is characteristically abundant in the shrub layer, along with various ericaceous species. Colonial shrubs usually preempt available microhabitats for most herbaceous species, but *Pteridium aquilinum var. latiusculum* and *Xerophyllum asphodeloides* are often competitive enough to achieve significant cover (VDNH 2007).

The globally rare *Carex polymorpha*, the state-rare northern pine snake (*Pituophis melanoleucus melanoleucus*) and several rare moths, all bear oak feeders, are locally associated with these woodlands. More common and conspicuous animals often found in these dry, rocky, semi-open habitats include the northern fence lizard (*Sceloporus undulatus hyacinthinus*) and the five-lined skink (*Eumeces fasciatus*) (VDNH 2007).
Dynamics: Periodic fire is an important ecological process that provides opportunities for regeneration of both pines and less competitive herbaceous species, while setting back successional encroachment of potential overstory oaks (especially chestnut oak). On cliffs and other very rocky sites, the vegetation is self-perpetuating due to extreme edaphic conditions. (VDNH 2007). Fire is the most common disturbance type, but frost pockets and late-spring frosts have been also documented. If disturbances occur very frequently (every 2-3years), *Quercus ilicifolia* may be replaced by low shrubs, grasses, ferns, and other herbs. If disturbances are infrequent, canopy trees can outgrow the shade-intolerant *Quercus ilicifolia*.

Component Associations:
- *Juniperus virginiana - Fraxinus americana / Danthonia spicata - Poa compressa* Woodland (CEGL006002, G3)
- *Kalmia latifolia - Gaylussacia baccata - Vaccinium (angustifolium, pallidum) - Menziesia pilosa* Shrubland (CEGL003939, G2)
- *Penstemon hirsutus* Sparse Vegetation (CEGL006535, GNR)
- *Photinia melanocarpa - Gaylussacia baccata / Carex pensylvanica* Shrubland (CEGL008508, G1?)
- *Pinus (pungens, rigida) - Quercus prinus / (Quercus ilicifolia) / Gaylussacia baccata* Woodland (CEGL004996, G4)
- *Pinus resinosa / Menziesia pilosa / Polypodium appalachianum* Forest (CEGL006108, G1)
- *Pinus rigida - Quercus coccinea / Vaccinium angustifolium* Woodland (CEGL006557, G4Q)
- *Pinus rigida / (Quercus ilicifolia) / Photinia melanocarpa / Deschampsia flexuosa* Woodland (CEGL006116, G4)
- *Pinus rigida / Corema conradii* Woodland (CEGL006154, G2)
- *Pinus rigida / Gaylussacia baccata* Shrubland (CEGL006079, G1)
- *Pinus virginiana - Pinus (rigida, echinata) - (Quercus prinus) / Vaccinium pallidum* Forest (CEGL007119, G3)
- *Quercus ilicifolia - Prunus pumila* Shrubland (CEGL006121, G4?)
- *Quercus prinus - Pinus virginiana - (Pinus pungens) / Schizachyrium scoparium - Dichanthelium depauperatum* Woodland (CEGL008540, G3?)
- *Quercus prinus / Quercus ilicifolia / Danthonia spicata* Woodland (CEGL008526, G3?)
- *Quercus prinus / Rhus* spp. / *Deschampsia flexuosa* Woodland (CEGL006074, G3)
- *Quercus rubra - (Quercus prinus) / Vaccinium* spp. / *Deschampsia flexuosa* Woodland (CEGL006134, G4)
- *Quercus rubra - Carya (glabra, ovata) / Ostrya virginiana / Carex lucorum* Forest (CEGL006301, G4)
- *Schizachyrium scoparium - Danthonia spicata - Carex pensylvanica / Cladonia* spp. Herbaceous Vegetation (CEGL006544, G3)
- *Vaccinium (angustifolium, myrtilloides, pallidum)* Central Appalachian Dwarf-shrubland (CEGL003958, G3G4)
- *Vaccinium angustifolium - Sorbus americana / Sibbaldiopsis tridentata* Dwarf-shrubland (CEGL005094, GNR)

SPATIAL CHARACTERISTICS

Size: Patch sizes can range from a few acres to 300+ acres, but typically range from 1-50 acres. It is usually a small-patch occurrence.

DISTRIBUTION

Range: This system occurs from central New England south to Virginia and West Virginia, with peripheral occurrences in southeastern Ohio and easternmost Kentucky.
Divisions: 202:C
Nations: US
Subnations: CT, KY, MA, MD?, ME, NH, NJ, NY, OH, PA, VA, VT, WV
Map Zones: 53:C, 57:P, 60:C, 61:C, 62:C, 63:C, 64:C, 65:C, 66:C
USFS Ecomap Regions: 211E:CC, 211F:CC, 221A:CC, 221B:CC, M211Bb:CCC, M211Bd:CCC, M211C:CC, M221A:CC, M221B:CP

TNC Ecoregions: 49:C, 50:C, 52:C, 59:C, 60:C, 61:C, 64:C

SOURCES

References: Comer et al. 2003, Eyre 1980, Fleming et al. 2005, Gawler and Cutko 2010, Landfire 2007a, Metzler and Barrett 2006, Sperduto 2005, VDNH 2007

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723009#references

Description Author: S.C. Gawler, mod. L.A. Sneddon

Version: 23 Jan 2012 **Stakeholders:** East, Midwest, Southeast

Concept Author: S.C. Gawler **ClassifResp:** East

CENTRAL ATLANTIC COASTAL PLAIN MARITIME FOREST (CES203.261)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Forest and Woodland (Treed); Coast
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2361; ESLF 4264; ESP 1361

CONCEPT

Summary: This system encompasses most woody vegetation of Atlantic Coast barrier islands and similar coastal strands, from Virginia Beach to central South Carolina (south approximately to the Cooper River where the true Sea Islands begin). It includes forests and shrublands whose structure and composition are influenced by salt spray, extreme disturbance events, and the distinctive climate of the immediate coast. Many examples of this system will include a component of *Quercus virginiana* or *Morella cerifera*. Also included are embedded freshwater depressional wetlands dominated by shrubs or small trees, such as *Cornus foemina, Persea palustris*, or *Salix caroliniana*. This system may experience less effects from fire than the equivalent Southern Atlantic Coastal Plain Maritime Forest (CES203.537).
Classification Comments: Southern Atlantic Coastal Plain Maritime Forest (CES203.537) occurs south of this system where barrier islands give way to sea islands (central South Carolina, approximately the Cooper River). Sea islands are wider and more extensive and their size may contribute to a greater ecological influence of fire resulting in a greater component of *Pinus elliottii* and *Pinus palustris* in maritime forests occurring there.

Northern Atlantic Coastal Plain Maritime Forest (CES203.302) occurs north of this system where deciduous trees come to prevail in the maritime forests [see Bellis (1992)] at approximately 37 degrees North latitude. There is a zone where both evergreen and deciduous forests occur (from approximately Nags Head, North Carolina, to Virginia Beach, Virginia), making the geographic boundary between the two systems somewhat unclear. The boundary of cold and warm offshore waters near Cape Hatteras may be an important climatic influence. This system is separated from Southern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.273) by the dominance of woody vegetation, which corresponds to increased shelter from salt spray and increased stability of landforms.

Similar Ecological Systems:
- Northern Atlantic Coastal Plain Maritime Forest (CES203.302)--occurs to north.
- Southern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.273)
- Southern Atlantic Coastal Plain Maritime Forest (CES203.537)--occurs to south.

Related Concepts:
- Baldcypress: 101 (Eyre 1980) Intersecting
- Cabbage Palmetto: 74 (Eyre 1980) Finer
- Estuarine Fringe Loblolly Pine Forest (Schafale and Weakley 1990) Finer
- Live Oak: 89 (Eyre 1980) Finer
- Loblolly Pine - Hardwood: 82 (Eyre 1980) Finer
- Loblolly Pine: 81 (Eyre 1980) Finer
- Sweetbay - Swamp Tupelo - Redbay: 104 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs on barrier islands and on coastal strands where barrier islands are lacking, and is seldom or never found more than 2 or 3 miles from the ocean. Chronic salt spray (sea salt aerosol), as well as intense salt spray during storms are important influences on vegetation structure and composition; however, the extent to which plant communities found in this system are shaped by salt spray varies. Examples closest to the coast are most likely to exhibit classic streamlined canopy shape due to spray sculpting and are less likely to support salt-intolerant plant species. Heavier salt spray often determines the boundary of this system with Southern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.273). Maritime forest requires some shelter from the ocean, in the form of high dunes or extensive sand flats, in order to develop. This system may occur from the top of interior dunes to wet swales. Soils are sandy, except for mucks in the wettest swamps. Soils range from excessively drained to permanently saturated. They are presumably low in nutrient-holding capacity. The presence of shell fragments and the input of nutrients in salt spray probably makes this system fairly fertile. Topography and apparent moisture may vary widely with little change in vegetation. The ocean's moderation of climate may be a significant factor in the character of this system. A number of plant species extend much farther north in the maritime forests than they do even a few miles inland.
Vegetation: Vegetation includes shrublands and forests. Shrubland dominated by salt-tolerant shrubs such as *Morella cerifera* and *Ilex vomitoria* or by stunted trees often occurs on the seaward edge where salt spray is heavier. Forests are typically dominated by a small set of salt-tolerant evergreen trees, mainly *Quercus virginiana, Quercus hemisphaerica, Pinus taeda*, and in the southern portions, *Sabal palmetto*. Rare forested wetlands are dominated by a variety of wetland tree species, including *Acer rubrum, Nyssa*

biflora, and *Taxodium distichum*. A few of the most sheltered areas near the northern end of the range have forests with deciduous species such as *Fagus grandifolia* and *Quercus falcata*. Also included are embedded freshwater depressional wetlands dominated by shrubs or small trees, such as *Cornus foemina, Persea palustris*, or *Salix caroliniana*. Communities tend to be low in species richness, with all strata limited to a set of salt-tolerant species.

Dynamics: Maritime forests occur in the most stable portions of barrier islands, but the maritime environment is still extremely dynamic. Wind events and hurricanes will have significant impacts on this system. The environment for these forests may be severely altered or destroyed by geologic processes, such as the slow movement of dunes or their catastrophic destruction by storms. Sand movement may also create new sites for this system to occupy. Chronic salt spray and intense salt spray during storms are important influences on vegetation structure and composition; however, the extent to which plant communities found in this system are shaped by salt spray varies. Extreme salt spray or saltwater flooding in storms can severely disturb vegetation, though it recovers if the landforms have not been altered. Mature *Quercus virginiana* trees are fire-resistant when mature, and their litter also does not easily burn (Stalter and Odum 1993). Fire may have naturally occurred infrequently in this system, but probably was not an important factor. Extreme salt spray or saltwater flooding in storms can severely disturb vegetation, although the vegetation recovers if the landforms have not been altered.

Component Associations:
- *Acer rubrum - Nyssa biflora - (Liquidambar styraciflua, Fraxinus* sp.) Maritime Swamp Forest (CEGL004082, G2)
- *Cornus foemina / Berchemia scandens* Forest (CEGL007384, G1)
- *Juniperus virginiana var. silicicola - Zanthoxylum clava-herculis - Quercus virginiana - (Sabal palmetto) / Sageretia minutiflora - (Sideroxylon tenax)* Woodland (CEGL003525, G2?)
- *Morella cerifera - Prunus caroliniana - Zanthoxylum clava-herculis* Shrubland (CEGL004784, G2?)
- *Morella cerifera / Spartina patens* Shrubland (CEGL003839, G3G4)
- *Persea palustris / Morella cerifera* Maritime Forest (CEGL004635, G1)
- *Pinus taeda / Morella cerifera / Osmunda regalis var. spectabilis* Forest (CEGL006137, G3)
- *Quercus falcata - Pinus taeda - (Fagus grandifolia, Quercus nigra) / Persea palustris* Maritime Forest (CEGL007540, G1)
- *Quercus virginiana - (Ilex vomitoria)* Shrubland (CEGL003833, G3)
- *Quercus virginiana - (Pinus elliottii var. elliottii, Sabal palmetto) / Persea borbonia - Callicarpa americana* Forest (CEGL007032, G2)
- *Quercus virginiana - Quercus hemisphaerica - Pinus taeda - Quercus falcata / Persea palustris* Forest (CEGL007026, G2)
- *Quercus virginiana - Quercus hemisphaerica - Pinus taeda / Persea palustris - Ilex vomitoria* Forest (CEGL007027, G2)
- *Quercus virginiana - Quercus hemisphaerica / Ilex vomitoria / Aristida condensata - Panicum amarum var. amarum* Forest (CEGL004399, G1G3)
- *Quercus virginiana - Quercus incana* Woodland (CEGL003750, G1)
- *Salix caroliniana / Sacciolepis striata - Boehmeria cylindrica* Woodland (CEGL004222, G2?)
- *Taxodium distichum / Cephalanthus occidentalis / Boehmeria cylindrica - Ceratophyllum muricatum* Maritime Swamp Forest (CEGL004079, G1)

Spatial Characteristics

Size: Occurs as medium to large patches. Patch size varies naturally with the character of barrier islands. South-facing islands tend to have more extensive dunes that provide shelter for extensive, contiguous maritime forests. East-facing islands tend to naturally have discontinuous dunes and only small patches sheltered enough to support maritime forests. Presettlement vegetation had a few occurrences of several thousand acres, but only a couple as large as 1000 acres remain. Most occurrences now are artificially bounded remnants or naturally small patches of tens to hundreds of acres.

Adjacent Ecological Systems:
- Southeastern Coastal Plain Interdunal Wetland (CES203.258)
- Southern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.273)
- Southern Atlantic Coastal Plain Salt and Brackish Tidal Marsh (CES203.270)

Adjacent Ecological System Comments: Always bordered by Southern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.273) on the seaward side, and sometimes surrounded by them. May border tidal salt marshes on the back of barrier islands.

Distribution

Range: This system is found from southernmost Virginia to central South Carolina (south approximately to the Cooper River where the true Sea Islands begin).
Divisions: 203:C
Nations: US
Subnations: NC, SC, VA
Map Zones: 58:C, 60:C
USFS Ecomap Regions: 232C:CC, 232Ib:CPP
TNC Ecoregions: 56:C, 57:C

Sources

References: Bellis 1992, Bellis 1995, Comer et al. 2003, Drehle 1973, Eaton 1979, Eyre 1980, Gaddy and Kohlsaat 1987, Johnson and Barbour 1990, Jolls pers. comm., NCDENR 2010, Saltonstall 2002, Schafale 2011, Schafale and Weakley 1990, Schafale pers. comm., Seneca and Broome 1981, Senter 2003, Stalter and Odum 1993, Ward 1975, Winner 1975, Winner 1979

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723225#references
Description Author: R. Evans, mod. M. Pyne
Version: 14 Jan 2014 **Stakeholders:** East, Southeast
Concept Author: R. Evans **ClassifResp:** Southeast

CENTRAL BOREAL JACK PINE-BLACK SPRUCE DRY WOODLAND (CES103.429)

CLASSIFIERS

Classification Status: Standard

Land Cover Class: Forest and Woodland
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
National Mapping Codes: ESLF 4403

CONCEPT

Classification Comments: This system is based on a group that was drafted by Don Faber-Langendoen in March 2012 as a provisional concept for discussion with USNVC and CNVC partners. It was developed to account for the hemi-boreal patterns between boreal and temperate forests. Further review is needed before its confidence status can be confirmed.
Similar Ecological Systems:

- Eastern Boreal Jack Pine-Black Spruce Dry Woodland (CES103.423)
- Northern Dry Jack Pine-Red Pine-Hardwood Woodland (CES103.424)

DISTRIBUTION

Nations: CA, US?
Subnations: AB, BC, MB, MN?, ON?, SK

SOURCES

References: Faber-Langendoen et al. 2013a, NatureServe n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.878460#references
Version: **Stakeholders:** Canada, Midwest
Concept Author: **ClassifResp:** Central

CENTRAL BOREAL JACK PINE-BLACK SPRUCE FOREST (CES103.428)

CLASSIFIERS

Classification Status: Standard

Land Cover Class: Forest and Woodland
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
National Mapping Codes: ESLF 4402

CONCEPT

Classification Comments: This system is based on a group that was drafted by Don Faber-Langendoen in March 2012 as a provisional concept for discussion with USNVC and CNVC partners. It was developed to account for the hemi-boreal patterns between boreal and temperate forests. Further review is needed before its confidence status can be confirmed.
Similar Ecological Systems:
- Eastern Boreal Black Spruce-Jack Pine Forest (CES103.422)

DISTRIBUTION

Nations: CA, US?
Subnations: AB, BC, MB, MN?, ON?, SK

SOURCES

References: Faber-Langendoen et al. 2013a, NatureServe n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.878459#references
Version:
Concept Author:
Stakeholders: Canada, Midwest
ClassifResp: Central

CENTRAL BOREAL WHITE SPRUCE-BALSAM FIR-PAPER BIRCH FOREST (CES103.427)

CLASSIFIERS

Classification Status: Standard

Land Cover Class: Forest and Woodland
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
National Mapping Codes: ESLF 4338

CONCEPT

Classification Comments: A separate aspen-birch system is not recognized in this region; and this system is directly comparable to the group concept (G641).

Similar Ecological Systems:
- Eastern Boreal Balsam Fir-White Spruce-Paper Birch Forest (CES103.421)

DISTRIBUTION

Nations: CA, US?
Subnations: AB, BC, MB, MN?, ON?, SK

SOURCES

References: Faber-Langendoen et al. 2013a, NatureServe n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.878458#references
Version:
Concept Author:
Stakeholders: Canada, Midwest
ClassifResp: Central

CENTRAL INTERIOR HIGHLANDS DRY ACIDIC GLADE AND BARRENS (CES202.692)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Non-Diagnostic Classifiers: Forest and Woodland (Treed); Woody-Herbaceous; Sedimentary Rock; Igneous Rock; Acidic Soil
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Mixed evergreen-deciduous open tree canopy
National Mapping Codes: EVT 2363; ESLF 4305; ESP 1363

CONCEPT

Summary: This system is primarily found in the Interior Highlands of the Ozark, Ouachita, and Interior Low Plateau regions with small occurrences in northern Missouri. It occurs on flatrock outcrops and along moderate to steep slopes or valley walls of rivers along most aspects. Parent material includes chert, igneous and/or sandstone bedrock with well- to excessively well-drained, shallow soils interspersed with rock and boulders. These soils are typically dry during the summer and autumn, becoming saturated during the spring and winter. Grasses such as *Schizachyrium scoparium* and *Sorghastrum nutans* dominate this system with stunted oak species (*Quercus stellata, Quercus marilandica*) and shrub species such as *Vaccinium* spp. occurring on variable depth soils. *Juniperus virginiana* can be present and often increases in the absence of fire. In Kentucky, this system includes both sandstone glades found in the Shawnee Hills, as well as shale glades found in the Knobs region, both in the Kentucky Interior Low Plateau. It also includes dry *Quercus stellata*-dominated barrens on Cretaceous-aged gravel substrates on the northern fringes of the Upper East Gulf Coastal Plain Ecoregion in southern Illinois and western Kentucky. This system is influenced by drought and infrequent to occasional fires. Prescribed fires help manage this system by maintaining an open glade structure.
Classification Comments: The occurrence of this system in TNC Ecoregion 43 is apparently confined to southern Illinois and/or Kentucky but does not include any portions of states to the south. Not all examples are acidic. Sometimes a layer of limestone or neutral shale occurs in these and thus are not acidic.
Similar Ecological Systems:
- Appalachian Shale Barrens (CES202.598)
- Cumberland Sandstone Glade and Barrens (CES202.337)
- Ouachita Shale Glade and Barrens (CES202.343)

Related Concepts:
- Chestnut Oak: 44 (Eyre 1980) Finer
- Eastern Redcedar: 46 (Eyre 1980) Finer
- Post Oak - Blackjack Oak: 40 (Eyre 1980) Finer
- Sandstone Prairie (Evans 1991) Finer
- Shale Barrens (Evans 1991) Finer
- Shawnee Hills Sandstone Glade (Evans 1991) Finer
- Virginia Pine: 79 (Eyre 1980) Finer
- Xeric Acidic Forest (Evans 1991) Finer

DESCRIPTION

Environment: This system occurs on flat outcrops of sandstone rock and along moderate to steep slopes or valley walls of rivers along most aspects. Parent material includes chert, shale, igneous and/or sandstone bedrock with well- to excessively well-drained, shallow soils interspersed with rock and boulders. These soils are typically dry during the summer and autumn, becoming saturated during the spring and winter.
Vegetation: Grasses such as *Schizachyrium scoparium* and *Sorghastrum nutans* dominate this system with stunted oak species (*Quercus stellata, Quercus marilandica*) and shrub species such as *Vaccinium* spp. occurring on variable depth soils. In the Shawnee Hills (EPA Ecoregions 71a, 72h of Woods et al. (2002)) of the Kentucky Interior Low Plateau, *Quercus marilandica, Quercus stellata,* and *Juniperus virginiana* are the dominant trees. *Ulmus alata* may be an understory component. Scattered shrubs, such as *Vaccinium arboreum* and *Chionanthus virginicus*, occur on the margins in patches of deeper soil. *Quercus prinus* may be present in the eastern part of the range. Some other plants that may be associated with these glades include *Andropogon ternarius, Danthonia spicata, Symphyotrichum patens var. patentissimum, Silene rotundifolia, Pityopsis graminifolia var. latifolia, Coreopsis grandiflora, Silene regia, Coreopsis lanceolata, Croton willdenowii, Sedum nuttallianum, Selaginella rupestris,* and *Portulaca pilosa*.
Dynamics: Ericaceous shrubs found here are different from calcareous glades. The thin, dry soil characteristic of this system dries out during the growing season and much of the vegetation dries, as well. This allows fires to spread easily and these fires restrict the abundance of woody species. In high-quality examples where the natural fire regime operates, small trees and shrubs are limited to the edges of stands or small "islands" of deeper soil that retain more moisture while grasses are the dominant vegetation. Sparsely vegetated areas between the dominant grassy zones contain most of the rare species found in this system (Ware 2002). In the absence of fire, from active suppression or a lack of fuel due to excessive grazing, woody species can increase greatly.

Component Associations:

- *(Quercus stellata, Ulmus alata) / Schizachyrium scoparium - Symphyotrichum patens var. patentissimum* Wooded Herbaceous Vegetation (CEGL007824, G2?)
- *Asplenium montanum - Heuchera parviflora var. parviflora - Silene rotundifolia* Sparse Vegetation (CEGL004392, G3G4)
- *Pinus virginiana - Pinus (rigida, echinata) - (Quercus prinus) / Vaccinium pallidum* Forest (CEGL007119, G3)
- *Quercus marilandica - Juniperus virginiana var. virginiana / Schizachyrium scoparium - Hypericum gentianoides* Wooded Herbaceous Vegetation (CEGL004062, G3?)
- *Quercus marilandica / Vaccinium arboreum / Danthonia spicata* Scrub Woodland (CEGL002425, G3G4)
- *Quercus prinus / Cornus florida - Amelanchier arborea / Pityopsis graminifolia var. latifolia* Woodland (CEGL003706, G2?)
- *Quercus prinus / Danthonia spicata - Silene caroliniana* Woodland (CEGL004439, G2?)
- *Quercus stellata - (Pinus echinata) / Vaccinium arboreum / Andropogon gerardii - Symphyotrichum patens var. patentissimum* Wooded Herbaceous Vegetation (CEGL007814, G2?)
- *Quercus stellata - Quercus marilandica - Quercus velutina - Carya texana / Schizachyrium scoparium* Woodland (CEGL002149, G2G3)
- *Quercus stellata - Quercus marilandica / Schizachyrium scoparium - Silphium terebinthinaceum* Wooded Herbaceous Vegetation (CEGL005134, G1)
- *Quercus stellata - Quercus marilandica / Schizachyrium scoparium* Wooded Herbaceous Vegetation (CEGL002391, G2G3)
- *Schizachyrium scoparium - Aristida dichotoma - Croton willdenowii* / Lichens Wooded Herbaceous Vegetation (CEGL002242, G3)
- *Schizachyrium scoparium - Sedum nuttallianum - Selaginella rupestris - Portulaca pilosa* / Lichens Wooded Herbaceous Vegetation (CEGL002244, G1G2)
- *Schizachyrium scoparium - Sorghastrum nutans - Andropogon ternarius - Coreopsis grandiflora* Sandstone - Shale Herbaceous Vegetation (CEGL002212, G3)
- *Schizachyrium scoparium - Sorghastrum nutans - Coreopsis lanceolata - Croton willdenowii* Wooded Herbaceous Vegetation (CEGL002243, G4?)
- *Schizachyrium scoparium - Sorghastrum nutans - Danthonia spicata - Silene regia* Chert Herbaceous Vegetation (CEGL002211, G3)

DISTRIBUTION

Range: This system is found in the Interior Highlands of the Ozark, Ouachita, and Interior Low Plateau regions, with rare and limited occurrences in the Upper East Gulf Coastal Plain of Kentucky and Illinois. That includes the Shawnee Hills (EPA Ecoregions 71a, 72h of Woods et al. (2002)) and Knobs region (EPA Ecoregions 70d, 71c of Woods et al. (2002)).
Divisions: 202:C; 203:C
Nations: US
Subnations: AR, IL, IN, KY, MO, OK, TN?
Map Zones: 43:P, 44:C, 47:C, 48:C, 49:C, 53:C
USFS Ecomap Regions: 221E:CC, 223A:CC, 223B:CC, 223D:CC, 223G:CC, 231H:CC, 251C:CC
TNC Ecoregions: 36:C, 38:C, 39:C, 43:C, 44:C

SOURCES

References: Baskin et al. 1995, Comer et al. 2003, Evans 1991, Eyre 1980, Heikens and Robertson 1995, Homoya 1994, Martin and Houf 1993, Nelson 1985, Nelson 2012, Ware 2002, Woods et al. 2002
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722967#references
Description Author: S. Menard and T. Nigh, mod. M. Pyne and J. Drake
Version: 14 Jan 2014 **Stakeholders:** Midwest, Southeast
Concept Author: S. Menard and T. Nigh **ClassifResp:** Midwest

COLORADO PLATEAU PINYON-JUNIPER WOODLAND (CES304.767)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Lower Montane]; Lowland [Foothill]; Mesa; Ridge/Summit/Upper Slope; Sedimentary Rock; Temperate [Temperate Xeric]; Aridic; Pinus edulis, Juniperus osteosperma
Non-Diagnostic Classifiers: Foothill(s); Piedmont; Plateau; Forest and Woodland (Treed); Sideslope; Alkaline Soil; Long Disturbance Interval; F-Patch/Medium Intensity
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2016; ESLF 4203; ESP 1016

CONCEPT

Summary: This ecological system occurs in dry mountains and foothills of the Colorado Plateau region including the Western Slope of Colorado to the Wasatch Range, south to the Mogollon Rim, and east into the northwestern corner of New Mexico. It is typically found at lower elevations ranging from 1500-2440 m. These woodlands occur on warm, dry sites on mountain slopes, mesas, plateaus, and ridges. Severe climatic events occurring during the growing season, such as frosts and drought, are thought to limit the distribution of pinyon-juniper woodlands to relatively narrow altitudinal belts on mountainsides. Soils supporting this system vary in texture, ranging from stony, cobbly, gravelly sandy loams to clay loam or clay. *Pinus edulis* and/or *Juniperus osteosperma* dominate the tree canopy. In the southern portion of the Colorado Plateau in northern Arizona and northwestern New Mexico, *Juniperus monosperma* and hybrids of *Juniperus* spp. may dominate or codominate the tree canopy. *Juniperus scopulorum* may codominate or replace *Juniperus osteosperma* at higher elevations. Understory layers are variable and may be dominated by shrubs, graminoids, or be absent. Associated species include *Arctostaphylos patula, Artemisia tridentata, Cercocarpus intricatus, Cercocarpus montanus, Coleogyne ramosissima, Purshia stansburiana, Purshia tridentata, Quercus gambelii, Bouteloua gracilis, Pleuraphis jamesii, Pseudoroegneria spicata, Poa secunda,* or *Poa fendleriana*. This system occurs at higher elevations than Great Basin Pinyon-Juniper Woodland (CES304.773) and Colorado Plateau shrubland systems where sympatric.

Similar Ecological Systems:
- Colorado Plateau Pinyon-Juniper Shrubland (CES304.766)
- Great Basin Pinyon-Juniper Woodland (CES304.773)
- Inter-Mountain Basins Juniper Savanna (CES304.782)

Related Concepts:
- Juniper - Pinyon Pine Woodland (504) (Shiflet 1994) Intersecting
- Juniper - Pinyon Woodland (412) (Shiflet 1994) Broader
- Pinyon - Juniper: 239 (Eyre 1980) Broader
- Rocky Mountain Juniper: 220 (Eyre 1980) Intersecting

Component Associations:
- *Juniperus monosperma - Rhus trilobata / Schizachyrium scoparium* Woodland (CEGL002121, GNR)
- *Juniperus monosperma / Agave lechuguilla* Woodland (CEGL000703, G4)
- *Juniperus monosperma / Andropogon hallii* Woodland (CEGL000704, G3?)
- *Juniperus monosperma / Artemisia bigelovii* Woodland (CEGL000705, G3?)
- *Juniperus monosperma / Artemisia tridentata* Woodland (CEGL000706, G5)
- *Juniperus monosperma / Atriplex confertifolia / Achnatherum hymenoides* Woodland (CEGL000707, G3G4)
- *Juniperus monosperma / Bouteloua curtipendula* Woodland (CEGL000708, G5)
- *Juniperus monosperma / Bouteloua eriopoda* Woodland (CEGL000709, GNR)
- *Juniperus monosperma / Bouteloua gracilis* Woodland (CEGL000710, G5)
- *Juniperus monosperma / Bouteloua hirsuta* Woodland (CEGL000711, GNR)
- *Juniperus monosperma / Cercocarpus montanus - Ribes cereum* Woodland (CEGL000714, GU)
- *Juniperus monosperma / Cercocarpus montanus* Woodland (CEGL000713, GNR)
- *Juniperus monosperma / Ericameria nauseosa - Fallugia paradoxa* Woodland (CEGL000715, G4)
- *Juniperus monosperma / Fallugia paradoxa* Woodland (CEGL000716, G4)
- *Juniperus monosperma / Hesperostipa neomexicana* Woodland (CEGL000722, G4)
- *Juniperus monosperma / Krascheninnikovia lanata* Woodland (CEGL000712, G3G4)
- *Juniperus monosperma / Nolina microcarpa - Agave lechuguilla* Woodland (CEGL000718, G4)
- *Juniperus monosperma / Quercus turbinella* Woodland (CEGL000720, GNR)
- *Juniperus monosperma / Quercus X pauciloba* Woodland (CEGL000721, G5)
- *Juniperus osteosperma - Juniperus monosperma* / Sparse Understory Woodland (CEGL000737, G4)
- *Juniperus osteosperma / Artemisia arbuscula* Woodland (CEGL002757, G5)

- *Juniperus osteosperma / Artemisia nova* / Rock Woodland (CEGL000729, G5)
- *Juniperus osteosperma / Artemisia nova* Woodland (CEGL000728, G5?)
- *Juniperus osteosperma / Artemisia tridentata / Achnatherum hymenoides* Woodland (CEGL000731, G4G5)
- *Juniperus osteosperma / Artemisia tridentata ssp. tridentata* Woodland (CEGL002360, GNR)
- *Juniperus osteosperma / Artemisia tridentata* Woodland (CEGL000730, G5?)
- *Juniperus osteosperma / Bouteloua gracilis* Woodland (CEGL002361, GNR)
- *Juniperus osteosperma / Cercocarpus intricatus* Woodland (CEGL000733, GNR)
- *Juniperus osteosperma / Cercocarpus ledifolius* Woodland (CEGL000734, G3?)
- *Juniperus osteosperma / Cercocarpus montanus* Woodland (CEGL000735, G2G3)
- *Juniperus osteosperma / Coleogyne ramosissima* Woodland (CEGL002909, GU)
- *Juniperus osteosperma / Hesperostipa comata* Wooded Herbaceous Vegetation (CEGL001489, G1Q)
- *Juniperus osteosperma / Hesperostipa comata* Woodland (CEGL002815, GNR)
- *Juniperus osteosperma / Hesperostipa neomexicana* Woodland (CEGL000740, GUQ)
- *Juniperus osteosperma / Leymus salinus ssp. salmonis* Wooded Herbaceous Vegetation (CEGL001488, G1Q)
- *Juniperus osteosperma / Leymus salinus* Woodland (CEGL003109, G3)
- *Juniperus osteosperma / Mahonia fremontii* Woodland (CEGL003965, GNR)
- *Juniperus osteosperma* / Mixed Shrubs Talus Woodland (CEGL002266, GNR)
- *Juniperus osteosperma / Pleuraphis jamesii* Woodland (CEGL002362, GNR)
- *Juniperus osteosperma / Pleuraphis mutica* Woodland (CEGL000736, G2)
- *Juniperus osteosperma / Pseudoroegneria spicata* Woodland (CEGL000738, G4)
- *Juniperus osteosperma* / Sparse Understory Woodland (CEGL000732, GNRQ)
- *Juniperus osteosperma / Symphoricarpos oreophilus* Woodland (CEGL000741, GU)
- *Juniperus osteosperma* Woodland (CEGL000727, G5)
- *Juniperus scopulorum - Quercus gambelii* Woodland (CEGL002967, GNR)
- *Juniperus scopulorum / Artemisia tridentata* Woodland (CEGL000743, G3Q)
- *Pinus edulis - (Juniperus monosperma, Juniperus deppeana) / Bouteloua gracilis* Woodland (CEGL002151, G5?)
- *Pinus edulis - (Juniperus monosperma, Juniperus osteosperma) / Hesperostipa comata* Woodland (CEGL000797, G2?)
- *Pinus edulis - (Juniperus osteosperma) / Bouteloua gracilis* Woodland (CEGL000778, G5)
- *Pinus edulis - Juniperus monosperma / Quercus X pauciloba* Woodland (CEGL000793, G5)
- *Pinus edulis - Juniperus osteosperma / Achnatherum hymenoides* Woodland (CEGL002364, GNR)
- *Pinus edulis - Juniperus osteosperma / Amelanchier utahensis* Woodland (CEGL002329, GNR)
- *Pinus edulis - Juniperus osteosperma / Arctostaphylos patula* Woodland (CEGL002939, GNR)
- *Pinus edulis - Juniperus osteosperma / Arctostaphylos pungens* Woodland (CEGL000775, G3)
- *Pinus edulis - Juniperus osteosperma / Artemisia bigelovii* Woodland (CEGL002118, GNR)
- *Pinus edulis - Juniperus osteosperma / Artemisia nova* Woodland (CEGL002331, GNR)
- *Pinus edulis - Juniperus osteosperma / Artemisia pygmaea* Woodland (CEGL002365, GNR)
- *Pinus edulis - Juniperus osteosperma / Atriplex* spp. Woodland (CEGL002366, GNR)
- *Pinus edulis - Juniperus osteosperma / Cercocarpus intricatus* Woodland (CEGL000779, G3)
- *Pinus edulis - Juniperus osteosperma / Cercocarpus ledifolius* Woodland (CEGL002940, GNR)
- *Pinus edulis - Juniperus osteosperma / Coleogyne ramosissima* Woodland (CEGL000781, G3)
- *Pinus edulis - Juniperus osteosperma* / Cushion Plant Woodland (CEGL002375, GNR)
- *Pinus edulis - Juniperus osteosperma / Ephedra torreyana - Artemisia bigelovii* Woodland (CEGL002369, GNR)
- *Pinus edulis - Juniperus osteosperma / Ephedra viridis* Woodland (CEGL002370, G3)
- *Pinus edulis - Juniperus osteosperma / Hesperostipa neomexicana* Woodland (CEGL002371, GNR)
- *Pinus edulis - Juniperus osteosperma* / Mixed Shrubs Talus Woodland (CEGL002328, GNR)
- *Pinus edulis - Juniperus osteosperma / Opuntia fragilis* Woodland (CEGL002374, GNR)
- *Pinus edulis - Juniperus osteosperma / Petradoria pumila* Woodland (CEGL002332, GNR)
- *Pinus edulis - Juniperus osteosperma / Pleuraphis jamesii* Woodland (CEGL002379, GNR)
- *Pinus edulis - Juniperus osteosperma / Purshia stansburiana* Woodland (CEGL000782, G4?)
- *Pinus edulis - Juniperus osteosperma / Purshia tridentata* Woodland (CEGL000789, G5)
- *Pinus edulis - Juniperus osteosperma / Quercus havardii var. tuckeri* Woodland (CEGL002497, G3?)
- *Pinus edulis - Juniperus osteosperma / Shepherdia rotundifolia* Woodland (CEGL002335, GNR)
- *Pinus edulis - Juniperus osteosperma* / Sparse Understory Woodland (CEGL002148, G5)
- *Pinus edulis - Juniperus scopulorum / Holodiscus dumosus* Woodland (CEGL002802, GNR)
- *Pinus edulis - Juniperus* spp. / *Artemisia tridentata (ssp. wyomingensis, ssp. vaseyana)* Woodland (CEGL000776, G5)
- *Pinus edulis - Juniperus* spp. / *Cercocarpus montanus* - Mixed Shrubs Woodland (CEGL000780, G5)
- *Pinus edulis - Juniperus* spp. / *Leymus salinus* Woodland (CEGL002340, G3G4)
- *Pinus edulis - Juniperus* spp. / *Poa fendleriana* Woodland (CEGL000787, G5)
- *Pinus edulis - Juniperus* spp. / *Pseudoroegneria spicata* Woodland (CEGL000788, G4)
- *Pinus edulis - Juniperus* spp. / *Quercus gambelii* Woodland (CEGL000791, G5)
- *Pinus edulis - Quercus arizonica / Rhus trilobata* Woodland (CEGL000790, G5?)
- *Pinus edulis / Achnatherum nelsonii ssp. dorei* Woodland (CEGL000796, G4)

- *Pinus edulis / Achnatherum scribneri* Woodland (CEGL000798, G3)
- *Pinus edulis / Andropogon hallii* Woodland (CEGL000774, G2)
- *Pinus edulis / Bouteloua curtipendula* Woodland (CEGL000777, GNR)
- *Pinus edulis / Festuca arizonica* Woodland (CEGL000783, G3)
- *Pinus edulis / Muhlenbergia pauciflora* Woodland (CEGL000785, G4)
- *Pinus edulis / Nolina microcarpa* Woodland (CEGL000786, GNR)
- *Pinus edulis* / Rockland Woodland (CEGL000794, G5)
- *Pinus edulis* / Sparse Understory Forest (CEGL000795, G5)

DISTRIBUTION

Range: This system occurs on dry mountains and foothills of the Colorado Plateau region from the Western Slope of Colorado to the Wasatch Range, south to the Mogollon Rim, and east into the northwestern corner of New Mexico. It is typically found at lower elevations, ranging from 1500-2440 m. In Wyoming, it would occur only in the southern portions of mapzone 22.
Divisions: 304:C; 306:C
Nations: US
Subnations: AZ, CO, NM, UT, WY?
Map Zones: 13:P, 15:C, 16:C, 17:P, 22:C, 23:C, 24:C, 25:C, 28:C
USFS Ecomap Regions: 313A:CC, 313B:CC, 313C:CC, 313D:CC, 315H:CC, 321A:CC, 322A:CC, 341A:CC, 341B:CC, 341C:CC, 341F:CP, 342E:CP, 342G:CC, M313A:CC, M313B:CC, M331D:CC, M331E:CC, M331G:CC, M331H:CC, M331I:CC, M341B:CC, M341C:CC
TNC Ecoregions: 18:C, 19:C, 20:?

SOURCES

References: Baker and Kennedy 1985, Comer et al. 2003, Stuever and Hayden 1997a, Tuhy et al. 2002, West et al. 1998
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722905#references
Description Author: K.A. Schulz and M.S. Reid
Version: 25 Jan 2007 **Stakeholders:** West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

COLUMBIA PLATEAU WESTERN JUNIPER WOODLAND AND SAVANNA (CES304.082)

CLASSIFIERS

Classification Status: Standard

Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Lower Montane]; Lowland [Foothill]; Forest and Woodland (Treed); Ridge/Summit/Upper Slope; Aridic; Juniperus occidentalis
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2017; ESLF 4204; ESP 1017

CONCEPT

Summary: This woodland system is found along the northern and western margins of the Great Basin, from southwestern Idaho, along the eastern foothills of the Cascades, south to the Modoc Plateau of northeastern California. Elevations range from under 200 m along the Columbia River in central Washington to over 1500 m. Generally soils are medium-textured, with abundant coarse fragments, and derived from volcanic parent materials. In central Oregon, the center of distribution, all aspects and slope positions occur. Where this system grades into relatively mesic forest or grassland habitats, these woodlands become restricted to rock outcrops or escarpments with excessively drained soils. *Pinus monophylla* is not present in this region, so *Juniperus occidentalis* is the only tree species, although *Pinus ponderosa* or *Pinus jeffreyi* may be present in some stands. *Cercocarpus ledifolius* may occasionally codominate. *Artemisia tridentata* is the most common shrub; others are *Purshia tridentata, Ericameria nauseosa, Chrysothamnus viscidiflorus, Ribes cereum,* and *Tetradymia* spp. Graminoids include *Carex filifolia, Festuca idahoensis, Poa secunda,* and *Pseudoroegneria spicata*. These woodlands are generally restricted to rocky areas where fire frequency is low. Throughout much of its range, fire exclusion and removal of fine fuels by grazing livestock have reduced fire frequency and allowed *Juniperus occidentalis* seedlings to colonize adjacent alluvial soils and expand into the shrub-steppe and grasslands. *Juniperus occidentalis* savanna may occur on the drier edges of the woodland where trees are intermingling with or invading the surrounding grasslands and where local edaphic or climatic conditions favor grasslands over shrublands.
Classification Comments: These woodlands are composed of two very different types. There are old-growth *Juniperus occidentalis* woodlands with trees and stands often over 1000 years old, with fairly well-spaced trees with rounded crowns. There are also large areas where juniper has expanded into sagebrush steppe and bunchgrass-dominated areas, with young, pointed-crowned trees growing closely together. Currently, these two very different types are about equally distributed across the landscape, with *Juniperus occidentalis* continuing to expand, either from the combination of fire exclusion, past grazing or climate change. *Juniperus occidentalis* has also expanded into *Pinus ponderosa* and *Pinus ponderosa - Pinus contorta* stands in central Oregon.
Related Concepts:
- Western Juniper - Big Sagebrush - Bluebunch Wheatgrass (107) (Shiflet 1994) Broader. Most of this SRM type corresponds to this ecological system.
- Western Juniper: 238 (Eyre 1980) Equivalent

DESCRIPTION

Environment: This woodland system is found along the northern and western margins of the Great Basin, from southwestern Idaho, along the eastern foothills of the Cascades, south to the Modoc Plateau of northeastern California. Elevations range from under 200 m along the Columbia River in central Washington to over 1500 m. Generally soils are medium-textured, with abundant coarse fragments, and derived from volcanic parent materials. In central Oregon, the center of distribution, all aspects and slope positions occur. Where this system grades into relatively mesic forest or grassland habitats, these woodlands become restricted to rock outcrops or escarpments with excessively drained soils.
Vegetation: *Pinus monophylla* is not present in this region, so *Juniperus occidentalis* is the only tree species, although *Pinus ponderosa* or *Pinus jeffreyi* may be present in some stands. *Cercocarpus ledifolius* may occasionally codominate. *Artemisia tridentata* is the most common shrub; others are *Purshia tridentata, Ericameria nauseosa, Chrysothamnus viscidiflorus, Ribes cereum,* and *Tetradymia* spp. Graminoids include *Carex filifolia, Festuca idahoensis, Poa secunda,* and *Pseudoroegneria spicata*.
Dynamics: These woodlands are generally restricted to rocky areas where fire frequency is low. Throughout much of its range, fire exclusion and removal of fine fuels by grazing livestock have reduced fire frequency and allowed *Juniperus occidentalis* seedlings to colonize adjacent alluvial soils and expand into the shrub-steppe and grasslands. *Juniperus occidentalis* savanna may occur on the drier edges of the woodland where trees are intermingling with or invading the surrounding grasslands and where local edaphic or climatic conditions favor grasslands over shrublands.

Component Associations:
- *Juniperus occidentalis / Achnatherum thurberianum* Woodland (CEGL002635, G2)
- *Juniperus occidentalis / Artemisia arbuscula / Festuca idahoensis* Wooded Herbaceous Vegetation (CEGL001716, G3?)
- *Juniperus occidentalis / Artemisia arbuscula / Poa secunda* Wooded Herbaceous Vegetation (CEGL001715, G2)
- *Juniperus occidentalis / Artemisia arbuscula / Pseudoroegneria spicata* Wooded Herbaceous Vegetation (CEGL001717, G3G4)
- *Juniperus occidentalis / Artemisia rigida / Poa secunda* Wooded Herbaceous Vegetation (CEGL001718, G2G3)

- *Juniperus occidentalis / Artemisia tridentata - Purshia tridentata* Wooded Herbaceous Vegetation (CEGL001722, G4Q)
- *Juniperus occidentalis / Artemisia tridentata / Carex filifolia* Wooded Herbaceous Vegetation (CEGL001719, G1)
- *Juniperus occidentalis / Artemisia tridentata / Festuca idahoensis* Wooded Herbaceous Vegetation (CEGL001720, G3)
- *Juniperus occidentalis / Artemisia tridentata / Pseudoroegneria spicata* Wooded Herbaceous Vegetation (CEGL001721, G3G4)
- *Juniperus occidentalis / Artemisia tridentata ssp. vaseyana* Woodland (CEGL000723, G4)
- *Juniperus occidentalis / Cercocarpus ledifolius - Symphoricarpos oreophilus* Woodland (CEGL000726, G2)
- *Juniperus occidentalis / Cercocarpus ledifolius / Carex geyeri* Wooded Herbaceous Vegetation (CEGL000724, G2)
- *Juniperus occidentalis / Cercocarpus ledifolius / Leymus cinereus* Wooded Herbaceous Vegetation (CEGL001723, G1Q)
- *Juniperus occidentalis / Cercocarpus ledifolius / Pseudoroegneria spicata* Woodland (CEGL000725, G4)
- *Juniperus occidentalis / Festuca idahoensis* Wooded Herbaceous Vegetation (CEGL001724, G2)
- *Juniperus occidentalis / Poa secunda - Achnatherum occidentale* Wooded Herbaceous Vegetation (CEGL001727, GU)
- *Juniperus occidentalis / Pseudoroegneria spicata* Wooded Herbaceous Vegetation (CEGL001728, G3)
- *Juniperus occidentalis / Purshia tridentata / Festuca idahoensis - Pseudoroegneria spicata* Wooded Herbaceous Vegetation (CEGL002622, G3)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Inter-Mountain Basins Big Sagebrush Steppe (CES304.778)

Adjacent Ecological System Comments: This system likely represents a transition between adjacent woodlands and Inter-Mountain Basins Big Sagebrush Steppe (CES304.778).

DISTRIBUTION

Range: This woodland and savanna system is found along the northern and western margins of the Great Basin, from southwestern Idaho, along the eastern foothills of the Cascades, south to the Modoc Plateau of northeastern California. It also occurs in scattered localities of northern Nevada and south-central Washington.
Divisions: 304:C
Nations: US
Subnations: CA, ID, NV, OR, WA
Map Zones: 6:C, 7:C, 9:C, 12:C, 18:C
USFS Ecomap Regions: 331A:??, 341G:CC, 342B:CC, 342C:CC, 342D:CP, 342H:CC, 342I:CC, 342J:CC, M242C:CC, M261A:C?, M261D:CC, M261E:CP, M261G:CC, M332G:CC
TNC Ecoregions: 6:C, 7:C, 68:C

SOURCES

References: Barbour and Major 1988, Holland and Keil 1995, Johnson and Clausnitzer 1992, Volland 1976, West et al. 1998, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.740155#references
Description Author: NatureServe Western Ecology Team
Version: 08 Sep 2004 **Stakeholders:** West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

CROSSTIMBERS OAK FOREST AND WOODLAND (CES205.682)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Eastern Great Plains (205)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Non-Diagnostic Classifiers: Forest and Woodland (Treed); Loam Soil Texture; Sand Soil Texture
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Deciduous open tree canopy
National Mapping Codes: EVT 2308; ESLF 4114; ESP 1308

CONCEPT

Summary: This system is primarily found within central Texas and Oklahoma, ranging north to southeastern Kansas and east into eastern Oklahoma. It is distinct from the surrounding prairie by the higher density of tree species. The area consists of irregular plains with primarily sandy to loamy Ustalf soils that range from shallow to moderately deep. Rainfall can be moderate, but somewhat erratic, therefore moisture is often limiting during part of the growing season. Short, stunted *Quercus stellata* and *Quercus marilandica* characterize and dominate this system. Other species, such as *Carya texana, Carya cordiformis, Quercus prinoides, Ulmus crassifolia*, and other *Quercus* spp., can also be present within their respective ranges. The understory often contains species typical of the surrounding prairies, in particular *Schizachyrium scoparium*. Shrubs such as *Rhus* spp. may also be present. Drought, grazing, and fire are the primary natural processes that affect this system. Overgrazing and conversion to agriculture, along with fire suppression, have led to the invasion of some areas by problematic brush species such as *Juniperus virginiana* and *Juniperus ashei* and *Prosopis glandulosa* farther south in Texas and Oklahoma. It has also led to decreases in native grass cover allowing for annual grasses and forbs to invade.
Classification Comments: This system currently includes woodlands of the Arbuckle Mountains, as well as a disjunct occurrence in the Wichita Mountains of Oklahoma comprised of the following member: *Quercus fusiformis - (Quercus stellata) / Schizachyrium scoparium* Granite Woodland (CEGL004937) (B. Hoagland pers. comm. 2005). This vegetation could also be considered an outlier of Edwards Plateau Limestone Savanna and Woodland (CES303.660).
Similar Ecological Systems:
- East-Central Texas Plains Post Oak Savanna and Woodland (CES205.679)

Related Concepts:
- Crosstimbers: Hardwood / Juniper Slope Forest (523) [CES205.682.14] (Elliott 2011) Finer
- Crosstimbers: Juniper Slope Forest (521) [CES205.682.11] (Elliott 2011) Finer
- Crosstimbers: Live Oak Forest and Woodland (502) [CES205.682.2] (Elliott 2011) Finer
- Crosstimbers: Oak / Hardwood Slope Forest (524) [CES205.682.16] (Elliott 2011) Finer
- Crosstimbers: Post Oak / Juniper Woodland (503) [CES205.682.4] (Elliott 2011) Finer
- Crosstimbers: Post Oak Woodland (504) [CES205.682.6] (Elliott 2011) Finer
- Crosstimbers: Redcedar Forest and Woodland (501) [CES205.682.1] (Elliott 2011) Finer
- Crosstimbers: Sandyland Oak Woodland (534) [CES205.682.26] (Elliott 2011) Finer
- Crosstimbers: Savanna Grassland (507) [CES205.682.9] (Elliott 2011) Finer
- Eastern Redcedar: 46 (Eyre 1980) Finer
- Post Oak - Blackjack Oak: 40 (Eyre 1980) Intersecting

DESCRIPTION

Environment: This system is located on irregular plains comprised of sandy to loamy Ustalf soils. These soils range from shallow to moderately deep. Rainfall can be moderate, but sporadic, leading to periods of limiting moisture. This system also includes smaller patch woodlands dominated by *Quercus stellata* occurring over Mollisols and scattered throughout the limestone uplands of the eastern Edwards Plateau and Lampasas Cutplain of Texas, locally referred to as "Redlands" (B. Carr pers. comm. 2005). The eastern occurrences of this system are associated with sandy members of the Cretaceous Woodbine Formation, while western occurrences occupy soils derived from the sands of the Cretaceous Trinity Group (such as Paluxy, Antler, and Twin Mountain-Travis Peak sands). Further west, in the fringe of the western Crosstimbers, the system occurs on more rugged, rocky and gravelly sites derived from Pennsylvanian formations. The landforms are gently rolling, moderately dissected uplands, and irregular plains becoming more rugged in the western fringe of the distribution of this system. Soils are sands or sandy loams, some with a claypan. Ecological Sites typical of the eastern expressions include Sandy Loam, Tight Sandy Loam, Claypan Prairie, Sandstone Hill, and Sandy. Those more typical of the western expressions include Sandy Loam, Loamy Sand, Tight Sandy Loam, Sandy, and Clay Loam (Elliott 2011).
Vegetation: This system is generally described as a savanna or woodland, distinguished by its dominance by short, stunted *Quercus stellata* and/or *Quercus marilandica*. It occurs in southwest/northeast-trending bands separated by the Grand Prairie. Other species in the canopy may include *Ulmus crassifolia, Quercus fusiformis, Celtis laevigata,* and *Juniperus virginiana*. The understory may have been historically dominated by *Schizachyrium scoparium*, but current understory composition may be largely determined by land-use history and grazing pressure. *Carya texana, Carya cordiformis,* and *Quercus prinoides* are lacking from Texas examples and are mainly present in stands of this system in the northern Crosstimbers of Oklahoma (L. Elliott pers. comm. 2011). In the east, where

precipitation is greater, tallgrass species such as *Andropogon gerardii* and *Sorghastrum nutans* may be important components of the understory or occupy prairie patches. In the drier west, shortgrass species such as *Buchloe dactyloides* become more conspicuous. Other graminoid species that may be present include *Schizachyrium scoparium, Paspalum setaceum, Sporobolus compositus, Bouteloua curtipendula, Bouteloua hirsuta, Bouteloua rigidiseta, Bothriochloa laguroides ssp. torreyana, Nassella leucotricha*, and *Aristida* spp. Non-native species such as *Cynodon dactylon* and *Bothriochloa ischaemum var. songarica* frequently dominate the herbaceous layer. With the disruption of a natural fire cycle, branching of overstory species may be continuous to near ground level, reducing light penetration and leading to reduced herbaceous cover. The shrub layer may contain species such as *Smilax bona-nox, Rhus glabra, Rhus trilobata, Crataegus* spp., and *Symphoricarpos orbiculatus*. Sites dominated by *Prosopis glandulosa*, sometimes with *Ziziphus obtusifolia* as a common shrub component, are particularly common to the west. Sites dominated by junipers (including *Juniperus virginiana, Juniperus ashei*, and *Juniperus pinchotii*, depending on the site) are also frequently encountered. Prairie openings and inclusions tend to occur on tighter soils. Shrubs such as *Rhus* spp. may also be present. Other species may include *Celtis laevigata, Cercis canadensis, Cotinus obovatus, Fraxinus texensis, Gleditsia triacanthos, Juniperus ashei, Juniperus virginiana var. virginiana, Quercus fusiformis, Quercus buckleyi, Quercus velutina, Ulmus alata*, and *Ulmus americana* (Elliott 2011).
Dynamics: Drought, grazing, and fire primarily influence this system. Overgrazing and conversion to agriculture have allowed for the invasion of eastern red-cedar (*Juniperus virginiana*), Ashe's juniper (*Juniperus ashei*), and honey mesquite (*Prosopis glandulosa*) in some areas. Decreases in native grass cover associated with overgrazing can also lead to an increase in invasive annual grasses and forbs.

Component Associations:
- *Quercus buckleyi - Fraxinus texensis - Quercus muehlenbergii* Forest (CEGL004912, G2G3)
- *Quercus stellata - (Ulmus crassifolia) / Sideroxylon lanuginosum / Nassella leucotricha* Paluxy Sands Woodland (CEGL004213, GNR)
- *Quercus stellata - Quercus marilandica - (Carya texana)* Forest (CEGL002074, G4)
- *Quercus stellata - Quercus marilandica - Carya texana - (Quercus shumardii, Quercus velutina)* Forest (CEGL002324, G3G5)
- *Quercus stellata - Quercus marilandica / Schizachyrium scoparium* Woodland (CEGL002147, G4)
- *Quercus stellata - Ulmus alata* Forest (CEGL004546, GNR)
- *Schizachyrium scoparium - Bouteloua curtipendula - Nassella leucotricha* Herbaceous Vegetation (CEGL004070, GNR)
- *Schizachyrium scoparium - Lechea tenuifolia - Acalypha radians* Herbaceous Vegetation (CEGL004913, G2G3)

DISTRIBUTION

Range: This system is primarily found within central Texas and Oklahoma, with the northern extent reaching into southeastern Kansas in the Cross Timbers (EPA level III ecoregion 29). It also includes the "Lower Canadian Hills" and "Osage Cuestas" in eastern Oklahoma and the Edwards Plateau Woodland, Semiarid Edwards Plateau and Broken Red Plains of Texas (37e, 40b, 30a, 30d, 27i of EPA, respectively).
Divisions: 205:C; 303:C
Nations: US
Subnations: AR, KS, MO?, OK, TX
Map Zones: 32:C, 34:P, 35:C, 38:?, 43:C, 44:C
USFS Ecomap Regions: 231G:CC, 251E:CC, 251H:CC, 255A:CC, 255B:C?, 255E:CC, 315C:CC, 315D:CC, 315G:CC, 321B:CC
TNC Ecoregions: 28:C, 29:C, 32:C, 33:C

SOURCES

References: Barbour and Billings 1988, Burns and Honkala 1990b, Comer et al. 2003, Elliott 2011, Elliott, L. pers. comm., Eyre 1980, Griffith et al. 2004, Hoagland 2000, Hoagland pers. comm., Ricketts et al. 1999
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722977#references
Description Author: S. Menard and K. Kindscher, mod. J. Teague, M. Pyne, L. Elliott
Version: 17 Feb 2011 **Stakeholders:** Midwest, Southeast
Concept Author: S. Menard and K. Kindscher **ClassifResp:** Midwest

CROWLEY'S RIDGE MESIC LOESS SLOPE FOREST (CES203.079)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Unglaciated
Non-Diagnostic Classifiers: Forest and Woodland (Treed); Loess; Broad-Leaved Deciduous Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: EVT 2322; ESLF 4128; ESP 1322

CONCEPT

Summary: This ecological system of mesic upland forests is confined to Crowley's Ridge, which extends from Missouri south into Arkansas along the western side of the lower Mississippi River. This vegetation and the ridge itself are very distinctive from that of the adjacent alluvial plain. The ridge is a remnant loess-capped feature rising from 30 m to over 60 m (100-200 feet) above the alluvial plain surface, to about 150 m (450 feet) above sea level. The base of the ridge is comprised of Tertiary substrates overlain by Quaternary alluvial deposits and capped with up to 15 m (50 feet) of Pleistocene loess. The system is generally comprised of mesic forests that occupy ravines between narrow, "finger" ridges and slopes in a highly dissected landscape. The sites tend to be more mesic than sites elsewhere in the southeastern United States. In many cases, these slopes and ravines provide habitat for plant species that are rare or absent from other parts of the alluvial plain (e.g., *Liriodendron tulipifera, Tilia americana*). Canopies are dominated by *Fagus grandifolia, Quercus alba*, and *Liriodendron tulipifera*, with many associates.

Classification Comments: This type does not include all forests across the entire extent of southern Crowley's Ridge; excluded are dry and dry-mesic forests, typically on west-facing slopes and ridgetops. This system is best developed on southern Crowley's Ridge where loess is most pronounced, and becomes much more isolated and rare on the ridge north of approximately Jonesboro, Arkansas. Conversely, dry-mesic oak and shortleaf pine communities are rare within this system, becoming dominant on western slopes and in the northern ridge, respectively. The vegetation may share some superficial similarities with types referred to as western mesophytic forests, but it is well-separated geographically from these. A similar ecological system is East Gulf Coastal Plain Northern Loess Bluff Forest (CES203.481) which occurs farther eastward and is restricted to the loess bluffs east of the Mississippi River. The vegetation of these areas is believed to share a great detail of overlap. They are recognized as distinct for now due to geographic separation; further work may suggest that these two systems should be merged. There are a number of state parks and small natural areas on Crowley's Ridge, including Village Creek State Park, Crowley's Ridge State Park, Wittsburg Natural Area and Chalk Bluff Natural Area (which is toward the northern end of the ridge). All of these have moderate to high-quality examples of this system.

Similar Ecological Systems:
- Mississippi River Alluvial Plain Dry-Mesic Loess Slope Forest (CES203.071)

Related Concepts:
- Beech - Sugar Maple: 60 (Eyre 1980) Finer
- Mesic Loess/Glacial Till Forest (Nelson 2005) Broader
- Northern Red Oak: 55 (Eyre 1980) Finer
- White Oak - Black Oak - Northern Red Oak: 52 (Eyre 1980) Finer
- White Oak: 53 (Eyre 1980) Finer

DESCRIPTION

Environment: These diverse-canopy forests occur in ravines in a highly dissected environment. The system is best expressed on southern Crowley's Ridge, Arkansas (Cross County south through Phillips County), with additional limited occurrences to the north, in undisturbed valleys and coves. Deep loessal soil is the most characteristic and diagnostic component of the environment of this system.

Vegetation: This system consists of forests that are typically dominated by beech, oaks and other hardwoods. Canopies are dominated by *Fagus grandifolia, Quercus alba*, and *Liriodendron tulipifera* (Clark 1977d), with many associates, including *Magnolia acuminata* and *Tilia americana* (T. Witsell pers. comm. 2013). Other oaks which may be present include *Quercus falcata, Quercus pagoda, Quercus rubra*, and *Quercus velutina*. Due to the apparent richness of the loessal soils, *Ostrya virginiana* is a particularly common species across many of the component community types. Species that may be present in the shrub layer include *Arundinaria gigantea, Asimina triloba, Bignonia capreolata, Lindera benzoin, Parthenocissus quinquefolia, Toxicodendron radicans*, and *Vitis rotundifolia*. Some possible herbs include *Cynoglossum virginianum, Dioscorea quaternata*, and *Sanicula canadensis*.

Dynamics: These are stable, generally fire-sheltered forests, with relatively low fire frequency and intensity. There is some natural disturbance from the effects of windstorms and collapse of the fragile loess. This mesic loess forest type typically experiences surface fires with return intervals of from 30 to greater than 100 years. Mixed-severity fires will occur approximately every 100 years, opening the canopy with increased mortality. This effect may also be achieved by recurrent, severe insect defoliations or droughts. Straight-line winds or microbursts may cause blowdowns on a scale of 1 to 100 acres. Stand-replacement fires happen very infrequently (Landfire 2007a).

Component Associations:
- *Fagus grandifolia - Quercus (alba, rubra) / Acer barbatum / Asimina triloba* Forest (CEGL004072, G2G3)
- *Quercus (rubra, alba, velutina) / Acer barbatum / Asimina triloba* Forest (CEGL004069, G1G2)
- *Quercus alba - Quercus falcata - Quercus velutina / Ostrya virginiana* Forest (CEGL004068, G1G2)
- *Quercus alba - Quercus rubra - Acer saccharum - Carya cordiformis / Lindera benzoin* Forest (CEGL002058, G3?)

SPATIAL CHARACTERISTICS

Spatial Summary: Small patch to large patch.

DISTRIBUTION

Range: This system is endemic to Crowley's Ridge (Arkansas, Missouri), which is a distinctive landscape feature in the Mississippi River Alluvial Plain.
Divisions: 203:C
Nations: US
Subnations: AR, MO
Map Zones: 45:C
USFS Ecomap Regions: 234D:CC
TNC Ecoregions: 42:C

SOURCES

References: Arkansas Forestry Commission 2010, Clark 1974, Clark 1977d, Engeman et al. 2007, Eyre 1980, Landfire 2007a, NatureServe Ecology - Southeastern U.S. unpubl. data, Nelson 2005, Southeastern Ecology Working Group n.d., Witsell pers. comm.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.798100#references
Description Author: T. Foti, D. Zollner, M. Pyne
Version: 14 Jan 2014 **Stakeholders:** Midwest, Southeast
Concept Author: T. Foti, D. Zollner, and M. Pyne **ClassifResp:** Southeast

CROWLEY'S RIDGE SAND FOREST (CES203.072)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Sand; Unglaciated
Non-Diagnostic Classifiers: Forest and Woodland (Treed); Needle-Leaved Tree; Broad-Leaved Deciduous Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Mixed evergreen-deciduous open tree canopy
National Mapping Codes: EVT 2510; ESLF 4332; ESP 1510

CONCEPT

Summary: This system of upland shortleaf pine - hardwood forests is confined to Crowley's Ridge on the western side of the Mississippi River. This vegetation is very distinctive from that of the adjacent alluvial plain, and the ridge itself also contrasts sharply with the adjacent alluvial plain. Crowley's Ridge is a remnant loess-capped feature rising from 30 m to over 60 m (100-200 feet) above the alluvial plain surface, to about 150 m (450 feet) above sea level. The base of the northern ridge is comprised of Tertiary substrates overlain by alluvial deposits and capped with generally thin layers of Pleistocene loess. The Pleistocene alluvial deposits are often sandy, and in a very limited area, there are outcrops of sandstone of uncertain origin. Forests on the ridgetops are dominated by *Pinus echinata* with varying amounts of *Quercus alba, Quercus rubra, Quercus falcata, Quercus stellata, Carya texana,* and *Quercus velutina*. Loess slopes and ravines are dominated by mesic or dry-mesic hardwood forests such as those of the southern ridge, but are of relatively limited extent.
Classification Comments: This system has been little studied, with the best description in Clark (1974). The presettlement and then-current distribution were mapped, and several sites were sampled. Clark classed the predominant community as Oak-Hickory-Pine, with shortleaf pine dominance ranging from 12-56% and combined white oak and post oak, the most abundant oaks, ranging from 24-60%.
Similar Ecological Systems:
- Lower Mississippi River Dune Woodland and Forest (CES203.531)
- Mississippi River Alluvial Plain Dry-Mesic Loess Slope Forest (CES203.071)

Related Concepts:
- Dry-mesic Sand Forest (Nelson 2005) Intersecting
- Shortleaf Pine - Oak: 76 (Eyre 1980) Finer
- Shortleaf Pine: 75 (Eyre 1980) Finer

DESCRIPTION

Environment: These forests occur on sandy ridges and slopes in a dissected environment. The system is best expressed on northern Crowley's Ridge, but there are limited occurrences on the southern ridge as well, on sandy, exposed sites. They generally lie to the east of hydroxeric Pleistocene terrace flatwoods (now usually converted to cropland) that burned frequently. Those fires would have continued into these dry to dry-mesic forests, thereby increasing the fire frequency.
Vegetation: This system consists of forests that are typically dominated by shortleaf pine with oaks and other hardwoods. Depending upon local soil moisture and other factors, canopy oaks can vary from *Quercus stellata* and *Quercus falcata* on the driest sites to *Quercus alba* and other oaks on more mesic sites. Associated species in the subcanopy and understory vary along this moisture gradient as well (refer to association-level descriptions for more details).
Dynamics: These are fire-adapted forests. There is presumably some natural disturbance from the effects of windstorms and collapse of the fragile loess. This vegetation is classed as Fire Regime I, with frequent surface fire (mean fire-return interval is approximately five years) and less frequent mixed fire. In addition, straight-line winds or microbursts may cause blowdowns on a scale of 1 to 100 acres. Stand-replacement fires happen very infrequently (Landfire 2007a).

Component Associations:
- *Quercus stellata - Quercus falcata / Ostrya virginiana* Forest (CEGL004064, G1)

DISTRIBUTION

Range: This system is endemic to Crowley's Ridge in the Mississippi River Alluvial Plain of Arkansas and Missouri (Nelson 2005).
Divisions: 203:C
Nations: US
Subnations: AR, MO
Map Zones: 45:C
USFS Ecomap Regions: 234D:CC
TNC Ecoregions: 42:C

SOURCES

References: Arkansas Forestry Commission 2010, Clark 1974, Engeman et al. 2007, Eyre 1980, Landfire 2007a, NatureServe

Ecology - Southeastern U.S. unpubl. data, Nelson 2005, Southeastern Ecology Working Group n.d., Zollner pers. comm.

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.798110#references

Description Author: T. Foti, D. Zollner, M. Pyne

Version: 14 Jan 2014 **Stakeholders:** Midwest, Southeast

Concept Author: T. Foti, D. Zollner, M. Pyne **ClassifResp:** Southeast

EAST CASCADES MESIC MONTANE MIXED-CONIFER FOREST AND WOODLAND (CES204.086)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Long (>500 yrs) Persistence; Forest and Woodland (Treed); Udic; Very Long Disturbance Interval; F-Landscape/Medium Intensity; Needle-Leaved Tree; Abies grandis - Mixed; Tsuga heterophylla, Thuja plicata; Pseudotsuga menziesii
Non-Diagnostic Classifiers: Montane [Montane]; Montane [Lower Montane]; Sideslope; Toeslope/Valley Bottom; Temperate [Temperate Continental]; Mesotrophic Soil
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2018; ESLF 4205; ESP 1018

CONCEPT

Summary: This ecological system occurs on the upper east slopes of the Cascades in Washington, south of Lake Chelan and south to Mount Hood in Oregon. Elevations range from 610 to 1220 m (2000-4000 feet) in a very restricted range occupying less than 5% of the forested landscape in the east Cascades. This system is associated with a submesic climate regime with annual precipitation ranging from 100 to 200 cm (40-80 inches) and maximum winter snowpacks that typically melt off in spring at lower elevations. This ecological system is composed of variable montane coniferous forests typically below Pacific silver fir forests along the crest east of the Cascades. This system also includes montane forests along rivers and slopes, and in mesic "coves" which were historically protected from wildfires. Most occurrences of this system are dominated by a mix of *Pseudotsuga menziesii* with *Abies grandis* and/or *Tsuga heterophylla*. Several other conifers can dominate or codominate, including *Thuja plicata, Pinus contorta, Pinus monticola,* and *Larix occidentalis*. *Abies grandis* and other fire-sensitive, shade-tolerant species dominate forests on many sites once dominated by *Pseudotsuga menziesii* and *Pinus ponderosa*, which were formerly maintained by wildfire. They are very productive forests in the eastern Cascades which have been priority stands for timber production. *Mahonia nervosa, Linnaea borealis, Paxistima myrsinites, Acer circinatum, Spiraea betulifolia, Symphoricarpos hesperius, Cornus nuttallii, Rubus parviflorus*, and *Vaccinium membranaceum* are common shrub species. The composition of the herbaceous layer reflects local climate and degree of canopy closure and contains species more restricted to the Cascades, for example, *Achlys triphylla, Anemone deltoidea*, and *Vancouveria hexandra*. Typically, stand-replacement fire-return intervals are 150-500 years with moderate-severity fire-return intervals of 50-100 years.
Classification Comments: Includes *Tsuga heterophylla* and *Thuja plicata* associations and moister *Abies grandis* associations in eastern Cascades.
Similar Ecological Systems:
- Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest (CES306.805)

Related Concepts:
- Grand Fir: 213 (Eyre 1980) Intersecting. Grand fir stands are an important component of this ecological system.
- Interior Ponderosa Pine: 237 (Eyre 1980) Intersecting
- Western Hemlock: 224 (Eyre 1980) Intersecting. 80% W. Hemlock
- Western Larch: 212 (Eyre 1980) Intersecting. Western larch stands are a seral component of this ecological system.
- Western Redcedar - Western Hemlock: 227 (Eyre 1980) Intersecting
- Western Redcedar: 228 (Eyre 1980) Intersecting

DESCRIPTION

Environment: This ecological system occurs on the upper east slopes of the Cascades in Washington, south of Lake Chelan and south to Mount Hood in Oregon. Elevations range from 610 to 1220 m (2000-4000 feet) in a very restricted range occupying less than 5% of the forested landscape in the east Cascades. This system is associated with a submesic climate regime with annual precipitation ranging from 100 to 200 cm (40-80 inches) and maximum winter snowpacks that typically melt off in spring at lower elevations. This ecological system is composed of variable montane coniferous forests typically below Pacific silver fir forests along the crest east of the Cascades. This system also includes montane forests along rivers and slopes, and in mesic "coves" which were historically protected from wildfires.
Vegetation: Most occurrences of this system are dominated by a mix of *Pseudotsuga menziesii* with *Abies grandis* and/or *Tsuga heterophylla*. Several other conifers can dominate or codominate, including *Thuja plicata, Pinus contorta, Pinus monticola,* and *Larix occidentalis*. *Abies grandis* and other fire-sensitive, shade-tolerant species dominate forests on many sites once dominated by *Pseudotsuga menziesii* and *Pinus ponderosa*, which were formerly maintained by wildfire. They are very productive forests in the eastern Cascades which have been priority stands for timber production. *Mahonia nervosa, Linnaea borealis, Paxistima myrsinites, Acer circinatum, Spiraea betulifolia, Symphoricarpos hesperius, Cornus nuttallii, Rubus parviflorus*, and *Vaccinium membranaceum* are common shrub species. The composition of the herbaceous layer reflects local climate and degree of canopy closure and contains species more restricted to the Cascades, for example, *Achlys triphylla, Anemone deltoidea*, and *Vancouveria hexandra*.
Dynamics: Typically, stand-replacement fire-return intervals are 150-500 years with moderate-severity fire-return intervals of 50-100

years. Landfire VDDT models: R#MCONm Eastside mixed conifer moist (GF/DF) model is applied with stages A-B-E.

Component Associations:
- *Abies concolor - Pinus contorta / Carex pensylvanica - Achnatherum occidentale* Forest (CEGL000256, G3)
- *Abies grandis - Picea engelmannii / Maianthemum stellatum* Forest (CEGL000278, G2)
- *Abies grandis - Pseudotsuga menziesii / Trientalis borealis ssp. latifolia* Forest (CEGL000040, G3)
- *Abies grandis - Thuja plicata / Achlys triphylla* Forest (CEGL002669, G2)
- *Abies grandis - Tsuga heterophylla / Clintonia uniflora* Forest (CEGL000286, G2)
- *Abies grandis / Acer circinatum* Forest (CEGL000266, G4)
- *Abies grandis / Achlys triphylla* Forest (CEGL000268, G3)
- *Abies grandis / Arctostaphylos nevadensis* Woodland (CEGL000915, G2G3)
- *Abies grandis / Chrysolepis chrysophylla* Forest (CEGL000038, G1)
- *Abies grandis / Cornus nuttallii - Acer glabrum* Forest (CEGL001104, G1)
- *Abies grandis / Holodiscus discolor* Forest (CEGL000274, G2G3)
- *Abies grandis / Polemonium pulcherrimum* Forest (CEGL000039, G3)
- *Abies grandis / Symphoricarpos albus* Forest (CEGL000282, G3?)
- *Abies grandis / Vaccinium membranaceum - Achlys triphylla* Forest (CEGL000291, G2G3)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest (CES204.001)
- North Pacific Mesic Western Hemlock-Silver Fir Forest (CES204.097)
- North Pacific Mountain Hemlock Forest (CES204.838)
- Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest (CES306.805)
- Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland (CES306.830)

Adjacent Ecological System Comments: This system lies between and interfingers with the higher North Pacific Mountain Hemlock Forest (CES204.838), North Pacific Mesic Western Hemlock-Silver Fir Forest (CES204.097) or Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland (CES306.830) and the lower Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest (CES306.805). Westward in the Columbia River Gorge, this system merges with North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest (CES204.001).

DISTRIBUTION

Range: This ecological system occurs on the upper east slopes of the Cascades in Washington, south of Lake Chelan and south to Mount Hood in Oregon.
Divisions: 204:C
Nations: CA, US
Subnations: BC, OR, WA
Map Zones: 1:C, 7:C, 9:P
USFS Ecomap Regions: 242A:CC, 342H:CP, 342I:CC, M242B:CC, M242C:CC, M242D:CC, M261G:CC
TNC Ecoregions: 4:C

SOURCES

References: Hessburg et al. 1999, Hessburg et al. 2000, Lillybridge et al. 1995, Topik 1989, Topik et al. 1988, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.740349#references
Description Author: G. Kittel, mod. C. Chappell and M.S. Reid
Version: 31 Mar 2005 **Stakeholders:** Canada, West
Concept Author: R. Crawford **ClassifResp:** West

EAST CASCADES OAK-PONDEROSA PINE FOREST AND WOODLAND (CES204.085)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Ridge/Summit/Upper Slope; Very Shallow Soil; Mineral: W/ A-Horizon <10 cm; Aridic; Intermediate Disturbance Interval [Periodicity/Polycyclic Disturbance]; F-Patch/Medium Intensity
Non-Diagnostic Classifiers: Short (50-100 yrs) Persistence; Montane [Montane]; Montane [Lower Montane]; Forest and Woodland (Treed); Temperate [Temperate Continental]; Circumneutral Soil; F-Landscape/Low Intensity
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Mixed evergreen-deciduous open tree canopy
National Mapping Codes: EVT 2060; ESLF 4301; ESP 1060

CONCEPT

Summary: This narrowly restricted ecological system appears at or near lower treeline in foothills of the eastern Cascades in Washington and Oregon within 65 km (40 miles) of the Columbia River Gorge. It also appears in the adjacent Columbia Plateau ecoregion. Elevations range from 460 to 1920 m. Most occurrences of this system are dominated by a mix of *Quercus garryana* and *Pinus ponderosa* or *Pseudotsuga menziesii*. Isolated, taller *Pinus ponderosa* or *Pseudotsuga menziesii* over *Quercus garryana* trees characterize parts of this system. Clonal *Quercus garryana* can create dense patches across a grassy landscape or can dominate open woodlands or savannas. The understory may include dense stands of shrubs or, more often, be dominated by grasses, sedges or forbs. Shrub-steppe shrubs may be prominent in some stands and create a distinct tree / shrub / sparse grassland habitat, including *Purshia tridentata, Artemisia tridentata, Artemisia nova,* and *Chrysothamnus viscidiflorus*. Understories are generally dominated by herbaceous species, especially graminoids. Mesic sites have an open to closed sodgrass understory dominated by *Calamagrostis rubescens, Carex geyeri, Carex rossii, Carex inops,* or *Elymus glaucus*. Drier savanna and woodland understories typically contain bunchgrass steppe species such as *Festuca idahoensis* or *Pseudoroegneria spicata*. Common exotic grasses that often appear in high abundance are *Bromus tectorum* and *Poa bulbosa*. These woodlands occur at the lower treeline/ecotone between *Artemisia* spp. or *Purshia tridentata* steppe or shrubland and *Pinus ponderosa* and/or *Pseudotsuga menziesii* forests or woodlands. In the Columbia River Gorge, this system appears as small to large patches in transitional areas in the Little White Salmon and White Salmon river drainages in Washington and Hood River, Rock Creek, Moiser Creek, Mill Creek, Threemile Creek, Fifteen Mile Creek, and White River drainages in Oregon. *Quercus garryana* can create dense patches often associated with grassland or shrubland balds within a closed *Pseudotsuga menziesii* forest landscape. Commonly the understory is shrubby and composed of *Ceanothus integerrimus, Holodiscus discolor, Symphoricarpos albus,* and *Toxicodendron diversilobum*. Fire plays an important role in creating vegetation structure and composition in this habitat. Decades of fire suppression have led to invasion by *Pinus ponderosa* along lower treeline and by *Pseudotsuga menziesii* in the gorge and other oak patches on xeric sites in the east Cascade foothills. In the past, most of the habitat experienced frequent low-severity fires that maintained woodland or savanna conditions. The mean fire-return interval is 20 years, although variable. Soil drought plays a role, maintaining an open tree canopy in part of this dry woodland habitat.
Classification Comments: Mapping this system presents a typical scale problem. Areas of pure ponderosa pine are found directly adjacent to oak stands. This system is a matrix type with stands of *Pinus ponderosa, Quercus garryana, Pinus ponderosa - (Pseudotsuga menziesii) - Quercus garryana*; still need to get a mapping protocol and concept to distinguish *Pseudotsuga menziesii* with *Quercus garryana* patches in the east gorge White Salmon. The Little White Salmon drainage near Augspurger Mountain is the transition area between North Pacific Oak Woodland (CES204.852) and this system (Dog Mountain is the westernmost in Washington).
Related Concepts:
- Interior Ponderosa Pine: 237 (Eyre 1980) Broader
- Oregon White Oak: 233 (Eyre 1980) Broader

DESCRIPTION

Environment: This narrowly restricted ecological system appears at or near lower treeline in foothills of the eastern Cascades in Washington and Oregon within 65 km (40 miles) of the Columbia River Gorge. It also appears in the adjacent Columbia Plateau ecoregion. Elevations range from 460 to 1920 m. In the Columbia River Gorge, this system appears as small to large patches in transitional areas in the Little White Salmon and White Salmon river drainages in Washington and Hood River, Rock Creek, Moiser Creek, Mill Creek, Threemile Creek, Fifteen Mile Creek, and White River drainages in Oregon. *Quercus garryana* can create dense patches often associated with grassland or shrubland balds within a closed *Pseudotsuga menziesii* forest landscape.
Vegetation: Most occurrences of this system are dominated by a mix of *Quercus garryana* and *Pinus ponderosa* or *Pseudotsuga menziesii*. Isolated, taller *Pinus ponderosa* or *Pseudotsuga menziesii* over *Quercus garryana* trees characterize parts of this system. Clonal *Quercus garryana* can create dense patches across a grassy landscape or can dominate open woodlands or savannas. The understory may include dense stands of shrubs or, more often, be dominated by grasses, sedges or forbs. Shrub-steppe shrubs may be prominent in some stands and create a distinct tree / shrub / sparse grassland habitat, including *Purshia tridentata, Artemisia tridentata, Artemisia nova,* and *Chrysothamnus viscidiflorus*. Understories are generally dominated by herbaceous species, especially

graminoids. Mesic sites have an open to closed sodgrass understory dominated by *Calamagrostis rubescens*, *Carex geyeri*, *Carex rossii*, *Carex inops*, or *Elymus glaucus*. Drier savanna and woodland understories typically contain bunchgrass steppe species such as *Festuca idahoensis* or *Pseudoroegneria spicata*. Common exotic grasses that often appear in high abundance are *Bromus tectorum* and *Poa bulbosa*.

Dynamics: Fire plays an important role in creating vegetation structure and composition in this habitat. Decades of fire suppression have led to invasion by *Pinus ponderosa* along lower treeline and by *Pseudotsuga menziesii* in the gorge and other oak patches on xeric sites in the east Cascade foothills. Most of the habitat experienced frequent low-severity fires that maintained woodland or savanna conditions. The mean fire-return interval is 20 years, although variable. Landfire VDDT models: #R OAP1 Oregon White Oak-Ponderosa Pine model describes general successional pathways treating drier pine succession separate from more mesic Douglas-fir pathways.

Component Associations:

- *Abies grandis / Holodiscus discolor* Forest (CEGL000274, G2G3)
- *Pinus ponderosa - Quercus garryana / Balsamorhiza sagittata* Woodland (CEGL000881, G2)
- *Pinus ponderosa - Quercus garryana / Carex geyeri* Woodland (CEGL000882, G2G3)
- *Pinus ponderosa - Quercus garryana / Purshia tridentata* Woodland (CEGL000883, G3)
- *Pinus ponderosa - Quercus garryana / Symphoricarpos albus* Woodland (CEGL000884, G2G3)
- *Pseudotsuga menziesii - Quercus garryana / Symphoricarpos albus* Woodland (CEGL000929, G2G3)
- *Pseudotsuga menziesii / Festuca occidentalis* Forest (CEGL000434, G2)
- *Quercus garryana / Carex geyeri* Woodland (CEGL000549, G1G2)
- *Quercus garryana / Elymus glaucus* Woodland (CEGL000550, G1G2)
- *Quercus garryana / Festuca idahoensis* Woodland (CEGL000551, G1?)
- *Quercus garryana / Pseudoroegneria spicata* Woodland (CEGL000552, G1G2)
- *Quercus garryana / Symphoricarpos albus* Woodland (CEGL000553, G2G3)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:

- California Montane Jeffrey Pine-(Ponderosa Pine) Woodland (CES206.918)

DISTRIBUTION

Range: This narrowly restricted ecological system appears at or near lower treeline in foothills of the eastern Cascades in Washington and Oregon within 65 km (40 miles) of the Columbia River Gorge. It also appears in the adjacent Columbia Plateau ecoregion. Disjunct occurrences in Klamath and Siskiyou counties, Oregon, have more sagebrush and bitterbrush in the understory, along with other shrubs.

Divisions: 204:C; 304:C
Nations: CA, US
Subnations: BC, OR, WA
Map Zones: 1:C, 7:C, 8:C
USFS Ecomap Regions: 342H:CC, 342I:CC, M242B:C?, M242C:CC, M242D:CC
TNC Ecoregions: 4:C, 6:C

SOURCES

References: John and Tart 1986, Lillybridge et al. 1995, Topik et al. 1988, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.740345#references
Description Author: G. Kittel, mod. C. Chappell and M.S. Reid
Version: 23 Jan 2006 **Stakeholders:** Canada, West
Concept Author: R. Crawford **ClassifResp:** West

EAST GULF COASTAL PLAIN INTERIOR SHORTLEAF PINE-OAK FOREST (CES203.506)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Short Disturbance Interval
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Mixed evergreen-deciduous closed tree canopy
National Mapping Codes: EVT 2372; ESLF 4315; ESP 1372

CONCEPT

Summary: This forested ecological system of the East Gulf Coastal Plain occurs most extensively on generally rolling uplands north of the range of *Pinus palustris*. It was the historical matrix in large areas of the region in Alabama and Mississippi, particularly between about 32 degrees 30 minutes N latitude (the approximate local northern limit of the historic range of *Pinus palustris*), and about 35 degrees N latitude (the approximate limit where relatively extensive examples of *Pinus echinata* are replaced by predominantly hardwood-dominated systems, although isolated examples of this system may occur both north and south of these boundaries in limited areas. Stands tend to occur on generally well-drained sandy or clayey soils with dry to dry-mesic moisture regimes. *Pinus echinata* is the dominant pine species of the generalized "dry and dry-mesic oak-pine" forest type in the Gulf Coastal Plain and is the most characteristic floristic component of this system. The actual amount of *Pinus echinata* present varies based on a number of factors, but intact examples of this system often include stands that are dominated by *Pinus echinata* grading into stands with a mixture of upland hardwoods. Locally, on mid to lower slopes, *Pinus taeda* may be a component, extending further upslope in the absence of fire. Fire is possibly the most important natural process affecting the floristic composition and vegetation structure of this system, although fire-return intervals are lower than those associated with the East Gulf Coastal Plain Interior Upland Longleaf Pine Woodland (CES203.496). *Pinus echinata* may have difficulty replacing itself in the absence of fire, particularly on sites other than the driest ones. Local topographic conditions affecting natural fire compartment size generally lend themselves to this fire frequency, although some examples may have more frequent fires and some less than this generalized value. Where fire is most frequent the system may develop a relatively pure canopy of *Pinus echinata* typified by a very open woodland structure with scattered overstory trees and an herbaceous-dominated understory; such examples are rare on the modern landscape. More typical are areas in which *Quercus* spp., *Carya* spp., *Liquidambar styraciflua, Liriodendron tulipifera, Acer* spp., and *Nyssa sylvatica* have become prominent in the midstory and even overstory and in which herbaceous patches are rare. Although the general distributional boundaries described above indicate where this system formed an historical landscape matrix, smaller patches of the system may also be present in limited areas both north and south of these boundaries. Although some sources map the native range of shortleaf pine throughout a relatively large area of western Tennessee, the actual distribution of the species appears to be much more confined and almost absent from the Coastal Plain; when present, it occurs in only small stands on dry southwestern aspects.
Classification Comments: The range of this system overlaps with East Gulf Coastal Plain Northern Dry Upland Hardwood Forest (CES203.483) in the Fall Line Hills ecoregion (65i) of Alabama and in the Southern Hilly Gulf Coastal Plain ecoregion (65d) of Mississippi and may overlap to some degree with Southern Coastal Plain Dry Upland Hardwood Forest (CES203.560) as well. In parts of the overlapping range (including the Oakmulgee Ranger District of the Talladega National Forest), these types occur in a mosaic which is difficult to interpret environmentally and ecologically (A. Schotz pers. comm.). East Gulf Coastal Plain Northern Loess Plain Oak-Hickory Upland (CES203.482) replaces this system along the northern and northwestern boundary in Tennessee.
Similar Ecological Systems:
- East Gulf Coastal Plain Interior Upland Longleaf Pine Woodland (CES203.496)
- East Gulf Coastal Plain Northern Dry Upland Hardwood Forest (CES203.483)
- East Gulf Coastal Plain Northern Loess Plain Oak-Hickory Upland (CES203.482)
- Ozark-Ouachita Shortleaf Pine-Bluestem Woodland (CES202.325)
- Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland (CES202.313)

Related Concepts:
- Shortleaf Pine - Oak: 76 (Eyre 1980) Finer
- Shortleaf Pine: 75 (Eyre 1980) Finer

DESCRIPTION

Environment: The core distribution of this system lies between about 32 degrees 30 minutes N latitude and about 35 degrees N latitude; more localized occurrences may be found as small patches both north and south of these boundaries embedded in other systems. The belted character of this region, in the form of inner lowlands and cuestas and other low-ridge landforms (Bowman 1911, Fenneman 1938), the associated diversity of soil types, and differences in settlement history appear to account for the importance of shortleaf pine in the Gulf Coast region when compared to the Atlantic Coastal Plain (White and Lloyd 1998). Cuestas and other hills create strong environmental gradients which, coupled with soil characteristics, promote a variety of mixed pine and pine-hardwood vegetation in this region; local differences in topography, parent material, and exposure influence site characteristics, resulting in numerous different plant communities. This system primarily occupies the dry and dry-mesic portion of regional moisture gradients.

Wide variation in vegetation composition across this gradient is also strongly related to fire frequency and intensity (White and Lloyd 1998). Generally to the south and southeast it grades into longleaf pine-dominated system(s), and to the north into hardwood-dominated ones.

Vegetation: This system is primarily composed of forest or woodland vegetation dominated by trees generally up to about 33 m (100 feet) in height. Individual patches or stands may be predominantly evergreen, predominantly deciduous, or mixed. The canopy will be primarily relatively closed (greater than 60%), but some areas may exhibit lower canopy closures, either as a result of repeated surface fires, timber removal, or other disturbances. This system includes the Shortleaf Pine-Oak Cover Type (Eyre 1980) as expressed in the Upper East Gulf Coastal Plain. In contrast to most of the Atlantic Coastal Plain, *Pinus echinata* is a much more ecologically and economically important species across much of the Gulf Coastal Plain, both presently and historically (Mohr 1901, Harper 1920, 1943). The actual vegetation composition depends greatly upon local site conditions, ongoing management, and disturbance history of an area. Locally, the species that comprise the system are strongly influenced by soil, slope, and aspect (Eyre 1980). Examples may be composed of various mixtures of pines and hardwoods. Although the actual amount of *Pinus echinata* present varies based on a number of factors, intact examples of this system often include stands that are dominated by *Pinus echinata* grading into stands with a mixture of upland hardwoods. Where fire is most frequent the system may develop a relatively pure canopy of shortleaf typified by a very open woodland structure with scattered overstory trees and an herbaceous-dominated understory; such examples are rare on the modern landscape. More typical are areas in which *Pinus echinata* trees occur in mixture with *Quercus* spp. and *Carya* spp. Many such areas also support *Liquidambar styraciflua, Liriodendron tulipifera, Acer* spp., and *Nyssa sylvatica*, and even *Pinus taeda*. When these species are prominent in the overstory and midstory it is generally though to be indicative of fire suppression. *Quercus alba* and *Quercus stellata* are common hardwood components, particularly in later-seral or higher-quality stands, typically combined with *Carya alba, Carya pallida, Carya glabra*, and other *Carya* spp. Higher-quality areas may exhibit somewhat open canopies. Other tree species indicative of recent disturbance and/or fire suppression are *Quercus nigra, Quercus hemisphaerica, Quercus falcata*, and *Quercus velutina*. Subcanopies will typically contain *Cornus florida, Oxydendrum arboreum, Nyssa sylvatica*, and *Liquidambar styraciflua*. The patchy shrub layer includes *Vaccinium arboreum, Vaccinium elliottii, Asimina parviflora, Aesculus pavia, Hamamelis virginiana, Callicarpa americana, Hypericum hypericoides, Gelsemium sempervirens, Vitis rotundifolia*, and *Arundinaria gigantea*. Herbs, which may be few and sparse, include *Cnidoscolus stimulosus, Indigofera caroliniana, Aristolochia serpentaria, Piptochaetium avenaceum, Chasmanthium sessiliflorum, Elephantopus tomentosus, Hexastylis arifolia, Iris verna, Rudbeckia fulgida, Solidago juncea, Euphorbia pubentissima, Mitchella repens*, and *Desmodium* spp. (NatureServe Ecology unpubl. data 2003). Other associates may include *Smilax* spp., *Symphyotrichum* spp., *Coreopsis* spp., *Lespedeza* spp., *Viola pedata, Mimosa microphylla, Antennaria* spp., *Clitoria mariana, Senna* spp., *Chasmanthium latifolium, Dichanthelium* spp., *Andropogon* spp., *Schizachyrium scoparium*, and *Carex* spp. (Lawson 1990).

Dynamics: The frequent presence of surface fire is important in order to support the reproduction of *Pinus echinata*, which is a critical species characteristic to the system. *Pinus echinata* is a shade-intolerant species and does not survive or grow well when fire-suppressed. Outbreaks of *Dendroctonus frontalis* (Southern Pine Beetle) also play an important role in shaping the dynamics of this system and the balance of pine versus hardwood dominance over time. Young shortleaf pines are generally slower growing and slower to dominate a site than *Pinus taeda* or many hardwood competitors, but they usually will endure competition longer than the common associate, *Pinus taeda*. *Pinus echinata* can maintain dominance on most sites after it overtops competing vegetation, but in general hardwoods cannot be eliminated from pine sites. On very good sites (i.e., with high site index), however, it may not outgrow competing species such as sweetgum and red maple (Lawson 1990).

Component Associations:
- *Pinus echinata - Pinus taeda - Quercus (alba, stellata) - Carya alba / Oxydendrum arboreum* Forest (CEGL008493, G2G3)
- *Pinus echinata - Quercus alba - Carya alba* East Gulf Coastal Plain Forest (CEGL004050, G2G3)
- *Pinus echinata - Quercus falcata* East Gulf Coastal Plain Forest (CEGL004052, G2G3)
- *Pinus echinata - Quercus stellata - (Quercus marilandica)* Forest (CEGL004053, G1)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- East Gulf Coastal Plain Northern Dry Upland Hardwood Forest (CES203.483)
- East Gulf Coastal Plain Southern Loblolly-Hardwood Flatwoods (CES203.557)
- Southern Coastal Plain Dry Upland Hardwood Forest (CES203.560)
- Southern Coastal Plain Limestone Forest (CES203.502)
- Western Highland Rim Prairie and Barrens (CES202.352)

Adjacent Ecological System Comments: Southern Coastal Plain Limestone Forest (CES203.502) occurs adjacent in parts of the region, especially the Black Belt.

DISTRIBUTION

Range: This system is restricted to the East Gulf Coastal Plain; it was the historical matrix in large areas of the region in Alabama and Mississippi, particularly between about 32 degrees 30 minutes N latitude and about 35 degrees N latitude. In southwestern Mississippi, this system is apparently dominant on the landscape west of 91 degrees W longitude to the limits of the alluvial plain and northwest of a line running approximately from the intersection of 31 degrees N latitude and 91 degrees W longitude, northeastward to the city of Jackson, Mississippi, extending at least to about 34 degrees N latitude. This is consistent with the ranges of Oak-Pine vegetation (generally equivalent to this system) versus Longleaf-Loblolly-Slash Pines in Shantz and Zon (1924).

Divisions: 203:C

Nations: US

Subnations: AL, MS, TN?
Map Zones: 46:C, 47:?, 99:C
USFS Ecomap Regions: 231B:CC, 231H:CC
TNC Ecoregions: 43:C

SOURCES

References: Bowman 1911, Chester et al. 1993, Comer et al. 2003, Eyre 1980, Fenneman 1938, Harper 1920b, Harper 1943, Landers 1989, Lawson 1990, Mohr 1901, NatureServe Ecology - Southeastern U.S. unpubl. data, Nordman pers. comm., Schotz pers. comm., Shantz and Zon 1924, White and Lloyd 1998

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723082#references

Description Author: R. Evans and A. Schotz
Version: 25 Aug 2004
Concept Author: R. Evans and A. Schotz

Stakeholders: Southeast
ClassifResp: Southeast

EAST GULF COASTAL PLAIN INTERIOR UPLAND LONGLEAF PINE WOODLAND (CES203.496)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); East Gulf Coastal Plain; Very Short Disturbance Interval
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2349; ESLF 4252; ESP 1349

CONCEPT

Summary: This system represents *Pinus palustris* forests of rolling, dissected to relatively flat uplands of the East Gulf Coastal Plain. These stands occur primarily in EPA Ecoregion 65. It is found inland of the coastal flatlands (EPA Ecoregion 75a) and extends landward into the Upper East Gulf Coastal Plain Ecoregion by about 80 km (50 miles). It potentially occupies a much larger geographic area than the related *Pinus palustris* woodlands of the outer coastal area. The characteristic species is *Pinus palustris*, although many stands may support only relictual individuals following a long history of exploitation, harvest, and stand conversion, primarily to agriculture or to planted stands of *Pinus elliottii var. elliottii* or *Pinus taeda*. This system includes stands with a range of soil and moisture conditions. Mesic stands on medium- to fine-textured soils are more typical of the system, although limited xeric areas on deep sands are also present. In natural condition, fire is believed to have been frequent enough to limit development of fire-intolerant hardwood species as well as *Pinus taeda* and *Pinus echinata*. Although such species may be present or even common in the most mesic stands, they generally do not share dominance in the overstory unless fire has been absent from the stand.
Classification Comments: The dominance of *Pinus palustris* in examples of this ecological system may be lost through fire suppression, bark beetle infestations, forestry and agricultural land conversion, and mechanical disturbance. Loss of *Pinus palustris* dominance will fundamentally change the ecological function of the landscape occupied by the system, primarily by altering the fire regime. Without the appropriate fire regime, canopy closure will increase along with shrub dominance, and grasses, forbs and other finer-fuel components will decline, further altering the fire regime dynamics.

Systems dominated by *Pinus palustris* are subdivided by biogeography, from northeast to southwest across the coastal plains from Virginia to Texas. Longleaf pine-dominated stands in the rocky submontane areas of the Piedmont as well as the Ridge and Valley (from North Carolina to Alabama) are classified as a separate system, Southeastern Interior Longleaf Pine Woodland (CES202.319).
Similar Ecological Systems:
- East Gulf Coastal Plain Interior Shortleaf Pine-Oak Forest (CES203.506)
- East Gulf Coastal Plain Near-Coast Pine Flatwoods (CES203.375)
- Southeastern Interior Longleaf Pine Woodland (CES202.319)

Related Concepts:
- Longleaf Pine - Scrub Oak: 71 (Eyre 1980) Finer
- Longleaf Pine: 70 (Eyre 1980) Finer
- Mesic Flatwoods (FNAI 1990) Undetermined
- Sandhill (FNAI 1990) Broader
- Upland Pine Forest (FNAI 1990) Undetermined

DESCRIPTION

Environment: This system once occupied extensive areas of the East Gulf Coastal Plain from the northern range limits of Pinus palustris southward to the inland terminus of the Coastal Flatlands (sensu Peet and Allard (1993); Ecoregion 75a (EPA 2004)). In its natural condition, this system occupied a range of upland soils from clays and loams to deep sands, including weathered and older Ultisols. Due to locally distinctive understory, shrub and herbaceous vegetation associated with differing soil textures, "sandhills" and "loamhills" are generally recognizable as distinctive components of this system. However, they are generally interspersed to such an extent that differentiating them as separate systems is not practical. The topography of this system is generally more rolling than East Gulf Coastal Plain Near-Coast Pine Flatwoods (CES203.375) to the south. The largest and best examples occupy landscapes where prescribed fire is an active management practice. Localized soil characteristics will determine the specific composition of the lower strata. Ultisols are the dominant soil order and cover most of the range of the system. Ultisols most commonly associated with *Pinus palustris* are the Typic Paleudults and Plinthic Paleudults. More limited areas are occupied by Psamments and other coarser-textured materials. *Pinus palustris* grows in warm, wet temperate climates characterized by hot summers and mild winters. Annual mean temperatures range from 16 to 23 degrees C (60-74 degrees F), and annual precipitation ranges from 1090 to 1750 mm (43-69 inches) (Boyer 1990). Fall is the driest season of the year, although periods of drought during the growing season are not unusual (Boyer 1990).
Vegetation: Occurrences of this system are typically more-or-less open-canopy stands (woodlands) dominated by the evergreen needle-leaved tree *Pinus palustris*. In parts of the range, and on more rolling topography, other pines may be present, including *Pinus echinata* and *Pinus taeda*. These may increase or become codominant with extended fire-return times. Unless fire suppression is extreme, deciduous trees generally do not share dominance in the canopy. More mesic stands (e.g., those on finer-textured soils) may

contain oaks, such as *Quercus falcata, Quercus nigra,* or *Quercus pumila,* and occasionally species favoring more xeric conditions, such as *Quercus marilandica* or *Quercus stellata,* in combination with the more mesic oaks. Even more xeric stands (uncommon in this system) may contain "scrub oaks" such as *Quercus incana, Quercus laevis, Quercus margarettiae,* or *Quercus arkansana*. In fire-suppressed areas, *Quercus falcata, Liquidambar styraciflua, Acer rubrum, Quercus nigra, Nyssa sylvatica, Cornus florida, Callicarpa americana,* and/or *Rhus copallinum* may invade or increase. Some typical mesic to dry-mesic herbaceous species include *Andropogon ternarius, Andropogon gyrans var. gyrans, Schizachyrium scoparium, Sorghastrum nutans*, and *Panicum virgatum. Aristida stricta* or *Aristida beyrichiana* are also dominant or at least present in the herbaceous layer of many more southern and coastward examples. Variation in floristic composition of this wide-ranging system is related to site conditions, fire-return interval, and local or regional floristics. The herbaceous layer typically becomes much less diverse with increased fire-return interval. The wiregrass *Aristida beyrichiana* is not present throughout the range of this system, and even within the range of this species, it tends to be dominant or more abundant in moister sites, particularly in the western part of the system's range (and also in examples of East Gulf Coastal Plain Near-Coast Pine Flatwoods (CES203.375)).

Dynamics: Frequent fire was the predominant natural disturbance in this system, which is now dependent on management with prescribed fire. Component communities naturally burned every few years, many averaging as often as every 3 years. Fires are naturally low to moderate in intensity. They burn above-ground parts of herbs and shrubs but have little effect on the fire-tolerant trees. Vegetation recovers very quickly from fire; the perennial species resprout quickly. Many herbaceous plants have their flowering triggered by burning. Frequent fires help maintain more species richness at small sample scales, compared to pinelands of the other regions (Carr et al. 2010). In the absence of fire, hardwoods increase. *Quercus* spp. and shrubs, kept to low density and mostly reduced to shrub size by fire, become tall and dense and can suppress *Pinus palustris* regeneration. Herb layer density and diversity decline without occasional fire. Frequent fire requires a mix of fine fuels composed both of herbaceous (primarily grasses) fine fuels and *Pinus palustris* leaf litter. Consequently, thinning the *Pinus palustris* canopy to low basal area or opening too large gaps, particularly in absence of *Aristida beyrichiana,* can lead to rapid hardwood encroachment due to lack of abundant and continuous fuels necessary for frequent fire (K. Kirkman pers. comm.). Only on the most excessively drained coarse sands does the vegetation not undergo substantial structural alteration and reduction in species richness after a number of years without burning. This is due to the infertile soils. This structural alteration occurs more slowly on these infertile soils, but due to the slow accumulation of fuels, lack of fire can become more pronounced.

Canopies are believed to naturally be multi-aged, consisting of a fine mosaic of small even-aged groves driven by gap-phase regeneration. *Pinus palustris* is shade-intolerant and slow to reach reproductive age but is very long-lived. *Pinus palustris* seedlings can survive under a gap opening in canopy >35%. However, they will not move out of grass stage unless the gap fraction is >60%. Because these canopy gaps have less needle fall, the frequent fires which burn there are less intense, which permits *Pinus palustris* seedlings to survive. *Pinus palustris* can also stay in the sapling stage for decades and still take advantage of a gap opening to move into the canopy (Kirkman and Mitchell 2006).

Component Associations:

- *Pinus palustris - Pinus (echinata, taeda) / Quercus (marilandica, laevis) / Schizachyrium scoparium* Woodland (CEGL008491, G3)
- *Pinus palustris - Pinus (echinata, taeda) / Schizachyrium tenerum - Vernonia angustifolia* Woodland (CEGL004774, G2G3)
- *Pinus palustris / Asimina angustifolia / Aristida beyrichiana - Schizachyrium scoparium - Dyschoriste oblongifolia* Woodland (CEGL004485, G2G3)
- *Pinus palustris / Quercus falcata / Cornus florida / Aristida beyrichiana* Woodland (CEGL004945, G1G2)
- *Pinus palustris / Quercus falcata / Cornus florida / Schizachyrium scoparium* Woodland (CEGL003575, G3)
- *Pinus palustris / Quercus incana / Sporobolus clandestinus* Woodland (CEGL004957, G1G2)
- *Pinus palustris / Quercus laevis / Aristida beyrichiana - Pityopsis aspera* Woodland (CEGL003583, G3)
- *Pinus palustris / Quercus laevis / Schizachyrium scoparium - Rhynchosia cytisoides* Woodland (CEGL003587, G3)
- *Pinus palustris / Quercus laevis / Serenoa repens - Clinopodium coccineum* Woodland (CEGL003601, G2)
- *Pinus palustris / Quercus laevis / Serenoa repens / Aristida condensata* Woodland (CEGL003588, G2)
- *Pinus palustris / Quercus marilandica / Schizachyrium scoparium - Schizachyrium tenerum - Rhexia alifanus* Woodland (CEGL003598, G2G3)
- *Pinus palustris / Quercus pumila / Aristida beyrichiana* Woodland (CEGL007749, G2G3)
- *Pinus palustris / Schizachyrium scoparium - Coreopsis tripteris - Baptisia bracteata var. leucophaea* Woodland (CEGL004955, G2)
- *Pinus palustris / Schizachyrium scoparium - Verbesina aristata* Loamhill Woodland (CEGL008452, G2G3)

DISTRIBUTION

Range: This system formerly occupied an extensive range across the southern parts of Alabama, northern Panhandle of Florida (north of the Cody Scarp), southern Mississippi, and southwestern Georgia and was also present in limited areas of Louisiana. It has been greatly reduced in its extent, with much of its range now occupied by agriculture or by planted stands of *Pinus taeda*. In southwestern Mississippi, this system is apparently absent (or very rare and limited) west of 91 degrees W longitude to the limits of the alluvial plain and northwest of a line running approximately from the intersection of 31 degrees N latitude and 91 degrees W longitude, northeastward to the city of Jackson, Mississippi. This is consistent with the ranges of "Oak-Pine" vegetation versus "Longleaf-Loblolly-Slash Pines" (generally equivalent to this system) in Shantz and Zon (1924). In southwest Georgia, this ecological system occurs in Coastal Plain areas which drain to the Gulf of Mexico.

Divisions: 203:C

Nations: US
Subnations: AL, FL, GA, LA, MS
Map Zones: 46:C, 55:C, 99:C
USFS Ecomap Regions: 231B:CC, 232B:CC, 232C:CC, 232J:CC, 232K:CC
TNC Ecoregions: 43:C, 53:C

SOURCES

References: Boyer 1990, Brewer 2008, Carr et al. 2010, Comer et al. 2003, EPA 2004, Eyre 1980, FNAI 1990, Kirkman and Mitchell 2006, NatureServe 2011, Oswalt et al. 2012, Peet and Allard 1993, Shantz and Zon 1924, Wahlenberg 1946
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723090#references
Description Author: R. Evans, A. Schotz, M. Pyne, mod. C. Nordman
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: R. Evans, A. Schotz, M. Pyne **ClassifResp:** Southeast

EAST GULF COASTAL PLAIN MARITIME FOREST (CES203.503)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); East Gulf Coastal Plain; Coast
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Mixed evergreen-deciduous closed tree canopy
National Mapping Codes: EVT 2380; ESLF 4323; ESP 1380

CONCEPT

Summary: This system encompasses a mosaic of woody vegetation present on barrier islands and near-coastal strands along the northern Gulf of Mexico, from the Florida panhandle to southern Mississippi. Examples may include forests and/or shrublands that are found in somewhat more protected environments than East Gulf Coastal Plain Dune and Coastal Grassland (CES203.500). Such areas include relatively stabilized coastal dunes, sometimes with a substantial shell component. Vegetation structure and composition are influenced by salt spray, extreme disturbance events, and the distinctive climate of the immediate coast. Stands may be dominated by a variety of needle-leaved and broad-leaved evergreen trees, including *Pinus clausa, Pinus elliottii var. elliottii, Pinus palustris, Quercus virginiana, Sabal palmetto, Carya glabra*, and *Carya pallida*. Wetland inclusions may be dominated by *Taxodium ascendens* and *Magnolia virginiana*. The most heavily salt-influenced examples may appear pruned or sculpted.

Similar Ecological Systems:
- East Gulf Coastal Plain Dune and Coastal Grassland (CES203.500)

Related Concepts:
- Cabbage Palmetto: 74 (Eyre 1980) Finer
- Live Oak: 89 (Eyre 1980) Finer
- Longleaf Pine - Scrub Oak: 71 (Eyre 1980) Finer
- Longleaf Pine: 70 (Eyre 1980) Finer
- Maritime Hammock (FNAI 1990) Broader
- Pondcypress: 100 (Eyre 1980) Finer
- Sand Pine: 69 (Eyre 1980) Finer
- Shell Mound (FNAI 1990) Intersecting
- Slash Pine: 84 (Eyre 1980) Finer

DESCRIPTION

Environment: This system is found on barrier islands and near-coastal strands, on stable dune-and-swale topography in somewhat more protected environments along the northern Gulf of Mexico. More specifically, these areas are generally landward of the foredune and transitional backdune zones. Examples may include forests and/or shrublands that are found in somewhat more protected environments than adjacent dune and coastal grassland vegetation. The system typically includes a series of stabilized dunes and interdune swales oriented parallel to the coastline. Soils are primarily wind- and wave-deposited, well-drained quartz sands of Appalachian origin (Drehle 1973, Johnson and Barbour 1990), sometimes with a substantial shell component, that have been stabilized long enough to support trees and shrubs. As the forest establishes, soil temperature fluctuations moderate and humus begins to build up over the well-drained sands, contributing to moisture retention and leading to more mesic conditions, especially in swales where soil moisture is typically higher (FNAI 1990).

Vegetation: Stands may be dominated by a variety of needle-leaved and broad-leaved evergreen trees, including *Pinus clausa, Pinus elliottii var. elliottii, Pinus palustris, Quercus virginiana, Sabal palmetto, Carya glabra*, and *Carya pallida*. Wetland inclusions may be dominated by *Taxodium ascendens* and *Magnolia virginiana*. Understory trees and shrubs may include *Quercus geminata, Quercus myrtifolia, Ilex vomitoria, Serenoa repens, Morella cerifera, Ilex glabra, Vaccinium arboreum, Juniperus virginiana, Zanthoxylum clava-herculis, Sideroxylon lanuginosum, Persea borbonia, Conradina canescens*, and *Callicarpa americana*. Herbs may include *Spartina patens, Juncus roemerianus*, and *Panicum virgatum*. Wetland inclusions may contain *Cladium mariscus ssp. jamaicense*.

Dynamics: The maritime environment for these forests is extremely dynamic, even though they occur on the most stable portions of barrier islands. Maritime forest systems remain subject to periodic severe physical stresses. The environment for these forests may be severely altered or destroyed by geologic processes such as the slow movement of dunes or their destruction by storms and hurricanes. Sand movement may also create new sites for this system to occupy or degrade them through erosion or sand burial. Chronic salt spray (sea salt aerosol), as well as intense salt spray during storms are important influences on vegetation structure and composition; however, the extent to which plant communities found in this system are shaped by salt spray varies. The most heavily salt-influenced examples of these systems may appear pruned or sculpted. Extreme salt spray or saltwater flooding in storms can severely disturb vegetation, though it recovers if the landforms have not been altered. Fire may have naturally occurred infrequently in this system, but probably was not an important factor. Mature *Quercus virginiana* trees are fire-resistant when mature, and their litter also does not easily burn (Stalter and Odum 1993).

Hurricanes frequently make landfall in the northern Gulf of Mexico and have a significant impact on coastal systems. Even when they

do not make landfall in the region, the storm surge and wave action generated by an off-shore storm can have a significant impact. For example, a total of 112 hurricanes made landfall from Wakulla County, Florida, to Hancock County, Mississippi, during the period 1926 to 2005 (Jarrell et al. 1992 with updates); 36 major hurricanes (Category 3 or higher) made landfall along the Gulf Coast from Louisiana to the Florida Panhandle between 1851 and 2004 (Blake et al. 2005). Hurricane-associated storm surges can overwash the dune system and cause significant erosion and/or sand burial of maritime forests (Landfire 2007a).

The role of fire in this system is poorly documented. The majority of this system occurs on narrow barrier islands along the northern Gulf of Mexico. FNAI (1990) indicates that the mesic conditions and insular locations of well-developed maritime hammock communities inhibit natural fires, which occur no more frequently than once every 26 to 100 years. Mature *Quercus virginiana* trees are fire-resistant when mature, and their litter also does not easily burn (Stalter and Odum 1993). Liu et al. (2003), in their study of sediment cores from Little Lake, Alabama, suggested that wildfires have been common in the coastal ecosystems in Alabama; however, they offered no frequency estimates. They did suggest a correlation between hurricanes and fire. This correlation was also supported by Meyers and van Lear (1998) who suggest that interactions between hurricanes and fires once played a major role in the development of ecosystems in the southern U.S., influencing their composition, structure, and pattern on the landscape (Landfire 2007a).

Component Associations:
- *Pinus clausa - Quercus geminata - Quercus hemisphaerica / Quercus myrtifolia* Forest (CEGL004942, G1G2)
- *Pinus clausa / Ceratiola ericoides / Cladonia* spp. Woodland (CEGL004668, G1G2)
- *Pinus clausa / Quercus geminata - Quercus myrtifolia - Conradina canescens* Woodland (CEGL003554, G2)
- *Pinus elliottii var. elliottii - (Pinus palustris) / Ilex vomitoria - Serenoa repens - Morella cerifera* Woodland (CEGL004658, G2G3)
- *Pinus elliottii var. elliottii / Serenoa repens - Ilex glabra - Morella cerifera - Ilex vomitoria* Woodland (CEGL004680, G3)
- *Pinus elliottii var. elliottii / Spartina patens - Juncus roemerianus - (Panicum virgatum)* Woodland (CEGL004958, G3?)
- *Quercus geminata / Serenoa repens - Ilex vomitoria - (Sideroxylon lanuginosum)* Forest (CEGL007019, G2?)
- *Quercus virginiana - (Juniperus virginiana) - Zanthoxylum clava-herculis / Sideroxylon lanuginosum* Woodland (CEGL003523, G2G3)
- *Quercus virginiana - (Pinus elliottii var. elliottii, Sabal palmetto) / Persea borbonia - Callicarpa americana* Forest (CEGL007032, G2)
- *Quercus virginiana - Pinus clausa / Carya (glabra, pallida) / Serenoa repens* Forest (CEGL004976, G2Q)
- *Quercus virginiana / Vaccinium arboreum - Ilex vomitoria* Forest (CEGL007028, G2G3)
- *Taxodium ascendens / Magnolia virginiana / Cladium mariscus ssp. jamaicense* Forest (CEGL004914, G1)

DISTRIBUTION

Range: This system is found along the northern Gulf of Mexico, from the Florida panhandle to southern Mississippi, restricted to the most coastward part of the "Gulf Coast Flatwoods" (Ecoregion 75a of EPA (2004)).
Divisions: 203:C
Nations: US
Subnations: AL, FL, MS
Map Zones: 55:C, 99:C
USFS Ecomap Regions: 232L:CC
TNC Ecoregions: 53:C

SOURCES

References: Bellis 1995, Blake et al. 2005, Comer et al. 2003, Drehle 1973, Eaton 1979, EPA 2004, Eyre 1980, FNAI 1990, FNAI 2010a, Gaddy and Kohlsaat 1987, Huffman and Platt 2004, Jarrell et al. 1992, Johnson and Barbour 1990, Landfire 2007a, Liu et al. 2003, Meyers and van Lear 1998, NCDENR 2010, Seneca and Broome 1981, Stalter and Odum 1993, Ward 1975, Winner 1975, Winner 1979
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723085#references
Description Author: R. Evans, mod. M. Pyne
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: R. Evans **ClassifResp:** Southeast

EAST GULF COASTAL PLAIN NORTHERN DRY UPLAND HARDWOOD FOREST (CES203.483)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Broad-Leaved Deciduous Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: EVT 2307; ESLF 4113; ESP 1307

CONCEPT

Summary: This system represents dry, upland, predominantly hardwood forests of limited portions of the East Gulf Coastal Plain of western Kentucky and Tennessee, northern Mississippi and Alabama. The core range of this type lies within the Northern Hilly Coastal Plain (EPA Level IV Ecoregion 65e), which includes the Northern Pontotoc Ridge (222Cf), Upper Loam Hills (222Cg), and Northern Loessal Hills (222Ce) Ecomap subsections. These areas occupy the eastern margin of the Upper East Gulf Coastal Plain where elevation is greatest and influence of loess is less than adjacent areas to the west. The vegetation has been broadly considered distinct from other coastal plain forests but has received almost no specific study. Although vastly forested when compared to the loess plains to the west, most of the vegetation is recovering from one or more forms of severe disturbance. *Quercus alba* dominates the upland forests which have been studied in a limited portion of this area, but communities have not been described to the same detail as in other ecological systems.

Classification Comments: The range of this system overlaps with East Gulf Coastal Plain Interior Shortleaf Pine-Oak Forest (CES203.506) in the Fall Line Hills (Ecoregion 65i) of Alabama and in the Southern Hilly Gulf Coastal Plain (Ecoregion 65d) of Mississippi and may overlap to some degree with Southern Coastal Plain Dry Upland Hardwood Forest (CES203.560) at its southern boundary as well. In parts of the overlapping range (including the Oakmulgee Ranger District of the Talladega National Forest), these types occur in a mosaic which is difficult to interpret environmentally and ecologically (A. Schotz pers. comm.). The vegetation of this system has received almost no specific study and is extremely poorly documented.

Similar Ecological Systems:
- East Gulf Coastal Plain Interior Shortleaf Pine-Oak Forest (CES203.506)
- Southern Interior Low Plateau Dry-Mesic Oak Forest (CES202.898)

Related Concepts:
- Eastern Redcedar: 46 (Eyre 1980) Finer
- Post Oak - Blackjack Oak: 40 (Eyre 1980) Finer
- White Oak - Black Oak - Northern Red Oak: 52 (Eyre 1980) Finer
- White Oak: 53 (Eyre 1980) Finer

DESCRIPTION

Environment: The most northern examples (e.g., western Tennessee and Kentucky) occur along the eastern margin of the East Gulf Coastal Plain where elevation is greatest and influence of loess is minimal, and where they occur as predominantly slope forests in relatively deep, dissected stream valleys. The vegetation in this region has been broadly considered distinct from other coastal plain forests (Bryant et al. 1993, Fralish and Franklin 2002) but has received almost no specific study (Franklin and Kupfer 2004). Although vastly forested when compared to the loess plains to the west (USGS 1992), most of the vegetation is recovering from one or more forms of severe disturbance (Franklin and Kupfer 2004). *Quercus alba* dominates the upland forests which have been studied in a limited portion of this area (Franklin and Kupfer 2004), but communities have not been described to the same detail as in other ecological systems.

Vegetation: Stands may contain *Aesculus pavia, Carya alba, Carya glabra, Carya pallida, Carya* spp., *Celtis laevigata, Iris verna var. smalliana, Kalmia latifolia, Liquidambar styraciflua, Liriodendron tulipifera, Ostrya virginiana, Oxydendrum arboreum, Quercus alba, Quercus falcata, Quercus marilandica, Quercus muehlenbergii, Quercus pagoda, Quercus stellata, Quercus velutina, Styrax grandifolius, Vaccinium arboreum, Vaccinium* spp., and *Vaccinium stamineum.*

Dynamics: Fire suppression and the resulting greater understory density and resulting cooler conditions on the forest floor affect this system.

Component Associations:
- *Quercus alba - Carya glabra - Carya alba / Aesculus pavia* Forest (CEGL007225, G4?)
- *Quercus alba - Carya glabra* / Mixed Herbs Coastal Plain Forest (CEGL007226, G4?)
- *Quercus falcata - Quercus alba - Carya alba / Oxydendrum arboreum / Vaccinium stamineum* Forest (CEGL007244, G4G5)
- *Quercus falcata - Quercus stellata - Carya alba / Vaccinium* spp. Coastal Plain Forest (CEGL007246, G4?)
- *Quercus muehlenbergii - Carya* spp. / *Ostrya virginiana* Upper East Gulf Coastal Plain Forest (CEGL003903, G3)
- *Quercus pagoda - (Quercus falcata) / Ostrya virginiana* Forest (CEGL003871, G3?)
- *Quercus prinus - Carya* spp. - *Quercus velutina / Vaccinium arboreum / Iris verna var. smalliana* Forest (CEGL007261, G3G4)
- *Quercus prinus - Quercus* spp. / *Vaccinium arboreum - (Kalmia latifolia, Styrax grandifolius)* Forest (CEGL007700, G4)

- *Quercus stellata - Quercus marilandica - Carya (alba, pallida)* Upper East Gulf Coastal Plain Woodland (CEGL003952, G2G3)
- *Quercus velutina - Carya pallida - Tilia americana var. heterophylla / Celtis laevigata / Aesculus pavia* Forest (CEGL008565, G3G4)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- East Gulf Coastal Plain Interior Shortleaf Pine-Oak Forest (CES203.506)
- East Gulf Coastal Plain Northern Loess Plain Oak-Hickory Upland (CES203.482)
- South-Central Interior / Upper Coastal Plain Flatwoods (CES203.479)

Adjacent Ecological System Comments: To the west this system grades into East Gulf Coastal Plain Northern Loess Plain Oak-Hickory Upland (CES203.482). The two types are similar and may be difficult to distinguish where they come together. The loess plain type is believed to be more mesic and richer floristically due to the influence of the loessal soils. However, it is also rare due to the fertility of the soils for agriculture. More work is needed to better quantify the differences between these types and their exact boundaries.

DISTRIBUTION

Range: This system is found in the Coastal Plain of western Kentucky and Tennessee, ranging south to northern Mississippi and Alabama.
Divisions: 203:C
Nations: US
Subnations: AL, KY, MS, TN
Map Zones: 46:C, 47:C
USFS Ecomap Regions: 231B:CC, 231H:CC
TNC Ecoregions: 43:C

SOURCES

References: Bryant et al. 1993, Comer et al. 2003, Fralish and Franklin 2002, Franklin and Kupfer 2004, Keys et al. 1995, Smalley et al. 1996, Springer and Elder 1980, USGS 1992
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723103#references
Description Author: R. Evans and M. Pyne
Version: 05 Apr 2007 **Stakeholders:** Southeast
Concept Author: R. Evans and M. Pyne **ClassifResp:** Southeast

EAST GULF COASTAL PLAIN NORTHERN LOESS BLUFF FOREST (CES203.481)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Loess deposit (undifferentiated); Forest and Woodland (Treed); Broad-Leaved Deciduous Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: EVT 2327; ESLF 4133; ESP 1327

CONCEPT

Summary: This system is largely confined to steep bluffs bordering the northern portion of the eastern edge of the Mississippi River Alluvial Plain. The geology is typically mapped as the Jackson Formation. These bluffs extend up to 150 m (500 feet) in elevation and from 30 to 60 m (100-200 feet) above the adjacent plain. They consist of a belt of Pleistocene and Tertiary eolian deposits that are often deeply eroded and very steep, with fertile topsoil and abundant moisture. The vegetation is often richer than surrounding non-loessal areas, or those with only thin loess deposits. The forests found on these bluffs are intermediate in soil moisture for the region and may best be thought of as mesic. The vegetation may sometimes be referred to as western mesophytic forest and may share some superficial similarities with cove forests of the Interior Highlands. In many cases, these bluffs provide habitat for plant species that are rare or absent from other parts of the Coastal Plain. The composition of these forests changes from north to south along the bluffs; more southerly examples are represented by the East Gulf Coastal Plain Southern Loess Bluff Forest (CES203.556), and these would contain *Magnolia grandiflora* as an important component. As currently defined this system ranges northward from about 32 degrees N latitude (where the Big Black River cuts through the bluffs), and occurs only in the westernmost portions of the Upper East Gulf Coastal Plain, including northern and central Mississippi, western Tennessee, and western Kentucky, being restricted to the northern part of the Loess Bluff Hills (EPA Ecoregion 74a).
Classification Comments: Similar ecological systems include East Gulf Coastal Plain Southern Loess Bluff Forest (CES203.556) which occurs further southward in the East Gulf Coastal Plain and has greater dominance by broad-leaved and needle-leaved evergreen trees, Southern Coastal Plain Mesic Slope Forest (CES203.476), and East Gulf Coastal Plain Northern Mesic Hardwood Slope Forest (CES203.477). There are other mixed deciduous mesic systems in the West Gulf Coastal Plain as well as other mesic forest systems to the east of this one, in areas other than the loess bluffs.
Similar Ecological Systems:
- East Gulf Coastal Plain Northern Mesic Hardwood Slope Forest (CES203.477)
- East Gulf Coastal Plain Southern Loess Bluff Forest (CES203.556)
- Southern Coastal Plain Mesic Slope Forest (CES203.476)

Related Concepts:
- Beech - Sugar Maple: 60 (Eyre 1980) Finer
- Coastal Plain Mesophytic Cane Forest (Evans 1991) Finer
- Northern Red Oak: 55 (Eyre 1980) Finer

DESCRIPTION

Environment: This system is largely confined to the lower portions of steep bluffs east of the Mississippi River. These bluffs consist of a belt of Pleistocene and Tertiary eolian deposits (Braun 1950) that are often deeply eroded and very steep, with fertile topsoil and abundant moisture (Miller and Neiswender 1987). The core of this is mapped as the Jackson Formation (Hardeman 1966) and corresponds more broadly with Ecoregion 74a (Bluff Hills) (EPA 2004). These bluffs border the eastern edge of the Mississippi River Alluvial Plain from about 32 degrees N latitude (where the Big Black River cuts through the bluffs) northward to western Tennessee and Kentucky. Examples may extend up to 150 m (500 feet) in elevation and from 30 to 60 m (100-200 feet) above the adjacent Mississippi Alluvial Plain. In Tennessee the loess soils may be 9-27.5 m (30-90 feet deep) (Springer and Elder 1980).
Vegetation: Examples of this system have deciduous canopies dominated by *Fagus grandifolia* or this species in combination with *Quercus alba*. The most mesic stands may lack codominance by *Quercus* spp. In addition, a variety of other hardwood species may also be found in the overstory, including *Liriodendron tulipifera, Liquidambar styraciflua, Acer rubrum, Nyssa sylvatica, Fraxinus americana, Magnolia acuminata* (of local distribution), and *Pinus taeda* (in more southern stands). This system is defined as being north of the range of *Magnolia grandiflora*, which excludes the "Beech-Magnolia" forests of the southern loess bluffs. Some subcanopy components (in addition to canopy species) include *Carpinus caroliniana, Diospyros virginiana, Oxydendrum arboreum, Cornus florida, Acer barbatum, Magnolia macrophylla, Ostrya virginiana, Ulmus alata*, and *Ilex opaca*. Other shrubs and woody vines include *Decumaria barbara, Rhododendron canescens, Toxicodendron radicans, Vitis rotundifolia*, and *Smilax glauca*. Important herbs include *Polystichum acrostichoides, Woodwardia areolata, Osmunda cinnamomea, Mitchella repens*, and *Hexastylis arifolia*. In many cases, these bluffs provide habitat for plant species that are rare or absent from other parts of the Coastal Plain, such as *Magnolia acuminata, Aralia racemosa*, and *Hydrophyllum canadense* (Chester et al. 1997).
Dynamics: These are stable, generally fire-sheltered forests. These forests probably generally exist naturally as old-growth forests, with canopy dynamics dominated by gap-phase regeneration. As modeled here, replacement disturbance is over 60% and more likely

due to weather-related events than fire. Included among these are windthrow, lightning, and ice damage, as well as the inclusion of the erosion and mass wastage (Bryant et al. 1993) that give the bluffs their characteristic steepness. Widespread insect or disease mortality has not been reported. Wind/weather/stress replacement frequency is modeled near 240 years, replacement fire return at approximately 385 years, and all fire return frequency at about 85 years. "Open" structure is uncommon, even when defined as canopy closure less than 81%, and may be created by mixed-severity fire. Surface fire may maintain open conditions, but it does not transition closed classes. Disturbance is presumed to mirror mixed mesophytic forest, occurring primarily in small gaps (less than one-quarter acre), although the occurrence of aggregates of intolerant species suggests that larger scale disturbances occasionally play a role (Landfire 2007a). In addition, periodic droughts may cause death of or stress to moisture-requiring canopy trees. There is presumably some natural disturbance from the effects of windstorms, which are relatively frequent in the range of this system.

Component Associations:
- *Fagus grandifolia - Quercus (alba, rubra) / Acer barbatum / Asimina triloba* Forest (CEGL004072, G2G3)
- *Quercus pagoda - Quercus nigra* Forest (CEGL004109, G3?)

DISTRIBUTION

Range: This system is endemic to the loess bluffs ("Bluff Hills" [Ecoregion 74a] of EPA (2004)) along the eastern edge of the Mississippi River Alluvial Plain in Mississippi, Tennessee, and Kentucky.
Divisions: 203:C
Nations: US
Subnations: KY, MS, TN
Map Zones: 46:C, 47:C
USFS Ecomap Regions: 231H:CC
TNC Ecoregions: 43:C

SOURCES

References: Batista and Platt 1997, Braun 1950, Bryant et al. 1993, Chester et al. 1997, Comer et al. 2003, Delcourt and Delcourt 2000, Edwards et al. 2013, Engeman et al. 2007, EPA 2004, Evans 1991, Eyre 1980, Greenberg et al. 1997, Hardeman 1966, Landfire 2007a, Miller and Neiswender 1987, Springer and Elder 1980
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723105#references
Description Author: R. Evans and M. Pyne
Version: 14 Jan 2014
Concept Author: R. Evans and M. Pyne
Stakeholders: Southeast
ClassifResp: Southeast

EAST GULF COASTAL PLAIN NORTHERN LOESS PLAIN OAK-HICKORY UPLAND (CES203.482)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Loess deposit (undifferentiated); Forest and Woodland (Treed); Broad-Leaved Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: EVT 2306; ESLF 4112; ESP 1306

CONCEPT

Summary: This is the former matrix hardwood system flanking the loess bluffs of the most northern portions of the Upper East Gulf Coastal Plain of western Tennessee, western Kentucky, possibly southern Illinois, and northern Mississippi. The core distribution of this system is mapped as the Loess Plains (EPA Ecoregion 74b). Extensive forests once covered this broad area of generally flat to rolling uplands. Most have been cleared for agriculture due to the rich, productive soils derived from relatively thick loess deposits. The areal extent of this forested system has been so heavily reduced that the component community types remain undocumented and speculative at best. Typical stands would contain oaks and other hardwoods. Some typical canopy dominants include *Quercus falcata, Quercus alba, Carya alba, Quercus stellata, Quercus marilandica*, and *Quercus velutina*. Scattered successional stands would be dominated by *Juniperus virginiana var. virginiana*. In addition, *Liquidambar styraciflua* and *Liriodendron tulipifera* may be present.
Classification Comments: The southern boundary of this system has not been clearly delineated; Omernik (EPA 2004) Ecoregion 74b extends farther south than the presumed boundary of this system. For now, the boundary is assumed to occur in northern Mississippi at the latitude of the junction of Omernik (EPA 2004) Ecoregion 65e and Ecoregion 65d (ca. 34 degrees N). To the east, this system grades into East Gulf Coastal Plain Northern Dry Upland Hardwood Forest (CES203.483). The two types may be similar and difficult to distinguish where they come together, but the former is believed to be more mesic and richer floristically due to the influence of the loessal soils. However, it is also rare due the fertility of the soils for agriculture. More work is needed to better quantify the differences between these types and their exact boundaries.
Similar Ecological Systems:
- East Gulf Coastal Plain Interior Shortleaf Pine-Oak Forest (CES203.506)

Related Concepts:
- Acidic Subxeric Forest (Evans 1991) Broader
- White Oak - Black Oak - Northern Red Oak: 52 (Eyre 1980) Finer

DESCRIPTION

Environment: The habitat for this system is a broad area of generally flat to rolling uplands. Soils included in this system in western Tennessee are rich, productive, and silty, being derived from relatively thick loess deposits. Most of the soils have fragipans and some are poorly drained (Springer and Elder 1980).
Vegetation: Typical stands would contain oaks and other hardwoods. Some typical canopy dominants include *Quercus falcata, Quercus alba, Carya alba, Quercus stellata, Quercus marilandica*, and *Quercus velutina*. Scattered successional stands would be dominated by *Juniperus virginiana var. virginiana*. In addition, *Liquidambar styraciflua* and *Liriodendron tulipifera* may be present.
Dynamics: Most of the landscape in which this was the matrix system was cleared of forests for settlement and agriculture during the nineteenth and early twentieth century and very few sites remain in primary forest condition. Fire frequency and severity are classified as Fire Regime Group I, with frequent, low-intensity surface fires. The mean fire-return interval (MFRI) is about 15 years with wide year-to-year and within-type variation related to moisture cycles, degree of sheltering, and proximity to more fire-prone vegetation types. Anthropogenic fire may have contributed to presettlement fire frequency (Landfire 2007a). When sites are cleared for settlement or agriculture, *Liquidambar styraciflua* is a major component of the replacement successional forest, in addition to other wind-blown or bird-dispersed trees such as *Acer rubrum, Celtis* spp., *Fraxinus americana, Juglans nigra, Juniperus virginiana, Liquidambar styraciflua, Liriodendron tulipifera, Prunus serotina, Robinia pseudoacacia, Sassafras albidum, Ulmus americana*, and the exotic *Ailanthus altissima*. In addition, *Baccharis halimifolia* is a native increaser shrub that will colonize disturbed sites.

Component Associations:
- *Quercus falcata - Quercus alba - Carya alba / Oxydendrum arboreum / Vaccinium stamineum* Forest (CEGL007244, G4G5)

SPATIAL CHARACTERISTICS

Spatial Summary: Historically a matrix system which dominated the landscape; in current condition only exists in small isolated patches.
Adjacent Ecological Systems:
- East Gulf Coastal Plain Jackson Plain Prairie and Barrens (CES203.353)
- East Gulf Coastal Plain Northern Dry Upland Hardwood Forest (CES203.483)
- East Gulf Coastal Plain Northern Mesic Hardwood Slope Forest (CES203.477)
- South-Central Interior / Upper Coastal Plain Flatwoods (CES203.479)

• South-Central Interior / Upper Coastal Plain Wet Flatwoods (CES203.480)

Adjacent Ecological System Comments: Included within this former matrix system were patches of other systems including East Gulf Coastal Plain Jackson Plain Prairie and Barrens (CES203.353), South-Central Interior / Upper Coastal Plain Wet Flatwoods (CES203.480), and South-Central Interior / Upper Coastal Plain Flatwoods (CES203.479). It is bordered on the west by East Gulf Coastal Plain Northern Mesic Hardwood Slope Forest (CES203.477) and to the east by East Gulf Coastal Plain Northern Dry Upland Hardwood Forest (CES203.483).

DISTRIBUTION

Range: This system would have occupied the most northern portions of the Upper East Gulf Coastal Plain of western Tennessee, western Kentucky, possibly southern Illinois, and northern Mississippi. Its core distribution is mapped by EPA (2004) as the Loess Plains (EPA Ecoregion 74b). Today it is reduced to remnant forest patches in a largely agricultural landscape.

Divisions: 203:C

Nations: US

Subnations: IL?, KY, MS, TN

Map Zones: 46:C, 47:C, 49:?

USFS Ecomap Regions: 231H:CC

TNC Ecoregions: 43:C

SOURCES

References: Bryant et al. 1993, Comer et al. 2003, Edwards et al. 2013, Engeman et al. 2007, EPA 2004, Evans 1991, Eyre 1980, Greenberg et al. 1997, Landfire 2007a, Springer and Elder 1980

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723104#references

Description Author: R. Evans and M. Pyne

Version: 14 Jan 2014 **Stakeholders:** Midwest, Southeast

Concept Author: R. Evans and M. Pyne **ClassifResp:** Southeast

EAST GULF COASTAL PLAIN NORTHERN MESIC HARDWOOD SLOPE FOREST (CES203.477)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Slope; Broad-Leaved Deciduous Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: EVT 2325; ESLF 4131; ESP 1325

CONCEPT

Summary: This system includes mesic deciduous hardwood forests of inland portions of the East Gulf Coastal Plain, including Alabama, Mississippi, western Kentucky, and western Tennessee. This system covers parts of the more mesic forests in the coastal plain portion of the Western Mesophytic Forest Region referred to as mesophytic mixed hardwoods, as well as mesic forests in the adjacent "Oak-Pine-Hickory" region to the south. Examples of this system occur on slopes and ravines between dry uplands and stream bottoms. Mesic forests of the loess bluffs are treated in separate ecological systems, being confined to that landform of steep bluffs and ravines on deep loess. The most characteristic feature of the vegetation in some examples may be *Fagus grandifolia*, but a variety of other hardwood species may also be found in the overstory, and *Fagus grandifolia* may not always be present. Some stands may be dominated by *Fagus grandifolia* and *Quercus alba*, others by *Quercus alba* or *Quercus pagoda* with other mesic hardwoods. In addition, *Pinus taeda* may be common in some examples in the southern portion of the range and, depending on previous disturbance and site conditions, may be locally dominant [see CEGL004763]. To the south this system is replaced by Southern Coastal Plain Mesic Slope Forest (CES203.476), which is within the range of *Pinus glabra* and *Magnolia grandiflora*.
Classification Comments: Southern Coastal Plain Mesic Slope Forest (CES203.476) is a similar mesic forest system to the south of this one in the East Gulf Coastal Plain with greater dominance by broad-leaved evergreen trees. The systems of the loess bluffs to the west of this one, bordering the Mississippi River Alluvial Plain, are treated as distinct and are more extensive and continuous in their extent both vertically and latitudinally [see East Gulf Coastal Plain Northern Loess Bluff Forest (CES203.481) and East Gulf Coastal Plain Southern Loess Bluff Forest (CES203.556)]. One association now (2005) included here (*Quercus alba - Fagus grandifolia / Hydrangea quercifolia - Viburnum acerifolium / Carex picta - Polystichum acrostichoides* Forest (CEGL007213)) has the majority of its occurrences in the interior regions (southern Cumberland Plateau, Ridge and Valley), but its flora contains some Coastal Plain elements as well as more interior ones. It is from a "transition region" where *Quercus rubra* may be present in parts of the upper Coastal Plain and conversely some more southerly affiliated species (e.g., *Decumaria barbara*) range farther north. This association is now affiliated with two different ecological systems.
Similar Ecological Systems:
- East Gulf Coastal Plain Northern Loess Bluff Forest (CES203.481)
- East Gulf Coastal Plain Southern Loess Bluff Forest (CES203.556)
- Southern Coastal Plain Mesic Slope Forest (CES203.476)

Related Concepts:
- Beech - Sugar Maple: 60 (Eyre 1980) Finer
- Deep Soil Mesophytic Forest (Evans 1991) Intersecting
- Loblolly Pine - Hardwood: 82 (Eyre 1980) Finer
- Northern Red Oak: 55 (Eyre 1980) Finer
- White Oak - Black Oak - Northern Red Oak: 52 (Eyre 1980) Finer
- White Oak: 53 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs along the eastern margin of the Upper Coastal Plain where elevation is greatest and influence of loess is minimal where stands occur as predominantly slope forests in relatively deep, dissected stream valleys. The vegetation in this region has been broadly considered distinct from other coastal plain forests (Bryant et al. 1993, Fralish and Franklin 2002) but has received almost no specific study (Franklin and Kupfer 2004). Although vastly forested when compared to the loess plains to the west (USGS 1992), most of the vegetation is recovering from one or more forms of severe disturbance (Franklin and Kupfer 2004). *Quercus alba* dominates the upland forests, examples of which have been studied in a limited portion of this area by Franklin and Kupfer (2004), but these communities have not been described to the same detail as other ecological systems.
Vegetation: The most characteristic feature of the vegetation is a high cover value for *Fagus grandifolia*, but a variety of other hardwood species may also be found in the overstory. Stands are mesic, and some may be dominated by *Fagus grandifolia* and *Quercus alba*, others by *Quercus alba* or *Quercus pagoda* with other mesic hardwoods. This system is defined as being north of the range of *Magnolia grandiflora*, which excludes the "Beech-Magnolia" forests of the deeper south. From north to south, there is some floristic variability in the component floristics of this system. *Quercus rubra* will be of greater importance north of 35 degrees N latitude, and *Pinus taeda* conversely of greater importance to the south of this boundary. The core concept of this system consists of association types in which *Quercus* spp. can be present in the canopy, but are not dominant; but some may exhibit codominance by

Fagus grandifolia and *Quercus alba* or other mesic *Quercus* spp. Other important canopy components include *Liriodendron tulipifera, Liquidambar styraciflua, Acer rubrum, Nyssa sylvatica, Fraxinus americana, Magnolia acuminata* (of local distribution), *Magnolia virginiana*, and *Pinus taeda*. Some subcanopy components (in addition to canopy species) include *Carpinus caroliniana, Diospyros virginiana, Oxydendrum arboreum, Cornus florida, Acer barbatum, Magnolia macrophylla* (to the south), *Ostrya virginiana, Ulmus alata*, and *Ilex opaca*. Other shrubs and woody vines include *Decumaria barbara, Rhododendron canescens, Toxicodendron radicans, Vitis rotundifolia*, and *Smilax glauca*. Important herbs include *Polystichum acrostichoides, Woodwardia areolata, Osmunda cinnamomea, Mitchella repens*, and *Hexastylis arifolia*. This system is found north of the distribution of *Pinus glabra* and *Magnolia grandiflora*, which will be absent.

Dynamics: These are stable, generally fire-sheltered forests. There is presumably some natural disturbance from the effects of hurricanes (to the south), or from other windstorms, which are relatively frequent in the range of this system. Most of the vegetation is recovering from one or more forms of severe anthropogenic disturbance (Franklin and Kupfer 2004). Infrequent, low-intensity surface fires and rare mosaic or replacement fires are typical in this system (Fire Regime Group III) (Landfire 2007a). The mean fire-return interval (MFRI) is about 35 years with wide year-to-year and within-type variation related to moisture cycles, degree of sheltering, and proximity to more fire-prone vegetation types. Anthropogenic fire is also part of this variation. Exposure to occasional fires and severe storms may create some canopy disturbances, which can be followed by waves of tree recruitment, growth, and death resulting in changes in the density and structure of tree populations and in consequent fluctuations in forest species composition. Periodic droughts will cause death of or stress to moisture-requiring canopy trees.

Component Associations:
- *Fagus grandifolia - Acer saccharum - Liriodendron tulipifera* Unglaciated Forest (CEGL002411, G4?)
- *Fagus grandifolia - Liriodendron tulipifera / Euonymus americanus / Athyrium filix-femina ssp. asplenioides* Forest (CEGL007201, G4)
- *Fagus grandifolia - Quercus alba / Cornus florida* Forest (CEGL007881, G4)
- *Pinus taeda - Quercus alba / Chasmanthium sessiliflorum* Forest (CEGL004763, G3G4)
- *Quercus alba - Carya (alba, ovata) - Liriodendron tulipifera - (Quercus phellos) / Cornus florida* Forest (CEGL007709, G4)
- *Quercus alba - Carya glabra - Carya alba / Aesculus pavia* Forest (CEGL007225, G4?)
- *Quercus alba - Fagus grandifolia / Hydrangea quercifolia - Viburnum acerifolium / Carex picta - Polystichum acrostichoides* Forest (CEGL007213, G3G4)
- *Quercus alba - Quercus rubra - Carya (alba, ovata) / Cornus florida* Acidic Forest (CEGL002067, G3)
- *Quercus pagoda - Quercus (michauxii, shumardii)* Forest (CEGL004545, G3G4)
- *Quercus pagoda - Quercus nigra* Forest (CEGL004109, G3?)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- East Gulf Coastal Plain Northern Loess Plain Oak-Hickory Upland (CES203.482)

DISTRIBUTION

Range: This system is found in northern and inland portions of the East Gulf Coastal Plain, including Alabama, Mississippi, western Kentucky, and western Tennessee. It does not occur in Arkansas. This area is equivalent to the coastal plain portion of the Western Mesophytic Forest Region of Braun (1950) and the "Oak-Pine-Hickory" region of Greller (1988).
Divisions: 203:C
Nations: US
Subnations: AL, GA, KY, MS, TN
Map Zones: 46:C, 47:C
USFS Ecomap Regions: 231B:CC, 231H:CC
TNC Ecoregions: 43:C

SOURCES

References: Batista and Platt 1997, Braun 1950, Bryant et al. 1993, Comer et al. 2003, Delcourt and Delcourt 2000, Edwards et al. 2013, Engeman et al. 2007, Evans 1991, Eyre 1980, Fralish and Franklin 2002, Franklin and Kupfer 2004, Greenberg et al. 1997, Greller 1988, Landfire 2007a, USGS 1992
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723109#references
Description Author: R. Evans, M. Pyne, A. Schotz
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: R. Evans, M. Pyne, A. Schotz **ClassifResp:** Southeast

EAST GULF COASTAL PLAIN SOUTHERN LOESS BLUFF FOREST (CES203.556)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Loess deposit (undifferentiated); Forest and Woodland (Treed); Broad-Leaved Deciduous Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: EVT 2329; ESLF 4135; ESP 1329

CONCEPT

Summary: This system of upland hardwood-dominated forests is defined as including both the steep loess bluffs bordering the eastern edge of the Mississippi River Alluvial Plain, ranging from south-central Mississippi to southeastern Louisiana, as well as hardwood vegetation of the "Loess Plains" immediately to the east of these bluffs and ravines. The vegetation is often richer than surrounding non-loessal areas, or those with only thin loess deposits. At least in some examples of this system, tree species normally associated with bottomland habitats are found to be abundant or even dominant in non-flooded uplands. In many cases, the bluffs provide habitat "refugia" for plant species that are more common to the north. The general composition of these forests along the bluffs changes from north to south; the more northerly examples are represented in this classification by East Gulf Coastal Plain Northern Loess Bluff Forest (CES203.481), north of the range of *Magnolia grandiflora* and *Pinus glabra*. As currently defined this system ranges from about 32 degrees N latitude (where the Big Black River dissects the bluffs) southward and is restricted to the southern part of the Loess Bluff Hills (EPA Ecoregion 74a).
Classification Comments: The vegetation of this system has been poorly studied and documented, and few associations have currently been described in the USNVC for this system. More information is needed. This system meets East Gulf Coastal Plain Interior Shortleaf Pine-Oak Forest (CES203.506) farther to the east in Louisiana and Mississippi.
Similar Ecological Systems:
- East Gulf Coastal Plain Northern Loess Bluff Forest (CES203.481)
- East Gulf Coastal Plain Northern Mesic Hardwood Slope Forest (CES203.477)
- Southern Coastal Plain Mesic Slope Forest (CES203.476)

Related Concepts:
- White Oak: 53 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occupies upland loess bluffs, ravines, and adjacent plains that are considerably higher in elevation than the adjacent Mississippi River Alluvial Plain. These bluffs consist of a belt of Pleistocene and Tertiary eolian deposits (Braun 1950) that are often deeply eroded and very steep, with fertile topsoil and abundant moisture. In many cases, the bluffs provide habitat "refugia" for plant species that are more common to the north (Delcourt and Delcourt 1975).
Vegetation: Forest stands of the southern loess bluffs are characteristically dominated by *Fagus grandifolia* and *Magnolia grandiflora*, with *Quercus pagoda*, *Liquidambar styraciflua*, and other hardwood species, along with *Pinus glabra* and *Pinus taeda*. Vegetation of the loess plains would more likely be dominated by *Quercus pagoda*, *Liquidambar styraciflua*, and other hardwood species, along with *Pinus taeda*.
Dynamics: Considering the southern bluffs in conjunction with a portion of the adjacent plains, along with proximity to the Gulf of Mexico, stands of this system tend to be somewhat less stable and more fire-prone than the bluffs alone to the north (Landfire 2007a). As modeled here, replacement disturbance has roughly equal probability of occurring by either fire or weather-related events. The latter include windthrow, lightning and ice damage, as well as the inclusion of the erosion and mass wastage that give the bluffs their characteristic steepness. Widespread insect or disease mortality has not been reported. Wind/weather/stress replacement frequency is modeled near 220 years, replacement fire return at approximately 215 years, and all fire return frequency at about 40 years. "Open" structure is uncommon, even when defined as canopy closure <81%, and may be created by mixed-severity fire. Surface fire may maintain open conditions, but it does not transition closed classes. Disturbance is presumed to occur primarily in small gaps (less than one-half acre). The presence of aggregates of intolerant species suggests that larger scale disturbances occasionally play a role, likely more so on the plains (Landfire 2007a). Periodic droughts will cause death of or stress to moisture-requiring canopy trees.

Component Associations:
- *(Fagus grandifolia) - Quercus pagoda - Magnolia grandiflora / Hydrangea quercifolia / Cystopteris protrusa - Thelypteris kunthii* Forest (CEGL007461, G3?)
- *Fagus grandifolia - Quercus alba - Liquidambar styraciflua / Magnolia grandiflora / Smilax pumila - Hexastylis arifolia* Forest (CEGL007210, G4)
- *Quercus alba - Quercus nigra - Carya pallida - (Quercus pagoda) / Magnolia (grandiflora, macrophylla)* Forest (CEGL004775, G3G4)
- *Quercus shumardii - Quercus pagoda - Fraxinus americana / Ostrya virginiana - Cornus florida / Trillium ludovicianum* Forest (CEGL007272, G1)

DISTRIBUTION

Range: This system is endemic to the loess bluffs ("Bluff Hills" [Ecoregion 74a] of EPA (2004)) and the immediately adjacent Southern Rolling Plains (western portion of EPA Ecoregion 74c) along the eastern edge of the Mississippi River Alluvial Plain in southwestern Mississippi and adjacent Louisiana.
Divisions: 203:C
Nations: US
Subnations: LA, MS
Map Zones: 46:C, 99:C
USFS Ecomap Regions: 231H:CC
TNC Ecoregions: 43:C

SOURCES

References: Batista and Platt 1997, Braun 1950, Bryant et al. 1993, Comer et al. 2003, Delcourt and Delcourt 1975, Delcourt and Delcourt 2000, Edwards et al. 2013, Engeman et al. 2007, EPA 2004, Eyre 1980, Landfire 2007a
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723048#references
Description Author: R. Wieland and R. Evans, mod. M. Pyne
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: R. Wieland and R. Evans **ClassifResp:** Southeast

EAST-CENTRAL TEXAS PLAINS POST OAK SAVANNA AND WOODLAND (CES205.679)

CLASSIFIERS

Classification Status: Standard

Primary Division: Eastern Great Plains (205)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Non-Diagnostic Classifiers: Forest and Woodland (Treed); Loam Soil Texture; Sand Soil Texture
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Deciduous open tree canopy
National Mapping Codes: EVT 2519; ESLF 4158; ESP 1519

CONCEPT

Summary: This ecological system is found in east-central Texas in a broad, northeast/southwest-trending band located west of the Upper West Gulf Coastal Plain, northwest of the Coastal Prairie, and east and south of the Blackland Prairie ecoregions. It exhibits some floristic and physiognomic variation across this northeast-southwest gradient, losing some eastern species and picking up some species with more western affinities. It is distinguished from the nearby prairie by the higher density of trees and diversity of woody species. The system differs from the floristically similar Crosstimbers Oak Forest and Woodland (CES205.682) in that it generally occurs on Tertiary (primarily Eocene) geologic formations on the east-central Texas Plains, while the related Crosstimbers ecological system occupies Cretaceous and older formations of the interior plains. Floristically, Post Oak Savanna (at least north of the Colorado River) contains species of more eastern affinities such as *Callicarpa americana, Sassafras albidum, Cornus florida, Vaccinium arboreum, Ulmus alata,* and particularly *Ilex vomitoria,* the latter species being absent from Crosstimbers Oak Forest and Woodland (CES205.682). Post Oak Savanna generally occurs on sandy or loamy soils, often underlain by a claypan subsoil. Rainfall ranges from about 120 cm in the northeastern part of the range to about 70 cm in the southwest, where it becomes increasingly erratic. Therefore moisture is often limiting during part of the growing season. The system was historically characterized as having significant areas of graminoid cover with species composition resembling that of nearby prairie systems, punctuated by short, stunted woodlands and forests dominated by *Quercus stellata* and *Quercus marilandica*. Drought, grazing, and fire are the primary natural processes that affect this system. Much of this system has been impacted by conversion to improved pasture or crop production. Overgrazing and fire suppression have led to increased woody cover on most extant occurrences and the invasion of some areas by problematic brush species such as *Juniperus virginiana var. virginiana* and *Prosopis glandulosa* in the southern part of the system's range. These factors have also led to decreases in native grass cover allowing for annual grasses and forbs to invade.
Classification Comments: Vegetation of East-Central Texas Plains Xeric Sandyland (CES205.897) can be embedded within the matrix-forming East-Central Texas Plains Post Oak Savanna and Woodland (CES205.679). East-Central Texas Plains Xeric Sandyland (CES205.897) was formerly called Crosstimbers Southern Xeric Sandhill but has been renamed to reflect this relationship.
Similar Ecological Systems:
- Crosstimbers Oak Forest and Woodland (CES205.682)--is found to the west of this system.
- East-Central Texas Plains Xeric Sandyland (CES205.897)--has an overlapping range but occupies sandier soils.

Related Concepts:
- Eastern Redcedar: 46 (Eyre 1980) Finer
- Post Oak - Blackjack Oak: 40 (Eyre 1980) Finer
- Post Oak Savanna: Live Oak Motte and Woodland (602) [CES205.679.2] (Elliott 2011) Finer
- Post Oak Savanna: Live Oak Shrubland (605) [CES205.679.5] (Elliott 2011) Finer
- Post Oak Savanna: Live Oak Slope Forest (622)[CES205.679.22] (Elliott 2011) Finer
- Post Oak Savanna: Oak / Hardwood Slope Forest (624) [CES205.679.16] (Elliott 2011) Finer
- Post Oak Savanna: Post Oak / Live Oak Motte and Woodland (633) [CES205.679.33] (Elliott 2011) Finer
- Post Oak Savanna: Post Oak / Live Oak Slope Forest (643) [CES205.679.43] (Elliott 2011) Finer
- Post Oak Savanna: Post Oak / Redcedar Motte and Woodland (603) [CES205.679.4] (Elliott 2011) Finer
- Post Oak Savanna: Post Oak / Yaupon Motte and Woodland (613) [CES205.679.7] (Elliott 2011) Finer
- Post Oak Savanna: Post Oak Motte and Woodland (604) [CES205.679.6] (Elliott 2011) Finer
- Post Oak Savanna: Redcedar Slope Forest (621) [CES205.679.14] (Elliott 2011) Finer
- Post Oak Savanna: Savanna Grassland (607) [CES205.679.9] (Elliott 2011) Finer

DESCRIPTION

Environment: This system is typically located on irregular plains in the East Central Texas Plains (Level III Ecoregion 33) of EPA (Griffith et al. 2004), comprised of sedimentary formations of Tertiary age, including Eocene sands such the Queen City, Sparta, and Carrizo sands, as well as the Wilcox and Claiborne groups. The system also occupies other Tertiary formations such as the Goliad and Willis formations, as well as portions of the Quaternary Willis Formation. This system occupies gently rolling to hilly topography. It is moderately dissected by drainages. It usually occurs on sandy to sandy loam soils, often with a marked clay subsurface horizon. Soils of this system are generally Alfisols, are typically acidic to neutral, and range from shallow to moderately deep. Typical Ecological Sites include Claypan Savannah, Claypan Prairie, Sandy Loam, Sandy, and Deep Sand (Elliott 2011). Rainfall ranges from about 120 cm in the northeastern part of the range to about 70 cm in the southwest, where it becomes increasingly erratic.

Vegetation: This system represents a transition from the woodlands and forests of East Texas to the prairies to the west, specifically the Blackland Prairie. Savannas and woodlands are typically dominated by *Quercus stellata, Quercus marilandica,* and *Carya texana*. Large areas of woodland, particularly in the south and east, are dominated or codominated by *Quercus fusiformis* or *Quercus virginiana* (east of the Brazos River). Other species, such as *Quercus incana* (on more xeric sites), *Ulmus alata, Ulmus crassifolia, Quercus nigra, Juniperus virginiana,* and *Prosopis glandulosa,* can also be present in the overstory. To the east, *Quercus falcata, Quercus nigra, Liquidambar styraciflua, Pinus echinata, Pinus taeda,* and *Carya alba* may be conspicuous in the overstory. Shrubs may attain significant cover in the understory, with species including *Ilex vomitoria* (often dominant), *Callicarpa americana, Sideroxylon lanuginosum, Crataegus* spp., *Ilex decidua, Toxicodendron radicans, Smilax bona-nox, Juniperus virginiana,* and *Symphoricarpos orbiculatus*. To the south, this system grades into vegetation more characteristic of southern Texas, with *Quercus fusiformis* and *Prosopis glandulosa* becoming the primary overstory components, and shrubs of southern Texas such as *Acacia rigidula, Forestiera angustifolia, Condalia hookeri, Colubrina texensis, Eysenhardtia texana, Opuntia engelmannii var. lindheimeri,* and *Diospyros texana* becoming increasingly conspicuous understory components. To the east, *Vaccinium arboreum, Morella cerifera, Diospyros virginiana,* and *Cornus florida* may be common components of the understory. On some sites, *Ilex vomitoria* can form a nearly continuous, sometimes impenetrable, dense shrub layer. Mid- and tallgrass species, including *Schizachyrium scoparium, Sorghastrum nutans,* and *Panicum virgatum*, are frequent in the understory where light penetration supports herbaceous cover, and also form prairie patches within the savanna, particularly on tighter soils. Other grasses present include *Andropogon gerardii, Bothriochloa laguroides ssp. torreyana, Paspalum plicatulum* (to the south), *Nassella leucotricha, Dichanthelium* spp., *Aristida* spp., and *Sporobolus cryptandrus*. Non-native grass species such as *Bothriochloa ischaemum var. songarica, Paspalum notatum,* and *Cynodon dactylon* may dominate some sites. Forbs are often conspicuous and may include species such as *Croton capitatus, Gaillardia pulchella, Monarda punctata, Rudbeckia hirta, Phlox drummondii, Commelina erecta, Acalypha radians, Verbesina virginica, Aphanostephus skirrhobasis, Froelichia gracilis, Cnidoscolus texanus,* and many others (Elliott 2011).
Dynamics: Drought, grazing, and fire are the primary natural processes that affect this system. This system is intricately tied with some occurrences of West Gulf Coastal Plain Herbaceous Seep and Bog (CES203.194). The sandy soils and underlying geologic strata that support this system serve as recharge areas for groundwater that supports seeps and bogs along hillsides and at the heads of drainages supporting West Gulf Coastal Plain Herbaceous Seep and Bog.

Component Associations:
- *Quercus stellata - Quercus marilandica - (Carya texana)* Forest (CEGL002074, G4)
- *Quercus stellata - Quercus marilandica - Carya texana - (Quercus shumardii, Quercus velutina)* Forest (CEGL002324, G3G5)
- *Quercus stellata - Quercus marilandica / Schizachyrium scoparium* Woodland (CEGL002147, G4)
- *Quercus stellata - Ulmus alata* Forest (CEGL004546, GNR)
- *Quercus virginiana - Quercus stellata / Schizachyrium scoparium - Paspalum plicatulum* Woodland (CEGL002155, G3)

DISTRIBUTION

Range: This ecological system is found in east-central Texas in a broad, northeast/southwest-trending band located west of the Upper West Gulf Coastal Plain, northwest of the Coastal Prairie, and east and south of the Blackland Prairie ecoregions. An arm extends along the Red River in north Texas.
Divisions: 203:P; 205:C
Nations: US
Subnations: OK, TX
Map Zones: 32:P, 35:P, 36:C, 37:C
USFS Ecomap Regions: 231Ef:CCC, 231Eg:CCC, 231Eo:CCC, 255A:CP, 255Ba:CCC, 255C:CC, 315E:CC
TNC Ecoregions: 31:C, 32:C, 40:C

SOURCES

References: Barbour and Billings 1988, Bartlett 1995, Bezanson 2000, Campbell 1925, Elliott 2011, Eyre 1980, Griffith et al. 2004, Loucks 1999, MacRoberts and MacRoberts 2004, MacRoberts et al. 2002a, MacRoberts et al. 2002b, McBride 1933, Midwood et al. 1998, Parmalee 1955, Ricketts et al. 1999, Singhurst et al. 2004, Smeins and Diamond 1986, Southeastern Ecology Working Group n.d., Stambaugh et al. 2011b, Tharp 1926, TPDW 2012a, Ward and Nixon 1992
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.802251#references
Description Author: L. Elliott and J. Teague, mod. M. Pyne
Version: 14 Jan 2014 **Stakeholders:** Midwest, Southeast
Concept Author: L. Elliott and J. Teague **ClassifResp:** Southeast

EASTERN BOREAL BALSAM FIR-WHITE SPRUCE-PAPER BIRCH FOREST (CES103.421)

CLASSIFIERS

Classification Status: Standard

Land Cover Class: Forest and Woodland
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
National Mapping Codes: ESLF 4343

CONCEPT

Summary: This ecological system represents the mesic boreal forests of eastern Canada, ranging from northwestern Ontario east to the Atlantic Provinces. The low-elevation forests are dominated by *Picea glauca* and *Abies balsamea*. *Picea mariana* is often present, along with occasional *Pinus banksiana*. Codominant boreal hardwoods include *Populus tremuloides* and *Betula papyrifera*. Northern hardwoods are essentially absent. The shrub and herb layers are variable, decreasing as the percent conifer cover increases. Common shrub species include *Alnus viridis, Corylus cornuta, Diervilla lonicera,* and *Lonicera canadensis*. The moss layer ranges from discontinuous to continuous. These upland forests typically occur on loamy soils over bedrock in scoured bedrock uplands and loamy, rocky, or sandy soils on glacial moraines, till plains and outwash plains. Moisture conditions range from well-drained to somewhat poorly drained. Wetter sites may contain *Alnus incana ssp. rugosa, Calamagrostis canadensis,* and *Equisetum* spp. This is the matrix mesic forest type of eastern Canada. This group may include earlier-successional patches, in which *Populus* spp. and *Betula* spp. are dominant or mixed with *Picea* and *Abies*, that will develop into spruce-fir forests. Blowdowns with subsequent gap regeneration are the most frequent form of natural disturbance, with large-scale fires important at longer return intervals. Insect infestations, in particular by *Choristoneura fumiferana* (spruce budworm), also can impact this group.
Classification Comments: A separate aspen-birch system is not recognized in this region; and this system is directly comparable to the group concept (G638).
Similar Ecological Systems:
- Atlantic Boreal Balsam Fir Wet Forest (CES103.433)
- Central Boreal White Spruce-Balsam Fir-Paper Birch Forest (CES103.427)
- Laurentian-Acadian Sub-boreal Mesic Balsam Fir-Spruce Forest (CES103.426)

Related Concepts:
- Balsam Fir: 5 (Eyre 1980) Finer
- White Spruce: 201 (Eyre 1980) Finer

DESCRIPTION

Environment: These upland forests typically occur on loamy soils over bedrock in scoured bedrock uplands and loamy, rocky, or sandy soils on glacial moraines, till plains and outwash plains. Moisture conditions range from well-drained to somewhat poorly drained. Climate is boreal. Soils are typically neutral to acidic, shallow sandy, sandy loam, or loamy sand. Some examples occur on heavier, mesic silty or clay loams that are more alkaline in nature.
Vegetation: *Picea glauca* typically dominates on drier sites or is codominant with *Abies balsamea* on more mesic sites. In some mesic to wet-mesic examples, *Abies balsamea* dominates. This group includes several successional stages, including earlier-successional patches in which *Populus* spp. and *Betula* spp. are dominant. Mid-successional stands often contain stands mixed with *Picea* and *Abies* that will develop into spruce-fir forests. The shrub and herb layers are variable, decreasing as the percent conifer cover increases. Common shrub species include *Acer spicatum, Corylus cornuta, Diervilla lonicera,* and *Lonicera canadensis*. The composition and density of the herbaceous layer can vary among associations and locations. Typically, *Aralia nudicaulis, Eurybia macrophylla, Clintonia borealis*, and *Maianthemum canadense* are common understory species. The moss layer ranges from discontinuous to continuous. Wetter sites may contain *Alnus incana ssp. rugosa, Calamagrostis canadensis*, and *Equisetum* spp.
Dynamics: These forests are affected by windthrow, insect defoliation, and infrequent fires. Selective herbivory by moose (*Alces americanus*) can alter the composition and structure and favor browse-tolerant species such as *Picea glauca*. These forests typically regenerate from gap-phase dynamics.

DISTRIBUTION

Range: This system ranges from northwestern Ontario to eastern Canada.
Nations: CA
Subnations: LB, MB?, NB?, NF, ON, QC
TNC Ecoregions: 48:?, 141:?

SOURCES

References: Comer et al. 2003, Eyre 1980, Faber-Langendoen et al. 2013a, Morneau pers. comm., NatureServe n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.878453#references
Description Author: D. Faber-Langendoen
Version: 24 Aug 2012 **Stakeholders:** Canada
Concept Author: K. Baldwin and Canadian NVC Committee (2012), in Faber-Langendoen et al. (2012) **ClassifResp:** Central

EASTERN BOREAL BLACK SPRUCE-JACK PINE FOREST (CES103.422)

CLASSIFIERS

Classification Status: Standard

Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
National Mapping Codes: ESLF 4405

CONCEPT

Summary: This conifer forest ecological system is found on nutrient-poor soils in a variety of topographic settings. It ranges from northwestern Ontario to Newfoundland and Labrador. Soils are loamy to sandy, varying from nutrient-poor, thin soil over bedrock to deeper soils, sometimes sandy. Sites are typically dry-mesic. The dominant fire regime varies from 50-100 years. *Picea mariana* and *Pinus banksiana* are characteristic overstory species over much of the range. Canopy structure is mostly closed but can be partially open. Conifers typically dominate the canopy, but boreal hardwoods (*Populus tremuloides, Betula papyrifera*) may codominate. As time since fire increases, *Picea mariana* may dominate. Tree regeneration includes *Abies balsamea, Betula papyrifera, Populus tremuloides,* and *Picea mariana*. The shrub and field layers can be very open to somewhat dense (5-75% cover). Characteristic low-shrub and herb species include *Amelanchier* spp., *Vaccinium angustifolium, Diervilla lonicera, Cornus canadensis, Linnaea borealis, Doellingeria umbellata (= Aster umbellatus),* and *Eurybia macrophylla*. Older *Picea mariana* stands may be strongly dominated by feathermosses.
Classification Comments: In Quebec, C. Morneau (pers. comm. 2009) made the following comments: "First, *Picea mariana* is far more common than *Pinus banksiana* in the boreal forest. Second, forests composed of a mixture of *Picea mariana* and *Abies balsamea* with a feathermoss carpet on the ground are very common east of 74 degrees W longitude and north of 48 degrees N latitude where climate undergoes a maritime influence and where *Pinus banksiana* gradually becomes absent. Third, the most common forest type in the northern part of the boreal forest (north of 51-52 degrees N latitude) is *Picea mariana* / lichen woodland characterized by an open spruce cover (15-40% cover) and a lichen carpet (*Cladina* spp.) on the ground" [these stands will be placed in a northern North American subarctic woodland group (under development)].

At this time, this system excludes xeric *Pinus banksiana* and *Picea mariana* stands, which are placed in their own system, Eastern Boreal Jack Pine - Black Spruce Dry Woodland (CES103.423), which is found on dry, poor sites, where there is a low density of *Picea mariana* and *Pinus banksiana* trees, resulting in a woodland condition. Lichens are dominant. Woodland physiognomy, plus lichen rather than feathermoss dominance, distinguish that system from this system, where feathermosses and herbs are more abundant.

Similar Ecological Systems:
- Central Boreal Jack Pine-Black Spruce Forest (CES103.428)
- Eastern Boreal Jack Pine-Black Spruce Dry Woodland (CES103.423)
- Laurentian-Acadian Sub-boreal Dry-Mesic Pine-Black Spruce-Hardwood Forest (CES103.425)

Related Concepts:
- Black Spruce: 12 (Eyre 1980) Intersecting
- Jack Pine: 1 (Eyre 1980) Intersecting

DESCRIPTION

Environment: Soils are loamy to sandy, varying from nutrient-poor, thin soil over bedrock to deeper soils, sometimes sandy. Sites are typically on dry-mesic to dry sites, but not commonly found on xeric sandplains or bedrock sites.
Vegetation: *Picea mariana* and *Pinus banksiana* are characteristic overstory species. Canopy structure is mostly closed but can be partially open. Conifers typically dominate the canopy; boreal hardwoods (*Populus tremuloides, Betula papyrifera*) may codominate but are typically less than 25% cover. As time since fire increases, *Picea mariana* may dominate. Tree regeneration of somewhat more moisture-preferring trees may be common and includes *Abies balsamea, Betula papyrifera, Populus tremuloides*, and *Picea mariana*. Ground layer is not lichen-dominated and contains at least 5%, and as much as 75%, cover by herbs and shrubs, and feathermosses are common, up to 100% cover in some stands. Characteristic low-shrub and herb species include *Amelanchier* spp., *Vaccinium angustifolium, Diervilla lonicera, Cornus canadensis, Linnaea borealis, Doellingeria umbellata (= Aster umbellatus),* and *Eurybia macrophylla*. Older *Picea mariana* stands may be strongly dominated by feathermosses.
Dynamics: The dominant fire regime varies from 50-100 years.

DISTRIBUTION

Range: This system ranges from northwestern Ontario (perhaps eastern Manitoba) to Newfoundland and Labrador.
Nations: CA
Subnations: LB, MB?, NF, ON, QC
TNC Ecoregions: 48:?, 141:?

SOURCES

References: Eyre 1980, Faber-Langendoen et al. 2013a, Morneau pers. comm., NatureServe n.d.
Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.878454#references
Description Author: D. Faber-Langendoen
Version: 24 Aug 2012 **Stakeholders:** Canada
Concept Author: K. Baldwin and Canadian NVC Committee (2012), in Faber-Langendoen et al. (2012) **ClassifResp:** Central

EASTERN BOREAL JACK PINE-BLACK SPRUCE DRY WOODLAND (CES103.423)

CLASSIFIERS

Classification Status: Standard

Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
National Mapping Codes: ESLF 4344

CONCEPT

Summary: This conifer woodland ecological system is found throughout the eastern boreal region of Canada. It occurs on dry nutrient-poor sandplains and along rocky ridges, often adjacent to rivers and lakes, and along talus slopes. The canopy ranges from patchy to continuous and is dominated by a mix of primarily conifer and hardwood species. In some examples, canopy trees may be stunted. *Picea mariana* and *Pinus banksiana* are the most frequent conifer species. Hardwood species vary in cover from 25-90% of the canopy. Most common are *Betula papyrifera* and *Populus* spp. In areas of open bedrock, species typical of bedrock outcrops and shallow soils can be found. The nonvascular layer can be absent or present with up to 30% cover. In the open bedrock areas, this layer consists mainly of the lichens and mosses. Infrequent fire is the primary dynamic, with catastrophic fires occurring approximately every 150-200 years with surface fires every 50-200 years.

Similar Ecological Systems:
- Central Boreal Jack Pine-Black Spruce Dry Woodland (CES103.429)
- Eastern Boreal Black Spruce-Jack Pine Forest (CES103.422)
- Laurentian-Acadian Sub-boreal Dry-Mesic Pine-Black Spruce-Hardwood Forest (CES103.425)
- Northern Dry Jack Pine-Red Pine-Hardwood Woodland (CES103.424)

Related Concepts:
- Black Spruce: 12 (Eyre 1980) Intersecting
- Jack Pine: 1 (Eyre 1980) Intersecting

DESCRIPTION

Environment: Examples of this system occur on rocky ridgetops, high slopes, and terraces sometimes along rivers or lakeshores. These areas are dry, well-drained sites, often with exposed bedrock. Soils range from bare bedrock and talus slopes to rocky, shallow loams and deep sands. Those stands on bedrock may have occasional cracks in the underlying bedrock resulting in pockets of relatively deep (15-20 cm) soil. Bare rock (with crustose lichens) can cover up to 50% of the area.

Vegetation: The canopy ranges from scattered trees to a moderately dense canopy. Stands are a mix of conifer species, occasionally with hardwood species. In some examples, canopy trees may be stunted. The conifers in most examples are dominated by *Picea mariana* and *Pinus banksiana*. Hardwood species vary in cover from 25-90% of the canopy, with *Betula papyrifera* and *Populus* spp. occurring more commonly. Shrubs may be absent to dense and include *Diervilla lonicera, Corylus cornuta, Juniperus communis,* and *Vaccinium angustifolium*. Herbaceous species vary across the range of this type. The nonvascular layer can be absent or present with up to 30% cover. In the open bedrock areas, this layer consists mainly of lichens and mosses. Lichen species may include *Cladina rangiferina (= Cladonia rangiferina)* and *Cladina mitis (= Cladonia mitis)*. Mosses include *Dicranum* spp., *Pleurozium schreberi*, and *Polytrichum* spp.

DISTRIBUTION

Range: This system ranges from northwestern Ontario (possibly eastern Manitoba) to Quebec, Newfoundland and Labrador.
Nations: CA
Subnations: LB, MB?, NF, ON, QC
TNC Ecoregions: 48:?, 141:?

SOURCES

References: Eyre 1980, Faber-Langendoen et al. 2013a, NatureServe n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.878455#references
Description Author: D. Faber-Langendoen
Version: 24 Aug 2012 **Stakeholders:** Canada
Concept Author: K. Baldwin and Canadian NVC Committee (2012), in Faber-Langendoen et al. (2012) **ClassifResp:** Central

EASTERN GREAT PLAINS TALLGRASS ASPEN PARKLAND (CES205.688)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Eastern Great Plains (205)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Non-Diagnostic Classifiers: Lakeplain; Forest and Woodland (Treed); Woody-Herbaceous; Sandplains/Glacial Outwash or Flats; Glaciated
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Deciduous open tree canopy
National Mapping Codes: EVT 2331; ESLF 4137; ESP 1331

CONCEPT

Summary: This system is found primarily on part of the Glacial Lake Agassiz plain in northwestern Minnesota, ranging into southern Canada. Calcareous glacial drift overlain with lacustrine soils ranging from loamy to gravelly is characteristic of the lakeplain within the range of this system. Historically this system included a mosaic of tallgrass prairie, wet prairie, brush prairie and aspen-oak woodlands. It is dominated by *Populus tremuloides* with scattered *Quercus macrocarpa* and *Betula papyrifera*. Shrubs such as willow (*Salix* spp.) and hazel (*Corylus* spp.) are also common. The dominant tallgrass species is *Andropogon gerardii* often associated with *Sorghastrum nutans, Calamagrostis* spp., and *Sporobolus heterolepis*. Fire is the most important natural dynamic in this system and helps maintain the open parkland or brush nature of this system. Wind and grazing are also important dynamics. Conversion to agriculture and fire suppression have decreased the range of this system and allowed more shrubs and trees to establish.
Similar Ecological Systems:
- Northwestern Great Plains Aspen Forest and Parkland (CES303.681)--biogeography and understory species separate. NW Great Plains system has a more mixed understory with *Stipa, Bouteloua,* and *Festuca*. *Festuca* would be a good differential genus.

Related Concepts:
- Aspen: 16 (Eyre 1980) Finer
- Bur Oak: 42 (Eyre 1980) Finer
- Paper Birch: 18 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs largely on the lakeplain of Glacial Lake Agassiz. This landscape is very flat with soils ranging from fine to somewhat coarse. Drainage is moderate to poor at most sites.
Dynamics: The interaction of fire and regional climate shaped this system. Aspen parklands occur on the margin of the northern prairies and northern forests. The climate will support tallgrass, tree and shrub species, and aspen parklands are a mix of these lifeforms. Frequent fires favor the spread of tallgrass species and reduce woody cover (Svedarsky et al. 1986). Sites not burned as often, due to a fire-protected position on the landscape or to a reduction in fire frequency across the entire landscape, tend to become dominated by trees and shrubs. An average fire-return interval of 10-15 years was estimated by Landfire modelers (Landfire 2007a), though individual areas would have burned less or more often. This system occurs on a very flat landscape and minor variations in topography can create wet prairie or wet shrub pockets within the parkland.

Component Associations:
- *Betula papyrifera / Corylus cornuta* Forest (CEGL002079, G2G3)
- *Populus tremuloides - Quercus macrocarpa - Salix* spp. / *Andropogon gerardii* Shrubland (CEGL002182, G2G3)
- *Populus tremuloides / Corylus americana* Forest (CEGL002063, G5)
- *Populus tremuloides / Corylus* spp. / *Andropogon gerardii* Woodland (CEGL005205, G4G5)
- *Quercus macrocarpa - Populus tremuloides / Corylus* spp. Woodland (CEGL002139, G4?)
- *Salix petiolaris - (Betula pumila) / Spartina pectinata - Carex pellita* Shrubland (CEGL002434, G3)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Northern Tallgrass Prairie (CES205.686)
- Northwestern Great Plains Aspen Forest and Parkland (CES303.681)

DISTRIBUTION

Range: This system is found primarily on part of the Glacial Lake Agassiz plain in northwestern Minnesota, ranging into southern Canada.
Divisions: 201:P; 205:C
Nations: CA, US
Subnations: MB, MN, ND
Map Zones: 39:P, 40:C, 41:P
USFS Ecomap Regions: 222N:CC, 251A:PP
TNC Ecoregions: 35:C, 46:?, 47:P, 66:P

SOURCES

References: Comer et al. 2003, Eyre 1980, Landfire 2007a, MNNHP 1993, Svedarsky et al. 1986

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722971#references

Description Author: S. Menard, mod. J. Drake

Version: 14 Jan 2014 **Stakeholders:** Canada, Midwest

Concept Author: S. Menard **ClassifResp:** Midwest

EASTERN SERPENTINE WOODLAND (CES202.347)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Rock Outcrops/Barrens/Glades; Serpentine; Unglaciated; Ultramafic with low Ca:Mg ratio
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Mixed evergreen-deciduous open tree canopy
National Mapping Codes: EVT 2375; ESLF 4318; ESP 1375

CONCEPT

Summary: This system consists of distinct vegetation associated with ultramafic rock substrates in the Piedmont and Blue Ridge of the eastern United States. The bedrock is serpentinite, dunite, or other ultramafic rocks. The soil has unusual and extreme chemical composition that includes strongly skewed calcium-to-magnesium ratios and often high levels of heavy metals such as chromium. Most examples are open woodlands with *Pinus rigida*, *Pinus virginiana*, and/or *Quercus alba, Quercus marilandica*, and *Quercus stellata* in the often stunted canopy. Extreme edaphic conditions lead to locally xerophytic growing conditions that contribute to relatively open canopies and a ground cover dominated by prairie grasses and a variety of forbs. Disjunct species from drier regions and some endemic plant taxa are often present. The unusual and extreme soil chemistry determines the underlying floristics and distinctive flora of the type, but fire frequency, extent, and severity determine the physiognomy of particular examples over time.
Classification Comments: While details of flora vary widely among the scattered examples of this system, all associations have in common a composition that is distinct from communities on other substrates and that is more xeric in aspect. Serpentine substrates support distinctive barren vegetation in most places where they occur. This system is distinguished from serpentine barrens in other regions because of the distinctive flora, as well as the climate, lack of glaciation, and other factors distinct to this region. A closely related Piedmont system, Piedmont Hardpan Woodland and Forest (CES202.268), may be only incompletely distinguished from this system. In this Appalachian system *Pinus rigida / Schizachyrium scoparium - Packera plattensis* Wooded Herbaceous Vegetation (CEGL006084) occurs in both the Appalachians and in the Piedmont.

Ultramafic rock substrate is apparently not sufficient to create this system. Some Piedmont areas with ultramafic rock outcrops on the most mesic sites support mesic forest vegetation not distinguishable from that on other substrates. It may be that these outcrops have less extreme chemistry, or that sufficient moisture levels or a long period without natural disturbance in the form of fire will override the effects of chemistry. The presence of unusually xerophytic or barren vegetation should be the defining characteristic of this system.

Related Concepts:
- Eastern Redcedar: 46 (Eyre 1980) Finer
- Virginia Pine: 79 (Eyre 1980) Finer
- White Oak - Black Oak - Northern Red Oak: 52 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs in a variety of topographic settings, perhaps excluding only alluvial sites. The bedrock is serpentinite, dunite, or other ultramafic rocks. The soil has unusual and extreme chemical composition that includes strongly skewed calcium-to-magnesium ratios and often high levels of heavy metals such as chromium. Owing to a high level of toxic metals and a deficiency in nutrients, serpentine outcrops are ecologically unique and provide habitat for many plant species that grow nowhere else. The soil may be shallow and rocky, or deep, and is usually very clayey. Seepage may be present locally.
Vegetation: Vegetation is generally an open woodland of pines or xerophytic hardwoods. The dominant vegetation is more xerophytic and more open than the topographic setting, soil moisture, and climate would suggest, and contrasts strongly with adjacent vegetation on other kinds of rock. *Pinus rigida* and *Pinus virginiana* are frequent canopy dominants, but *Quercus marilandica*, *Quercus alba*, and *Quercus stellata* dominate some examples. There is generally not a well-developed understory. Shrubs may be sparse to dense. The herb layer is usually dense; grasses, including prairie elements such as *Schizachyrium scoparium, Andropogon gerardii*, and/or *Sorghastrum nutans*, usually dominate, but a number of forbs may be present. In the northern portion of this system's range in Pennsylvania and Maryland, *Phlox subulata* and the endemic *Symphyotrichum depauperatum* are characteristic; in the southern Appalachian portion of its range, *Packera plattensis, Hexastylis arifolia var. ruthii*, and *Thalictrum macrostylum* are characteristic. Often, paradoxical mixtures of xerophytic and mesophytic species are present, though the overall plant composition is characteristic of a drier setting. Disjunct species from drier regions and some endemic plant taxa are often present. There is one site where *Pinus palustris* occurs over serpentine (Burks Mountain, Columbus County, Georgia), but this is classed as a "Piedmont Longleaf" site.
Dynamics: Although the unique soil chemistry is the crucial determining factor for this system, fire is generally a crucial process influencing species composition and vegetation structure. The unusual and extreme soil chemistry determines the underlying floristics and distinctive flora of the type, but fire frequency, extent, and severity determine the physiognomy of particular examples over time. Without fire, vegetation can sometimes become dense enough to suppress or eliminate the distinctive herbaceous layer, as well as

turning a distinctive savanna or woodland structure into dense forest. Southern pine beetle (*Dendroctonus frontalis*) damage is an important factor in examples dominated by *Pinus* species.

Component Associations:
- *(Quercus stellata) / Schizachyrium scoparium - Packera plattensis - Parthenium auriculatum - Phemeranthus piedmontanus* Wooded Herbaceous Vegetation (CEGL006084, G1)
- *Acer rubrum - Pinus virginiana - Pinus rigida / Smilax* spp. Serpentine Forest (CEGL006439, G1G2)
- *Acer rubrum - Quercus* spp. / *Smilax* spp. Serpentine Forest (CEGL006438, G1G2)
- *Deschampsia caespitosa - Vernonia noveboracensis* Herbaceous Vegetation (CEGL006316, G1)
- *Juniperus virginiana - Pinus virginiana / Smilax rotundifolia* Serpentine Forest (CEGL006440, G1G2)
- *Pinus rigida - Quercus alba / Sporobolus heterolepis - Andropogon gerardii* Woodland (CEGL003768, G1)
- *Pinus rigida - Quercus stellata / Andropogon gerardii - Packera paupercula* Woodland (CEGL004968, G1)
- *Pinus virginiana - Pinus rigida - Quercus stellata / Ceanothus americanus - Kalmia latifolia / Thalictrum revolutum* Woodland (CEGL007721, G1)
- *Quercus alba / Physocarpus opulifolius / Packera plattensis - Hexastylis arifolia var. ruthii* Forest (CEGL007296, G1)
- *Schizachyrium scoparium - Sporobolus heterolepis* Serpentine Herbaceous Vegetation (CEGL006442, G1G2)
- *Sorghastrum nutans - Schizachyrium scoparium* Serpentine Herbaceous Vegetation (CEGL006441, G1G2)

SPATIAL CHARACTERISTICS

Spatial Summary: Small- to large-patch system, most examples covering a few dozen acres at most. The largest, in Maryland, is 2000 acres.
Size: Most examples naturally cover a few to perhaps several dozen acres. A few in Pennsylvania and Maryland are 100-200 acres, with one Maryland site covering 2000 acres.
Adjacent Ecological System Comments: May be bordered by any other system appropriate for the region, often with abrupt boundaries at geologic contacts. Ultramafic rocks are often associated with mafic rocks such as amphibolite, so systems with basic soils are likely to be associated.

DISTRIBUTION

Range: This system is widely scattered throughout the Southern and Central Appalachians and Piedmont, from Pennsylvania to North Carolina.
Divisions: 202:C
Nations: US
Subnations: MD, NC, PA, VA
Map Zones: 57:C, 59:C, 60:C, 61:C
USFS Ecomap Regions: 221An:CCC, 221Da:CCC, 221Db:CCC, 231Ib:CCC, 232Hd:CCC, M221Db:CCC, M221Dc:CCC, M221Dd:CCC
TNC Ecoregions: 51:C, 52:C, 61:C

SOURCES

References: Arabas 2000, Barton and Wallenstein 1997, Brooks 1987, Comer et al. 2003, Dann 1988, DeSelm and Murdock 1993, Duffey et al. 1974, Estes et al. 1979, Eyre 1980, Harshberger 1903, Latham 1993, Mansberg and Wentworth 1984, McKinney and Lockwood 1999, Murdock pers. comm., Noss 2013, Pennell 1910, Pennell 1912, Pennell 1929, Radford 1948, Taft 1997, Taft 2009, Taft et al. 1995, TNC 1996c, Wherry 1963, Wiens and Dyer 1975
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723163#references
Description Author: M. Schafale, R. Evans, S.C. Gawler, M. Pyne
Version: 14 Jan 2014 **Stakeholders:** East, Southeast
Concept Author: M. Schafale, R. Evans, S.C. Gawler **ClassifResp:** Southeast

EDWARDS PLATEAU DRY-MESIC SLOPE FOREST AND WOODLAND (CES303.656)

CLASSIFIERS

Classification Status: Standard

Primary Division: Western Great Plains (303)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Midslope; Forest and Woodland (Treed); Broad-Leaved Deciduous Tree; Broad-Leaved Evergreen Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Mixed evergreen-deciduous open tree canopy
National Mapping Codes: EVT 2523; ESLF 4331; ESP 1523

CONCEPT

Summary: This system occurs on dry to mesic, middle slopes of the rolling uplands and escarpments of the Edwards Plateau and similar sites in the adjacent Blackland Prairie region. The canopy is typically dominated or codominated by deciduous trees, including *Quercus buckleyi, Quercus sinuata var. breviloba, Ulmus crassifolia,* and/or *Celtis laevigata var. reticulata*. *Quercus fusiformis* and *Juniperus ashei* are often present and are sometimes codominant with deciduous species of this system. Canopy closure is variable, and this system can be expressed as forests or woodlands. The shrub layer may be well-represented, especially where the overstory canopy is discontinuous. Species such as *Aesculus pavia var. flavescens, Cercis canadensis var. texensis, Forestiera pubescens, Ungnadia speciosa, Ceanothus herbaceus, Sophora secundiflora, Rhus* spp., *Vitis* spp., and *Garrya ovata* may be present in the shrub layer. With the large amount of exposed rock, frequent accumulation of leaf litter, and significant canopy closure, herbaceous cover is generally sparse, with *Carex planostachys* often present. Woodland forbs such as *Tinantia anomala, Chaptalia texana, Nemophila phacelioides, Salvia roemeriana, Lespedeza texana*, and various ferns may also be present, these often being patchy in distribution.
Classification Comments: Further field investigation is needed to better develop the association-level information for this system.
Similar Ecological Systems:
- Edwards Plateau Limestone Savanna and Woodland (CES303.660)--is typically expressed as a mixed evergreen-deciduous woodland or forest characterized by *Quercus fusiformis* and/or *Juniperus ashei*. It occurs on rolling uplands and dry to xeric slopes.
- Edwards Plateau Mesic Canyon (CES303.038)--is currently described as limited to steep, narrow canyons that support more mesic forests. It is limited in extent to steep canyons bordering the Balcones Escarpment.

Related Concepts:
- Ashe Juniper - Redberry (Pinchot) Juniper: 66 (Eyre 1980) Finer
- Edwards Plateau: Ashe Juniper Slope Forest (901) [CES303.656.1] (Elliott 2011) Finer
- Edwards Plateau: Live Oak Slope Forest (902) [CES303.656.2] (Elliott 2011) Finer
- Edwards Plateau: Oak / Ashe Juniper Slope Forest (903) [CES303.656.4] (Elliott 2011) Finer
- Edwards Plateau: Oak / Hardwood Slope Forest (904) [CES303.656.6] (Elliott 2011) Finer

DESCRIPTION

Environment: This system occurs on dry-mesic, primarily north- and east-facing limestone slopes in the Edwards Plateau of Texas. In the adjacent Blackland Prairie region, it is found on limestone chalk cuestas (Elliott 2011). Stones and boulders are conspicuous on the soil surface. Soils are generally dark clay to clay loam and shallow. Steep Rocky and Steep Adobe Ecological Sites may be associated with this system (Elliot 2011).
Vegetation: The canopy is typically dominated or codominated by deciduous trees, including *Quercus buckleyi, Quercus laceyi, Quercus sinuata var. breviloba, Fraxinus texensis, Ulmus crassifolia, Prunus serotina var. eximia, Juglans major,* and/or *Celtis laevigata var. reticulata*. *Quercus fusiformis* and *Juniperus ashei* are often present and are sometimes codominant with deciduous species of this system. Canopy closure is variable, and this system can be expressed as forests or woodlands. The shrub layer may be well-represented, especially where the overstory canopy is discontinuous. Species such as *Aesculus pavia var. flavescens, Cercis canadensis var. texensis, Forestiera pubescens, Ungnadia speciosa, Ceanothus herbaceus, Frangula caroliniana, Sophora secundiflora, Viburnum rufidulum, Rhus* spp., *Vitis* spp., and *Garrya ovata* may be present in the shrub layer. With the large amount of exposed rock, frequent accumulation of leaf litter, and significant canopy closure, herbaceous cover is generally sparse, with *Carex planostachys* often present. Woodland forbs such as *Tinantia anomala, Chaptalia texana, Nemophila phacelioides, Salvia roemeriana, Lespedeza texana*, and various ferns may also be present, if patchy (Elliott 2011).

Component Associations:
- *Juniperus ashei - Quercus buckleyi* Woodland (CEGL004172, G4)
- *Muhlenbergia reverchonii - Bouteloua hirsuta var. pectinata - Carex microdonta* Herbaceous Vegetation (CEGL004520, G3?)
- *Quercus buckleyi - Fraxinus texensis - Juniperus ashei* Forest (CEGL002135, G3)
- *Quercus laceyi - Juniperus ashei* Woodland (CEGL002136, G2)

SPATIAL CHARACTERISTICS

Spatial Summary: This system often forms deciduous bands at midslope on hills in the Edwards Plateau of Texas.
Adjacent Ecological Systems:
- Edwards Plateau Carbonate Glade and Barrens (CES303.655)

- Edwards Plateau Cliff (CES303.653)
- Edwards Plateau Floodplain Terrace (CES303.651)
- Edwards Plateau Limestone Savanna and Woodland (CES303.660)
- Edwards Plateau Limestone Shrubland (CES303.041)
- Edwards Plateau Mesic Canyon (CES303.038)
- Edwards Plateau Riparian (CES303.652)
- Edwards Plateau Upland Depression (CES303.654)

Adjacent Ecological System Comments: The predominantly evergreen Edwards Plateau Limestone Savanna and Woodland (CES303.660) occurs on adjacent drier upland ridges, flats and upper slopes. Very steep and moist canyons of the Edwards Plateau are classified as Edwards Plateau Mesic Canyon (CES303.038).

DISTRIBUTION

Range: This system is expected to occur on dry-mesic slopes in the Edwards Plateau and Lampasas Cutplain.
Divisions: 303:C
Nations: US
Subnations: TX
Map Zones: 35:C
USFS Ecomap Regions: 255E:CC, 315C:C?, 315D:CC, 315G:C?
TNC Ecoregions: 29:C

SOURCES

References: Elliott 2011, Eyre 1980, Southeastern Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.791384#references
Description Author: J. Teague, mod. M. Pyne and L. Elliott
Version: 24 Feb 2011 **Stakeholders:** Midwest, Southeast, West
Concept Author: L. Elliott and J. Teague **ClassifResp:** Southeast

EDWARDS PLATEAU LIMESTONE SAVANNA AND WOODLAND (CES303.660)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Western Great Plains (303)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Non-Diagnostic Classifiers: Forest and Woodland (Treed); Ridge/Summit/Upper Slope; Sedimentary Rock; Temperate [Temperate Continental]; Unglaciated; Alkaline Soil; Calcareous; Ustic
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Mixed evergreen-deciduous closed tree canopy
National Mapping Codes: EVT 2383; ESLF 4326; ESP 1383

CONCEPT

Summary: This upland system occurs primarily on soils derived from chalk or limestone of Cretaceous or Pennsylvanian origin in the Edwards Plateau; it forms the matrix within this ecoregion. It can also occur on limestone in the shortgrass regions of Texas and north into Oklahoma in areas such as the Arbuckle Mountains. This system is typified by a mosaic of evergreen oak forests, woodlands and savannas over shallow soils of rolling uplands and upper slopes within the Edwards Plateau and Lampasas Cutplain. *Quercus fusiformis* or *Juniperus ashei* typically dominate the canopy of this system. Other species may include *Quercus buckleyi, Quercus laceyi, Quercus stellata, Ulmus crassifolia, Fraxinus texensis, Quercus sinuata, Quercus vaseyana, Sophora secundiflora, Mahonia trifoliolata,* and *Diospyros texana*. Physiographic expression of this system varies from dense mottes (patches of forest where canopy cover approaches 100%) interspersed with grasslands to open savannalike woodlands with scattered individual or small groups of trees. Understories can contain various shrubs and graminoids, including *Cercis canadensis var. texensis, Forestiera pubescens, Sideroxylon lanuginosum, Diospyros texana, Rhus trilobata, Bouteloua* spp., *Schizachyrium scoparium, Nassella leucotricha, Carex planostachys, Aristida purpurea, Aristida oligantha, Liatris mucronata, Stillingia texana, Symphyotrichum ericoides, Hedyotis nigricans, Monarda citriodora,* and *Salvia texana*. Grasslands dominated by *Schizachyrium scoparium* occur in small patches within more closed woodlands and in larger patches between mottes or in open savannalike woodlands with scattered trees. Grasslands in this system tend to grade from shortgrass communities in the west to mixedgrass communities to the east. Substrate (limestone) determines the range of this system within given examples. Some disturbed areas of the western plateau are now dominated by mesquite woodland. Natural mesquite woodlands are believed to have occurred on the deeper soils of adjacent riparian systems.
Classification Comments: Distribution in Oklahoma needs to be reviewed. This system is described as a mosaic of grassland and woodland or forest communities.
Similar Ecological Systems:
- Edwards Plateau Dry-Mesic Slope Forest and Woodland (CES303.656)
- Edwards Plateau Limestone Shrubland (CES303.041)
- Llano Uplift Acidic Forest, Woodland and Glade (CES303.657)

Related Concepts:
- Ashe Juniper - Redberry (Pinchot) Juniper: 66 (Eyre 1980) Finer
- Edwards Plateau: Ashe Juniper Motte and Woodland (1101) [CES303.660.1] (Elliott 2011) Finer
- Edwards Plateau: Deciduous Oak / Evergreen Motte and Woodland (1103) [CES303.660.4] (Elliott 2011) Finer
- Edwards Plateau: Live Oak Motte and Woodland (1102) [CES303.660.2] (Elliott 2011) Finer
- Edwards Plateau: Oak / Hardwood Motte and Woodland (1104) [CES303.660.5] (Elliott 2011) Finer
- Edwards Plateau: Post Oak Motte and Woodland (1114) [CES303.660.6] (Elliott 2011) Finer
- Edwards Plateau: Savanna Grassland (1107) [CES303.660.9] (Elliott 2011) Finer
- Post Oak - Blackjack Oak: 40 (Eyre 1980) Finer

DESCRIPTION

Environment: This system is primarily found on Cretaceous limestones of the Edwards Plateau and Limestone (also referred to as Lampasas) Cutplain, but also associated with Pennsylvanian limestones of the Palo Pinto Formation and Winchell, Ranger, Home Creek limestone in the vicinity of Palo Pinto County, as well as on Cretaceous chalk formations in the northern Blackland Prairie and Cretaceous limestones of the western Crosstimbers and Rolling Plains. It ranges north into Oklahoma and is found on rolling to level upland topography, often on plateau tops, but also on gentle slopes. Soils are generally loams, clay loams, or clays, often with limestone parent material apparent. Low Stony Hill, Adobe, Clay Loam, and Shallow Ecological Sites are commonly associated with this system (Elliott 2011). Soil moisture and topography influence this system.
Vegetation: This forest and woodland system is dominated by species such as *Quercus fusiformis, Quercus laceyi, Quercus vaseyana, Juniperus ashei*, or *Pinus remota*. Other species may include *Quercus buckleyi, Ulmus crassifolia, Fraxinus texensis, Quercus sinuata,* and *Diospyros texana*. Certain uplands may have mottes of *Quercus fusiformis* dominating a savannalike woodland. Physiographic expression varies from dense mottes (patches of forest where canopy cover approaches 100%) interspersed with large or small grassland patches to open savannalike woodlands with scattered individual or small groups of trees. Understories can contain various shrubs and graminoids, including *Cercis canadensis var. texensis, Forestiera pubescens, Sideroxylon lanuginosum, Diospyros*

texana, Rhus trilobata, Mahonia trifoliolata, Sophora secundiflora, Opuntia engelmannii var. lindheimeri, and *Opuntia leptocaulis (= Cylindropuntia leptocaulis)*. Grasses and forbs include *Bouteloua* spp., *Schizachyrium scoparium, Sorghastrum nutans, Bouteloua curtipendula, Bothriochloa barbinodis, Bothriochloa laguroides ssp. torreyana, Nassella leucotricha, Hilaria belangeri, Buchloe dactyloides (= Bouteloua dactyloides), Andropogon gerardii, Bouteloua hirsuta, Bouteloua rigidiseta, Muhlenbergia reverchonii, Muhlenbergia lindheimeri, Carex planostachys, Aristida purpurea, Aristida oligantha, Liatris mucronata, Stillingia texana, Symphyotrichum ericoides, Hedyotis nigricans, Monarda citriodora*, and *Salvia texana*. Grasslands dominated by *Schizachyrium scoparium* occur in small patches within more closed woodlands and in larger patches between mottes or in open savannalike woodlands with scattered trees. Grasslands in this system tend to grade from shortgrass communities in the west to mixedgrass communities to the east. Substrate (limestone) determines the range of this system within given examples. The herbaceous stratum is often dominated by non-native grass species, especially *Bothriochloa ischaemum var. songarica*.
Dynamics: Substrate (limestone) and topographic position primarily influence this system. Fire, grazing and browsing may also influence this system.

Component Associations:
- *Hilaria belangeri - Bouteloua curtipendula* Herbaceous Vegetation (CEGL002238, G3?)
- *Juniperus ashei - Quercus buckleyi* Woodland (CEGL004172, G4)
- *Juniperus ashei - Quercus sinuata var. breviloba* Woodland (CEGL004170, G4)
- *Muhlenbergia reverchonii - Bouteloua hirsuta var. pectinata - Carex microdonta* Herbaceous Vegetation (CEGL004520, G3?)
- *Pinus remota - Juniperus ashei - Quercus* spp. Woodland (CEGL002124, G2G3)
- *Quercus fusiformis - Quercus buckleyi - Ulmus crassifolia / Schizachyrium scoparium* Woodland (CEGL004168, GNR)
- *Quercus fusiformis - Quercus buckleyi / Quercus sinuata - (Juniperus ashei)* Woodland (CEGL004215, GNR)
- *Quercus fusiformis / Hilaria belangeri* Woodland (CEGL002116, GNR)
- *Quercus fusiformis / Schizachyrium scoparium* Woodland (CEGL002115, G2G4)
- *Quercus sinuata var. breviloba* Scrub (CEGL004453, G2G3)
- *Quercus stellata - (Quercus marilandica, Ulmus crassifolia) / Schizachyrium scoparium* Woodland (CEGL004176, GNR)
- *Schizachyrium scoparium - (Sorghastrum nutans) - Sporobolus compositus var. compositus - Liatris mucronata* Herbaceous Vegetation (CEGL004211, GNR)
- *Schizachyrium scoparium - Bouteloua curtipendula - Nassella leucotricha* Herbaceous Vegetation (CEGL004070, GNR)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Edwards Plateau Carbonate Glade and Barrens (CES303.655)
- Edwards Plateau Cliff (CES303.653)
- Edwards Plateau Dry-Mesic Slope Forest and Woodland (CES303.656)
- Edwards Plateau Floodplain Terrace (CES303.651)
- Edwards Plateau Limestone Shrubland (CES303.041)
- Edwards Plateau Mesic Canyon (CES303.038)
- Edwards Plateau Riparian (CES303.652)
- Edwards Plateau Upland Depression (CES303.654)
- Llano Uplift Acidic Forest, Woodland and Glade (CES303.657)

Adjacent Ecological System Comments: A common component of Edwards Plateau Limestone Savanna and Woodland (CES303.660), *Quercus buckleyi*, is conspicuously absent from Llano Uplift Acidic Forest, Woodland and Glade (CES303.657).

DISTRIBUTION

Range: This system is found primarily within the Edwards Plateau ecoregion but can extend north into Oklahoma and into portions of the Southern Shortgrass region of Texas.
Divisions: 303:C
Nations: US
Subnations: OK, TX
Map Zones: 26:C, 34:?, 35:C
USFS Ecomap Regions: 255E:CC, 315C:CC, 315D:CC, 315G:CC
TNC Ecoregions: 28:P, 29:C, 33:?

SOURCES

References: Barbour and Billings 1988, Comer et al. 2003, Elliott 2011, Eyre 1980, Ricketts et al. 1999, TNC 2004b
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722998#references
Description Author: S. Menard and K. Kindscher, mod. J. Teague, M. Pyne, L. Elliott
Version: 24 Feb 2011 **Stakeholders:** Midwest, Southeast, West
Concept Author: S. Menard and K. Kindscher **ClassifResp:** Southeast

EDWARDS PLATEAU MESIC CANYON (CES303.038)

CLASSIFIERS

Classification Status: Standard

Primary Division: Western Great Plains (303)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Canyon Mosaic; Forest and Woodland (Treed); Toeslope/Valley Bottom; Ustic; Flood Scouring; Canyon
Non-Diagnostic Classifiers: Lowland [Foothill]; Lowland [Lowland]; Moss/Lichen (Nonvascular); Temperate [Temperate Continental]; Alkaline Soil; Calcareous; Landslide
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: EVT 2524; ESLF 4153; ESP 1524

CONCEPT

Summary: This system is largely endemic to the Edwards Plateau ecoregion and occurs on canyon bottoms, mesic lower slopes and steep canyons, primarily in the Southern Balcones Escarpment, but also in the Eastern Balcones Escarpment. This system also includes cliff faces and lower slopes of boxed canyons occurring as narrow, sometimes long bands in areas often with seeps where moisture is consistently more available than on adjacent slopes. The tree canopy is generally closed. Common components include *Ulmus crassifolia, Juglans major, Quercus buckleyi, Quercus laceyi, Prunus serotina var. eximia* (becoming less common to the north), *Fraxinus texensis* (dominant in the northeastern plateau), *Quercus muehlenbergii*, and *Acer grandidentatum*. Canyon bottoms may have scattered *Quercus macrocarpa*. Substrate (limestone) and topographic position (north and east aspects and lower slopes) are the dominant characteristics of this system. Small seepage areas are often dominated by *Adiantum capillus-veneris*, with *Thelypteris ovata var. lindheimeri* on nearby moist habitats. Other prominent species include *Buddleja racemosa, Ungnadia speciosa*, and *Toxicodendron radicans ssp. eximium*. Fire probably plays little role in the system, while grazing and browsing (by native as well as exotic ungulates) may play an important role in recruitment and understory composition. Adjacent, drier slopes are usually dominated by various *Quercus* species and *Juniperus ashei*.

Similar Ecological Systems:
- Edwards Plateau Cliff (CES303.653)--represents sparsely vegetated cliff faces and could be considered a part this system and may not be justified as distinct from it.
- Edwards Plateau Dry-Mesic Slope Forest and Woodland (CES303.656)--represents dry-mesic slopes in the Edwards Plateau characterized by woodlands often dominated by *Quercus buckleyi*.

Related Concepts:
- Edwards Plateau Bigtooth Maple Mesic Canyon (not mapped) [CES303.038.1] (Elliott 2011) Finer
- Edwards Plateau Mixed Deciduous Mesic Canyon (not mapped) [CES303.038.2] (Elliott 2011) Finer
- Sugar Maple: 27 (Eyre 1980) Finer

DESCRIPTION

Environment: This system is largely endemic to the Edwards Plateau ecoregion. Examples are associated with lower Cretaceous limestones of the Edwards Plateau, often on the Glen Rose or related formations. This system occurs on mesic lower slopes (toeslopes), canyon bottoms, and onto the margins of adjacent valleys of small drainages, primarily in the Southern Balcones Escarpment, but also in the Eastern Balcones Escarpment (also on the Limestone Cutplain). Occurrences are generally found in steep canyons where insolation is minimal, or on lower positions on northern- or eastern-facing slopes. This system also includes areas of cliff faces and lower slopes of boxed canyons occurring as narrow, sometimes long bands in areas often with seeps where moisture is consistently more available than on adjacent slopes. Soils are rich loams, often very rocky, with little soil development. It includes Steep Rocky Ecological Site, in part (Elliott 2011).

Vegetation: The tree canopy is generally closed. Composition is variable among examples, depending on moisture status. Common components include *Ulmus crassifolia, Juglans major, Quercus buckleyi, Quercus laceyi, Prunus serotina var. eximia* (becoming less common to the north), *Fraxinus texensis* (dominant in the northeastern plateau), *Quercus muehlenbergii*, and *Acer grandidentatum*. Canyon bottoms may have scattered *Quercus macrocarpa*. Small seepage areas are often dominated by *Adiantum capillus-veneris*, with *Thelypteris ovata var. lindheimeri* on nearby moist habitats. Other prominent species include *Buddleja racemosa, Ungnadia speciosa*, and *Toxicodendron radicans ssp. eximium*. Mesic examples are characterized by the presence of *Acer grandidentatum*, with *Quercus muehlenbergii* as a common associate, along with *Ulmus crassifolia, Juglans major, Quercus buckleyi, Quercus laceyi, Prunus serotina var. eximia* (becoming less common to the north), and *Fraxinus texensis* (dominant in the northeastern plateau). Mesic herbaceous indicators such as *Aquilegia canadensis* and *Clematis texensis* may be present in these examples (Elliott 2011).

Dynamics: Substrate (limestone) and topographic position (northern and eastern aspects and lower slopes) are the dominant characteristics of this system. Fire probably plays little role in the system, while grazing and browsing (by native as well as exotic ungulates) may play an important role in recruitment and understory composition.

Component Associations:
- *Acer grandidentatum - (Quercus muehlenbergii) / Carex edwardsiana* Lampasas Cutplain Forest (CEGL002319, G2)
- *Acer grandidentatum - Quercus muehlenbergii - Quercus laceyi / Carex edwardsiana - Chaetopappa effusa* Southern Edwards

Plateau Forest (CEGL004931, G2)
- *Adiantum capillus-veneris - (Thelypteris ovata var. lindheimeri, Thelypteris kunthii)* Herbaceous Vegetation (CEGL004514, G2)
- *Muhlenbergia reverchonii - Bouteloua hirsuta var. pectinata - Carex microdonta* Herbaceous Vegetation (CEGL004520, G3?)
- *Quercus laceyi - Juniperus ashei* Woodland (CEGL002136, G2)
- *Quercus muehlenbergii - Juglans major - (Ulmus rubra) / Verbesina virginica* Forest (CEGL004927, G2G3)

Spatial Characteristics

Adjacent Ecological Systems:
- Edwards Plateau Carbonate Glade and Barrens (CES303.655)
- Edwards Plateau Cliff (CES303.653)
- Edwards Plateau Dry-Mesic Slope Forest and Woodland (CES303.656)
- Edwards Plateau Floodplain Terrace (CES303.651)
- Edwards Plateau Limestone Savanna and Woodland (CES303.660)
- Edwards Plateau Limestone Shrubland (CES303.041)
- Edwards Plateau Riparian (CES303.652)
- Edwards Plateau Upland Depression (CES303.654)
- Llano Uplift Acidic Forest, Woodland and Glade (CES303.657)

Distribution

Range: Largely endemic to the Edwards Plateau ecoregion and occurs on canyon bottoms, mesic lower slopes and steep canyons, primarily in the Southern Balcones Escarpment, but also in the Eastern Balcones Escarpment.
Divisions: 303:C
Nations: US
Subnations: TX
Map Zones: 35:C
USFS Ecomap Regions: 255E:CC, 315D:CC
TNC Ecoregions: 29:C

Sources

References: Comer et al. 2003, Elliott 2011, Eyre 1980, TNC 2004b
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722669#references
Description Author: L. Elliott and K. Schulz, mod. J. Teague
Version: 24 Feb 2011 **Stakeholders:** Southeast, West
Concept Author: L. Elliott, K. Schulz **ClassifResp:** Southeast

FLORIDA LONGLEAF PINE SANDHILL (CES203.284)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Xeric; Very Short Disturbance Interval; Needle-Leaved Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2356; ESLF 4259; ESP 1356

CONCEPT

Summary: This system represents stands of *Pinus palustris* on excessively well-drained, sandy soils in the Outer Coastal Plain and adjacent Inner Coastal Plain of Florida. This includes the "high pine islands" of central Florida, as well as vegetation of extensive areas of sand in the Florida Panhandle, north of the Cody Scarp, including at Eglin Air Force Base (with greater than 100,000 hectares of this ecological system). In central Florida on the Ocala National Forest, these stands are found in relation with sand pine scrub vegetation. This system is represented by larger patches of *Pinus palustris* sandhills, generally ranging from 60 to 4000 hectares in size. In addition to the largest extent at Eglin Air Force Base, examples also occur on the Ocala National Forest, the southern end of the Lake Wales Ridge, the Brooksville Ridge, and in other parts of the Florida Peninsula. Fire is absolutely essential to maintain this system, without which it may be almost completely replaced by scrub vegetation, hardwood trees, *Pinus taeda*, or other non-*Pinus palustris*-dominated vegetation.

Related Concepts:
- Longleaf Pine: 70 (Eyre 1980) Finer
- Sandhill (FNAI 1990) Broader

DESCRIPTION

Environment: Surface soils tend to be coarse, with <5% composition of finer-textured particles (silt and clay), and very low organic content and low moisture-holding capacity. Soils are typically Entisols (Psamments), with very limited profile development. In the Florida Panhandle soils can be Ultisols. Some soil series associated with this system include the Astatula series (Kalisz 1982), as well as the Lakeland, Tavares, and Orsino series (Abrahamson et al. 1984). Candler is the most extensive soil on sandhills on the ridges of Central Florida (S. Carr pers. comm.) In some cases on the Ocala National Forest the soils may be unusually dark in color at the surface, which has been attributed, in part, to the presence of charcoal. Soils are strongly acidic (pH 4.7-5.0). Some Central Florida sites have silt or clay in the subsoil contributing to significantly higher extractable bases at the surface when compared to nearby scrub sites (Kalisz 1982). Excluded are areas with a "shallow sand cap" (K. Outcault pers. comm.). On Eglin Air Force Base in the western Florida Panhandle, this ecological system occurs on deep sands on the Citronelle Formation. Psamments are the dominant soil suborder in the areas of Florida where this system is found (NRCS n.d.).

Vegetation: Stands of this system typically lack a well-developed subcanopy, especially in contrast to surrounding *Pinus clausa* scrub vegetation. However, the shrub layer may be well-developed, even under frequent fire conditions, and appears to be dominated by sprouts of *Quercus laevis* and *Quercus myrtifolia*. A rich herbaceous layer is present. Characteristic species in this stratum are *Aristida beyrichiana* and *Licania michauxii*. In addition, a number of species found primarily in central Florida may also be present, among the most frequent of which is *Chapmannia floridana*. Other geographically limited species may include *Sabal etonia, Polygonella ciliata,* and *Arnoglossum floridanum*.

Dynamics: Fire is absolutely essential to maintain this system, without which it may be almost completely replaced by scrub vegetation (in the Florida Peninsula), hardwood trees, *Pinus taeda*, or other non-*Pinus palustris*-dominated vegetation.

Component Associations:
- *Bigelowia nuttallii - Schizachyrium scoparium - Eurybia hemispherica* Florida Sandstone Herbaceous Vegetation (CEGL004946, G1)
- *Pinus palustris / Quercus (incana, margarettiae) / Aristida beyrichiana - Asimina angustifolia* Woodland (CEGL008586, G2?)
- *Pinus palustris / Quercus (laevis, myrtifolia) / Aristida beyrichiana - Chapmannia floridana* Woodland (CEGL008569, G2)
- *Pinus palustris / Quercus laevis - Quercus geminata / Ceratiola ericoides* Woodland (CEGL004491, G1G2)
- *Pinus palustris / Quercus laevis / Aristida beyrichiana - Pityopsis aspera* Woodland (CEGL003583, G3)
- *Pinus palustris / Quercus laevis / Schizachyrium scoparium - Rhynchosia cytisoides* Woodland (CEGL003587, G3)

SPATIAL CHARACTERISTICS

Spatial Summary: This system represents larger patches of *Pinus palustris* Sandhills (in Florida), ranging from 60 to 4000 hectares in size.

Adjacent Ecological Systems:
- Central Florida Pine Flatwoods (CES203.382)
- Central Florida Wet Prairie and Herbaceous Seep (CES203.491)
- Florida Peninsula Inland Scrub (CES203.057)

Adjacent Ecological System Comments: Adjacent to Central Florida Wet Prairie and Herbaceous Seep (CES203.491) and Central Florida Pine Flatwoods (CES203.382). It can be surrounded by Florida Peninsula Inland Scrub (CES203.057).

DISTRIBUTION

Range: This ecological system is found in the Outer Coastal Plain and adjacent Inner Coastal Plain of Florida, including the central Florida Peninsula (Ocala National Forest, Brooksville Ridge, southern end of the Lake Wales Ridge) (Abrahamson et al. 1984) and the Florida Panhandle, mainly north of the Cody Scarp (e.g., Eglin Air Force Base).
Divisions: 203:C
Nations: US
Subnations: FL
Map Zones: 55:C, 56:C, 99:C
USFS Ecomap Regions: 232D:CC, 232G:CC, 232K:CC
TNC Ecoregions: 53:C, 55:C

SOURCES

References: Abrahamson et al. 1984, Brewer 2008, Carr et al. 2010, Comer et al. 2003, Eyre 1980, FNAI 1990, FNAI 2010a, Kalisz 1982, NatureServe 2011, NRCS n.d., Oswalt et al. 2012, Outcalt pers. comm., Wahlenberg 1946
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723204#references
Description Author: R. Evans and C. Nordman, mod. M. Pyne
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: R. Evans and C. Nordman **ClassifResp:** Southeast

GREAT BASIN PINYON-JUNIPER WOODLAND (CES304.773)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Lower Montane]; Foothill(s); Lowland [Foothill]; Piedmont; Plateau; Forest and Woodland (Treed); Ridge/Summit/Upper Slope; Aridic; Pinus monophylla, Juniperus osteosperma
Non-Diagnostic Classifiers: Sideslope; Temperate [Temperate Continental]; Alkaline Soil; Long Disturbance Interval; F-Patch/Medium Intensity
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2019; ESLF 4206; ESP 1019

CONCEPT

Summary: This ecological system occurs on dry mountain ranges of the Great Basin region and eastern foothills of the Sierra Nevada south in scattered locations throughout southern California. It is typically found at lower elevations ranging from 1600-2600 m. These woodlands occur on warm, dry sites on mountain slopes, mesas, plateaus and ridges. Severe climatic events occurring during the growing season, such as frosts and drought, are thought to limit the distribution of pinyon-juniper woodlands to relatively narrow altitudinal belts on mountainsides. Woodlands dominated by a mix of *Pinus monophylla* and *Juniperus osteosperma*, pure or nearly pure occurrences of *Pinus monophylla*, or woodlands dominated solely by *Juniperus osteosperma* comprise this system, but in some regions of southern California, *Juniperus osteosperma* is replaced by *Juniperus californica*. *Cercocarpus ledifolius* is a common associate. On the east slope of the Sierras in California, *Pinus jeffreyi* and *Juniperus occidentalis var. australis* may be components of these woodlands. Understory layers are variable. Associated species include shrubs such as *Arctostaphylos patula, Artemisia arbuscula, Artemisia nova, Artemisia tridentata, Cercocarpus ledifolius, Cercocarpus intricatus, Coleogyne ramosissima, Yucca brevifolia, Quercus gambelii, Quercus turbinella, Quercus john-tuckeri, Juniperus californica, Quercus chrysolepis*, and bunch grasses *Hesperostipa comata, Festuca idahoensis, Pseudoroegneria spicata, Leymus cinereus (= Elymus cinereus),* and *Poa fendleriana*. This system occurs at lower elevations than Colorado Plateau Pinyon-Juniper Woodland (CES304.767) where sympatric.
Similar Ecological Systems:
- Colorado Plateau Pinyon-Juniper Woodland (CES304.767)
- Inter-Mountain Basins Juniper Savanna (CES304.782)

Related Concepts:
- Juniper - Pinyon Woodland (412) (Shiflet 1994) Broader
- Pinyon - Juniper: 239 (Eyre 1980) Broader

Component Associations:
- *Juniperus osteosperma - (Pinus monophylla) / Arctostaphylos pungens* Woodland (CEGL005299, GNR)
- *Juniperus osteosperma - (Pinus monophylla) / Ceanothus greggii* Woodland (CEGL005300, GNR)
- *Juniperus osteosperma / Artemisia arbuscula* Woodland (CEGL002757, G5)
- *Juniperus osteosperma / Artemisia nova* / Rock Woodland (CEGL000729, G5)
- *Juniperus osteosperma / Artemisia nova* Woodland (CEGL000728, G5?)
- *Juniperus osteosperma / Artemisia tridentata / Achnatherum hymenoides* Woodland (CEGL000731, G4G5)
- *Juniperus osteosperma / Cercocarpus intricatus* Woodland (CEGL000733, GNR)
- *Juniperus osteosperma / Pseudoroegneria spicata* Woodland (CEGL000738, G4)
- *Juniperus osteosperma* / Sparse Understory Woodland (CEGL000732, GNRQ)
- *Pinus edulis - Juniperus osteosperma / Atriplex* spp. Woodland (CEGL002366, GNR)
- *Pinus edulis - Juniperus osteosperma* / Sparse Understory Woodland (CEGL002148, G5)
- *Pinus monophylla - Juniperus osteosperma - Quercus gambelii / Artemisia tridentata* Woodland (CEGL000837, G4?)
- *Pinus monophylla - Juniperus osteosperma / (Shepherdia rotundifolia, Amelanchier utahensis)* Woodland (CEGL002942, GNR)
- *Pinus monophylla - Juniperus osteosperma / Artemisia arbuscula* Woodland (CEGL000830, G5)
- *Pinus monophylla - Juniperus osteosperma / Artemisia nova* Woodland (CEGL000831, G5?)
- *Pinus monophylla - Juniperus osteosperma / Artemisia tridentata ssp. vaseyana / Pseudoroegneria spicata* Woodland (CEGL000833, G1)
- *Pinus monophylla - Juniperus osteosperma / Artemisia tridentata* Woodland (CEGL000832, G5?)
- *Pinus monophylla - Juniperus osteosperma / Bouteloua gracilis* Woodland (CEGL005396, GNR)
- *Pinus monophylla - Juniperus osteosperma / Cercocarpus ledifolius / Pseudoroegneria spicata* Woodland (CEGL000834, G1)
- *Pinus monophylla - Juniperus osteosperma / Cercocarpus ledifolius* Woodland (CEGL000828, G5)
- *Pinus monophylla - Juniperus osteosperma / Hesperostipa comata* Woodland (CEGL002969, GNR)
- *Pinus monophylla - Juniperus osteosperma / Leymus cinereus* Wooded Herbaceous Vegetation (CEGL000835, G1Q)
- *Pinus monophylla - Juniperus osteosperma / Prunus virginiana* Woodland (CEGL000836, G1Q)

- *Pinus monophylla - Juniperus osteosperma / Purshia stansburiana* Woodland (CEGL005397, GNR)
- *Pinus monophylla - Juniperus osteosperma / Quercus gambelii* Woodland (CEGL002968, GNR)
- *Pinus monophylla - Juniperus osteosperma / Quercus turbinella* Woodland (CEGL002941, GNR)
- *Pinus monophylla - Juniperus osteosperma* / Sparse Understory Woodland (CEGL000829, G5)
- *Pinus monophylla - Quercus gambelii / Artemisia tridentata* Woodland (CEGL000838, G4?)
- *Pinus monophylla / Amelanchier alnifolia / Arctostaphylos patula* Woodland (CEGL000826, G3G4)
- *Pinus monophylla / Artemisia tridentata* Woodland (CEGL000827, G5)
- *Pinus monophylla / Ribes velutinum* Woodland (CEGL003153, GNR)
- *Pinus monophylla / Symphoricarpos oreophilus - Artemisia tridentata* Woodland (CEGL000839, G5)
- *Pinus monophylla* Woodland (CEGL000825, G5)
- *Quercus turbinella - Juniperus osteosperma* Shrubland (CEGL000981, G4?)

DISTRIBUTION

Range: This system occurs on dry mountain ranges of the Great Basin region and eastern foothills of the Sierra Nevada, typically at lower elevations ranging from 1600-2600 m. It extends southwest in California to the northern Transverse Ranges (Ventura County) and San Jacinto Mountains (Riverside County).
Divisions: 206:C; 304:C
Nations: US
Subnations: AZ, CA, ID, NV, UT
Map Zones: 4:C, 6:C, 7:?, 9:C, 12:C, 13:C, 14:C, 15:C, 16:C, 17:C, 18:C, 23:C
USFS Ecomap Regions: 313A:CC, 322A:CC, 322B:CC, 341A:CC, 341D:CC, 341E:CC, 341F:CC, 341G:CC, 342B:CC, 342C:CC, 342D:CC, 342J:CC, M242C:??, M261D:C?, M261E:CC, M261G:CC, M331D:CC, M341A:CC, M341C:CC, M341D:CC
TNC Ecoregions: 6:C, 11:C, 12:C, 18:C, 19:C

SOURCES

References: Barbour and Major 1977, Comer et al. 2003, Holland and Keil 1995
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722899#references
Description Author: T. Keeler-Wolf and M.S. Reid
Version: 16 Jan 2009 **Stakeholders:** West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

HAWAI'I LOWLAND DRY FOREST (CES412.408)

CLASSIFIERS

Classification Status: Standard

Primary Division: Northern Polynesia (412)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland; Forest and Woodland (Treed); Tropical/Subtropical [Tropical Xeric]
Non-Diagnostic Classifiers: Broad-Leaved Evergreen Tree; Broad-Leaved Evergreen Shrub
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2813; ESLF 4291; ESP 1813

CONCEPT

Summary: This ecological system occurs on dry slopes of the main islands generally from 15-1000 m (50-3280 feet) elevation, but it may extend to 1500 m (4920 feet). Stands typically occur on the leeward sides of islands where there is a strong rainshadow effect from high mountains that reduce precipitation from moisture-laden trade winds. Annual rainfall is generally 500-2000 mm. Substrates include well-drained, sandy loam soils derived from volcanic ash or cinder and weathered 'a'Ã¢ or pÃ¢hoehoe basaltic lava. Vegetation is characterized by an open to dense tree layer typically dominated or codominated by a variety of mostly evergreen trees and diverse shrubs, ferns and lianas depending on location and age of stands. Lowland dry and mesic forests are exceptionally rich in tree species. Widespread species *Metrosideros polymorpha* is a constituent or may codominate in relatively young stands. Late-seral stands are dominated by *Diospyros sandwicensis* and, less commonly, *Colubrina oppositifolia*. In driest settings supporting trees, summer deciduous *Erythrina sandwicensis* may dominate. Presence of diagnostic tree species such as *Acacia koaia, Erythrina sandwicensis, Gardenia brighamii, Hibiscadelphus* spp., *Kokia* spp., *Nesoluma polynesicum, Reynoldsia sandwicensis*, or the shrubs *Achyranthes* spp., *Nototrichium* spp., or *Tephrosia* spp. indicate this dry lowland system. Other characteristics trees include *Canthium odoratum, Alphitonia ponderosa, Nestegis sandwicensis, Pleomele* spp., *Rauvolfia sandwicensis, Santalum* spp., *Sophora chrysophylla, Pouteria sandwicensis*, and *Sapindus oahuensis*. Native shrubs include *Dodonaea, Styphelia, Osteomeles, Sida, Waltheria, Nothocestrum* spp., *Myrsine lanaiensis, Wikstroemia* spp., *Plumbago zeylanica, Senna gaudichaudii, Plectranthus parviflorus (= Plectranthus australis), Lipochaeta* spp., *Tetramolopium* spp., and *Chamaesyce* spp. Native vines include *Ipomoea* spp., *Bonamia menziesii*, and *Canavalia* spp. Native ferns include *Doryopteris* and *Pellaea ternifolia*. Almost all native lowland dry forests have been degraded and include some invasive exotic woody species such as *Lantana camara, Leucaena leucocephala, Schinus terebinthifolius*, and widespread exotic grasses such as *Andropogon virginicus, Pennisetum setaceum*, and *Schizachyrium condensatum*. Where substrate is rocky, lichens are often common.

Similar Ecological Systems:

- Hawai'i Montane-Subalpine Dry Forest and Woodland (CES412.402)

DESCRIPTION

Environment: This lowland ecological system occurs over a broad moisture range from very dry to seasonally mesic zones (Zones 2, 3, and 4) of the 7 Moisture Zones developed for the Hawaiian Islands by Price et al. (2007). It occurs on dry slopes of the main islands generally from 15-1000 m (50-3280 feet) elevation, but it may extend to 1500 m (4920 feet) (Gagne and Cuddihy 1990). Stands typically occur on the leeward sides of islands where there is a strong rainshadow effect from high mountains that reduce precipitation from moisture-laden trade winds. Annual rainfall is generally 500-2000 mm. Substrates include well-drained, sandy loam soils derived from volcanic ash or cinder and weathered 'a'Ã¢ or pÃ¢hoehoe basaltic lava.

Vegetation: Vegetation is characterized by an open to dense tree layer typically dominated or codominated by a variety of mostly evergreen trees and diverse shrubs, ferns and lianas depending on location and age of stands. Lowland dry and mesic forests are exceptionally rich in tree species. Widespread species *Metrosideros polymorpha* is a constituent or may codominate in relatively young stands. Late-seral stands are dominated by *Diospyros sandwicensis* and, less commonly, *Colubrina oppositifolia*. In driest settings supporting trees, summer deciduous *Erythrina sandwicensis* may dominate. Presence of diagnostic tree species such as *Acacia koaia, Erythrina sandwicensis, Gardenia brighamii, Hibiscadelphus* spp., *Kokia* spp., *Nesoluma polynesicum, Reynoldsia sandwicensis*, or the shrubs *Achyranthes* spp., *Nototrichium* spp., or *Tephrosia* spp. indicate this dry lowland system. Other characteristics trees include *Canthium odoratum, Alphitonia ponderosa, Nestegis sandwicensis, Pleomele* spp., *Rauvolfia sandwicensis, Santalum* spp., *Sophora chrysophylla, Pouteria sandwicensis*, and *Sapindus oahuensis*. Native shrubs include *Dodonaea, Styphelia, Osteomeles, Sida, Waltheria, Nothocestrum* spp., *Myrsine lanaiensis, Wikstroemia* spp., *Plumbago zeylanica, Senna gaudichaudii, Plectranthus parviflorus (= Plectranthus australis), Lipochaeta* spp., *Tetramolopium* spp., and *Chamaesyce* spp. Native vines include *Ipomoea* spp., *Bonamia menziesii*, and *Canavalia* spp. Native ferns include *Doryopteris* and *Pellaea ternifolia*. Almost all native lowland dry forests have been degraded and include some invasive exotic woody species such as *Lantana camara, Leucaena leucocephala, Schinus terebinthifolius*, and widespread exotic grasses such as *Andropogon virginicus, Pennisetum setaceum*, and *Schizachyrium condensatum*. Where substrate is rocky, lichens are often common.

Dynamics: Severe weather (windthrow), drought, fire, landslides, and rats could all suppress reproduction or induce gaps, lowering tree cover; repeated fire could convert forest to shrubland and grassland. Wood harvested from dry forest for fuel could open closed forest.

Component Associations:
- *Acacia koaia* Lowland Dry Forest (CEGL008024, G1)
- *Diospyros sandwicensis - Colubrina oppositifolia* Lowland Dry Forest (CEGL008025, G1)
- *Diospyros sandwicensis* Lowland Dry Forest (CEGL008027, G3)
- *Erythrina sandwicensis* Lowland Dry Woodland (CEGL008036, G3)
- *Metrosideros polymorpha* Lowland Dry Forest (CEGL008029, G3)
- *Nestegis sandwicensis / Diospyros sandwicensis* Lowland Dry Forest (CEGL008031, G1)
- *Sapindus oahuensis* Lowland Dry Forest (CEGL008015, G1)

DISTRIBUTION

Range: This lowland forest ecological system occurs on dry slopes of the main Hawai'ian Islands, except for Kaho'olawe.
Divisions: 412:C
Nations: US
Subnations: HI
Map Zones: 79:C
USFS Ecomap Regions: M423:C
TNC Ecoregions: 65:C

SOURCES

References: Gagne and Cuddihy 1990, Mueller-Dombois and Fosberg 1998, Price et al. 2007, Wagner et al. 1999, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.821120#references
Description Author: K.A. Schulz, mod. S. Gon III
Version: 02 Feb 2009 **Stakeholders:** West
Concept Author: K.A. Schulz **ClassifResp:** West

HAWAI'I LOWLAND MESIC FOREST (CES412.411)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Northern Polynesia (412)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland; Forest and Woodland (Treed); Tropical/Subtropical [Tropical Pluviseasonal]
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2814; ESLF 4292; ESP 1814

CONCEPT

Summary: This ecological system occurs on mesic slopes of Hawai'i, Moloka'i, Maui, Kaua'i and O'ahu, from 30 to 1500 m (100-4920 feet) elevation, typically from 250 to1000 m (820-3280 feet). Stands are found in the mesic seasonal zone between the dry leeward and wet windward climates. Sites are considered mesic; too dry to support rainforests, but typically do not experience extended periods of drought like the dry forests. These mesic sites have relatively even precipitation throughout the year or have a distinct, seasonally dry period. Annual rainfall is 1200-2500 mm (47-98 inches) and falls largely from October to March. Substrates are highly variable but are generally well-drained and include steep, rocky talus, shallow to deep soils over weathered rock and gravelly alluvium, rocky shallow organic muck. Vegetation is variable, ranging from an open to dense, mostly evergreen tree layer 2-20 m tall. There is often diverse canopy, subcanopy and tall-shrub layers with lianas. As with lowland dry forest, tree diversity is very high. *Metrosideros polymorpha, Acacia koa, Diospyros sandwicensis, Nestegis sandwicensis, Pleomele* spp., and *Pritchardia kaalae* dominate or codominate. Diagnostic species of this system include the trees *Antidesma pulvinatum, Cryptocarya mannii, Alectryon macrococcus, Charpentiera* spp., *Flueggea neowawraea, Rhus sandwicensis, Pisonia* spp., and shrub and vine species *Ctenitis squamigera, Doodia* spp., and *Strongylodon ruber*. Other characteristic species in these diverse mesic forests may include *Antidesma platyphyllum, Bobea* spp., *Coprosma* spp., *Gardenia* spp., *Hibiscus* spp., *Melicope* spp., *Myrsine* spp., *Nothocestrum* spp., *Psychotria* spp., *Ochrosia* spp., *Pandanus tectorius, Pipturus albidus, Pittosporum* spp., *Rauvolfia* spp., *Santalum* spp., *Syzygium sandwicense, Xylosma hawaiiensis, Tetraplasandra* spp., *Zanthoxylum hawaiiense*, and drier forest species such as *Chamaesyce celastroides, Sophora chrysophylla*, and *Myoporum sandwicense*. The understory is variable and may be dominated by sedges and ferns or shrubs. The tree fern *Cibotium* spp. is typically absent. Common shrubs and vines include *Alyxia oliviformis, Cyanea* spp., *Delissea* spp., *Dodonaea viscosa, Eugenia* spp., *Freycinetia arborea, Hedyotis* spp., *Lobelia* spp., *Styphelia tameiameiae*, and *Vaccinium dentatum*. Common ferns and fern allies present are *Asplenium nidus, Dicranopteris linearis, Pteris* spp., and graminoids *Carex* spp. Exotic trees *Morella faya, Psidium* spp., and *Schinus terebinthifolius* are often present in disturbed stands. Fire-adapted exotic grasses such as *Oplismenus hirtellus* and *Pennisetum setaceum* are invasive and threaten these forests by increasing fire intensity, frequency and size.

Similar Ecological Systems:

- Hawai'i Mesic Coastal Forest (CES412.417)

DESCRIPTION

Environment: This lowland ecological system occurs mostly within the seasonally mesic and moist mesic zones (Zones 4 and 5) of the 7 Moisture Zones developed for the Hawaiian Islands by Price et al. (2007), but may extend into the moderately dry (Zone 3) at lower elevation (<300 m). This ecological system occurs on mesic slopes of Hawai'i, Moloka'i, Maui, Kaua'i and O'ahu, from 30 to 1500 m (100-4920 feet) elevation, typically from 250 to1000 m (820-3280 feet). Stands are found in the mesic seasonal zone between the dry leeward and wet windward climates. Sites are considered mesic; too dry to support rainforests, but typically do not experience extended periods of drought like the dry forests. These mesic sites have relatively even precipitation throughout the year or have a distinct, seasonally dry period. Annual rainfall is 1200-2500 mm (47-98 inches) and falls largely from October to March. Substrates are highly variable but are generally well-drained and include steep, rocky talus, shallow to deep soils over weathered rock and gravelly alluvium, and rocky shallow organic muck.

Vegetation: Vegetation is variable, ranging from an open to dense, mostly evergreen tree layer 2-20 m tall. There is often diverse canopy, subcanopy and tall-shrub layers with lianas. As with lowland dry forest, tree diversity is very high. *Metrosideros polymorpha, Acacia koa, Diospyros sandwicensis, Nestegis sandwicensis, Pleomele* spp., and *Pritchardia kaalae* dominate or codominate. Diagnostic species of this system include the trees *Antidesma pulvinatum, Cryptocarya mannii, Alectryon macrococcus, Charpentiera* spp., *Flueggea neowawraea, Rhus sandwicensis, Pisonia* spp., and shrub and vine species *Ctenitis squamigera, Doodia* spp., and *Strongylodon ruber*. Other characteristic species in these diverse mesic forests may include *Antidesma platyphyllum, Bobea* spp., *Coprosma* spp., *Gardenia* spp., *Hibiscus* spp., *Melicope* spp., *Myrsine* spp., *Nothocestrum* spp., *Psychotria* spp., *Ochrosia* spp., *Pandanus tectorius, Pipturus albidus, Pittosporum* spp., *Rauvolfia* spp., *Santalum* spp., *Syzygium sandwicense, Xylosma hawaiiensis, Tetraplasandra* spp., *Zanthoxylum hawaiiense*, and drier forest species such as *Chamaesyce celastroides, Sophora chrysophylla*, and *Myoporum sandwicense*. The understory is variable and may be dominated by sedges and ferns or shrubs. The tree fern *Cibotium* spp. is typically absent. Common shrubs and vines include *Alyxia oliviformis, Cyanea* spp., *Delissea* spp., *Dodonaea viscosa, Eugenia* spp., *Freycinetia arborea, Hedyotis* spp., *Lobelia* spp., *Styphelia tameiameiae*, and *Vaccinium dentatum*. Common ferns and fern allies present are *Asplenium nidus, Dicranopteris linearis, Pteris* spp., and graminoids *Carex* spp. Exotic trees *Morella faya, Psidium*

spp., and *Schinus terebinthifolius* are often present in disturbed stands. Fire-adapted exotic grasses such as *Oplismenus hirtellus* and *Pennisetum setaceum* are invasive and threaten these forests by increasing fire intensity, frequency and size.

Component Associations:
- *Acacia koa - Metrosideros polymorpha* Lowland Mesic Forest (CEGL008023, G3)
- *Acacia koa / Dodonaea viscosa* Lowland Mesic Forest (CEGL008022, G3)
- *Diospyros sandwicensis - Metrosideros polymorpha* Lowland Mesic Forest (CEGL008026, G3)
- *Diospyros sandwicensis* Lowland Mesic Forest (CEGL008028, G3)
- *Metrosideros polymorpha / Dicranopteris linearis* Lowland Wet Woodland (CEGL008039, G3)
- *Metrosideros polymorpha* Lowland Mesic Forest (CEGL008030, G3)
- *Nestegis sandwicensis* Lowland Mesic Forest (CEGL008010, G2)
- *Pleomele auwahiensis* Lowland Mesic Woodland (CEGL008045, G1)
- *Pouteria sandwicensis - Bobea sandwicensis - Antidesma pulvinatum* Forest (CEGL008012, G1)
- *Pouteria sandwicensis - Cryptocarya mannii - Diospyros sandwicensis* Forest (CEGL008013, G1)
- *Pouteria sandwicensis - Pittosporum confertiflorum - Diospyros sandwicensis* Forest (CEGL008014, G1)
- *Pouteria sandwicensis - Pleomele auwahiensis - Nothocestrum latifolium* Woodland (CEGL008046, G1)
- *Pritchardia kaalae* Lowland Mesic Forest (CEGL008034, G1)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Hawai'i Lowland Mesic Shrubland (CES412.412)
- Hawai'i Mesic Coastal Forest (CES412.417)

DISTRIBUTION

Range: This forest ecological system occurs on mesic slopes of Hawai'i, Moloka'i, Maui, Kaua'i and O'ahu.
Divisions: 412:C
Nations: US
Subnations: HI
Map Zones: 79:C
USFS Ecomap Regions: M423:C
TNC Ecoregions: 65:C

SOURCES

References: Gagne and Cuddihy 1990, Mueller-Dombois and Fosberg 1998, Price et al. 2007, Wagner et al. 1999, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.821132#references
Description Author: K.A. Schulz, mod. S. Gon III
Version: 02 Feb 2009 **Stakeholders:** West
Concept Author: K.A. Schulz **ClassifResp:** West

HAWAI'I LOWLAND RAINFOREST (CES412.226)

CLASSIFIERS

Classification Status: Standard

Primary Division: Northern Polynesia (412)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland; Forest and Woodland (Treed); Tropical/Subtropical [Tropical Pluvial]; Broad-Leaved Evergreen Tree; Tree Fern
Non-Diagnostic Classifiers: Sideslope; Toeslope/Valley Bottom
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2808; ESLF 4293; ESP 1808

CONCEPT

Summary: Hawai'i Lowland Rainforest occurs on all the main islands except Ni'ihau and Kaho'olawe. Lowland wet forests are thought to have been the predominant original vegetation of the windward lowlands on the larger main islands. The system typically occurs on windward slopes high enough to intercept orographic rainfall resulting from rising moist tradewind air, but also occurs in a relatively narrow high precipitation band on the leeward side of the Big Island resulting from Kona storms. Soils vary throughout the island chain, from gray acidic clays on older islands to thin organic mucks over lava flows and ash beds on Hawai'i. The canopy is dominated by *Metrosideros polymorpha* or, in some forests, by *Acacia koa* where it attains heights up to 40 m. On some islands, this system forms a distinct belt above *Acacia*-dominated mesic forest. Diversity in the lowland rainforest is high, and *Metrosideros* and *Acacia* at times form an emergent layer over a diverse layer of native trees and an understory of native ferns, herbs, shrubs and vines. Important taxa in this rainforest system include *Alyxia oliviformis, Antidesma platyphyllum, Broussaisia arguta, Cheirodendron* spp., *Cibotium* spp., *Coprosma* spp., *Cyrtandra* spp., *Dicranopteris linearis, Diospyros sandwicensis, Freycinetia arborea, Hedyotis* spp., *Ilex anomala, Korthalsella* spp., *Machaerina* spp., *Melicope* spp., *Myrsine* spp., *Peperomia* spp., *Pittosporum* spp., *Psychotria* spp., *Sadleria* spp., *Smilax melastomifolia*, and in some areas *Pritchardia* spp. Native trees that occur in the understory include *Psychotria hawaiiensis* (kopiko) and *Antidesma platyphyllum* (hame). The endemic liana (*Freycinetia arborea*) is often abundant in these forests. Species that act as epiphytes include *Astelia menziesiana, Peperomia* spp., *Adenophorus, Huperzia*, and *Elaphoglossum* spp.

In the upper reaches of the lowland ohi'a forest on the island of Hawai'i, the understory is dominated by tree ferns or *Cibotium* spp. (hapu'u) which form a distinct closed layer beneath the trees. A more open *Metrosideros* forest with other scattered native trees and a dense ground cover of the indigenous mat-forming *Dicranopteris linearis* (uluhe) and other related ferns (*Diplopterygium pinnatum, Sticherus owhyensis*) is seen on steep ridges and valley walls of Kaua'i, O'ahu, Moloka'i, Maui, and the Kohola Mountains of Hawai'i Island. *Freycinetia, Antidesma platyphyllum, Perrottetia*, and *Bobea* are constituents restricted largely to the lowland zone.
Classification Comments: The boundary between the lowland and montane wet forests in Hawai'i is not generally agreed upon by all botanists and ecologists, and it may be variable on different islands. A clear picture of pre-human vegetation is complicated by the extreme disturbance the lowlands have suffered. Nonetheless, roughly 1000 m elevation marks the transition between the warmer lowlands and the cooler montane zone.

DESCRIPTION

Environment: Hawai'i Lowland Rainforest occurs on all the main islands except Ni'ihau and Kaho'olawe. Lowland wet forests are thought to have been the predominant original vegetation of the windward lowlands on the larger main islands. The system typically occurs on windward slopes high enough to intercept orographic rainfall resulting from rising moist tradewind air, but also occurs in a relatively narrow high precipitation band on the leeward side of the Big Island resulting from Kona storms. Climate is moderately wet to very wet (Zones 6 and 7) of the 7 Moisture Zones developed for the Hawaiian Islands by Price et al. (2007). Elevations range from 100-1200 m (328-3935 feet). Annual rainfall ranges from 1500 to over 5000 mm, sometimes less on sheltered sites. Soils vary throughout the island chain, from gray acidic clays on older islands to thin organic mucks over lava flows and ash beds on Hawai'i.
Vegetation: The canopy is dominated by *Metrosideros polymorpha* or, in some forests, by *Acacia koa* where it attains heights up to 40 m. On some islands, this system forms a distinct belt above *Acacia*-dominated mesic forest. Diversity in the lowland rainforest is high, and *Metrosideros* and *Acacia* at times form an emergent layer over a diverse layer of native trees beneath the *Metrosideros* canopy, and an understory of native ferns, herbs, shrubs and vines, including *Alyxia oliviformis, Antidesma platyphyllum, Broussaisia arguta, Cheirodendron* spp., *Cibotium* spp., *Coprosma* spp., *Cyrtandra* spp., *Dicranopteris linearis, Diospyros sandwicensis, Freycinetia arborea, Hedyotis* spp., *Ilex anomala, Korthalsella* spp., *Machaerina* spp., *Melicope* spp., *Myrsine* spp., *Peperomia* spp., *Pittosporum* spp., *Psychotria* spp., *Sadleria* spp., *Smilax melastomifolia*, and in some areas *Pritchardia* spp. Native trees that occur in the understory include *Psychotria hawaiiensis* (kopiko) and *Antidesma platyphyllum* (hame). The endemic *Freycinetia arborea* (liama) is often abundant in these forests. Species that act as epiphytes include *Astelia menziesiana, Peperomia* spp., *Adenophorus, Huperzia*, and *Elaphoglossum* spp. In the upper reaches of the lowland ohi'a forest on the island of Hawai'i, the understory is dominated by tree ferns or *Cibotium* spp. (hapu'u) which form a distinct closed layer beneath the trees. A more open *Metrosideros* forest with other scattered native trees and a dense ground cover of the indigenous mat-forming *Dicranopteris linearis* (uluhe) and other related ferns (*Diplopterygium pinnatum, Sticherus owhyensis*) is seen on steep ridges and valley walls of Kaua'i, O'ahu, Moloka'i, Maui, and the Kohola Mountains of Hawai'i Island (Cuddihy and Stone 1990). *Freycinetia, Antidesma platyphyllum,*

Perrottetia, and *Bobea* are constituents restricted largely to the lowland zone.
Dynamics: The lowland wet forest historically (pre-Polynesian times) was more widespread below 1000 m (3280 feet) elevation on the larger islands in windward areas with deep soils before being subjected to cultivation by Hawaiians. Where lands cultivated by Hawaiians were not subsequently used for agriculture, grazing, or urban development, they were invaded by species of Polynesian introduction, particularly *Aleurites moluccana* (kukui) and by later post-European introductions such as *Psidium cattleianum* (strawberry guava). Disturbances in this system include landslides in wet valleys, flood, lava flows, storms, rat predation, and fire. Major storms, particularly hurricanes will often open up the tree canopy. Although most of the species found in the tree canopy, subcanopy, and understory will still be present, *Dicranopteris linearis*, and taxa such as *Cibotium* and *Sadleria* may temporarily increase in cover because of the increased light levels with the more open canopy.

Component Associations:
- *Acacia koa / Metrosideros polymorpha - Dicranopteris linearis* Lowland Wet Forest (CEGL008005, G3)
- *Dicranopteris linearis* Wet Herbaceous Mat (CEGL008048, G4)
- *Metrosideros polymorpha / Cheirodendron* spp. Lowland Wet Forest (CEGL008000, G3)
- *Metrosideros polymorpha / Cibotium* spp. Lowland Wet Forest (CEGL008001, G3)
- *Metrosideros polymorpha / Dicranopteris* spp. Lowland Wet Shrubland (CEGL008049, G3)
- *Metrosideros polymorpha / Freycinetia arborea* Lowland Wet Forest (CEGL008002, G3)
- *Metrosideros polymorpha / Pandanus tectorius* Lowland Wet Forest (CEGL008003, G3)
- *Pritchardia martii* Lowland Wet Forest (CEGL008004, G2)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Hawai'i Montane Rainforest (CES412.215)

DISTRIBUTION

Range: This system occurs at 100 to 1200 m (328-3940 feet) elevation on Kaua'i, O'ahu, Moloka'i, LÃ¢na'i, Maui, and Hawai'i.
Divisions: 412:C
Nations: US
Subnations: HI
Map Zones: 79:C
USFS Ecomap Regions: M423:C
TNC Ecoregions: 65:C

SOURCES

References: Cuddihy and Stone 1990, Gagne and Cuddihy 1990, Mueller-Dombois and Fosberg 1998, Price et al. 2007, Wagner et al. 1999, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.770662#references
Description Author: M. Castillo, mod. D. Johnson, J. Jacobi, S. Gon, K.A. Schulz
Version: 06 Aug 2009 **Stakeholders:** West
Concept Author: M. Castillo and G. Kittel **ClassifResp:** West

HAWAI'I MESIC COASTAL FOREST (CES412.417)

CLASSIFIERS

Classification Status: Standard

Primary Division: Northern Polynesia (412)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Shoreline; Tropical/Subtropical [Tropical Pluviseasonal]; Salt Spray; Coast
Non-Diagnostic Classifiers: Lowland [Lowland]; Beach (Substrate)
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2812; ESLF 4294; ESP 1812

CONCEPT

Summary: This ecological system is restricted to the windward sides of the larger main islands that intercept sufficient orographic rainfall to maintain a forest condition, yet are influenced strongly by coastal factors such as salt spray. A few representatives can be found in the northwestern Hawaiian Islands. Coastal mesic volcanic substrates are often dominated by *Pandanus tectorius* (hala). Native plant associates in coastal mesic forest may include coastal shrubs, forbs and grasses. They are now relatively uncommon, having been largely replaced by alien species, but a diverse flora once likely existed. Remnant native constituents such as *Lipochaeta succulenta* (nehe) may dominate the understory and forest edges. In areas with annual rainfall of 1800-3800 mm on Hawai'i, recent lava flows exposed to salt spray are believed to have undergone succession involving eventual replacement of colonizing *Metrosideros polymorpha* (Ã´hi'a) by hala. Included in this system are the highly fragmented *Pritchardia* (loula) coastal forests, which occur on windward sea cliffs of Moloka'i, Huelo Islet, and Nihoa Island in the northwestern Hawaiian Islands.
Classification Comments: Planted coconut groves occur after Hawaiian colonization.
Similar Ecological Systems:
- Hawai'i Dry Coastal Strand (CES412.418)
- Hawai'i Lowland Mesic Forest (CES412.411)
- Hawai'i Wet-Mesic Coastal Strand (CES412.419)

DESCRIPTION

Environment: This mesic coastal forest ecological system occurs within the moderately dry, seasonal mesic, moist mesic, and moderately wet zones (Zones 3, 4, 5 and 6) of the 7 Moisture Zones developed for the Hawaiian Islands by Price et al. (2007). This ecological system is restricted to the windward sides of the larger main islands that intercept sufficient orographic rainfall to maintain a forest condition, yet are influenced strongly by coastal factors such as salt spray. A few representatives can be found in the northwestern Hawaiian Islands. Coastal mesic volcanic substrates are often dominated by *Pandanus tectorius* (hala).
Vegetation: Native plant associates in coastal mesic forest may include coastal shrubs, forbs and grasses. They are now relatively uncommon, having been largely replaced by alien species, but a diverse flora once likely existed. Remnant native constituents such as *Lipochaeta succulenta* (nehe) may dominate the understory and forest edges. In areas with annual rainfall of 1800-3800 mm on Hawai'i, recent lava flows exposed to salt spray are believed to have undergone succession involving eventual replacement of colonizing *Metrosideros polymorpha* (Ã´hi'a) by *Pandanus tectorius* (hala) (Atkinson 1970, as cited in Wagner et al. 1999).

Component Associations:
- *Pandanus tectorius* Coastal Mesic Forest (CEGL008032, G3)
- *Pritchardia hillebrandii* Coastal Mesic Forest (CEGL008033, G1)
- *Pritchardia remota* Coastal Dry Forest (CEGL008035, G1)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Hawai'i Dry Coastal Strand (CES412.418)
- Hawai'i Lowland Mesic Forest (CES412.411)
- Hawai'i Wet-Mesic Coastal Strand (CES412.419)

Adjacent Ecological System Comments: This system occurs adjacent to lowland mesic forest and may grade into it; both include a component of *Pandanus*, but this coastal forest is influenced by coastal spray/salinity-adapted species.

DISTRIBUTION

Range: This ecological system is known from the windward sides of the larger main islands that intercept sufficient orographic rainfall to maintain a forest condition, yet are influenced strongly by coastal factors such as salt spray. It also occurs on cliffs of Huelo Islet, Moloka'i, and Nihoa Island in the northwestern Hawai'ian Islands.
Divisions: 412:C
Nations: US
Subnations: HI
Map Zones: 79:C
USFS Ecomap Regions: M423:C

TNC Ecoregions: 65:C

SOURCES

References: Atkinson 1970, Gagne and Cuddihy 1990, Price et al. 2007, Wagner et al. 1999, Western Ecology Working Group n.d.

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.821167#references

Description Author: G. Kittel, mod. S. Gon III and K.A. Schulz

Version: 03 Feb 2009 **Stakeholders:** West

Concept Author: G. Kittel **ClassifResp:** West

HAWAI'I MONTANE CLOUD FOREST (CES412.217)

CLASSIFIERS

Classification Status: Standard

Primary Division: Northern Polynesia (412)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch, Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane; Forest and Woodland (Treed); Ridge; Ridge/Summit/Upper Slope; Tropical/Subtropical [Tropical Pluvial]; Tree Fern; Epiphyte
Non-Diagnostic Classifiers: Broad-Leaved Evergreen Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2809; ESLF 4295; ESP 1809

CONCEPT

Summary: Hawai'i Montane Cloud Forest occurs between 1065 and 1830 m (3500-6000 feet) elevation as a large-patch mosaic on windward aspects of all the high islands that receive evenly distributed orographically derived rainfall exceeding 2500 mm (99 inches) annually. Montane cloud forests are defined by the regular presence of clouds, low stature of the tree canopy, the abundance of epiphytes, and the significant proportion by which those passing clouds contribute fog water (fog drip) to total annual precipitation (up to 1073 mm [42 inches]). Regular fog drip sustains relatively constant streamflow and shallow groundwater hydrology in montane forests, particularly during dry seasons. Hawai'i cloud forests occur on older volcanic substrates that are nutrient-poor and lateritic due to leaching. They generally have a gley layer 10 to 70 cm (4-28 inches) thick with an organic overlay that varies from 10 to 30 cm (4-12 inches) deep. This ecological system is rich in species, with multiple species represented in each of several genera of shrubs and ferns. Vegetation is dominated by low-statured *Metrosideros polymorpha* and *Cheirodendron* spp. (specifically *Cheirodendron platyphyllum* on O'ahu and *Cheirodendron dominii* on Kaua'i), which form a low to medium-height canopy from 3 to 40 m tall. Subdominant tree species include *Ilex anomala, Alyxia oliviformis*, and shrubs *Clermontia* spp., *Cyanea* spp., *Dubautia platyphylla, Korthalsella* spp., *Myrsine* spp., *Trematolobelia* spp., *Smilax melastomifolia, Stenogyne* spp., *Phyllostegia* spp., and *Vaccinium* sp. This system supports an abundance of epiphytic shrubs, ferns, mosses and bryophytes. Species that act as epiphytes include *Astelia menziesiana, Peperomia* spp., and thick mats of bryophytes. Ferns include *Dicranopteris linearis, Cibotium* spp., *Astelia, Adenophorus* and *Elaphoglossum* spp. Cloud forests are distinguished from montane rainforests by the presence of a low-statured tree canopy and the ground-level clouds for a portion of nearly every day. Cloud forests generally support more epiphytes than montane rainforests.
Classification Comments: Hawai'i Montane Cloud Forest is similar to Hawai'i Montane Rainforest (CES412.215), but this community is generally found only on wet wind-exposed upper slopes of the major Hawaiian Islands and is characterized by a low-statured tree canopy and thick mats of bryophytes and epiphytes.
Similar Ecological Systems:
- Hawai'i Montane Rainforest (CES412.215)

DESCRIPTION

Environment: Hawai'i Montane Cloud Forest occurs between 1065 and 1830 m (3500-6000 feet) elevation as a large-patch mosaic on windward aspects of all the high islands that receive evenly distributed orographically derived rainfall exceeding 2500 mm (99 inches) annually. Climate is generally very wet (Zone 7) of the 7 Moisture Zones developed for the Hawaiian Islands by Price et al. (2007). Montane cloud forests are defined by the regular presence of clouds, low stature of the tree canopy, the abundance of epiphytes, and the significant proportion by which those passing clouds contribute fog water (fog drip) to total annual precipitation (up to 1073 mm [42 inches]). Regular fog drip sustains relatively constant streamflow and shallow groundwater hydrology in montane forests, particularly during dry seasons. Hawai'i cloud forests occur on older volcanic substrates that are nutrient-poor and lateritic due to leaching. They generally have a gley layer 10 to 70 cm (4-28 inches) thick with an organic overlay that varies from 10 to 30 cm (4-12 inches) deep.
Vegetation: This ecological system is rich in species, with multiple species represented in each of several genera of shrubs and ferns. Vegetation is dominated by low-statured *Metrosideros polymorpha* and *Cheirodendron* spp. (specifically *Cheirodendron platyphyllum* on O'ahu and *Cheirodendron dominii* on Kaua'i), which form a low to medium-height canopy from 3 to 40 m tall. Subdominant tree species include *Ilex anomala, Alyxia oliviformis*, and shrubs *Clermontia* spp., *Cyanea* spp., *Dubautia platyphylla, Korthalsella* spp., *Myrsine* spp., *Trematolobelia* spp., *Smilax melastomifolia, Stenogyne* spp., *Phyllostegia* spp., and *Vaccinium* sp. This system supports an abundance of epiphytic shrubs, ferns, mosses and bryophytes. Species that act as epiphytes include *Astelia menziesiana, Peperomia* spp., and thick mats of bryophytes. Ferns include *Dicranopteris linearis, Cibotium* spp., *Astelia, Adenophorus* and *Elaphoglossum* spp.
Dynamics: The major disturbance factors in this system are from climatic factors, particularly hurricanes and drought. After a hurricane, the tree canopy will be opened up, although most of the species found in the tree canopy, subcanopy, and understory will still be present. Species such as *Dicranopteris linearis* may temporarily increase in cover because of the increased light levels with the more open canopy.

Component Associations:

- *Metrosideros polymorpha - Cheirodendron trigynum* / (*Cibotium* spp.) Montane Wet Forest (CEGL008008, G3)
- *Metrosideros polymorpha / Cibotium* spp. Montane Wet Forest (CEGL008009, G3)
- *Metrosideros polymorpha* / Mixed Shrub Montane Wet Forest (CEGL008007, G3)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Hawai'i Montane Rainforest (CES412.215)

DISTRIBUTION

Range: This system is found from 1065 to 1830 m (3500-6000 feet) elevation on Kaua'i, O'ahu, Moloka'i, Maui, and Hawai'i.
Divisions: 412:C
Nations: US
Subnations: HI
Map Zones: 79:C
USFS Ecomap Regions: M423:C
TNC Ecoregions: 65:C

SOURCES

References: Gagne and Cuddihy 1990, Mueller-Dombois and Fosberg 1998, Price et al. 2007, Scholl et al. 2002, Scholl et al. 2004, Wagner et al. 1999, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.770635#references
Description Author: M. Castillo, mod. K.A. Schulz
Version: 05 Mar 2009 **Stakeholders:** West
Concept Author: M. Castillo and G. Kittel **ClassifResp:** West

HAWAI'I MONTANE RAINFOREST (CES412.215)

CLASSIFIERS

Classification Status: Standard

Primary Division: Northern Polynesia (412)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane; Forest and Woodland (Treed); Tropical/Subtropical [Tropical Pluvial]; Tree Fern; Epiphyte
Non-Diagnostic Classifiers: Mountainside; Sideslope; Broad-Leaved Evergreen Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2810; ESLF 4296; ESP 1810

CONCEPT

Summary: Hawai'i Montane Rainforest encompasses a mosaic of rainforest and shrublands between 1100 and 2200 m (3600-7000 feet) elevation on all of the high islands. Montane rainforest occurs as a large-patch mosaic on windward areas that receive evenly distributed orographically derived rainfall exceeding 2500 mm (99 inches) annually. Stands also occur in a relatively narrow high precipitation band on the leeward side of the Big Island resulting from Kona storms. The climate is warm, with frequent afternoon fog often generating fog drip. Soils generally have a gley horizon 10 to 70 cm (4-28 inches) deep, underlain by lateritic weathered basalt and overlain with organic hummus ranging from 10 to 30 cm (4-12 inches) deep.

Across the range of the ecological system, vegetation varies in height, structural complexity and species richness. Forests can be dominated by *Metrosideros polymorpha, Cibotium* spp. (tree fern) in some areas, or by a tall, well-stratified canopy of *Acacia koa* (koa) in other areas. At higher elevations on Maui and Hawai'i, *Metrosideros* forms a 5- to 8-m canopy that is relatively simple floristically. Canopy height becomes as low as 2 m in poorly drained areas and along bog margins. At the lower elevational limit, montane rainforests merge with Hawai'i Lowland Rainforest (CES412.226). At the upper elevational limit on Hawai'i and Maui, they quickly grade into *Acacia / Sophora* forest and other mesic communities. Montane rainforests frequently support a large mass of epiphytic mosses, ferns, and other plants. Common codominant and associated species include *Cheirodendron* spp., *Astelia menziesiana, Carex alligata, Clermontia* spp., *Cyrtandra* spp., *Dicranopteris* spp., *Psychotria* spp., *Pteridium aquilinum, Rubus* spp., *Urera glabra*, and *Vaccinium calycinum*. Plants that act as epiphytes include *Astelia menziesiana, Carex alligata, Elaphoglossum* spp., *Metrosideros polymorpha, Peperomia* spp., *Vaccinium calycinum*, and others. Montane rainforests differ from cloud forests by the lack of ground-level clouds nearly every day. Cloud forests support more epiphytes than montane rainforests.
Classification Comments: The boundary between the lowland and montane wet forests in Hawai'i is not generally agreed upon by all botanists and ecologists, and it may be variable on different islands. A clear picture of pre-human vegetation is complicated by the extreme disturbance the lowlands have suffered. Nonetheless, roughly 1000 m elevation marks the transition between the warmer lowlands and the cooler montane zone.
Similar Ecological Systems:
- Hawai'i Montane Cloud Forest (CES412.217)

DESCRIPTION

Environment: Montane rainforest occurs as a large-patch mosaic on windward areas that receive evenly distributed orographically-derived rainfall exceeding 2500 mm (99 inches) annually. Stands also occur in a relatively narrow high precipitation band on the leeward side of the Big Island resulting from Kona storms. Climate is moderately wet to very wet (Zones 6 and 7) of the 7 Moisture Zones developed for the Hawaiian Islands by Price et al. (2007).There is also frequent afternoon fog often generating fog drip. Soils generally have a gley horizon 10 to 70 cm (4-28 inches) deep, underlain by lateritic weathered basalt and overlain with organic hummus ranging from 10 to 30 cm (4-12 inches) deep.
Vegetation: Across the range of the ecological system, vegetation varies in height, structural complexity and species richness. Forests can be dominated by *Metrosideros polymorpha, Cibotium* spp. (tree fern) in some areas, or by a tall, well-stratified canopy of *Acacia koa* (koa) in other areas. At higher elevations on Maui and Hawai'i, *Metrosideros* forms a 5- to 8-m canopy that is relatively simple floristically. Canopy height becomes as low as 2 m in poorly drained areas and along bog margins. Montane rainforests frequently support a large mass of epiphytic mosses, ferns, and other plants. Common codominant and associated species include *Cheirodendron* spp., *Astelia menziesiana, Carex alligata, Clermontia* spp., *Cyrtandra* spp., *Dicranopteris* spp., *Psychotria* spp., *Pteridium aquilinum, Rubus* spp., *Urera glabra*, and *Vaccinium calycinum*. *Cheirodendron* spp. (olapa) are often codominant in low-statured, wind-stunted forests of peaks and ridges, areas almost continually brushed by clouds (Cuddihy et al. 1990). Plants that act as epiphytes include *Astelia menziesiana, Carex alligata, Elaphoglossum* spp., *Metrosideros polymorpha, Peperomia* spp., *Vaccinium calycinum*, and others.
Dynamics: The major disturbance factors in this system are from climatic factors, particularly hurricanes and drought, or periodic and widespread dieback of the *Metrosideros* tree canopy that has been documented for the islands of Hawai'i and Maui. After major storms or drought, the tree canopy will often be opened up. Although most of the species found in the tree canopy, subcanopy, and understory will still be present, *Dicranopteris linearis*, and taxa such as *Cibotium* and *Sadleria* may temporarily increase in cover because of the increased light levels with the more open canopy. On the island of Hawai'i, lava flows periodically run through forests on the flanks of Mauna Loa and Hualalai volcanoes. The invasive *Morella faya (= Myrica faya)* has formed closed-canopy dominance

in some montane rainforests on Hawai'i and Maui. The invasive *Passiflora mollissima* is a problem within this ecological system on Kaua'i and Hawai'i.

Component Associations:
- *Acacia koa / Metrosideros polymorpha - Cibotium* spp. Montane Wet Forest (CEGL008006, G3)
- *Carex alligata* Montane Wet Herbaceous Vegetation (CEGL008091, G3)
- *Metrosideros polymorpha / Cibotium* spp. Montane Wet Forest (CEGL008009, G3)
- *Metrosideros polymorpha / Dicranopteris linearis* Montane Wet Woodland (CEGL008041, G3)
- *Metrosideros polymorpha* / Mixed Shrub Montane Wet Forest (CEGL008007, G3)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Hawai'i Lowland Rainforest (CES412.226)
- Hawai'i Montane Cloud Forest (CES412.217)
- Hawai'i Subalpine Mesic Shrubland (CES412.404)

Adjacent Ecological System Comments: At the lower elevational limit, montane rainforests merge with Hawai'i Lowland Rainforest (CES412.226). At the upper elevational limit on Hawai'i and Maui, they quickly grade into *Acacia / Sophora* forest and other mesic communities.

DISTRIBUTION

Range: This system is found from 1200 to 2200 m (4000-7000 feet) elevation on Kaua'i, O'ahu, Moloka'i, Maui, and Hawai'i.
Divisions: 412:C
Nations: US
Subnations: HI
Map Zones: 79:C
USFS Ecomap Regions: M423:C
TNC Ecoregions: 65:C

SOURCES

References: Gagne and Cuddihy 1990, Mueller-Dombois and Fosberg 1998, Price et al. 2007, Wagner et al. 1999, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.770629#references
Description Author: M. Castillo, mod. D. Johnson, J. Jacobi, S. Gon III, K.A. Schulz
Version: 06 Aug 2009 **Stakeholders:** West
Concept Author: M. Castillo and G. Kittel **ClassifResp:** West

HAWAI'I MONTANE-SUBALPINE DRY FOREST AND WOODLAND (CES412.402)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Northern Polynesia (412)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Upper Montane]; Montane [Montane]; Forest and Woodland (Treed); Tropical/Subtropical [Tropical Xeric]; Very Shallow Soil
Non-Diagnostic Classifiers: Mountainside; Saddle; Broad-Leaved Evergreen Tree; Broad-Leaved Evergreen Shrub
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2815; ESLF 4297; ESP 1815

CONCEPT

Summary: This ecological system occurs on dry slopes of higher mountains of Maui and Hawai'i, from 1000-2900 m (3280-9510 feet) elevation. An inversion layer of warmer air forms 50-70% of the time between 1600 and 3000 m that dramatically reduces precipitation at higher elevations. This is because the wet trade winds generally do not rise above 1900 m (6230 feet) and are deflected around the mountains, leaving upper slopes too dry to support rain forests. Stands also occur at lower elevations on the leeward sides of islands where there is a strong rainshadow effect. Annual rainfall is generally 300-1200 mm. Many sites are wind-exposed. Substrates include cinder, well-drained, sandy loam soils derived from volcanic ash, and weathered 'a'Ã¢ or pÃ¢hoehoe basaltic lava with little soil development. Vegetation is characterized by an open to dense tree layer dominated or codominated by *Metrosideros polymorpha, Sophora chrysophylla, Myoporum sandwicense, Acacia koa, Chamaesyce celastroides,* or *Chamaesyce olowaluana*. *Acacia koa* forests are tallest (up to 18 m), and *Sophora - Myoporum* and *Chamaesyce* forests range from 3-5 m tall, and up to 10 m in some places. Diagnostic taxa for this system are *Chamaesyce olowaluana, Sophora chrysophylla* and species of *Exocarpos* shrubs. Other trees include *Myrsine lanaiensis, Santalum* spp., and *Zanthoxylum hawaiiense*. *Dodonaea viscosa, Styphelia tameiameiae, Chenopodium oahuense,* and *Vaccinium* spp. frequently form a sparse to moderately dense shrub layer up to 3 m tall. Other shrubs may include *Bidens menziesii, Coprosma ernodeoides, Dubautia ciliolata, Dubautia linearis, Geranium cuneatum, Geranium multiflorum, Osteomeles anthyllidifolia, Silene* spp., and *Tetramolopium* spp. Native graminoids (e.g., *Gahnia* spp.) usually have less than 10% cover and ferns (e.g., *Pteridium aquilinum*) are present, but contribute low cover especially at higher elevations. Native grasses include *Eragrostis atropioides*. Fire-adapted exotic grasses such as *Pennisetum setaceum* are invasive and threaten these dry shrublands by increasing fire intensity, frequency and size. The exotic rosette forb *Verbascum thapsus* is a common in many stands.
Similar Ecological Systems:
- Hawai'i Lowland Dry Forest (CES412.408)
- Hawai'i Montane-Subalpine Dry Shrubland (CES412.403)
- Hawai'i Montane-Subalpine Mesic Forest (CES412.406)

Related Concepts:
- *Chamaesyce* Treeland (Shaw and Castillo 1997) Finer
- *Myoporum-Chamaesyce* Treeland (Shaw and Castillo 1997) Finer
- *Sophora-Myoporum* Parkland (Mueller-Dombois and Fosberg 1998) Finer
- Akoko (*Chamaesyce*) Forest (Gagne and Cuddihy 1990) Finer
- Intermediate *Metrosideros* Mixed Treeland (Shaw and Castillo 1997) Finer
- Koa/Mamame (*Acacia/Sophora*) Forest (Gagne and Cuddihy 1990) Finer
- Ohi'a (*Metrosideros*) Montane Dry Forest (Gagne and Cuddihy 1990) Finer
- Ohi'a (*Metrosideros*) Subalpine Forest (Gagne and Cuddihy 1990) Finer
- Open *Metrosideros* Treeland with dense shrub understory (Shaw and Castillo 1997) Finer
- Open *Metrosideros* Treeland with sparse shrub understory (Shaw and Castillo 1997) Finer

DESCRIPTION

Environment: This montane to subalpine ecological system occurs within the very dry and moderately dry zones (Zones 2 and 3) of the 7 Moisture Zones developed for the Hawaiian Islands by Price et al. (2007). This ecological system occurs on dry slopes of higher mountains of Maui and Hawai'i, from 1000-2900 m (3280-9510 feet) elevation. An inversion layer of warmer air forms 50-70% of the time between 1600 and 3000 m that dramatically reduces precipitation at higher elevations (Gagne and Cuddihy 1990). This is because the wet trade winds generally do not rise above 1900 m (6230 feet) and are deflected around the mountains, leaving upper slopes too dry to support rain forests (Mueller-Dombois and Fosberg 1998). Stands also occur at lower elevations on the leeward sides of islands where there is a strong rainshadow effect. Annual rainfall is generally 300-1200 mm. Many sites are wind-exposed. Substrates include cinder, well-drained, sandy loam soils derived from volcanic ash, and weathered 'a'Ã¢ or pÃ¢hoehoe basaltic lava with little soil development.
Vegetation: Vegetation is characterized by an open to dense tree layer dominated or codominated by *Metrosideros polymorpha, Sophora chrysophylla, Myoporum sandwicense, Acacia koa, Chamaesyce celastroides,* or *Chamaesyce olowaluana*. *Acacia koa* forests are tallest (up to 18 m), and *Sophora - Myoporum* and *Chamaesyce* forests range from 3-5 m tall, and up to 10 m in some

places. Diagnostic taxa for this system are *Chamaesyce olowaluana, Sophora chrysophylla*, and species of *Exocarpos* shrubs. Other trees include *Myrsine lanaiensis, Santalum* spp., and *Zanthoxylum hawaiiense*. *Dodonaea viscosa, Styphelia tameiameiae, Chenopodium oahuense*, and *Vaccinium* spp. frequently form a sparse to moderately dense shrub layer up to 3 m tall. Other shrubs may include *Bidens menziesii, Coprosma ernodeoides, Dubautia ciliolata, Dubautia linearis, Geranium cuneatum, Geranium multiflorum, Osteomeles anthyllidifolia, Silene* spp., and *Tetramolopium* spp. Native graminoids(e.g., *Gahnia* spp., *Eragrostis atropioides*) usually have less than 10% cover and ferns (e.g., *Pteridium aquilinum*) are present but contribute low cover, especially at higher elevations. Fire-adapted exotic grasses such as *Pennisetum setaceum* are invasive and threaten these dry woodlands by increasing fire intensity, frequency and size (Castillo 1997). The exotic rosette forb *Verbascum thapsus* is common in many stands.
Dynamics: This is a structurally diverse system that varies depending on pioneer substrates. On basalt lava, ohi'a is the pioneer species with a mixture of sparse ferns, grasses, and shrubs. Then shrubs such as *Dodonaea viscosa, Styphelia tameiameiae, Chenopodium oahuense*, and *Vaccinium* spp. form a layer with shrubby and tree *Metrosideros polymorpha*. As more ash blows in, other tree species may colonize, such as *Sophora chrysophylla, Myoporum sandwicense, Acacia koa, Chamaesyce celastroides*, or *Chamaesyce olowaluana* forming an open tree canopy and eventually a closed tree canopy.

On cinder and ash deposits, shrubs such as *Dodonaea viscosa, Styphelia tameiameiae, Chenopodium oahuense*, grasses and ferns colonize barren substrates. *Sophora chrysophylla* and *Myoporum sandwicense* become established as the shrub layer closes and stands resemble climax dry shrubland with scattered trees. Grasses may be present with up to 40% cover. *Sophora chrysophylla* and *Myoporum sandwicense* continue to grow and form an open tree canopy with a moderately dense shrub layer and a grass layer (up to 20% cover). Eventually the *Sophora chrysophylla* and *Myoporum sandwicense* tree canopy closes. This late-seral tree canopy may become mixed with or in time dominated by *Acacia koa, Chamaesyce celastroides*, or *Chamaesyce olowaluana*.

Component Associations:
- *Acacia koa / Sophora chrysophylla* Montane Dry Forest (CEGL008019, G1)
- *Chamaesyce celastroides* Montane Dry Woodland (CEGL008037, G1)
- *Chamaesyce olowaluana* Montane Dry Woodland (CEGL008038, G1)
- *Metrosideros polymorpha* Montane Dry Woodland (CEGL008042, G3)
- *Metrosideros polymorpha* Subalpine Dry Woodland (CEGL008043, G3)
- *Sophora chrysophylla / Myoporum sandwicense* Subalpine Dry Forest (CEGL008021, G1)
- *Sophora chrysophylla* Subalpine Dry Woodland (CEGL008047, G2)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Hawai'i Alpine Bedrock and Scree (CES412.400)
- Hawai'i Alpine Dwarf-Shrubland (CES412.401)
- Hawai'i Montane-Subalpine Dry Shrubland (CES412.403)
- Hawai'i Montane-Subalpine Mesic Forest (CES412.406)

DISTRIBUTION

Range: This forest ecological system is restricted to drier upper slopes of the higher mountains of Maui (Haleakala) and Hawai'i (Mauna Kea, Mauna Loa, and Hualalai).
Divisions: 412:C
Nations: US
Subnations: HI
Map Zones: 79:C
USFS Ecomap Regions: M423:C
TNC Ecoregions: 65:C

SOURCES

References: Castillo 1997, Gagne and Cuddihy 1990, Mueller-Dombois and Fosberg 1998, Price et al. 2007, Shaw and Castillo 1997, Wagner et al. 1999, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.821099#references
Description Author: K.A. Schulz, mod. S. Gon III
Version: 05 Mar 2009 **Stakeholders:** West
Concept Author: K.A. Schulz **ClassifResp:** West

HAWAI'I MONTANE-SUBALPINE MESIC FOREST (CES412.406)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Northern Polynesia (412)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Upper Montane]; Montane [Montane]; Forest and Woodland (Treed); Tropical/Subtropical [Tropical Pluviseasonal]
Non-Diagnostic Classifiers: Mountainside
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2816; ESLF 4298; ESP 1816

CONCEPT

Summary: This ecological system occurs on mesic montane and subalpine slopes of Kaua'i, Maui and Hawai'i, from 900-2000 m (2950-6560 feet) elevation. Stands are found in the zone of mesic, seasonal precipitation between the dry leeward and wet windward climates. Sites are too dry to support rainforests, but do not experience extended periods of drought like the dry forests. Annual rainfall is generally 1000-2500 mm, with some areas experiencing a distinct dry period. Substrates include deep volcanic ash soils and trachyte, rocky mucks, and silty loams derived from weathered 'a'Ã¢ lava. Vegetation is characterized by an open to dense, mostly evergreen tree layer 10-35 m tall. There are often diverse subcanopy and tall-shrub layers with lianas. *Metrosideros polymorpha, Acacia koa*, or *Nestegis sandwicensis* dominate or codominate with other trees (e.g., *Santalum* spp., *Sapindus* spp.). *Sapindus saponaria* is a diagnostic species of this mesic system. Other trees may be present such as *Coprosma* spp., *Ilex anomala, Melicope* spp., *Myoporum sandwicense, Myrsine* spp., *Nothocestrum breviflorum, Pipturus albidus, Pisonia brunoniana, Pittosporum* spp., *Psychotria hawaiiensis, Zanthoxylum hawaiiense*, and drier forest species such as *Chamaesyce celastroides* and *Sophora chrysophylla*. The understory is variable and may be dominated by sedges and ferns or shrubs. Tree ferns (*Cibotium* spp.) are typically much less prominent than in wet forest. Common shrubs include *Clermontia* spp., *Cyanea* spp., *Dodonaea viscosa, Hedyotis* spp., *Rubus hawaiensis, Stenogyne* spp., and *Styphelia tameiameiae*. Common ferns and fern allies present include *Dryopteris wallichiana, Microlepia strigosa, Nephrolepis cordifolia, Melicope* spp. (= *Pelaea* spp.), *Sadleria* spp., and graminoids *Carex* spp. and *Uncinia uncinata*. Exotic trees *Morella faya, Psidium* spp., and *Schinus terebinthifolius* are often present in disturbed stands. Fire-adapted exotic grasses such as *Holcus lanatus, Pennisetum clandestinum*, and *Pennisetum setaceum* are invasive and threaten these forests by increasing fire intensity, frequency and size.
Similar Ecological Systems:
- Hawai'i Montane-Subalpine Dry Forest and Woodland (CES412.402)
- Hawai'i Montane-Subalpine Dry Shrubland (CES412.403)
- Hawai'i Subalpine Mesic Shrubland (CES412.404)

DESCRIPTION

Environment: This montane to subalpine ecological system occurs within the seasonally mesic and moist mesic zones (Zones 4 and 5) of the 7 Moisture Zones developed for the Hawaiian Islands by Price et al. (2007). This ecological system occurs on mesic montane and subalpine slopes of Kaua'i, Maui and Hawai'i, from 900-2000 m (2950-6560 feet) elevation. Stands are found in the zone of mesic, seasonal precipitation between the dry leeward and wet windward climates. Sites are too dry to support rainforests, but do not experience extended periods of drought like the dry forests (Gagne and Cuddihy 1990). Annual rainfall is generally 1000-2500 mm, with some areas experiencing a distinct dry period. Substrates include deep volcanic ash soils and trachyte, rocky mucks, and silty loams derived from weathered 'a'Ã¢ lava (Gagne and Cuddihy 1990).
Vegetation: Vegetation is characterized by an open to dense, mostly evergreen tree layer 10-35 m tall. There are often diverse subcanopy and tall-shrub layers with lianas. *Metrosideros polymorpha, Acacia koa*, or *Nestegis sandwicensis* dominate or codominate with other trees (e.g., *Santalum* spp., *Sapindus* spp.). *Sapindus saponaria* is a diagnostic species of this mesic system. Other trees may be present such as *Coprosma* spp., *Ilex anomala, Melicope* spp., *Myoporum sandwicense, Myrsine* spp., *Nothocestrum breviflorum, Pipturus albidus, Pisonia brunoniana, Pittosporum* spp., *Psychotria hawaiiensis, Zanthoxylum hawaiiense*, and drier forest species such as *Chamaesyce celastroides* and *Sophora chrysophylla*. The understory is variable and may be dominated by sedges and ferns or shrubs. Tree ferns (*Cibotium* spp.) are typically much less prominent than in wet forest. Common shrubs include *Clermontia* spp., *Cyanea* spp., *Dodonaea viscosa, Hedyotis* spp., *Rubus hawaiensis, Stenogyne* spp., and *Styphelia tameiameiae*. Common ferns and fern allies present include *Dryopteris wallichiana, Microlepia strigosa, Nephrolepis cordifolia, Melicope* spp. (= Pelaea spp.), *Sadleria* spp., and graminoids *Carex* spp. and *Uncinia uncinata*. Exotic trees *Morella faya, Psidium* spp., and *Schinus terebinthifolius* are often present in disturbed stands. Fire-adapted exotic grasses such as *Holcus lanatus, Pennisetum clandestinum*, and *Pennisetum setaceum* are invasive and threaten these forests by increasing fire intensity, frequency and size.
Dynamics: Major disturbances are storms, lava flow, lava or lightning-ignited fire.

Component Associations:
- *Acacia koa / Metrosideros polymorpha - Sapindus saponaria* Montane Mesic Forest (CEGL008016, G1)
- *Acacia koa / Metrosideros polymorpha* Montane Mesic Forest (CEGL008017, G1)

- *Acacia koa / Santalum paniculatum* Montane Mesic Forest (CEGL008018, G1)
- *Metrosideros polymorpha* Montane Mesic Forest (CEGL008020, G3)
- *Nestegis sandwicensis* Montane Mesic Woodland (CEGL008044, G1)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Hawai'i Montane-Subalpine Dry Forest and Woodland (CES412.402)
- Hawai'i Subalpine Mesic Shrubland (CES412.404)

DISTRIBUTION

Range: This forest ecological system occurs on mesic montane and subalpine slopes of Kaua'i, Maui and Hawai'i.
Divisions: 412:C
Nations: US
Subnations: HI
Map Zones: 79:C
USFS Ecomap Regions: M423:C
TNC Ecoregions: 65:C

SOURCES

References: Gagne and Cuddihy 1990, Mueller-Dombois and Fosberg 1998, Price et al. 2007, Wagner et al. 1999, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.821111#references
Description Author: K.A. Schulz, mod. S. Gon III
Version: 02 Feb 2009 **Stakeholders:** West
Concept Author: K.A. Schulz **ClassifResp:** West

INTER-MOUNTAIN BASINS ASPEN-MIXED CONIFER FOREST AND WOODLAND (CES304.776)

CLASSIFIERS

Conf.: 3 - Weak **Classification Status:** Standard
Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Needle-Leaved Tree; Broad-Leaved Deciduous Tree; Aspen - Conifer Mix
Non-Diagnostic Classifiers: Montane [Upper Montane]; Montane [Montane]; Montane [Lower Montane]; Sideslope; Toeslope/Valley Bottom; Temperate [Temperate Continental]
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Mixed evergreen-deciduous open tree canopy
National Mapping Codes: EVT 2061; ESLF 4302; ESP 1061

CONCEPT

Summary: This ecological system occurs on montane slopes and plateaus in Utah, western Colorado, northern Arizona, eastern Nevada, southern Idaho, western Wyoming, and in north-central Montana in the Big Snowy Mountains. It also occurs in localized settings in the Klamath Mountains of California, as well as in the Sierra Nevada and adjacent Great Basin mountains (Inyo, White, Warner, and Modoc Plateau). Elevations range from 1700 to 2800 m. Occurrences are typically on gentle to steep slopes on any aspect but are often found on clay-rich soils in intermontane valleys. Soils are derived from alluvium, colluvium and residuum from a variety of parent materials but most typically occur on sedimentary rocks. The tree canopy is composed of a mix of deciduous and coniferous species, codominated by *Populus tremuloides* and conifers, including *Pseudotsuga menziesii, Abies concolor, Abies lasiocarpa, Abies magnifica, Picea engelmannii, Picea glauca X engelmannii, Picea pungens, Pinus contorta, Pinus flexilis, Pinus jeffreyi, Pinus contorta var. murrayana*, and *Pinus ponderosa*. As the occurrences age, *Populus tremuloides* is slowly reduced until the conifer species become dominant. Common shrubs include *Amelanchier alnifolia, Prunus virginiana, Acer grandidentatum, Symphoricarpos oreophilus, Juniperus communis, Paxistima myrsinites, Rosa woodsii, Spiraea betulifolia, Symphoricarpos albus*, or *Mahonia repens*. Herbaceous species include *Bromus carinatus, Calamagrostis rubescens, Carex geyeri, Elymus glaucus, Poa* spp., and *Achnatherum, Hesperostipa, Nassella*, and/or *Piptochaetium* spp. (= *Stipa* spp.), *Achillea millefolium, Arnica cordifolia*, Asteraceae spp., *Erigeron* spp., *Galium boreale, Geranium viscosissimum, Lathyrus* spp., *Lupinus argenteus, Mertensia arizonica, Mertensia lanceolata, Maianthemum stellatum, Osmorhiza berteroi (= Osmorhiza chilensis)*, and *Thalictrum fendleri*. Most occurrences at present represent a late-seral stage of aspen changing to a pure conifer occurrence. Nearly a hundred years of fire suppression and livestock grazing have converted much of the pure aspen occurrences to the present-day aspen-conifer forest and woodland ecological system. This is the typical meadow edge aspen-conifer setting in the Sierra Nevada where frequently, due to fire suppression, the conifers are replacing aspens.

Related Concepts:
- Aspen Woodland (411) (Shiflet 1994) Intersecting
- Aspen: 217 (Eyre 1980) Intersecting

DESCRIPTION

Environment: The aspen-conifer forest and woodland ecological system is very similar to the aspen forest ecological system with regards to environmental characteristics. It is usually found on montane slopes and plateaus in western Wyoming, Idaho, Utah, and eastern Nevada. Elevations range from 1700 to 2800 m. Climate is temperate with cold winters. Mean annual precipitation is greater than 38 cm and typically greater than 50 cm. Occurrences are typically on gentle to steep slopes on any aspect. Soils are derived from alluvium, colluvium and residuum from a variety of parent materials, but most typically occur on sedimentary rocks.

Distribution of this ecological system is primarily limited by adequate soil moisture required to meet its high evapotranspiration demand (Mueggler 1988). Secondarily, its range is limited by the length of the growing season or low temperatures (Mueggler 1988). Topography is variable; sites range from level to steep slopes. Aspect varies according to the limiting factors. Occurrences at high elevations are restricted by cold temperatures and are found on warmer southern aspects. At lower elevations aspen is restricted by lack of moisture and is found on cooler north aspects and mesic microsites. The soils are typically deep and well-developed with rock often absent from the soil. Soil texture ranges from sandy loam to clay loam. Parent materials are variable and may include sedimentary, metamorphic or igneous rocks, but it appears to grow best on limestone, basalt, and calcareous or neutral shales (Mueggler 1988).

Vegetation: The open to moderately closed, mixed evergreen needle-leaved and deciduous broad-leaved tree canopy is composed of short to moderately tall trees and is codominated by *Populus tremuloides* and conifers, including *Pseudotsuga menziesii, Abies concolor, Abies lasiocarpa, Picea engelmannii, Picea pungens, Pinus contorta, Pinus flexilis*, and *Pinus ponderosa*. As the occurrences age, *Populus tremuloides* is slowly reduced until the conifer species becomes dominant (Mueggler 1988). The sparse to moderately dense understory may be structurally complex and includes tall-shrub, short-shrub and herbaceous layers, or it may be simple with just an herbaceous layer. Because of the open growth form of *Populus tremuloides*, more light can penetrate the canopy than in a pure conifer occurrence. Typically the understory is denser in younger occurrences that are dominated by *Populus tremuloides* and in more mesic sites with open canopies. If present, the tall-shrub layer may be dominated by *Amelanchier alnifolia, Prunus virginiana*, or *Acer grandidentatum*, and short-shrub layer by *Symphoricarpos oreophilus, Juniperus communis*, or *Mahonia*

repens. Other common shrubs include *Paxistima myrsinites, Rosa woodsii, Spiraea betulifolia, Symphoricarpos albus,* and in wet areas *Salix scouleriana*. Where dense, the herbaceous layer is often dominated by graminoids such as *Bromus carinatus, Calamagrostis rubescens, Carex geyeri, Elymus glaucus, Poa* spp., and *Achnatherum, Hesperostipa, Nassella,* and/or *Piptochaetium* spp. (= *Stipa* spp.). More sparse herbaceous layers are generally a more even mixture of forbs such as *Achillea millefolium, Arnica cordifolia, Eucephalus engelmannii (= Aster engelmannii), Erigeron speciosus, Fragaria vesca, Galium boreale, Geranium viscosissimum, Lathyrus* spp., *Lupinus argenteus, Mertensia arizonica, Mertensia lanceolata, Maianthemum stellatum, Osmorhiza berteroi (= Osmorhiza chilensis),* and *Thalictrum fendleri*. Annuals are typically uncommon. The exotic species *Poa pratensis* and *Taraxacum officinale* are more common in livestock-impacted occurrences (Mueggler 1988).

Dynamics: *Populus tremuloides* is thin-barked and readily killed by fire. It is a fire-adapted species that generally needs a large disturbance to establish and maintain dominance in a forest. These mixed forests are generally seral and, in the absence of stand-replacing disturbance such as fire, will slowly convert to a conifer-dominated forest (Mueggler 1988). The natural fire-return interval is approximately 20 to 50 years for seral occurrences (Hardy and Arno 1996). Intervals that approach 100 years are typical of late-seral occurrences (Hardy and Arno 1996). Although the young conifer trees in these occurrences are susceptible to fire, older individuals develop self-pruned lower branches and develop a thick corky bark that makes them resistant to ground fires. Most of the occurrences sampled by Mueggler (1988) had a history of livestock grazing, as evidenced by relative abundance of the exotics *Taraxacum officinale, Poa pratensis,* and other grazing-tolerant plants, and the scarcity of grazing-susceptible plants (Mueggler 1988). Most occurrences that we see today represent a late-seral stage of aspen changing to a pure conifer occurrence. Nearly a hundred years of fire suppression and livestock grazing have converted much of the pure aspen occurrences to the present-day aspen-conifer forest and woodland ecological system.

Component Associations:

- *Pinus contorta var. murrayana - Populus tremuloides / Artemisia tridentata / Poa pratensis* Forest (CEGL008669, GNR)
- *Pinus ponderosa - Populus tremuloides / Carex* spp. - (*Poa* spp.) Forest (CEGL000191, G2G3)
- *Populus tremuloides - Abies concolor / Arctostaphylos patula* Forest (CEGL000522, G4)
- *Populus tremuloides - Abies concolor / Symphoricarpos oreophilus* Forest (CEGL000523, G4G5)
- *Populus tremuloides - Abies lasiocarpa / Amelanchier alnifolia* Forest (CEGL000524, G3?)
- *Populus tremuloides - Abies lasiocarpa / Carex geyeri - Calamagrostis rubescens* Forest (CEGL000525, G3?)
- *Populus tremuloides - Abies lasiocarpa / Carex rossii* Forest (CEGL000526, G5)
- *Populus tremuloides - Abies lasiocarpa / Juniperus communis* Forest (CEGL000527, G3G4)
- *Populus tremuloides - Abies lasiocarpa / Pedicularis racemosa* Forest (CEGL000528, G2)
- *Populus tremuloides - Abies lasiocarpa / Shepherdia canadensis* Forest (CEGL000529, G3?)
- *Populus tremuloides - Abies lasiocarpa / Symphoricarpos oreophilus / Bromus carinatus* Forest (CEGL000530, G3G4)
- *Populus tremuloides - Abies lasiocarpa / Symphoricarpos oreophilus* / Tall Forbs Forest (CEGL000531, G4G5)
- *Populus tremuloides - Abies lasiocarpa / Symphoricarpos oreophilus / Thalictrum fendleri* Forest (CEGL000532, G3?)
- *Populus tremuloides - Abies lasiocarpa* / Tall Forbs Forest (CEGL000533, G5)
- *Populus tremuloides - Abies lasiocarpa / Thalictrum fendleri* Forest (CEGL000534, G4G5)
- *Populus tremuloides - Picea pungens* Forest (CEGL000535, G3G4)
- *Populus tremuloides - Pinus contorta / Carex geyeri - Calamagrostis rubescens* Forest (CEGL000536, G3?)
- *Populus tremuloides - Pinus contorta / Juniperus communis* Forest (CEGL000537, G4G5)
- *Populus tremuloides - Pinus contorta / Symphoricarpos oreophilus* Forest (CEGL000538, G3G4)
- *Populus tremuloides - Pinus contorta / Thalictrum fendleri* Forest (CEGL000539, G3?)
- *Populus tremuloides - Pinus flexilis* Forest (CEGL000540, G2G3)
- *Populus tremuloides - Pinus jeffreyi* Forest (CEGL003147, GNR)
- *Populus tremuloides - Pinus ponderosa* Rocky Mountain Forest (CEGL000541, G3G4)
- *Populus tremuloides - Pseudotsuga menziesii / Amelanchier alnifolia* Forest (CEGL000543, G3?)
- *Populus tremuloides - Pseudotsuga menziesii / Calamagrostis rubescens* Forest (CEGL000544, G3?)
- *Populus tremuloides - Pseudotsuga menziesii / Juniperus communis* Forest (CEGL000545, G3G4)
- *Populus tremuloides - Pseudotsuga menziesii / Symphoricarpos oreophilus* Forest (CEGL000546, G4)

SPATIAL CHARACTERISTICS

Adjacent Ecological System Comments: Adjacent occurrences above or beside these mixed forests are typically pure aspen forest or mixed-conifer forest, or subalpine spruce-fir forest and woodlands, while lower elevations may include grasslands and shrublands.

DISTRIBUTION

Range: This system occurs on montane slopes and plateaus in Utah, eastern Nevada, southern Idaho, western and central Wyoming (in the Bighorn Mountains), and in north-central Montana in the Big Snowy Mountains. Elevations range from 1700 to 2800 m.
Divisions: 304:C; 306:C
Nations: US
Subnations: AZ, CO, ID, MT, NV, UT, WY
Map Zones: 3:C, 6:C, 8:?, 9:C, 10:C, 12:C, 15:C, 16:C, 17:P, 18:C, 19:C, 20:C, 21:C, 22:P, 23:C, 24:C, 25:?, 27:P, 28:C, 29:C
USFS Ecomap Regions: 313A:CC, 313B:CC, 315H:??, 331D:C?, 331J:CC, 341A:CC, 341B:CC, 341F:CC, 341G:CP, 342B:CP, 342C:CC, 342D:CC, 342E:CC, 342G:CP, 342J:CC, M242C:??, M313B:CC, M331A:CC, M331B:CC, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M331J:CP, M332A:CP, M332B:C?, M332D:CC, M332E:CC, M332F:CC, M333A:CC, M333B:CC, M333C:C?, M333D:C?, M341A:CC, M341B:CC, M341C:CC, M341D:CC

TNC Ecoregions: 6:C, 9:C, 11:C, 18:C, 19:P, 26:C

SOURCES

References: Bartos and Campbell 1998, Comer et al. 2003, DeByle and Winokur 1985, DeVelice et al. 1986, Hardy and Arno 1996, Henderson et al. 1977, Mueggler 1988, Tuhy et al. 2002, Youngblood and Mauk 1985, Youngblood and Mueggler 1981

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722896#references

Description Author: K.A. Schulz, mod. M.S. Reid and G. Kittel

Version: 20 Apr 2006 **Stakeholders:** West

Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

INTER-MOUNTAIN BASINS CURL-LEAF MOUNTAIN-MAHOGANY WOODLAND AND SHRUBLAND (CES304.772)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Lower Montane]; Lowland [Foothill]; Aridic; Cercocarpus ledifolius
Non-Diagnostic Classifiers: Foothill(s); Piedmont; Plateau; Forest and Woodland (Treed); Shrubland (Shrub-dominated); Ridge/Summit/Upper Slope; Sideslope; Temperate [Temperate Continental]; Long Disturbance Interval; F-Patch/Medium Intensity
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Mixed evergreen-deciduous open tree canopy
National Mapping Codes: EVT 2062; ESLF 4303; ESP 1062

CONCEPT

Summary: This ecological system occurs in hills and mountain ranges of the Intermountain West basins from the eastern foothills of the Sierra Nevada northeast to the foothills of the Bighorn Mountains. It typically occurs from 600 m to over 2650 m in elevation on rocky outcrops or escarpments and forms small- to large-patch stands in forested areas. Most stands occur as shrublands on ridges and steep rimrock slopes, but they may be composed of small trees in steppe areas. Scattered junipers or pines may also occur. This system includes both woodlands and shrublands dominated by *Cercocarpus ledifolius*. *Artemisia tridentata ssp. vaseyana, Purshia tridentata,* with species of *Arctostaphylos, Ribes*, or *Symphoricarpos* are often present. Undergrowth is often very sparse and dominated by bunch grasses, usually *Pseudoroegneria spicata* and *Festuca idahoensis*. *Cercocarpus ledifolius* is a slow-growing, drought-tolerant species that generally does not resprout after burning and needs the protection from fire that rocky sites provide.
Related Concepts:
- Curlleaf Mountain-Mahogany (415) (Shiflet 1994) Finer
- Curlleaf Mountain-Mahogany - Bluebunch Wheatgrass (322) (Shiflet 1994) Finer

DESCRIPTION

Environment: Curl-leaf mountain-mahogany (*Cercocarpus ledifolius var. intermontanus*) communities are usually found on upper slopes and ridges between 2135 and 3200 m (7000-10,500 feet) elevations (NRCS 2003), although northern stands may occur as low as 610 m (2000 feet) (Marshall 1995). In western Nevada, curl-leaf mountain-mahogany may occur down to 1525 m (5000 feet) or lower and be restricted to northwestern and especially northeastern aspects at drier, lower edge of range. Most stands occur on rocky shallow soils and outcrops, with mature stand cover between 10-55%. In the absence of fire, old stands may occur on somewhat deeper soils, with more than 55% cover.
Dynamics: LANDFIRE model information: Fire: Curl-leaf mountain-mahogany does not resprout and is easily killed by fire (Marshall 1995). It is a primary early-successional colonizer rapidly invading bare mineral soils after disturbance. Fires are not common in early-seral stages, when there is little fuel, except in chaparral. Replacement fires (MFRI=150-500 years) become more common in mid-seral stands, where herbs and smaller shrubs provide ladder fuels. By late succession, two classes and fire regimes are possible depending on the history of mixed-severity and surface fires. In the presence of surface fire (MFRI=50 years) and past mixed-severity fires in younger classes, the stand will adopt a savanna-like woodland structure with a grassy understory, spiny phlox, and currant. Trees can become very old and will rarely show fire scars. In late, closed stands, the absence of herbs and small forbs makes replacement fires uncommon (MFRI of 500 years), requiring extreme winds and drought, because thick duff provides fuel for more intense fires. Mixed-severity fires (MFRI=50-200 years) are present in all classes, except the late closed one, and more frequent in the mid-development classes.

Ungulate herbivory: Heavy browsing by native medium-sized and large mammals reduces mountain-mahogany productivity and reproduction (NRCS 2003). This is an important disturbance in early- and mid-seral stages, when mountain-mahogany seedlings are becoming established. Browsing by small mammals has been documented (Marshall 1995), but is relatively unimportant and was incorporated as a minor component of native herbivory mortality.

Avian-caused mortality: In western Nevada for ranges in close proximity to the Sierra Nevada, sapsuckers drilling of young curl-leaf mountain-mahogany has been observed to cause stand-replacement mortality (C. Ross, NV BLM, pers. comm.).

Windthrow and snow creep on steep slopes are also sources of mortality.

Component Associations:
- *Artemisia arbuscula - Cercocarpus ledifolius / Pseudoroegneria spicata - Poa secunda* Scrub (CEGL001487, G4Q)
- *Cercocarpus ledifolius / Artemisia tridentata ssp. vaseyana* Woodland (CEGL001022, G3)
- *Cercocarpus ledifolius / Artemisia tridentata* Woodland (CEGL000960, G3G4)
- *Cercocarpus ledifolius / Calamagrostis rubescens* Woodland (CEGL000961, G2)
- *Cercocarpus ledifolius / Festuca idahoensis* Woodland (CEGL000962, G3)
- *Cercocarpus ledifolius / Holodiscus dumosus* Woodland (CEGL000963, G1G2)
- *Cercocarpus ledifolius / Leymus salinus ssp. salmonis* Woodland (CEGL000964, G2Q)
- *Cercocarpus ledifolius / Mahonia repens* Scrub (CEGL000965, GNR)

- *Cercocarpus ledifolius / Prunus virginiana* Scrub (CEGL000966, G4)
- *Cercocarpus ledifolius / Pseudoroegneria spicata - Festuca idahoensis* Woodland (CEGL000968, G3G4)
- *Cercocarpus ledifolius / Pseudoroegneria spicata* Scrub (CEGL000967, G4Q)
- *Cercocarpus ledifolius / Quercus gambelii* Woodland (CEGL005359, GNR)
- *Cercocarpus ledifolius / Symphoricarpos longiflorus* Scrub (CEGL000969, G4)
- *Cercocarpus ledifolius / Symphoricarpos oreophilus* Woodland (CEGL000970, G2)

SPATIAL CHARACTERISTICS

Spatial Summary: Because these communities are restricted to rock outcrops and thin soils, stands usually occur on a small scale, and are spatially separated from each other by other communities that occur on different aspects or soil types. A few curl-leaf mountain-mahogany stands may be much larger than 100 acres.

DISTRIBUTION

Range: This system occurs in hills and mountain ranges of the Intermountain West basins from the eastern foothills of the Sierra Nevada northeast to the foothills of the Bighorn Mountains.
Divisions: 206:?; 304:C; 306:C
Nations: US
Subnations: CA, CO, ID, MT, NV, OR, UT, WY
Map Zones: 2:C, 6:P, 7:C, 8:C, 9:C, 10:C, 12:C, 16:C, 17:C, 18:C, 19:C, 21:C, 22:C, 23:?, 29:C, 30:?
USFS Ecomap Regions: 313A:CC, 331A:CC, 331G:CC, 341A:CC, 341B:CP, 341D:CC, 341E:CC, 341F:CC, 341G:CC, 342B:CC, 342C:CC, 342D:CC, 342E:CC, 342F:CP, 342G:CC, 342H:CC, 342I:CP, 342J:CC, M242C:CC, M261E:CC, M261G:CC, M331A:C?, M331B:CC, M331D:CC, M331E:CC, M331J:C?, M332A:CC, M332B:C?, M332D:C?, M332E:CC, M332F:CC, M332G:CC, M333D:PP, M341A:CC, M341B:CC, M341C:CC, M341D:CC
TNC Ecoregions: 6:P, 9:C, 10:P, 11:C, 12:C

SOURCES

References: Comer et al. 2003, Dealy 1975, Dealy 1978, Knight 1994, Knight et al. 1987, Lewis 1975b, Mueggler and Stewart 1980, Ross pers. comm., Shiflet 1994
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722900#references
Description Author: M.S. Reid and G. Kittel
Version: 12 Jan 2012 **Stakeholders:** West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

INTER-MOUNTAIN BASINS SUBALPINE LIMBER-BRISTLECONE PINE WOODLAND (CES304.790)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Upper Montane]; Montane [Montane]; Forest and Woodland (Treed); Ridge; Ridge/Summit/Upper Slope; Temperate [Temperate Continental]; Xeric; Pinus longaeva, P. flexilis
Non-Diagnostic Classifiers: Calcareous
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2020; ESLF 4207; ESP 1020

CONCEPT

Summary: This ecological system extends from the Mojave Desert and Sierra Nevada across the central Great Basin to the central Wasatch and western Uinta mountains. These open woodlands are typically found on high-elevation ridges and rocky slopes above subalpine forests and woodlands. Site are harsh, exposed to desiccating winds with rocky substrates and a short growing season that limit plant growth. Parent materials include dolomitic, limestone or granitic rocks. Occurrences can be found on all aspects but are more common on southwestern exposures on steep convex slopes and ridges between 2530 and 3600 m (8300-12,000 feet). Stands are strongly dominated by *Pinus flexilis* and/or *Pinus longaeva*. *Pinus monophylla* may be present in lower-elevation stands. If present, shrub and herbaceous layers are generally sparse and composed of xeric shrubs, graminoids and cushion plants. Associated species may include *Antennaria rosea, Arenaria kingii, Artemisia tridentata, Cercocarpus intricatus, Chamaebatiaria millefolium, Cymopterus cinerarius, Elymus elymoides, Erigeron pygmaeus, Eriogonum ovalifolium, Festuca brachyphylla, Koeleria macrantha, Leptodactylon pungens, Ribes cereum,* or *Ribes montigenum*.
Related Concepts:
- Bristlecone Pine: 209 (Eyre 1980) Broader
- Limber Pine: 219 (Eyre 1980) Intersecting

DESCRIPTION

Environment: The bristlecone pine-limber pine woodland ecological system denotes some of the driest and windiest sites capable of supporting trees other than *Juniperus*. Sites are typically xeric on exposed, windswept rocky slopes and ridges. It can be found on all aspects but is more common on southwestern exposures on steep convex slopes and ridges between 2530 and 3600 m (8300-12,000 feet). It commonly represents a topographic or edaphic climax within the *Abies lasiocarpa* and upper *Pseudotsuga menziesii* zones. This system occurs on a variety of substrates but is best represented on residuum and colluvium derived from limestone and dolomite or Tertiary and Cretaceous sandstone. A characteristic feature is the predominance of bare soil; almost all sites have between 25 and 50% bare ground. Consequently, litter accumulations are slight and intermittent. Most sites are droughty, with gravel in the shallow subsurface horizons. Surface textures vary depending upon parent material. Steep slopes, high-intensity summer convection storms, and only partial ground cover for interception often result in severe sheet erosion of fine particles. This usually leads to the development of gravel pavements. Additional erosion can be expected from wind action. High insolation and wind during the winter usually result in reduced snowpack accumulations. However, soils can be expected to freeze.
Dynamics: Both *Pinus longaeva* and *Pinus flexilis* are short-statured, slow-growing, long-lived trees that are intolerant of shade. *Pinus longaeva* may attain nearly 4900 years in age and 12 m in height, whereas *Pinus flexilis* may live 1000 years and attain 18 m in height. Bristlecone pine branches retain needles for as long as 30 years, whereas limber pine needles are lost after only several years. Bristlecone pine trees produce dense, resinous wood that is resistant to rot and disease. Mature trees have massive, contorted trunks with mostly dead and gnarled wood (Sawyer et al. 2009). Tree-ring data over the last 4000 years indicate that droughts of 200 years or more have occurred.

Natural regeneration of *Pinus flexilis* appears to be closely associated with caching of the large wingless seeds, primarily by Clark's nutcracker (*Nucifraga columbiana*) (Lanner and Vander Wall 1980). Germination of cached seeds often results in the multi-stemmed clumps characteristic of these sites, although the species may produce multiple stems from boles damaged near the ground. Germination and rooting will sometimes be restricted to crevices in rock. *Pinus longaeva* has smaller winged seeds that are wind-disseminated. However, caching by nutcrackers does take place, especially when other *Pinus* species are also available (Dr. R. Lanner pers. comm.). The longevity of individuals enables stands to persist for centuries between times of favorable seedling establishment (Keeley and Zedler 1998). Stands are subject to long, intense droughts.

Stands vary from tens to hundreds of acres in size with stand-replacement fires ranging from 1/10th acre to 100 acres (Landfire 2007a). These pines have relatively thin bark adapted to survive only low-severity surface fires. However, fires seldom consume whole stands due to the open to sparse nature of the tree canopy and abundant bare ground. When fires occur on high-elevation sites, they are usually small, low-severity surface fires (Bradley et al. 1992). The sparsity of shrubs, forbs, grasses, and litter, in addition to the widely spaced trees, usually means that fire does not carry easily. Individual trees may be ignited and damaged or killed from lightning strikes, but seldom is an entire stand burned except when fire is spread via high winds. At lower elevations surface fuels should be more abundant and could allow for spreading surface fires (Kilpatrick and Biondi 2013).

Pinus longaeva and *Pinus flexilis* are both experiencing mountain pine beetle (*Dendroctonus ponderosae*) infestations throughout much of their ranges (Lanner 1983). Logan and Powell (2001) provide information on the ecology and management of mountain pine beetles in high-elevation ecosystems. Gibson et al. (2008) reported recently detected mortality of *Pinus longaeva* in the Great Basin, including 100 acres in 2005, 60 acres in 2006, and 300 acres in 2007, all within the Snake Range in east-central Nevada (aerial detection surveys). Western dwarf mistletoe (*Arceuthobium campylopodum*) infests Great Basin bristlecone pines in southern Nevada and Utah (Mathiasen and Hawksworth 1990).

Component Associations:
- *Abies concolor var. concolor - Pinus ponderosa - Pinus longaeva* Forest (CEGL002736, GNR)
- *Pinus flexilis / Cercocarpus ledifolius* Woodland (CEGL000804, G4)
- *Pinus flexilis / Festuca idahoensis* Woodland (CEGL000805, G5)
- *Pinus flexilis / Juniperus communis* Woodland (CEGL000807, G5)
- *Pinus flexilis / Juniperus osteosperma* Woodland (CEGL000808, G3)
- *Pinus flexilis / Mahonia repens* Woodland (CEGL000811, G3?)
- *Pinus longaeva* Woodland (CEGL002380, GNR)

Spatial Characteristics

Adjacent Ecological System Comments: Adjacent vegetation at high elevations includes alpine meadows and shrublands and subalpine forests dominated by *Picea, Abies,* or *Pseudotsuga*. Adjacent montane occurrences are dominated by *Pinus ponderosa, Pinus contorta,* or *Pseudotsuga menziesii*. At lower elevations adjacent vegetation may include *Juniperus*-dominated woodland and savannas; shrublands dominated by species of *Artemisia, Cercocarpus,* or *Purshia tridentata*.

Distribution

Range: This system extends from the Mojave Desert and Sierra Nevada across the Great Basin to the central Wasatch and extreme western Uinta mountains.
Divisions: 304:C; 306:?
Nations: US
Subnations: CA, NV, UT
Map Zones: 6:P, 7:?, 9:?, 12:C, 13:C, 16:C, 17:C, 18:P
USFS Ecomap Regions: 322A:CC, 331J:CC, 341A:CC, 341D:CC, 341E:CC, 341F:CC, 341G:CC, 342B:CC, 342J:C?, M261E:CC, M331D:PP, M341A:CC, M341D:CC
TNC Ecoregions: 9:?, 11:C, 12:C, 18:C, 19:C

Sources

References: Bradley et al. 1992, Comer et al. 2003, Eyre 1980, Fryer 2004, Gibson et al. 2008, Graybosch and Buchanan 1983, Hiebert and Hamrick 1984b, Holland and Keil 1995, Keeley and Zedler 1998, Kilpatrick and Biondi 2013, Landfire 2007a, Lanner 1983, Lanner and Vander Wall 1980, Lanner pers. comm., Logan and Powell 2005?, Logan et al. 2010, Mathiasen and Hawksworth 1990, McKinney et al. 2007, Nachlinger and Reese 1996, Sawyer et al. 2009, Schoettle and Sniezko 2007a, Schoettle et al. 2008, Smith and Hoffman 2000, TNC 2013
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722882#references
Description Author: NatureServe Western Ecology Team, mod. K.A. Schulz
Version: 14 Jan 2014 **Stakeholders:** West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

INTERIOR HIGHLANDS UNGLACIATED FLATWOODS (CES202.454)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch, Matrix, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Forest and Woodland (Treed); Hardpan; Broad-Leaved Deciduous Tree
National Mapping Codes: ESLF 4339

CONCEPT

Summary: This system represents hardwood- or pine-hardwood-dominated flatwoods of the Ozarks, Arkansas Valley, and Ouachitas of Arkansas, adjacent Missouri and possibly Oklahoma. Sites are high, fairly level and generally unflooded but seasonally saturated. There is some local variability in the expression of this system along a hydrologic/microtopographic gradient. The elevated ridges or pimple mounds are better drained and retain less moisture than do the lower areas, although both occur in a tight local mosaic. The soils appear to have well-developed subsurface hardpans, the impermeability of which contributes to shallowly perched water tables during portions of the year when precipitation is greatest and evapotranspiration is lowest. Soil moisture fluctuates widely throughout the growing season, from saturated to very dry, a condition sometimes referred to as xerohydric. Fire was an important natural process in this system, and well-burned examples tend to be relatively open-canopied with well-developed herbaceous layers.

Similar Ecological Systems:
- Lower Mississippi River Flatwoods (CES203.193)
- South-Central Interior / Upper Coastal Plain Flatwoods (CES203.479)
- South-Central Interior / Upper Coastal Plain Wet Flatwoods (CES203.480)
- West Gulf Coastal Plain Nonriverine Wet Hardwood Flatwoods (CES203.548)

DESCRIPTION

Environment: This system occupies level or nearly level ground on upland plains, flat ridgetops, and floodplain terraces. Soils are usually deep but with an impermeable or slowly permeable hardpan or fragipan which creates a shallow perched water table. It is seasonally wet in winter and spring, becoming very dry in summer and autumn. Sites are high, fairly level and generally not flooded, but seasonally saturated. There is some local variability in the expression of this system along a hydrologic/microtopographic gradient. The elevated ridges or pimple mounds are better drained and retain less moisture than do the lower areas, although both occur in a tight local mosaic. The soils appear to have well-developed subsurface hardpans, the impermeability of which contributes to shallowly perched water tables during portions of the year when precipitation is greatest and evapotranspiration is lowest. Soil moisture fluctuates widely throughout the growing season, from saturated to very dry, a condition sometimes referred to as xerohydric. Fire was an important natural process in this system, and well-burned examples tend to be relatively open-canopied with well-developed herbaceous layers (Nelson 2005).

Vegetation: These are hardwood- or pine-hardwood-dominated forests or woodlands. *Quercus phellos* is typically dominant or codominant except in the occurrences that are seasonally driest, where *Quercus stellata* is dominant. *Pinus echinata* may be dominant or codominant with *Quercus phellos* in sites of intermediate moisture. The medium tree canopy is somewhat open-grown with a somewhat open to mostly closed canopy (70-90% cover). The understory is poorly developed. Ground cover is variable with a low to medium diversity consisting of plants characteristic of dry soils on higher ground and wet soils in depressions.

Dynamics: Hydrology is the most important ecosystem process. Fire is of variable importance, i.e., it was very frequent and important in large sites ranging from very dry to moderately dry, but less frequent and less important on the wettest sites, where long-duration saturation leads to shallow rooting depths and consequent susceptibility to windthrow. Therefore, communities of wettest sites are more likely to be closed forest and uneven-aged whereas intermediate to very dry sites may be more likely to be woodland, perhaps even-aged. Drought and, in the past, gazing by bison and elk also influenced the woodland structure and composition (Nelson 2005).

Component Associations:
- *Quercus phellos - Quercus similis* Flatwoods Forest (CEGL007112, G3?)
- *Quercus stellata / Cinna arundinacea* Flatwoods Forest (CEGL002405, G2G3)

SPATIAL CHARACTERISTICS

Spatial Summary: Small to large patch in Arkansas; Nelson (2005) says it can be matrix in Missouri.

Adjacent Ecological Systems:
- Central Interior Highlands and Appalachian Sinkhole and Depression Pond (CES202.018)
- Ozark Prairie and Woodland (CES202.326)
- Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland (CES202.313)

Adjacent Ecological System Comments: Topographic relief and soil profile that affect seasonal moisture regime control transition to a different system. The system may grade into wet depressional ponds (CES202.018). As topography becomes more undulating to hilly and hardpan is lost, it may grade into Ozark-Ouachita Shortleaf Pine - Oak Forest and Woodland (CES202.313). It exists on

margins of prairies (CES202.326) where there is still a hardpan, but slightly more undulation than in typical prairie.

DISTRIBUTION

Range: This system is found in the Ozarks, Arkansas Valley, and Ouachitas of Arkansas, adjacent Missouri and possibly Oklahoma
Divisions: 202:C
Nations: US
Subnations: AR, MO, OK?
Map Zones: 44:C
USFS Ecomap Regions: 223A:CC, 231Ee:CCC, 231Gc:CCC, M223A:CC, M231A:CC
TNC Ecoregions: 38:C, 39:C

SOURCES

References: Foti pers. comm., NatureServe Ecology - Southeastern U.S. unpubl. data, Nelson 1985, Nelson 2005, Southeastern Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.873647#references
Description Author: M. Pyne and T. Foti, mod. C. Nordman
Version: 14 Jan 2014 **Stakeholders:** Midwest, Southeast
Concept Author: M. Pyne and T. Foti **ClassifResp:** Southeast

KLAMATH-SISKIYOU LOWER MONTANE SERPENTINE MIXED CONIFER WOODLAND (CES206.917)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Serpentine; Mediterranean [Mediterranean Pluviseasonal-Oceanic]; Ultramafic with low Ca:Mg ratio
Non-Diagnostic Classifiers: Montane [Lower Montane]; Xeric
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2021; ESLF 4208; ESP 1021

CONCEPT

Summary: This system occurs throughout the Klamath-Siskiyou region below 1500 m (4550 feet) elevation on thin, rocky, ultramafic (gabbro, peridotite, serpentinite) soils below winter snow accumulations and typically experiences hot and dry summers. Soils are not always rocky; they can be loamy, up to 76 cm (30 inches) in depth, and can be heavy clay. Not all ultramafic outcrops support distinct vegetation; only those with very low Ca:Mg ratios impact biotic composition. These woodlands are highly variable and spotty in distribution. These sites are more productive and can support large-statured (dbh, height) trees, although they tend to be widely spaced. Common species include *Pseudotsuga menziesii, Pinus sabiniana, Pinus lambertiana, Pinus jeffreyi, Pinus attenuata, Lithocarpus densiflorus var. echinoides, Calocedrus decurrens, Arctostaphylos* spp., *Quercus vacciniifolia,* and *Xerophyllum tenax*. Perennial grasses such as *Festuca idahoensis* may also be characteristic. *Chamaecyparis lawsoniana* communities can occur within occurrences of this system in mesic and linear riparian zones. Herbaceous-dominated serpentine fens (and bogs) are treated in Mediterranean California Serpentine Fen (CES206.953).
Classification Comments: It has been proposed to merge this system with the similar Klamath-Siskiyou Upper Montane Serpentine Mixed Conifer Woodland (CES206.914), as they are similar in composition and structure. For now, they are kept as separate systems pending further review and comment from California ecologists.
Similar Ecological Systems:
- Klamath-Siskiyou Xeromorphic Serpentine Savanna and Chaparral (CES206.150)

Related Concepts:
- Knobcone Pine: 248 (Eyre 1980) Intersecting
- Port Orford-Cedar: 231 (Eyre 1980) Intersecting

DESCRIPTION

Environment: This system occurs throughout the Klamath-Siskiyou region below 1500 m (4550 feet) elevation on thin, rocky, ultramafic (gabbro, peridotite, serpentinite) soils below winter snow accumulations and typically experiences hot and dry summers. Soils are not always rocky; they can be loamy, up to 76 cm (30 inches) in depth, and can be heavy clay. Not all ultramafic outcrops support distinct vegetation; only those with very low Ca:Mg ratios impact biotic composition. Soils on ultramafics are usually shallow and skeletal, with little profile development. Ultramafic soils impose the following stresses on plants: imbalance of calcium and magnesium, magnesium toxicity, low availability of molybdenum, toxic levels of heavy metals, sometime high alkalinity, low concentrations of some essential nutrients, and low soil water storage capacity (Kruckeberg 1984, Sanchez-Mata 2007). In some cases, the steepness of the slopes and general sparseness of the vegetation result in continual erosion.
Dynamics: Sites are productive and can support large-statured trees, although they will generally be widely spaced. Trees tend to grow very slowly due to the soil chemistry and textural characteristics which limit available nutrients.

Several important trees in this systems are fire-adapted, but the system as a whole is an edaphically-controlled type. Fire regimes vary depending on the slope position, elevation, fire history, and successional stage. *Chamaecyparis lawsoniana*-dominated stands have a low frequency of stand-replacing fires with an age class distribution showing >50% of stands are more than 300 years old (Jimerson et al. 1995). Other forest types in this system have more frequent stand-replacing fires. *Pseudotsuga menziesii* woodlands age class distribution shows >80% of stands were older than 175 years. *Pinus jeffreyi* occurs on drier sites and has more frequent fires, age classes are evenly distributed from young to old; while *Pinus lambertiana* has highest age class frequency of stands <175 years. *Pinus lambertiana* stands burn more frequently due to upper slope positions (Jimerson et al. 1995). Native dwarf mistletoe (*Arceuthobium* spp.) infest many trees within this system; generally they do not cause mortality but weaken trees sufficiently for bark or engraver beetles or wood borers to successfully attack and kill the tree.

Parker (1990) suggests that species growing on serpentine sites may suffer greater mortality and poorer recruitment after a fire than the same species on adjacent sandstone soils. Landfire (2007a): This type has a very limited distribution and consequently limited information for fire occurrence history. Adjacent mixed conifer forest types have similar characteristics and are detailed below. Surface and mixed-severity fires occur at an average of about 10-15 years (Taylor and Skinner 1998, 2003, Sensenig 2002). Kilgore and Taylor (1979) reported a FRI=19-39 years (N/NE aspects), which may favor mixed fires. Replacement fires with longer (70-110 years) return intervals are possible (Frost and Sweeney 2000). With historic fire regimes, insect outbreaks may have been much reduced compared to current conditions. Snow breakage occurs in the mid-seral closed state about every 5 years. While model is

aspatial, most medium- and high-severity fire may actually occur on mid and upper slope positions (Taylor and Skinner 1998, Taylor 2000, Bekker and Taylor 2001).

Component Associations:
- *Abies concolor - Chamaecyparis lawsoniana - Picea breweriana / Quercus vacciniifolia* Forest (CEGL000049, G1)
- *Abies concolor - Chamaecyparis lawsoniana / Quercus sadleriana / Leucothoe davisiae - Rhododendron macrophyllum* Forest (CEGL000042, G2)
- *Chamaecyparis lawsoniana - Pseudotsuga menziesii / (Rhododendron macrophyllum) / Xerophyllum tenax* Forest (CEGL000044, G1)
- *Chamaecyparis lawsoniana - Pseudotsuga menziesii / Lithocarpus densiflorus / Gaultheria shallon* Forest (CEGL000043, G2)
- *Pinus attenuata / Arctostaphylos nevadensis* Woodland (CEGL000763, G2)
- *Pinus jeffreyi / Quercus vacciniifolia - Arctostaphylos nevadensis* Woodland (CEGL003448, G2)
- *Pinus jeffreyi / Quercus vacciniifolia - Garrya buxifolia* Woodland (CEGL003447, G2G3)

DISTRIBUTION

Range: This system occurs throughout the Klamath - Siskiyou region below 1500 m (4550 feet) elevation.
Divisions: 206:C
Nations: US
Subnations: CA, OR
Map Zones: 2:C, 3:C, 7:?
USFS Ecomap Regions: 263A:CC, M242A:CP, M242B:CC, M242C:C?, M261A:CC, M261B:CC, M261C:CP, M261D:CC
TNC Ecoregions: 5:C

SOURCES

References: Atzet et al. 1996, Barbour and Major 1988, Barbour et al. 2007, Bekker and Taylor 2001, Comer et al. 2003, Eyre 1980, Frost and Sweeney 2000, Holland and Keil 1995, Jimerson 1993, Jimerson 1994, Jimerson and Daniel 1999, Jimerson et al. 1995, Kilgore and Taylor 1979, Kruckberg 1984, Landfire 2007a, Parker 1990, PRBO Conservation Science 2011, Sanchez-Mata 2007, Sawyer and Keeler-Wolf 1995, Sensenig 2002, Taylor 2000, Taylor and Skinner 1998, Taylor and Skinner 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722764#references
Description Author: P. Comer and T. Keeler-Wolf, mod. M.S. Reid
Version: 14 Jan 2014 **Stakeholders:** West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

KLAMATH-SISKIYOU UPPER MONTANE SERPENTINE MIXED CONIFER WOODLAND (CES206.914)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Upper Montane]; Forest and Woodland (Treed); Mediterranean [Mediterranean Pluviseasonal-Oceanic]; Ultramafic with low Ca:Mg ratio; Very Shallow Soil; Ustic
Non-Diagnostic Classifiers: Serpentine; Needle-Leaved Tree; Broad-Leaved Evergreen Tree; Broad-Leaved Evergreen Shrub
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2022; ESLF 4209; ESP 1022

CONCEPT

Summary: This system occurs throughout the Klamath - Siskiyou region above 1500 m (4550 feet) elevation on thin, rocky, ultramafic (gabbro, peridotite, serpentinite) soils in dry-mesic conditions. Not all ultramafic outcrops support distinct vegetation; only those with very low Ca:Mg ratios impact biotic composition. Although ultramafics may be relatively dry and have a moderate to high grass component, they do not burn often where the serpentine syndrome [see Kruckeberg (1984)] is severe. The problem is not just the calcium:magnesium ratio, but heavy metals and sometimes high clay content limit biomass production. These systems are highly variable and spotty in distribution. Common species include *Pinus monticola, Pinus balfouriana, Quercus vacciniifolia, Pinus jeffreyi, Ceanothus pumilus, Arctostaphylos* spp., *Lithocarpus densiflorus var. echinoides, Abies X shastensis (= Abies magnifica var. shastensis*), and *Chamaecyparis nootkatensis*. Stands of stunted (up to 12 m [40 feet]) but straight *Pinus contorta* are also possible. *Chamaecyparis lawsoniana* communities can occur in this system in mesic and linear riparian zones. Herbaceous-dominated serpentine fens (and bogs) are treated in Mediterranean California Serpentine Fen (CES206.953).
Classification Comments: It has been proposed to merge this system with the similar Klamath-Siskiyou Lower Montane Serpentine Mixed Conifer Woodland (CES206.917), as they are similar in composition and structure. For now, they are kept as separate systems pending further review and comment from California ecologists.
Related Concepts:
- Knobcone Pine: 248 (Eyre 1980) Intersecting

Component Associations:
- *Pinus monticola - Pseudotsuga menziesii / Quercus vacciniifolia - Lithocarpus densiflorus* Woodland (CEGL003449, G2)

DISTRIBUTION

Range: This system occurs throughout the Klamath - Siskiyou region above 1500 m (4550 feet) elevation.
Divisions: 206:C
Nations: US
Subnations: CA, OR
Map Zones: 2:C, 3:C, 7:?
USFS Ecomap Regions: M242A:??, M261A:CC, M261B:CC, M261C:CP, M261D:CC
TNC Ecoregions: 5:C

SOURCES

References: Barbour and Major 1988, Comer et al. 2003, Holland and Keil 1995, Jimerson 1993, Jimerson 1994, Jimerson and Daniel 1999, Jimerson et al. 1995, Kruckeberg 1984, Sawyer and Keeler-Wolf 1995
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722767#references
Description Author: P. Comer, T. Keeler-Wolf, mod. M.S. Reid, G. Kittel
Version: 25 Apr 2006 **Stakeholders:** West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

LAURENTIAN JACK PINE-RED PINE FOREST (CES103.075)

CLASSIFIERS

Classification Status: Standard

Primary Division: Boreal (103)
Land Cover Class: Forest and Woodland
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
National Mapping Codes: ESLF 4262

DISTRIBUTION

Divisions: 103:C
Nations: CA, US
Subnations: MI, ON, WI

SOURCES

References: Eastern Ecology Working Group n.d., Midwestern Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.821526#references
Version:
Concept Author: P. Comer
Stakeholders: Canada, Midwest
ClassifResp: Midwest

LAURENTIAN-ACADIAN NORTHERN HARDWOOD FOREST (CES201.564)

CLASSIFIERS

Classification Status: Standard

Primary Division: Laurentian-Acadian (201)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane; Forest and Woodland (Treed); Eutrophic Soil; Mesotrophic Soil; Broad-Leaved Tree; Acer saccharum - Betula spp.
Non-Diagnostic Classifiers: Lowland; Ridge/Summit/Upper Slope; Sideslope; Glaciated; Circumneutral Soil; Acidic Soil; Shallow Soil; Deep Soil; Mineral: W/ A-Horizon >10 cm; Loam Soil Texture; Udic; Long Disturbance Interval; W-Patch/Medium Intensity
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: EVT 2302; ESLF 4108; ESP 1302

CONCEPT

Summary: These northern hardwood forests range across New England and adjacent Canada, south to northern Pennsylvania and west to Minnesota. They occur in various dry-mesic to wet-mesic settings at low to moderate elevations (generally <610 m [2000 feet]) throughout the Laurentian-Acadian Division. *Acer saccharum, Betula alleghaniensis*, and *Fagus grandifolia* are the dominant trees (the latter only east of northern Wisconsin). *Tsuga canadensis* or, in the Northeast, *Picea rubens* are common minor canopy associates. *Ostrya virginiana* is frequent but not dominant. Oak is a minor component and absent from northern regions. Successional stands may be dominated by *Populus tremuloides, Betula papyrifera, Acer rubrum, Fraxinus americana, Prunus serotina,* sometimes with scattered *Pinus strobus*. Soils range from moderately nutrient-poor to quite enriched, with associated shifts in the herb flora. This system can include large expanses of rich forest in areas of limestone or similar bedrock, as well as forests that are relatively poor floristically in areas of granitic (or similar) bedrock or acidic till. Blowdowns or snow and ice loading, with subsequent gap regeneration, are the most frequent form of natural disturbance.
Classification Comments: An east-west separation between the Laurentian and Acadian regions was considered, but the hardwoods component is essentially similar (though beech drops out in the most western part of this system). It appears to be more of a gradient, with beech and hobblebush dropping out and fire frequency probably a little greater in the western portion. A possible split at Lake Michigan could be considered if one could make a better case than just beech. Hemlock-hardwood inclusions in the East may be part of this system where the matrix and surroundings are predominantly hardwood, but where hemlock and pine are prevalent, as in ravines or cool slopes, Laurentian-Acadian Pine-Hemlock-Hardwood Forest (CES201.563) is the appropriate system.
Similar Ecological Systems:
- Acadian Low-Elevation Spruce-Fir-Hardwood Forest (CES201.565)--is primarily coniferous though portions may have hardwoods present or codominant; *Picea rubens* is characteristic in the Acadian region and *Picea mariana* associations are also attributed.
- Appalachian (Hemlock)-Northern Hardwood Forest (CES202.593)--occurs southward of this type; the two overlap in parts of Pennsylvania, New York and the Connecticut Valley.
- Laurentian-Acadian Pine-Hemlock-Hardwood Forest (CES201.563)--is primarily coniferous and often on lower slopes or ravines.
- North-Central Interior Beech-Maple Forest (CES202.693)

Related Concepts:
- Aspen - Birch Woodland/Forest Complex (Gawler and Cutko 2010) Finer
- Aspen: 16 (Eyre 1980) Finer
- Beech - Birch - Maple Forest (Gawler and Cutko 2010) Finer
- Beech - Sugar Maple: 60 (Eyre 1980) Finer
- Hardwood Seepage Forest (Gawler and Cutko 2010) Finer
- Maple - Basswood - Ash Forest (Gawler and Cutko 2010) Finer
- Paper Birch: 18 (Eyre 1980) Finer
- Red Spruce - Sugar Maple - Beech: 31 (Eyre 1980) Finer
- Semi-rich Northern Hardwood Forest (Gawler and Cutko 2010) Finer
- Sugar Maple - Basswood: 26 (Eyre 1980) Finer
- Sugar Maple - Beech - Yellow Birch: 25 (Eyre 1980) Finer
- Sugar Maple: 27 (Eyre 1980) Finer

Component Associations:
- *Acer saccharum - (Fraxinus americana) / Arisaema triphyllum* Forest (CEGL006211, G4)
- *Acer saccharum - Betula alleghaniensis - Fagus grandifolia / Viburnum lantanoides* Forest (CEGL006252, G5)
- *Acer saccharum - Betula alleghaniensis - Tilia americana* Forest (CEGL002457, G3G4)
- *Acer saccharum - Fagus grandifolia - Betula* spp. / *Maianthemum canadense* Forest (CEGL005004, G4G5)
- *Acer saccharum - Fraxinus americana - Tilia americana / Acer spicatum / Caulophyllum thalictroides* Forest (CEGL005008, G4?)
- *Acer saccharum - Tilia americana / Ostrya virginiana / Lonicera canadensis* Forest (CEGL002458, G3?)
- *Betula papyrifera - Acer saccharum* / Mixed Hardwoods Forest (CEGL002464, G4?)

- Boreal Glaciere Talus Sparse Vegetation (CEGL005243, G2G3)
- *Populus (tremuloides, grandidentata) - Betula (populifolia, papyrifera)* Semi-natural Woodland (CEGL006303, G5)
- *Populus tremuloides - Betula papyrifera - (Acer rubrum, Fraxinus nigra)* Forest (CEGL002467, G5)
- *Symplocarpus foetidus* - Mixed Forbs Wet Meadow (CEGL002385, G4?)
- *Thuja occidentalis - Betula alleghaniensis* Forest (CEGL002450, G2Q)
- *Thuja occidentalis / Abies balsamea - Acer spicatum* Forest (CEGL002449, G4)
- *Tsuga canadensis - (Betula alleghaniensis) - Picea rubens / Cornus canadensis* Forest (CEGL006129, GNR)

DISTRIBUTION

Range: This system occurs in northern New England and northern New York west across the upper Great Lakes to northern Minnesota, and adjacent Canada; occasional southwards.
Divisions: 201:C; 202:C
Nations: CA, US
Subnations: MA, ME, MI, MN, NB, NH, NS, NY, ON, PA, QC, VT, WI
Map Zones: 41:C, 50:C, 51:C, 63:C, 64:C, 65:C, 66:C
USFS Ecomap Regions: 211A:CC, 211B:CC, 211C:CC, 211D:CC, 211E:CC, 211F:CC, 211I:CC, 211J:CC, 212Ha:CCC, 212Hb:CCC, 212Hc:CCC, 212Hd:CCC, 212He:CCC, 212Hf:CCC, 212Hg:CCC, 212Hh:CCC, 212Hi:CCC, 212Hj:CCC, 212Hk:CCC, 212Hl:CCC, 212Hm:CCC, 212J:CC, 212K:CC, 212L:CC, 212M:CC, 212N:CC, 212Q:CC, 212Ra:CCC, 212Rb:CCC, 212Rc:CCC, 212Rd:CCC, 212Re:CCC, 212S:CC, 212T:CC, 212X:CC, 212Y:CC, 212Z:CC, 221B:CC, 222I:CC, 222Ja:CCC, 222Jf:CCC, 222Ud:CCC, 222Ue:CCC, M211A:CC, M211B:CC, M211C:CC, M211D:CC
TNC Ecoregions: 47:C, 48:C, 60:C, 61:C, 63:C, 64:C

SOURCES

References: Comer and Albert 1997, Comer et al. 1995a, Comer et al. 1998, Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723040#references
Description Author: S.C. Gawler
Version: 04 Feb 2009 **Stakeholders:** Canada, East, Midwest
Concept Author: S.C. Gawler **ClassifResp:** East

LAURENTIAN-ACADIAN NORTHERN PINE-(OAK) FOREST (CES201.719)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Laurentian-Acadian (201)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed)
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2362; ESLF 4265; ESP 1362

CONCEPT

Summary: This is a pine-dominated, or occasionally pine-oak, forest system that is typically found on nutrient-poor soils, or on moderately rich soils in the upper Midwest, northeastern U.S., and adjacent Canada, in a variety of topographic settings. Soils are loamy to sandy, varying from thin soil over bedrock to deeper soils, sometimes sandy. Sites are xeric to subxeric, but less strongly than barrens and sandplains. The dominant fire regime varies from 100-200 years for *Pinus strobus* and *Pinus resinosa*. Other boreal conifers, or in the East *Picea rubens*, may occasionally be present. Canopy structure is mostly closed but can be partially open. Conifers typically dominate the canopy, but codominates may include hardwoods, especially *Quercus rubra* or *Acer rubrum*, but also *Populus tremuloides* or *Betula papyrifera*. The shrub and field layers can be somewhat dense to sparse.
Classification Comments: This system is dominated by white pine and red pine forests, which are found primarily in the Great Lakes and sub-boreal region, but extend eastward to Acadia. Where *Pinus strobus* is a codominant with *Tsuga canadensis*, stands most typically are placed within Laurentian-Acadian Pine-Hemlock-Hardwood Forest (CES201.563).
Similar Ecological Systems:
- Central Appalachian Dry Oak-Pine Forest (CES202.591)
- Laurentian Pine-Oak Barrens (CES201.718)
- Laurentian-Acadian Pine-Hemlock-Hardwood Forest (CES201.563)--is more mesic; red pine and jack pine are good differential species for CES201.719 versus CES201.563.

Related Concepts:
- Eastern White Pine: 21 (Eyre 1980) Finer
- Northern Red Oak: 55 (Eyre 1980) Finer
- Red Oak - Northern Hardwoods - White Pine Forest (Gawler and Cutko 2010) Finer
- Red Pine - White Pine Forest (Gawler and Cutko 2010) Finer
- Red Pine: 15 (Eyre 1980) Finer
- White Pine - Mixed Conifer Forest (Gawler and Cutko 2010) Finer
- White Pine - Northern Red Oak - Red Maple: 20 (Eyre 1980) Finer

Component Associations:
- *Pinus resinosa - Pinus strobus - (Quercus rubra) / Corylus cornuta* Forest (CEGL005399, G3)
- *Pinus resinosa - Pinus strobus / Corylus cornuta / Vaccinium angustifolium* Forest (CEGL002443, G3)
- *Pinus strobus - (Pinus resinosa) - Quercus rubra* Forest (CEGL002480, G4)
- *Pinus strobus - Pinus resinosa / Cornus canadensis* Forest (CEGL006253, GNR)
- *Pinus strobus / Acer spicatum - Corylus cornuta* Forest (CEGL002445, G3G4)

DISTRIBUTION

Range: This system is found in the upper midwestern and northeastern United States and adjacent Canada.
Divisions: 102:?; 103:?; 201:C
Nations: CA, US
Subnations: MB, ME, MI, MN, NB, NH, NS, NY, ON, PA?, PE?, QC, VT, WI
Map Zones: 41:C, 50:C, 51:C, 63:C, 64:C, 65:C, 66:C
USFS Ecomap Regions: 211A:CP, 211B:CC, 211C:CC, 211D:CC, 211E:CC, 211J:CP, 212Ha:CCC, 212Hb:CCC, 212Hc:CCC, 212Hd:CCC, 212He:CCC, 212Hf:CCC, 212Hg:CCC, 212Hh:CCC, 212Hi:CCC, 212Hj:CCC, 212Hk:CCC, 212Hl:CCC, 212Hm:CCC, 212Jb:CCC, 212Jc:CCC, 212Jo:CCC, 212Ka:CCC, 212Kb:CCC, 212La:CCC, 212Lb:CCC, 212Lc:CCC, 212Ld:CCC, 212Le:CCC, 212Ma:CCC, 212Mb:CCC, 212Na:CCC, 212Nb:CCC, 212Nc:CCC, 212Nd:CCC, 212Qa:CCC, 212Qb:CCC, 212Qc:CCC, 212Qd:CCC, 212Ra:CCC, 212Rb:CCC, 212Rc:CCC, 212Rd:CCC, 212Re:CCC, 212Sb:CCC, 212Sc:CCC, 212Sn:CCC, 212Sq:CCC, 212Ta:CCC, 212Tb:CCC, 212Tc:CCC, 212Te:CCC, 212Tf:CCC, 212Xa:CCC, 212Xb:CCC, 212Xc:CCC, 212Xd:CCC, 212Xe:CCC, 212Xf:CCC, 212Ya:CCC, 212Za:CCC, 212Zb:CCC, 212Zc:CCC, 221Ai:CCC, 221Al:CCC, 222I:CP, 222Ja:CCC, 222Ud:CCC, 222Ue:CCC, M211A:CC, M211Bd:CCC, M211C:CP, M211D:CP
TNC Ecoregions: 46:?, 47:C, 48:C, 61:C, 63:C

SOURCES

References: Comer et al. 1995a, Comer et al. 1998, Comer et al. 2003, Frelich 1992, Heinselman 1973, Whitney 1986, Whitney 1987

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722950#references
Description Author: D. Faber-Langendoen
Version: 04 Mar 2004 **Stakeholders:** Canada, East, Midwest
Concept Author: D. Faber-Langendoen and S.C. Gawler **ClassifResp:** Midwest

LAURENTIAN-ACADIAN PINE-HEMLOCK-HARDWOOD FOREST (CES201.563)

CLASSIFIERS

Classification Status: Standard

Primary Division: Laurentian-Acadian (201)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland; Forest and Woodland (Treed); Pinus spp. - Tsuga canadensis
Non-Diagnostic Classifiers: Sideslope; Glaciated; Mesotrophic Soil; Acidic Soil; Shallow Soil; Deep Soil; Mineral: W/ A-Horizon >10 cm; Loam Soil Texture; Sand Soil Texture; Udic; Very Long Disturbance Interval; F-Landscape/Medium Intensity; W-Patch/Medium Intensity; Needle-Leaved Tree; Broad-Leaved Deciduous Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Mixed evergreen-deciduous closed tree canopy
National Mapping Codes: EVT 2366; ESLF 4308; ESP 1366

CONCEPT

Summary: This north-temperate forest system ranges from the northeastern U.S. and adjacent Canada west to the Great Lakes and upper Midwest. The mesic to dry-mesic forests usually occur on low-nutrient soils at low elevations, mostly less than 610 m (2000 feet). Canopy dominants include *Pinus strobus, Tsuga canadensis*, and *Quercus rubra* in varying percentages. *Acer rubrum* is also quite common; *Betula lenta* may be common at the southern periphery of this system's range. *Quercus velutina* and *Quercus alba* are essentially absent from this system, being more representative of systems in the Central Interior-Appalachian Division to the south. This is a widespread, matrix forest type for the more temperate portions of this division. Gap replacement and infrequent fire are the major natural regeneration modes.
Classification Comments: *Tsuga canadensis* is useful to separate this system from Laurentian-Acadian Northern Pine-(Oak) Forest (CES201.719), but does not always occur in this system. Hemlock draws in USFS Section 222L (Baraboo) could be considered as remnants of this system rather than an inclusion in the hardwood matrix, as they are very distinctive from the surrounding forest and have the northern representative flora. In the East, northern hardwoods other than beech, e.g., sugar maple, are rarely found in this system. This system and Appalachian (Hemlock)-Northern Hardwood Forest (CES202.593) grade into one another in southern New York and northern Pennsylvania; the presence of *Liriodendron tulipifera* is diagnostic for the Division 202 Appalachian (Hemlock)-Northern Hardwood Forest (CES202.593).
Similar Ecological Systems:
- Appalachian (Hemlock)-Northern Hardwood Forest (CES202.593)--is the counterpart to this system as one moves southward; also can have more northern hardwood species than usually seen in this system.
- Laurentian-Acadian Northern Hardwood Forest (CES201.564)
- Laurentian-Acadian Northern Pine-(Oak) Forest (CES201.719)--occurs in slightly to considerably drier settings and rarely has hemlock. Fire return interval is shorter too. May have red pine.

Related Concepts:
- Aspen - Birch Woodland/Forest Complex (Gawler and Cutko 2010) Finer
- Eastern Hemlock: 23 (Eyre 1980) Finer
- Eastern White Pine: 21 (Eyre 1980) Finer
- Hemlock - Yellow Birch: 24 (Eyre 1980) Finer
- Hemlock Forest (Gawler and Cutko 2010) Finer
- Northern Red Oak: 55 (Eyre 1980) Finer
- Oak - Pine Forest (Gawler and Cutko 2010) Finer
- Red Maple: 108 (Eyre 1980) Finer
- Red Oak - Northern Hardwoods - White Pine Forest (Gawler and Cutko 2010) Finer
- White Pine - Hemlock: 22 (Eyre 1980) Finer
- White Pine - Northern Red Oak - Red Maple: 20 (Eyre 1980) Finer

Component Associations:
- (*Pinus strobus, Quercus rubra*) / *Danthonia spicata* Acidic Bedrock Wooded Herbaceous Vegetation (CEGL005101, G3G4)
- *Acer rubrum - Nyssa sylvatica - Betula alleghaniensis / Sphagnum* spp. Forest (CEGL006014, G3)
- *Acer saccharum - Pinus strobus / Acer pensylvanicum* Forest (CEGL005005, GNR)
- *Betula alleghaniensis - Acer rubrum - (Tsuga canadensis, Abies balsamea) / Osmunda cinnamomea* Forest (CEGL006380, G4?)
- *Pinus strobus - (Pinus resinosa) - Quercus rubra* Forest (CEGL002480, G4)
- *Pinus strobus - Quercus (rubra, velutina) - Fagus grandifolia* Forest (CEGL006293, G5)
- *Pinus strobus - Quercus alba / (Corylus americana, Gaylussacia baccata)* Forest (CEGL002481, G3)
- *Pinus strobus - Tsuga canadensis - Picea rubens* Forest (CEGL006324, GNR)
- *Pinus strobus - Tsuga canadensis* Great Lakes Forest (CEGL002590, G3)
- *Pinus strobus / Acer spicatum - Corylus cornuta* Forest (CEGL002445, G3G4)
- *Quercus rubra - Acer saccharum - (Betula alleghaniensis)* Forest (CEGL002461, G4G5)

- *Quercus rubra - Acer saccharum - Fagus grandifolia / Viburnum acerifolium* Forest (CEGL006173, G4G5)
- *Quercus rubra - Quercus alba - (Quercus velutina, Acer rubrum) / Viburnum acerifolium* Forest (CEGL002462, GNR)
- *Symplocarpus foetidus* - Mixed Forbs Wet Meadow (CEGL002385, G4?)
- *Thuja occidentalis - (Betula alleghaniensis, Tsuga canadensis)* Forest (CEGL002595, G3?)
- *Tsuga canadensis - (Betula alleghaniensis) - Picea rubens / Cornus canadensis* Forest (CEGL006129, GNR)
- *Tsuga canadensis - (Betula alleghaniensis)* Forest (CEGL002598, G3?)
- *Tsuga canadensis - Acer saccharum - Betula alleghaniensis* Forest (CEGL005044, G4?)
- *Tsuga canadensis - Fagus grandifolia - (Acer saccharum)* Great Lakes Forest (CEGL005042, G4G5)
- *Tsuga canadensis - Fagus grandifolia - Acer saccharum / (Hamamelis virginiana, Kalmia latifolia)* Forest (CEGL005043, G3?)
- *Tsuga canadensis - Fagus grandifolia - Quercus rubra* Forest (CEGL006088, G4G5)

DISTRIBUTION

Range: New England west to the Great Lakes and northern Minnesota.
Divisions: 201:C
Nations: CA, US
Subnations: MA, ME, MI, MN, NB, NH, NS, NY, ON, PA, QC, VT, WI
Map Zones: 41:C, 50:C, 51:C, 63:C, 64:C, 65:C, 66:C
USFS Ecomap Regions: 211A:CC, 211B:CC, 211C:CC, 211D:CC, 211E:CC, 211Fa:CCC, 211Fb:CCC, 211Ff:CCC, 212Ha:CCC, 212Hb:CCC, 212Hc:CCC, 212Hd:CCC, 212He:CCC, 212Hf:CCC, 212Hg:CCC, 212Hh:CCC, 212Hi:CCC, 212Hj:CCC, 212Hk:CCC, 212Hl:CCC, 212Hm:CCC, 212J:CC, 212K:CC, 212L:CC, 212M:CC, 212N:CC, 212Ra:CCC, 212Rb:CCC, 212Rc:CCC, 212Rd:CCC, 212Re:CCC, 212S:CC, 212T:CC, 212X:CC, 212Y:CC, 212Z:CC, 221Al:CCC, 222Ja:CCC, 222Jf:CCC, 222L:CC, 222Ud:CC?, 222Ue:CCC, M211A:CC, M211B:CC, M211C:CC, M211D:CC
TNC Ecoregions: 47:C, 48:C, 60:C, 61:C, 63:C, 64:C

SOURCES

References: Comer and Albert 1997, Comer et al. 1995a, Comer et al. 1998, Comer et al. 2003, Whitney 1984
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723041#references
Description Author: S.C. Gawler
Version: 20 Aug 2007 **Stakeholders:** Canada, East, Midwest
Concept Author: S.C. Gawler **ClassifResp:** East

LAURENTIAN-ACADIAN SUB-BOREAL ASPEN-BIRCH FOREST (CES103.020)

CLASSIFIERS

Classification Status: Standard

Primary Division: Boreal (103)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Boreal [Boreal Continental]; Intermediate Disturbance Interval
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: EVT 2301; ESLF 4107; ESP 1301

CONCEPT

Summary: These early-successional boreal hardwood forests and woodlands are widespread throughout the eastern hemi-boreal region of Canada, extending into parts of the Laurentian-Acadian region, but more localized eastward. They originate naturally after fires and blowdowns, but more commonly originate after logging of conifer or mixed conifer-hardwood systems. *Populus tremuloides* and *Betula papyrifera* are the most important tree species. This system is maintained by repeated disturbance within 50-year return intervals and would otherwise succeed to conifer systems. Localized stands of mixed conifer-hardwoods (pines and spruces) can occur in this type, but are more typically part of conifer systems.
Classification Comments: As defined here, these are deciduous forest-dominated systems; mixed conifer-hardwoods areas will go in the appropriate conifer forest system. In addition, this system is primarily eastern hemi-boreal, because some northern hardwood species do occur; in the Laurentian-Acadian region, successional aspen-birch or red maple stands would be placed within the appropriate mature Laurentian-Acadian forest system (e.g., aspen-birch stands in Maine are placed within Acadian Low-Elevation Spruce-Fir-Hardwood Forest (CES201.565). The perspective here is that *Picea rubens* (red spruce) is not a boreal species; stands of *Picea rubens* often contain many typical northern hardwood associates, rather than *Populus tremuloides* or *Betula papyrifera*. It is not clear how naturally this system occurs in the upper Midwest given catastrophic fires in the 1800s-early 1900s; is the extensive aspen-birch found in northern Minnesota this system or should those be considered part of northern hardwoods or spruce-fir? A workable approach for now would be to restrict this system to northernmost Minnesota and southern Lake Superior [see USFS Ecomap Regions].

The original "Boreal Aspen-Birch Forest" system was not well defined in Canada. As described it only covered the hemi-boreal region of eastern Canada. It has been renamed to reflect that concept. This system is closely related to Eastern Hemi-Boreal Mesic Balsam Fir-Spruce Forest (CES103.426), and within the IVC these are part of Eastern Hemi-Boreal Mesic Balsam Fir - Spruce - Hardwood Forest Group (G048). It may be that a series of aspen-birch systems separate from the spruce-fir systems, are needed for Eastern Boreal, Central Hemi-Boreal, Central Boreal, Western Boreal and Western Hemi-Boreal regions of the North American Boreal Forest. Or, conversely, this system (CES103.020) could be lumped within Eastern Hemi-Boreal Mesic Balsam Fir-Spruce Forest (CES103.426), and the distinction treated here and elsewhere at the alliance level, below system.
Similar Ecological Systems:
- Acadian Low-Elevation Spruce-Fir-Hardwood Forest (CES201.565)--occurs farther east and does not overlap.

Related Concepts:
- Aspen: 16 (Eyre 1980) Finer
- Aspen: 217 (Eyre 1980) Finer
- Paper Birch: 18 (Eyre 1980) Finer

Component Associations:
- Boreal Glaciere Talus Sparse Vegetation (CEGL005243, G2G3)
- *Populus (tremuloides, balsamifera) - (Betula papyrifera) - Picea mariana / Alnus viridis* Forest (CEGL002514, GNR)
- *Populus tremuloides - Betula papyrifera - (Acer rubrum, Fraxinus nigra)* Forest (CEGL002467, G5)
- *Populus tremuloides - Betula papyrifera / (Abies balsamea, Picea glauca)* Forest (CEGL002466, G5)
- *Populus tremuloides - Populus balsamifera* - Mixed Hardwoods Lowland Forest (CEGL005036, G5)

DISTRIBUTION

Range: This system is found in the hemi-boreal region of the Upper Great Lakes and southeastern Canada from northwestern Ontario and northern Minnesota east to Quebec (and possibly northern portions of the Canadian Maritimes).
Divisions: 103:C; 201:C
Nations: CA, US
Subnations: LB, MI, MN, NB?, NF, ON, QC, WI
Map Zones: 41:C, 50:C, 51:C
USFS Ecomap Regions: 212Ha:CPP, 212Hf:CPP, 212Hl:CPP, 212J:CP, 212Lb:CCC, 212M:CC, 212R:CP, 212S:CP, 212T:CP, 212X:CP, 212Y:CP
TNC Ecoregions: 47:C, 48:C

SOURCES

References: Brandt 2009, Comer et al. 2003, Eyre 1980

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722685#references

Description Author: D. Faber-Langendoen

Version: 15 Oct 2012

Concept Author: D. Faber-Langendoen and S. Gawler

Stakeholders: Canada, East, Midwest

ClassifResp: Midwest

LAURENTIAN-ACADIAN SUB-BOREAL DRY-MESIC PINE-BLACK SPRUCE-HARDWOOD FOREST (CES103.425)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Land Cover Class: Forest and Woodland
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
National Mapping Codes: ESLF 4336

CONCEPT

Summary: This hemi-boreal forest ecological system is found on dry-mesic nutrient-poor soils in a variety of topographic settings. It ranges from northwestern Ontario to eastern Canada, and southward into Minnesota, the Great Lakes region, and very locally into northwestern Maine. Soils are loamy to sandy, varying from nutrient-poor, thin soils over bedrock to deeper soils, sometimes sandy. Sites are typically dry-mesic. The dominant fire regime varies from 50-100 years. *Pinus banksiana, Pinus resinosa,* and *Picea mariana* are characteristic overstory species, with *Pinus strobus* occasionally common, over much of the range, but east of the Great Lakes, *Picea mariana* becomes increasingly dominant with *Abies balsamea* as an important associate. Canopy structure is mostly closed but can be partially open. Conifers typically dominate the canopy, but boreal hardwoods (*Populus tremuloides, Betula papyrifera*) may codominate. As time since fire increases, *Picea mariana* may dominate. Tree regeneration includes *Abies balsamea, Betula papyrifera, Populus tremuloides*, and *Picea mariana*. The shrub and field layers can be very open to somewhat dense (5-75% cover). Characteristic low-shrub and herb species include *Amelanchier* spp., *Vaccinium angustifolium, Diervilla lonicera, Cornus canadensis, Linnaea borealis, Doellingeria umbellata (= Aster umbellatus)*, and *Eurybia macrophylla*. Older *Picea mariana* stands may be strongly dominated by feathermosses.
Classification Comments: In Quebec (C. Morneau pers. comm. 2009), *Picea mariana* is far more common than *Pinus banksiana* in the boreal forest. Secondly, forests composed of a mixture of *Picea mariana* and *Abies balsamea* with a feathermoss carpet on the ground are very common east of 74 degrees W longitude and north of 48 degrees N latitude where climate undergoes a maritime influence and where *Pinus banksiana* gradually becomes absent. *Picea mariana - Picea rubens / Rhododendron canadense / Cladina* spp. Woodland (CEGL006421), in the present system, represents spruce-lichen woodlands at the boreal-temperate forest interface.

At this time, this system excludes xeric *Pinus banksiana* and *Picea mariana* stands, which are placed in their own system, Eastern Hemi-Boreal Dry Jack Pine - Red Pine - Hardwood Woodland (CES103.424), found on dry, poor sites, where there is a low density of *Pinus banksiana* trees resulting in a woodland condition. Lichens are dominant. Woodland physiognomy and lichen dominance distinguish that system from this system, which has more of a closed canopy and feathermosses and herbs are more abundant. See also Minnesota DNR (2003), which separates Northern Dry-Sand Pine Woodland (FDn12) and Northern Dry-Bedrock Pine-(Oak) Woodland (FDn22), and belong with CES103.424, from the dry-mesic *Pinus banksiana* and *Picea mariana* Forests and Woodlands (FDn32 and FDn33), which belong with this system.

Placement of *Populus tremuloides - (Populus grandidentata)* Rocky Woodland (CEGL002487) in this system needs review.
Similar Ecological Systems:
- Eastern Boreal Black Spruce-Jack Pine Forest (CES103.422)
- Eastern Boreal Jack Pine-Black Spruce Dry Woodland (CES103.423)
- Northern Dry Jack Pine-Red Pine-Hardwood Woodland (CES103.424)

Related Concepts:
- Black Spruce: 12 (Eyre 1980) Intersecting
- Jack Pine - Black Spruce (Heinselman 1973) Finer
- Jack Pine - Fir, Black Spruce - Feathermoss (Heinselman 1973) Finer
- Jack Pine: 1 (Eyre 1980) Intersecting

DESCRIPTION

Environment: Soils are loamy to sandy, varying from nutrient-poor, thin soil over bedrock to deeper soils, sometimes sandy. Sites are typically on dry-mesic to dry sites, but not commonly found on xeric sandplains or bedrock sites.
Vegetation: *Pinus banksiana* and *Picea mariana* are characteristic overstory species. In the Upper Great Lakes region, *Pinus banksiana* may intermix with *Pinus resinosa*. Canopy structure is mostly closed but can be partially open. Conifers typically dominate the canopy, but boreal hardwoods (*Populus tremuloides, Betula papyrifera*) may codominate. As time since fire increases, *Picea mariana* may dominate. Tree regeneration includes *Abies balsamea, Betula papyrifera, Populus tremuloides,* and *Picea mariana*. Characteristic low-shrub and herb species include *Amelanchier* spp., *Vaccinium angustifolium, Diervilla lonicera, Cornus canadensis, Linnaea borealis, Doellingeria umbellata (= Aster umbellatus)*, and *Eurybia macrophylla*. Older *Picea mariana* stands may be strongly dominated by feathermosses (Minnesota DNR 2003).

DISTRIBUTION

Range: This system ranges from northwestern Ontario to eastern Canada, and southward into Minnesota, the Great Lakes region, and very locally into northwestern Maine.
Nations: CA, US
Subnations: LB, MB?, MI, MN, NB, NF, ON, QC, WI
TNC Ecoregions: 47:C, 48:C, 63:C

SOURCES

References: Comer et al. 2003, Eyre 1980, Faber-Langendoen et al. 2013a, Minnesota DNR 2003, NatureServe n.d.

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.878456#references

Description Author: S. Menard and D. Faber-Langendoen

Version: 05 Sep 2012 **Stakeholders:** Canada, East, Midwest

Concept Author: K.A. Schulz, in Faber-Langendoen et al. (2012) **ClassifResp:** Midwest

LAURENTIAN-ACADIAN SUB-BOREAL MESIC BALSAM FIR-SPRUCE FOREST (CES103.426)

CLASSIFIERS

Conf.: 1 - Strong
Classification Status: Standard
Land Cover Class: Forest and Woodland
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
National Mapping Codes: ESLF 4337

CONCEPT

Summary: This ecological system represents the mesic southern or hemi-boreal eastern boreal forest, ranging from northwestern Ontario to eastern Canada's Atlantic provinces and extending into the U.S. in northeastern Minnesota, Isle Royale, and near-coastal areas of Lake Superior shores in northern Wisconsin and Michigan. The low-elevation forests are dominated by *Picea glauca* and *Abies balsamea*. *Picea mariana* is often present, along with occasional *Pinus banksiana*. Codominant boreal hardwoods include *Populus tremuloides* and *Betula papyrifera*. Northern hardwoods, such as *Acer saccharum* and *Tilia americana* are relatively minor. The shrub and herb layers are variable, decreasing as the percent conifer cover increases. Common shrub species include *Acer spicatum, Alnus viridis, Corylus cornuta, Diervilla lonicera*, and *Lonicera canadensis*. The moss layer ranges from discontinuous to continuous. These upland forests typically occur on loamy soils over bedrock in scoured bedrock uplands and loamy, rocky, or sandy soils on glacial moraines, till plains and outwash plains, and moisture conditions range from well-drained to somewhat poorly drained. Wetter sites may contain *Alnus incana ssp. rugosa, Calamagrostis canadensis*, and *Equisetum* spp. This is the matrix forest type in many parts of its range. This group may include earlier-successional patches, in which *Populus* spp. and *Betula* spp. are dominant or mixed with *Picea* and *Abies*, that will develop into spruce-fir forests. Blowdown with subsequent gap regeneration is the most frequent form of natural disturbance, with large-scale fires important at longer return intervals. Insect infestations, in particular by *Choristoneura fumiferana* (spruce budworm), also can impact this group.
Classification Comments: The transition zone from the Boreal (including hemi-boreal) Forest formation (where *Abies balsamea* is the dominant tree species) to the Cool Temperate Forest (where *Acer saccharum* is the dominant tree species) is difficult to untangle, but depends on the increasing abundance of northern hardwood tree species and more cool-temperate shrubs and herbs. Where these species occur with the boreal conifers, they are placed in 1.B.2 Cool Temperate Forest Formation (F008). Forest associations typical of this transition zone are mixedwood associations dominated by *Betula alleghaniensis* or *Acer rubrum* and *Abies balsamea* or *Acer rubrum* and *Abies balsamea*. These associations are currently placed in Cool Temperate Forest under Sub-Boreal Mesic Fir - Yellow Birch - Hardwoods Forest (CES103.434). In Quebec (C. Morneau pers. comm. 2009), the most northerly cool temperate transition zone extends between 47 degrees N latitude and 49 degrees N latitude, including Bas-St. Laurent and Gaspesie regions.

A separate aspen-birch system is recognized in the eastern hemi-boreal region, Eastern Hemi-Boreal Aspen-Birch Forest (CES103.020), though these are lumped together at the group level (G048).

Similar Ecological Systems:
- Atlantic Boreal Balsam Fir Wet Forest (CES103.433)
- Eastern Boreal Balsam Fir-White Spruce-Paper Birch Forest (CES103.421)--represents the core mesic spruce-fir forests of the eastern boreal region, with temperate and transitional species, such as *Acer spicatum* and *Betula alleghaniensis*, absent.

Related Concepts:
- Balsam Fir: 5 (Eyre 1980) Finer
- Boreal Forest (Kost et al. 2007) Broader
- Boreal Forest (Curtis 1959) Broader. The bulk of Curtis's concept fits well with this type, but he also included stands further inland in Wisconsin, that appear to contain a large abundance of northern hardwoods, and those stands probably fit better with Sub-Boreal Mesic Fir - Yellow Birch - Hardwoods Forest (CES103.434).
- Boreal Forest (Wisconsin DNR 2009a) Broader
- Fir-Birch (Heinselman 1996) Finer
- White Spruce: 201 (Eyre 1980) Finer

DESCRIPTION

Environment: These upland forests typically occur on loamy soils over bedrock in scoured bedrock uplands and loamy, rocky, or sandy soils on glacial moraines, till plains and outwash plains (Minnesota DNR 2003). Moisture conditions range from well-drained to somewhat poorly drained. Climate typically is characterized by cool, even temperatures, shorter growing season, and deep and sometimes severe winter snowfall. In the southern part of their range in the Great Lakes states, they occur along northern Great Lakes shorelines and on islands in Lake Superior. Cold temperate to boreal. Soils are typically neutral to acidic, shallow sandy, sandy-loam, or loamy-sand. Some examples occur on heavier, mesic silty or clay loams that are more alkaline in nature. Along Great Lakes shorelines, these soils overlay limestone or volcanic bedrock.
Vegetation: *Picea glauca* typically dominates on drier sites or is codominant with *Abies balsamea* on more mesic sites. In some mesic to wet-mesic examples, *Abies balsamea* dominates. This group includes several successional stages, including earlier-successional patches in which *Populus* spp. and *Betula* spp. are dominant. Mid-successional stands often contain stands mixed with *Picea* and *Abies*, that will develop into spruce-fir forests. The shrub and herb layers are variable, decreasing as the percent conifer cover increases. Common shrub species include *Acer spicatum, Corylus cornuta, Diervilla lonicera*, and *Lonicera canadensis*. The composition and density of the herbaceous layer can vary among associations and location. Typically, *Aralia nudicaulis, Eurybia*

macrophylla, *Clintonia borealis*, and *Maianthemum canadense* are common understory species. The moss layer ranges from discontinuous to continuous. Wetter sites may contain *Alnus incana ssp. rugosa*, *Calamagrostis canadensis*, and *Equisetum* spp. Additional diagnostic shrub and herb species of this hemi-boreal type will be added through further analyses.
Dynamics: These forests are affected by windthrow, insect defoliation, and infrequent fires. Forests closer to the Great Lakes shorelines occur on shallower soils and are more likely to experience more serious windthrow and snap-off of larger trees. Mammalian herbivory also can impact forest stands. Selective herbivory by white-tailed deer and moose (*Alces americanus*) can alter the composition and structure and favor browse-tolerant species such as *Picea glauca*. These forests typically regenerate from gap-phase dynamics.

DISTRIBUTION

Range: This system ranges in Canada from northwestern Ontario (possibly eastern Manitoba) to eastern Canada's Atlantic provinces and extending into the U.S. in northeastern Minnesota, Isle Royale, and near-coastal areas of Lake Superior shores in northern Wisconsin and Michigan. Its range westward is marked by a shift towards greater *Picea glauca* dominance and lower *Abies balsamea* dominance.
Nations: CA, US
Subnations: LB, MB?, MI, MN, NB?, NF, ON, QC, WI
TNC Ecoregions: 47:C, 48:C, 63:?, 64:?

SOURCES

References: Curtis 1959, Eyre 1980, Faber-Langendoen et al. 2013a, Minnesota DNR 2003, NatureServe n.d., Wisconsin DNR 2009a
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.878457#references
Description Author: D. Faber-Langendoen
Version: 05 Sep 2012 **Stakeholders:** Canada, Midwest
Concept Author: Faber-Langendoen, in Faber-Langendoen et al. (2012) **ClassifResp:** Midwest

LLANO UPLIFT ACIDIC FOREST, WOODLAND AND GLADE (CES303.657)

CLASSIFIERS

Classification Status: Standard

Primary Division: Western Great Plains (303)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Isolated Wetland [Strictly Isolated]
Non-Diagnostic Classifiers: Inselberg; Forest and Woodland (Treed); Woody-Herbaceous; Herbaceous; Moss/Lichen (Nonvascular); Ridge/Summit/Upper Slope; Rock Outcrops/Barrens/Glades; Granitic Rock; Metamorphic Rock; Igneous Rock; Temperate [Temperate Continental]; Depressional; Unglaciated; Bald; Acidic Soil; Sand Soil Texture
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2410; ESLF 7159; ESP 1410

CONCEPT

Summary: This upland matrix system occurs primarily on coarse soils derived from the weathering of underlying Precambrian granites in the Llano Uplift region of Texas. The underlying intrusive granitic bedrock substrate determines the range of this system. It is composed of a mosaic of vegetation types, including closed-canopy forests, open woodlands, savannas and sparsely vegetated rock outcrops. Common trees include *Quercus marilandica, Quercus fusiformis, Quercus stellata, Carya texana, Ulmus crassifolia*, and *Prosopis glandulosa*. Subcanopy species may include *Diospyros texana, Aloysia gratissima, Ungnadia speciosa, Ziziphus obtusifolia var. obtusifolia, Eysenhardtia texana, Aesculus glabra var. arguta, Opuntia engelmannii var. lindheimeri (= Opuntia lindheimeri), Yucca elata, Nolina texana*, and *Opuntia leptocaulis*. Grasslands may be dominated by *Schizachyrium scoparium, Sorghastrum nutans, Panicum virgatum, Bouteloua hirsuta, Bouteloua curtipendula, Nassella leucotricha, Bothriochloa laguroides*, and *Plantago wrightiana*. Granitic glades and barrens are sparsely vegetated by crustose and foliose lichens, several ferns and fern allies, and cacti. This system also includes small (up to 16 m in diameter) shallow depressions that hold rainwater and support wetland flora including the Texas endemic, *Isoetes lithophila*.
Classification Comments: This ecological system is defined to include a diversity of vegetation occurring on granitic outcrops and on soils that have developed over these outcrops in central Texas. In comparison to other areas of the U.S. where sparsely vegetated glades and barrens may be defined separately from the woodland surrounding them and/or the woodland separately from the forest (e.g., Southern Piedmont Granite Flatrock and Outcrop (CES202.329) just includes the sparsely vegetated barrens), these different vegetation types are included together here because they occur as an ecological complex or mosaic and they share floristic and geologic affinities that set them apart from the surrounding landscape. In the central mineral region of central Texas, granite glades and barrens are surrounded by areas of deeper soils derived from granite that support denser herbaceous or woody vegetation that includes many species found sparsely on the glades. In the eastern U.S. xeric granite outcrops are generally separated from one another by large areas of mesic to dry-mesic forests, whereas the granitic outcrops in central Texas are separated from one another by areas of coarse soils derived from the underlying granite. In addition, the xeric nature of the granite outcrops in the eastern U.S. is a stark contrast to the other vegetation in this humid temperate environment. Whereas, west of the dry line, the moisture availability of the granite outcrops in central Texas is not as starkly contrasted with the surrounding landscape. This has been suggested as a reason why the granite glades of central Texas do not support the degree of endemism that is found on the granite outcrops of the eastern U.S. (Walters and Wyatt 1982). The relationship of this ecological system to the granite glades and woodlands occurring in Oklahoma (currently included in Crosstimbers Oak Forest and Woodland (CES205.682)) needs to be further explored.

Currently this system includes dry woodlands on shallow soil and mesic woodlands on deeper soil. The more mesic woodlands tend to support *Carya texana* which is generally absent in other areas on the plateau. Further investigation is needed to determine if the mesic and dry components should be classified as two separate systems.

Similar Ecological Systems:
- Edwards Plateau Limestone Savanna and Woodland (CES303.660)
- Edwards Plateau Limestone Shrubland (CES303.041)

Related Concepts:
- Live Oak: 89 (Eyre 1980) Finer
- Llano Uplift Acidic Glade (not mapped) [CES303.657.3] (Elliott 2011) Finer
- Llano Uplift: Grassland (1607) [CES303.657.9] (Elliott 2011) Finer
- Llano Uplift: Live Oak Woodland (1602) [CES303.657.2] (Elliott 2011) Finer
- Llano Uplift: Mesquite / Whitebrush Shrubland (1606) [CES303.657.8] (Elliott 2011) Finer
- Llano Uplift: Post Oak Woodland (1604) [CES303.657.6] (Elliott 2011) Finer

DESCRIPTION

Environment: This system is restricted to the Llano Uplift, also known as the central mineral region of Texas. Though named as an uplift because it is an intrusion of Precambrian metamorphic rocks and large granitic massifs, this area is generally lower in elevation than the surrounding Edwards Plateau (Walters and Wyatt 1982, Riskind and Diamond 1988). At a regional scale, it is a topographic bowl, though rock outcrops such as Enchanted Rock often produce dramatic increases in elevation at a local scale. Aside from these

massif intrusions, topography is generally level to rolling. The substrate of granites, gneisses and schists determines the range of this system in central Texas. Elevation ranges from 251 to 686 m above sea level (825-2250 feet). Rainfall averages about 76 cm (30 inches), peaking in May or June and September. The central mineral region occupies approximately 1.5 million hectares in central Texas (Riskind and Diamond 1988). Mineralogy of the granitic material varies, with hornblende schist, graphite schist, quartz-feldspar gneiss and quartz-plagioclase-microcline rock common (Riskind and Diamond 1988). Soils are generally sandy loams, with gravelly soils common. They are generally acidic and coarse, resulting from weathering of the underlying granite. Many areas of exposed bedrock are present. Most frequently encountered Ecological Sites include Shallow Granite, Sandy Loam, Red Savannah, Gravelly Sandy Loam, Shallow Ridge, Granite Gravel, Sandstone Hill, and Granite Hill (Elliott 2011).

Vegetation: This system is typified by a mosaic of vegetation types, including mixed oak forests and savannas over coarse soils and sparsely vegetated areas on rock outcrops. Species such as *Quercus marilandica, Quercus fusiformis, Quercus stellata, Carya texana, Ulmus crassifolia,* and *Prosopis glandulosa* may dominate the canopy of this system. Some areas are characterized by dense forest patches (mottes) of *Quercus fusiformis*, with various mixtures of other oaks and shrubs surrounded by open grasslands. Subcanopy species may include *Diospyros texana, Aloysia gratissima, Ungnadia speciosa, Ziziphus obtusifolia var. obtusifolia, Eysenhardtia texana, Aesculus glabra var. arguta, Opuntia engelmannii var. lindheimeri (= Opuntia lindheimeri), Yucca elata, Nolina texana,* and *Opuntia leptocaulis*. The ground flora may contain *Schizachyrium scoparium, Sorghastrum nutans, Panicum virgatum, Bouteloua hirsuta, Bouteloua curtipendula, Nassella leucotricha, Eragrostis intermedia, Croton monanthogynus,* and *Plantago wrightiana*. In addition to oak woodlands and grasslands, this system also includes granitic glades and barrens. These are sparsely vegetated areas characterized by crustose and foliose lichens, several ferns and fern allies, and cacti, including *Cheilanthes lindheimeri, Pellaea ternifolia, Selaginella arenicola ssp. riddellii, Selaginella peruviana, Selaginella wrightii, Echinocereus reichenbachii,* and *Echinocereus triglochidiatus (= Echinocereus coccineus)*. Other species that may occur in cracks and crevices or slight depressions with shallow, gravelly soil include *Eriogonum tenellum, Lechea san-sabeana, Sedum nuttallianum, Tripogon spicatus, Plantago wrightiana, Talinum parviflorum, Helenium amarum, Campanula reverchonii, Aphanostephus skirrhobasis,* and *Hypericum gentianoides*. Small-scale shallow vernal pools formed within barrens by weathering of the granitic surface support *Crassula aquatica, Sedum nuttallianum, Talinum parviflorum, Eleocharis montevidensis, Elatine brachysperma, Juncus diffusissimus, Allium canadense, Nothoscordum bivalve, Cooperia drummondii, Lepuropetalon spathulatum, Isoetes melanopoda,* and the Texas endemic *Isoetes lithophila*. Larger pools often exhibit a pattern of zonation of the vegetation as soil accumulates in the center. Crevices in the rock outcrops tend to support scattered, stunted individuals of trees and shrubs found in the adjacent woodland. Endemics or near-endemics occurring within this ecological system include *Isoetes lithophila, Campanula reverchonii, Eriogonum tenellum var. ramosissimum, Elatine brachysperma, Valerianella texana, Packera texensis, Tradescantia pedicellata, Brazoria enquistii, Indigofera miniata (= var. texana),* and *Tripogon spicatus*.

Dynamics: This ecological system is a complex of vegetation types. The different physiognomies are maintained by an interaction between site conditions and disturbance dynamics. The forest patches, woodlands, savannas and grasslands are thought to have been maintained historically by various fire frequencies and intensities. In the absence of natural or prescribed fire, increased cover of woody vegetation has increased in some occurrences. Native grazing may have also played a role in preventing woody encroachment though the rough terrain of much of this system would have limited the extent of native grazers.

Component Associations:
- *Hilaria belangeri - Bouteloua curtipendula* Herbaceous Vegetation (CEGL002238, G3?)
- *Quercus fusiformis - (Quercus stellata) / Schizachyrium scoparium* Granite Woodland (CEGL004937, G2?)
- *Quercus fusiformis / Schizachyrium scoparium* Woodland (CEGL002115, G2G4)
- *Sedum nuttallianum - Selaginella peruviana* Granitic Outcrop Sparse Vegetation (CEGL004396, G2)

Spatial Characteristics

Spatial Summary: This system is the matrix system of the Llano Uplift area (EPA ecoregion 30b) of central Texas.

Size: As a complex, this system covered large areas (>2000 ha), but occurrences of individual physiognomies (forests, woodlands, grasslands, barrens) may occur as large (50-2000 ha) or small (1-50 ha) patches.

Adjacent Ecological Systems:
- Edwards Plateau Floodplain Terrace (CES303.651)
- Edwards Plateau Limestone Savanna and Woodland (CES303.660)
- Edwards Plateau Limestone Shrubland (CES303.041)
- Edwards Plateau Mesic Canyon (CES303.038)
- Edwards Plateau Riparian (CES303.652)

Adjacent Ecological System Comments: This system is found adjacent to Edwards Plateau Limestone Savanna and Woodland (CES303.660), Edwards Plateau Limestone Shrubland (CES303.041), and is dissected by Edwards Plateau Mesic Canyon (CES303.038), Edwards Plateau Riparian (CES303.652), and Edwards Plateau Floodplain (CES303.651). A common component of Edwards Plateau Limestone Savanna and Woodland (CES303.660), *Quercus buckleyi*, is conspicuously absent from Llano Uplift Acidic Forest, Woodland and Glade (CES303.657).

Distribution

Range: This system is restricted to the Llano Uplift region of Texas.

Divisions: 303:C

Nations: US

Subnations: TX

Map Zones: 35:C

USFS Ecomap Regions: 315D:CC
TNC Ecoregions: 29:C

SOURCES

References: Elliott 2011, Eyre 1980, Riskind and Diamond 1988, Southeastern Ecology Working Group n.d., Walters and Wyatt 1982, Whitehouse 1933

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.770686#references

Description Author: J. Teague and L. Elliott

Version: 24 Feb 2011

Concept Author: J. Teague and L. Elliott

Stakeholders: Southeast

ClassifResp: Southeast

LOWER MISSISSIPPI RIVER DUNE POND (CES203.189)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Forest and Woodland (Treed); Dune (Substrate); Sand Soil Texture
National Mapping Codes: ESLF 4151

CONCEPT

Summary: This system represents distinctive wetlands that are called "sand ponds" in Arkansas. They occur in isolated depressions in the context of sand dunes and related eolian features of the lower Mississippi River Alluvial Valley in Missouri and Arkansas. These depressions have silty bottoms and may be connected to the local aquifer or have a perched water table. The margins of these ponds are rimmed by *Quercus phellos* and also have *Quercus lyrata*. These Pleistocene dunes were overlooked or unrecognized until the late 1970s (Saucier 1978). These dunes are west of Crowley's Ridge and near the Black and White rivers, above the normal flood level of the Mississippi. Examples in Missouri occur amidst a series of low-lying, anastomosing channels that have helped to protect them from extensive alteration more typical in Arkansas where the uplands have been largely cleared.
Classification Comments: These depressions in the dune fields are one of the principal habitats for the rare shrub *Lindera melissifolia* (Heineke 1987). The dunes consist of a layer of sand or sandy loam over an impervious sublayer. This large area of eolian sand dunes occurs "mainly in a long band to the west of Crowley's Ridge" and occupies approximately 1000 square kilometers (400 square miles) in discrete fields of up to 78 square kilometers (30 square miles) each (Heineke 1987).

Quercus lyrata - Quercus palustris / Acer rubrum var. drummondii / Itea virginica - Cornus foemina - (Lindera melissifolia) Forest (CEGL004778), a wetland type, occurs in isolated depressions in the dunes that may be connected to the local aquifer or have a perched water table (T. Foti pers. comm.).
Related Concepts:
- Overcup Oak - Water Hickory: 96 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs in isolated depressions in the context of sand dunes and related eolian features of the lower Mississippi River Alluvial Valley in Missouri and Arkansas. These depressions have silty bottoms and may be connected to the local aquifer or have a perched water table (T. Foti pers. comm.). These dunes are west of Crowley's Ridge and near the Black and White rivers, above the normal flood level of the Mississippi. Examples in Missouri occur amidst a series of low-lying, anastomosing channels that have helped to protect them from extensive alteration more typical in Arkansas where the uplands have been largely cleared.
Vegetation: The margins of these ponds are rimmed by *Quercus phellos* and also have *Quercus lyrata* (Heineke 1987).

Component Associations:
- *Quercus lyrata - Quercus palustris / Acer rubrum var. drummondii / Itea virginica - Cornus foemina - (Lindera melissifolia)* Forest (CEGL004778, G2?)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Lower Mississippi River Dune Woodland and Forest (CES203.531)

DISTRIBUTION

Range: This system is found in the Lower Mississippi River Alluvial Valley in Missouri (Ripley County, Sand Ponds Natural Area) and Arkansas. In Arkansas, examples occur in Clay, Jackson, Lawrence, and Woodruff counties.
Divisions: 202:?; 203:C
Nations: US
Subnations: AR, MO
Map Zones: 45:C
TNC Ecoregions: 42:C

SOURCES

References: Foti pers. comm., Heineke 1987, Saucier 1978, Southeastern Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.759075#references
Description Author: T. Foti and M. Pyne
Version: 27 Jan 2005
Concept Author: T. Foti and M. Pyne
Stakeholders: Midwest, Southeast
ClassifResp: Southeast

LOWER MISSISSIPPI RIVER DUNE WOODLAND AND FOREST (CES203.531)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Dune (Substrate); Sand Soil Texture
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Mixed evergreen-deciduous open tree canopy
National Mapping Codes: EVT 2381; ESLF 4324; ESP 1381

CONCEPT

Summary: This system represents the vegetation of sand dunes and related eolian features of the lower Mississippi River Alluvial Valley in Missouri and Arkansas. These Pleistocene dunes were overlooked or unrecognized until the late 1970s (Saucier 1978). This fact coupled with long periods of weathering and human disturbance, as well as proximity to a terrace mapped as "prairie" in General Land Office records, has led to considerable confusion regarding this type (T. Foti pers. comm.). These dunes are west of Crowley's Ridge and near the Black and White rivers, above the normal flood level of the Mississippi. Examples in Missouri occur amidst a series of low-lying, anastomosing channels that have helped to protect them from extensive alteration more typical in Arkansas where the uplands have been largely cleared. The uppermost portions of the dunes support a xeric community similar to sandhills of the West Gulf Coastal Plain (WGCP), but are outside the natural range of *Quercus incana*, a diagnostic species typical of the WGCP examples. Instead the dunes support very open *Quercus stellata* woodlands with *Schizachyrium scoparium* and abundant lichen cover (presumably *Cladonia* spp.), along with *Opuntia* sp. Less edaphically extreme slopes support more closed-canopied forests in which *Quercus stellata* is still important, along with *Quercus falcata* and possibly other species. In many instances, distinctive wetlands imbedded within this system are also present (Lower Mississippi River Dune Pond (CES203.189)). Called "sand ponds" in Arkansas, these depressions have silty bottoms and perched water tables. The margins of these ponds are rimmed by *Quercus phellos* and have *Quercus lyrata* (Heineke 1987).
Classification Comments: Heineke (1987) states that this large area of eolian sand dunes occurs "mainly in a long band to the west of Crowley's Ridge," and occupies approximately 1000 square kilometers (400 square miles) in discrete fields of up to 78 square kilometers (30 square miles) each. The dunes consist of a layer of sand or sandy loam over an impervious sublayer (Heineke 1987). Depressions in the dune fields (e.g., Lower Mississippi River Dune Pond (CES203.189)) are one of the principal habitats for the rare shrub *Lindera melissifolia*.
Similar Ecological Systems:
- Crowley's Ridge Sand Forest (CES203.072)

Related Concepts:
- Eastern Redcedar: 46 (Eyre 1980) Finer
- Post Oak - Blackjack Oak: 40 (Eyre 1980) Finer
- White Oak - Black Oak - Northern Red Oak: 52 (Eyre 1980) Finer

DESCRIPTION

Environment: These dunes are west of Crowley's Ridge and near the Black and White rivers, above the normal flood level of the Mississippi. Examples in Missouri occur amidst a series of low-lying, anastomosing channels that have helped to protect them from extensive alteration more typical in Arkansas where the uplands have been largely cleared. The uppermost portions of the dunes support a xeric community similar to sandhills of the West Gulf Coastal Plain.
Vegetation: The uppermost portions of the dunes support a xeric community of very open *Quercus stellata* woodlands with *Schizachyrium scoparium* and abundant lichen cover (presumably *Cladonia* spp.), along with *Opuntia* sp. Less edaphically extreme slopes support more closed-canopied forests in which *Quercus stellata* is still important, along with *Quercus falcata* and possibly other species.

Component Associations:
- *Quercus stellata - Quercus marilandica - Quercus falcata / Schizachyrium scoparium* Sand Woodland (CEGL002417, G2)
- *Quercus stellata - Quercus velutina - Quercus alba - (Quercus falcata) / Croton michauxii* Sand Woodland (CEGL002396, G2)
- *Schizachyrium scoparium - Sorghastrum nutans - Aristida lanosa - Polypremum procumbens* Herbaceous Vegetation (CEGL002397, G1Q)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Lower Mississippi River Dune Pond (CES203.189)

DISTRIBUTION

Range: Lower Mississippi River Alluvial Valley in Missouri (Ripley County, Sand Ponds Natural Area) and Arkansas. In Arkansas, examples occur in Clay, Jackson, Lawrence, and Woodruff counties.
Divisions: 202:?; 203:C

Nations: US
Subnations: AR, MO
Map Zones: 45:C
USFS Ecomap Regions: 234D:CC
TNC Ecoregions: 42:C

SOURCES

References: Comer et al. 2003, Heineke 1987, Saucier 1978
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723069#references
Description Author: T. Foti and R. Evans, mod. M. Pyne
Version: 26 Jan 2005
Concept Author: T. Foti and R. Evans
Stakeholders: Midwest, Southeast
ClassifResp: Southeast

MADREAN ENCINAL (CES305.795)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Sierra Madre (305)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Lower Montane]; Lowland [Foothill]; Tropical/Subtropical [Tropical Xeric]; Xeric; F-Patch/Medium Intensity; Broad-Leaved Evergreen Tree; Graminoid; Quercus arizonica, Q. emoryi, Q. grisea, Q. oblongifolia Q. toumeyi
Non-Diagnostic Classifiers: Forest and Woodland (Treed); Shrubland (Shrub-dominated); Sideslope; Intermediate Disturbance Interval
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2023; ESLF 4210; ESP 1023

CONCEPT

Summary: Madrean Encinal occurs on foothills, canyons, bajadas and plateaus in the Sierra Madre Occidentale and Sierra Madre Orientale in Mexico, extending north into Trans-Pecos Texas, southern New Mexico and sub-Mogollon Arizona. These woodlands are dominated by Madrean evergreen oaks along a low-slope transition below Madrean Lower Montane Pine-Oak Forest and Woodland (CES305.796) and Madrean Pinyon-Juniper Woodland (CES305.797). Lower elevation stands are typically open woodlands or savannas where they transition into desert grasslands, chaparral or in some cases desertscrub. Common evergreen oak species include *Quercus arizonica, Quercus emoryi, Quercus intricata, Quercus grisea, Quercus oblongifolia, Quercus toumeyi*, and in Mexico *Quercus chihuahuensis* and *Quercus albocincta*. Madrean pine, Arizona cypress, pinyon and juniper trees may be present but do not codominate. Chaparral species such as *Arctostaphylos pungens, Cercocarpus montanus, Purshia* spp., *Garrya wrightii, Quercus turbinella, Frangula betulifolia (= Rhamnus betulifolia)*, or *Rhus* spp. may be present but do not dominate. The graminoid layer is usually prominent between trees in grassland or steppe that is dominated by warm-season grasses such as *Aristida* spp., *Bouteloua gracilis, Bouteloua curtipendula, Bouteloua rothrockii, Digitaria californica, Eragrostis intermedia, Hilaria belangeri, Leptochloa dubia, Muhlenbergia* spp., *Pleuraphis jamesii*, or *Schizachyrium cirratum*, species typical of Apacherian-Chihuahuan Semi-Desert Grassland and Steppe (CES302.735). This system includes seral stands dominated by shrubby Madrean oaks typically with a strong graminoid layer. In transition areas with drier chaparral systems, stands of chaparral are not dominated by Madrean oaks; however, Madrean Encinal may extend down along drainages.
Classification Comments: Although some stands may be shrubby especially in the north, E. Muldavin (pers. comm.) says encinal is considered woodland in Mexico.
Similar Ecological Systems:
- Apacherian-Chihuahuan Semi-Desert Grassland and Steppe (CES302.735)

Related Concepts:
- Arizona Cypress: 240 (Eyre 1980) Intersecting
- Oak - Juniper Woodland and Mahogany - Oak (509) (Shiflet 1994) Broader
- Western Live Oak: 241 (Eyre 1980) Broader

DESCRIPTION

Vegetation: Stands of this system are dominated by evergreen oak species including *Quercus arizonica, Quercus emoryi, Quercus intricata, Quercus grisea, Quercus oblongifolia, Quercus toumeyi*, and in Mexico *Quercus chihuahuensis* and *Quercus albocincta*. Madrean pine, Arizona cypress, pinyon and juniper trees may be present but do not codominate. Chaparral species such as *Arctostaphylos pungens, Cercocarpus montanus, Purshia* spp., *Garrya wrightii, Quercus turbinella, Frangula betulifolia (= Rhamnus betulifolia)*, or *Rhus* spp. may be present but do not dominate. The graminoid layer is usually prominent between trees in grassland or steppe that is dominated by warm-season grasses such as *Aristida* spp., *Bouteloua gracilis, Bouteloua curtipendula, Bouteloua rothrockii, Digitaria californica, Eragrostis intermedia, Hilaria belangeri, Leptochloa dubia, Muhlenbergia* spp., *Pleuraphis jamesii*, or *Schizachyrium cirratum*. These species are also typical of Apacherian-Chihuahuan Semi-Desert Grassland and Steppe (CES302.735).

Component Associations:
- *Cupressus arizonica / Quercus hypoleucoides* Forest (CEGL000352, G2)
- *Cupressus arizonica / Quercus turbinella* Forest (CEGL000353, G2G3)
- *Quercus arizonica / Bouteloua curtipendula* Woodland (CEGL000680, G3)
- *Quercus arizonica / Muhlenbergia emersleyi* Woodland (CEGL000681, G4)
- *Quercus emoryi / Arctostaphylos pungens* Woodland (CEGL000682, GNR)
- *Quercus emoryi / Bouteloua curtipendula* Woodland (CEGL000683, G3)
- *Quercus emoryi / Dasylirion wheeleri* Woodland (CEGL000684, G3)
- *Quercus emoryi / Muhlenbergia emersleyi* Woodland (CEGL000685, G4)
- *Quercus emoryi / Piptochaetium fimbriatum* Woodland (CEGL000686, G2)

- *Quercus emoryi / Schizachyrium cirratum* Woodland (CEGL000687, GNR)
- *Quercus emoryi / Sporobolus flexuosus* Woodland (CEGL000688, G1)
- *Quercus grisea / Bouteloua curtipendula* Woodland (CEGL000689, G5)
- *Quercus grisea / Cercocarpus montanus* Woodland (CEGL000690, G5?)
- *Quercus grisea / Juniperus deppeana* Woodland (CEGL003521, GNR)
- *Quercus grisea / Rhus trilobata* Woodland (CEGL000691, GNR)
- *Quercus intricata - Dasylirion leiophyllum* Shrubland (CEGL004530, GNR)
- *Quercus oblongifolia / Bouteloua curtipendula* Shrubland (CEGL000973, G4)
- *Quercus oblongifolia / Dasylirion wheeleri* Scrub (CEGL000974, G4)
- *Quercus toumeyi / Bouteloua curtipendula* Scrub (CEGL000975, G1)
- *Quercus toumeyi / Muhlenbergia emersleyi* Scrub (CEGL000976, G1)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Madrean Lower Montane Pine-Oak Forest and Woodland (CES305.796)
- Madrean Pinyon-Juniper Woodland (CES305.797)

Adjacent Ecological System Comments: This system occurs along a low-slope transition from Madrean Pinyon-Juniper Woodland (CES305.797) or Madrean Lower Montane Pine-Oak Forest and Woodland (CES305.796).

DISTRIBUTION

Range: This system is found in the Sierra Madre Occidentale and Sierra Madre Orientale of Mexico, Trans-Pecos Texas, southern New Mexico and southeastern Arizona.
Divisions: 305:C
Nations: MX, US
Subnations: AZ, MXCH(MX), MXSO(MX), NM, TX
Map Zones: 14:P, 15:C, 24:C, 25:C, 26:C, 27:P
USFS Ecomap Regions: 313C:CC, 315A:CC, 321A:CC, 322A:CP, 322B:CC, M313A:CC, M313B:CC
TNC Ecoregions: 22:C, 23:C, 24:C, 30:P

SOURCES

References: Barbour and Billings 2000, Brown 1982a, Brown et al. 1980, Brown et al. 1998, Comer et al. 2003, Muldavin pers. comm.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722878#references
Description Author: NatureServe Western Ecology Team
Version: 11 Nov 2003 **Stakeholders:** Latin America, Southeast, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

MADREAN LOWER MONTANE PINE-OAK FOREST AND WOODLAND (CES305.796)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Sierra Madre (305)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Montane]; Tropical/Subtropical [Tropical Xeric]; Shallow Soil; Xeric; F-Patch/High Intensity; Needle-Leaved Tree; Evergreen Sclerophyllous Shrub; Quercus arizonica, Q. emoryi, Q. grisea, Q. oblongifolia Q. toumeyi; Pinus discolor, P. leiophylla, P. engelmannii
Non-Diagnostic Classifiers: Forest and Woodland (Treed); Ridge/Summit/Upper Slope; Sideslope; Intermediate Disturbance Interval; Xeromorphic Shrub
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2024; ESLF 4211; ESP 1024

CONCEPT

Summary: This system occurs on mountains and plateaus in the Sierra Madre Occidentale and Sierra Madre Orientale in Mexico, Trans-Pecos Texas, southern New Mexico and Arizona, generally south of the Mogollon Rim. These forests and woodlands are composed of Madrean pines (*Pinus arizonica, Pinus engelmannii, Pinus leiophylla*, or *Pinus strobiformis*) and evergreen oaks (*Quercus arizonica, Quercus emoryi*, or *Quercus grisea*) intermingled with patchy shrublands on most mid-elevation slopes (1500-2300 m elevation). Other tree species include *Cupressus arizonica, Juniperus deppeana, Pinus cembroides, Pinus discolor, Pinus ponderosa* (with Madrean pines or oaks), and *Pseudotsuga menziesii*. Subcanopy and shrub layers may include typical encinal and chaparral species such as *Agave* spp., *Arbutus arizonica, Arctostaphylos pringlei, Arctostaphylos pungens, Garrya wrightii, Nolina* spp., *Quercus hypoleucoides, Quercus rugosa*, and *Quercus turbinella*. Some stands have moderate cover of perennial graminoids such as *Muhlenbergia emersleyi, Muhlenbergia longiligula, Muhlenbergia virescens*, and *Schizachyrium cirratum*. Fires are frequent with perhaps more crown fires than ponderosa pine woodlands, which tend to have more frequent ground fires on gentle slopes.

Similar Ecological Systems:
- Madrean Mesic Canyon Forest and Woodland (CES302.454)

Related Concepts:
- Western Live Oak: 241 (Eyre 1980) Intersecting

DESCRIPTION

Vegetation: These forests and woodlands are composed of Madrean pines (*Pinus arizonica, Pinus engelmannii, Pinus leiophylla*, or *Pinus strobiformis*) and evergreen oaks (*Quercus arizonica, Quercus emoryi*, or *Quercus grisea*) intermingled with patchy shrublands on most mid-elevation slopes (1500-2300 m elevation). Other tree species include *Cupressus arizonica, Juniperus deppeana, Pinus cembroides, Pinus discolor, Pinus ponderosa* (with Madrean pines or oaks), and *Pseudotsuga menziesii*. Subcanopy and shrub layers may include typical encinal and chaparral species such as *Agave* spp., *Arbutus arizonica, Arctostaphylos pringlei, Arctostaphylos pungens, Garrya wrightii, Nolina* spp., *Quercus hypoleucoides, Quercus rugosa*, and *Quercus turbinella*. Some stands have moderate cover of perennial graminoids such as *Muhlenbergia emersleyi, Muhlenbergia longiligula, Muhlenbergia virescens*, and *Schizachyrium cirratum*.

Component Associations:
- *Arbutus xalapensis - Quercus grisea - Juniperus deppeana - Acer grandidentatum - Quercus muehlenbergii* Forest (CEGL004504, G2?)
- *Arbutus xalapensis - Quercus grisea - Juniperus flaccida - Acer grandidentatum - Quercus gravesii* Forest (CEGL004553, G2)
- *Arctostaphylos pungens* Shrubland (CEGL000958, G4)
- *Juniperus deppeana - Quercus X pauciloba* Woodland (CEGL005370, GNR)
- *Pinus (discolor, cembroides) / Quercus arizonica / Muhlenbergia emersleyi* Woodland (CEGL000769, G3)
- *Pinus engelmannii / Muhlenbergia longiligula* Woodland (CEGL000799, G3)
- *Pinus engelmannii / Quercus gambelii* Woodland (CEGL000800, G1)
- *Pinus engelmannii / Quercus hypoleucoides* Woodland (CEGL000801, G3)
- *Pinus leiophylla / Piptochaetium fimbriatum* Woodland (CEGL000821, G2)
- *Pinus leiophylla / Quercus arizonica* Woodland (CEGL000822, G3)
- *Pinus leiophylla / Quercus emoryi* Woodland (CEGL000823, G3)
- *Pinus leiophylla / Quercus hypoleucoides* Woodland (CEGL000824, G3)
- *Pinus ponderosa / Quercus arizonica* Woodland (CEGL000868, G4)
- *Pinus ponderosa / Quercus emoryi* Woodland (CEGL000869, G4)
- *Pinus ponderosa / Quercus grisea* Woodland (CEGL000871, G4)
- *Pinus ponderosa / Quercus hypoleucoides* Woodland (CEGL000872, G3)
- *Quercus arizonica / Bouteloua curtipendula* Woodland (CEGL000680, G3)

- *Quercus arizonica / Muhlenbergia emersleyi* Woodland (CEGL000681, G4)
- *Quercus gambelii / Robinia neomexicana / Symphoricarpos rotundifolius* Shrubland (CEGL001116, GU)
- *Quercus gambelii / Symphoricarpos oreophilus* Shrubland (CEGL001117, G5)
- *Quercus grisea / Bouteloua curtipendula* Woodland (CEGL000689, G5)
- *Quercus X pauciloba / Cercocarpus montanus* Shrubland (CEGL001118, G4)
- *Robinia neomexicana / Thalictrum fendleri* Shrubland (CEGL001125, GNR)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Madrean Encinal (CES305.795)

DISTRIBUTION

Range: This system is found in the Sierra Madre Occidentale and Sierra Madre Orientale of Mexico, Trans-Pecos Texas, southern New Mexico and Arizona, generally south of the Mogollon Rim.
Divisions: 305:C
Nations: MX, US
Subnations: AZ, NM, TX
Map Zones: 14:C, 15:C, 24:C, 25:C, 26:C, 27:P, 28:?
USFS Ecomap Regions: 313B:CC, 313C:CC, 313D:C?, 315A:CC, 315H:CC, 321A:CC, 322A:CC, 322B:CC, M313A:CC, M313B:CC, M331F:??, M331G:??
TNC Ecoregions: 22:C, 24:C

SOURCES

References: Barbour and Billings 2000, Brown 1982a, Brown et al. 1998, Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722877#references
Description Author: NatureServe Western Ecology Team
Version: 11 Nov 2003 **Stakeholders:** Latin America, Southeast, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

MADREAN MESIC CANYON FOREST AND WOODLAND (CES302.454)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Warm Desert (302)
Land Cover Class: Forest and Woodland
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
National Mapping Codes: ESLF 4342

CONCEPT

Summary: These woodlands of the Trans-Pecos mountains occur in canyons and along streams, sometimes occupying benches, terraces, and adjacent lower slopes with coarse, rocky substrate. The canopy may be variously dominated by a number of coniferous, broad-leaved evergreen, and deciduous components depending on phytogeography, elevation, and availability of groundwater. Occurrences may be dominated by evergreen conifers *Pinus* spp., *Juniperus* spp., *Pseudotsuga menziesii*, and/or *Cupressus arizonica* or codominated by a mix of evergreen conifers and evergreen and deciduous hardwoods, including *Quercus* sp., *Acer grandidentatum, Quercus muehlenbergii, Quercus gravesii*, and *Fraxinus velutina*. In addition these woodlands may also contain a shrubland component.
Classification Comments: Formerly, this previously undescribed system had components that may have been included in Madrean Lower Montane Pine-Oak Forest and Woodland (CES305.796), Madrean Upper Montane Conifer-Oak Forest and Woodland (CES305.798), North American Warm Desert Lower Montane Riparian Woodland and Shrubland (CES302.748), or Rocky Mountain Bigtooth Maple Ravine Woodland (CES306.814).
Similar Ecological Systems:
- Madrean Lower Montane Pine-Oak Forest and Woodland (CES305.796)
- Madrean Upper Montane Conifer-Oak Forest and Woodland (CES305.798)
- North American Warm Desert Lower Montane Riparian Woodland and Shrubland (CES302.748)
- Rocky Mountain Bigtooth Maple Ravine Woodland (CES306.814)

DESCRIPTION

Environment: This system is found in montane canyons and stream terraces on various geological strata of the Trans-Pecos mountains, particularly limestone and igneous formations. The system often occupies local alluvium, both fine and coarse, and sometimes Quaternary alluvium as mapped. It may be expected to occur on Canyon (Mountain Savannah), Foothill Slope, Draw, Limestone Canyon, Mountain Loam, Limestone Hill & Mountain, and Igneous Hill & Mountain Ecological Sites.
Vegetation: Canopy species may include *Pseudotsuga menziesii* (lacking in the Davis Mountains), *Pinus ponderosa var. scopulorum, Pinus arizonica var. stormiae* (in the Chisos Mountains), *Pinus cembroides, Pinus edulis* (in the Guadalupe Mountains), *Cupressus arizonica, Juniperus deppeana, Juniperus flaccida* (in the Chisos Mountains), *Quercus emoryi, Quercus rugosa, Quercus hypoleucoides, Quercus graciliformis, Quercus gravesii, Quercus muehlenbergii*, and *Quercus grisea*. Species such as *Ungnadia speciosa, Acer grandidentatum, Fraxinus velutina, Prunus serotina var. virens, Arbutus xalapensis, Ostrya knowltonii* (in the Guadalupe Mountains), and/or *Ostrya virginiana var. chisosensis* (in the Chisos Mountains) may be present in more mesic situations, such as perennial water sources. Shrubs that may be present include *Salvia regla, Juglans microcarpa, Nolina erumpens, Dasylirion leiophyllum, Agave havardiana, Agave parryi ssp. neomexicana, Mahonia haematocarpa, Garrya ovata, Ceanothus greggii, Crataegus tracyi, Cercocarpus montanus, Sambucus nigra ssp. cerulea, Frangula betulifolia, Philadelphus* spp., and *Vitis arizonica*. The herbaceous layer is patchy with species such as *Piptochaetium fimbriatum, Bouteloua curtipendula, Poa strictiramea, Muhlenbergia rigida, Muhlenbergia emersleyi, Bothriochloa laguroides ssp. torreyana*, and *Schizachyrium scoparium*.

DISTRIBUTION

Range: This system occurs in the mountains of the Trans-Pecos region of Texas and adjacent New Mexico.
Divisions: 302:C
Nations: US
Subnations: NM, TX
Map Zones: 26:C
USFS Ecomap Regions: 321Aa:CCC, M313Ba:CCC
TNC Ecoregions: 24:C

SOURCES

References: Southeastern Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.885193#references
Description Author: L. Elliott and J. Teague
Version: 03 Feb 2014 **Stakeholders:** Southeast, West
Concept Author: **ClassifResp:** Southeast

MADREAN PINYON-JUNIPER WOODLAND (CES305.797)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Sierra Madre (305)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Lower Montane]; Tropical/Subtropical [Tropical Xeric]; Shallow Soil; Xeric; F-Patch/Medium Intensity; Needle-Leaved Tree; Evergreen Sclerophyllous Shrub; Pinus cembroides, Juniperus deppeana
Non-Diagnostic Classifiers: Forest and Woodland (Treed); Shrubland (Shrub-dominated); Sideslope; Intermediate Disturbance Interval; Broad-Leaved Evergreen Tree; Xeromorphic Shrub
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2025; ESLF 4212; ESP 1025

CONCEPT

Summary: This system occurs on foothills, mountains and plateaus in the Sierra Madre Occidentale and Sierra Madre Orientale in Mexico, Trans-Pecos Texas, southern New Mexico and Arizona, generally south of the Mogollon Rim. Substrates are variable, but soils are generally dry and rocky. The presence of *Pinus cembroides, Pinus discolor*, or other Madrean trees and shrubs is diagnostic of this woodland system. *Juniperus coahuilensis, Juniperus deppeana, Juniperus pinchotii, Juniperus monosperma,* and/or *Pinus edulis* may be present to dominant. Madrean oaks such as *Quercus arizonica, Quercus emoryi, Quercus grisea*, or *Quercus mohriana* may be codominant. *Pinus ponderosa* is absent or sparse. If present, understory layers are variable and may be dominated by shrubs or graminoids.
Classification Comments: According to USFS TES mapping (USDA 2001), *Quercus grisea* woodlands (Madrean Encinal) occur on both sides of the Guadalupe Mountains and in the southeastern portion of the Sacramento Mountains. This suggests that the associated pinyon and juniper woodlands are Madrean Pinyon-Juniper Woodland (CES305.797).
Related Concepts:
- Juniper - Pinyon Pine Woodland (504) (Shiflet 1994) Broader
- Oak - Juniper Woodland and Mahogany - Oak (509) (Shiflet 1994) Intersecting
- Pinyon - Juniper: 239 (Eyre 1980) Broader

Component Associations:
- *Juniperus coahuilensis / Bouteloua curtipendula - Bouteloua gracilis* Woodland (CEGL004584, G3?)
- *Juniperus coahuilensis / Bouteloua eriopoda* Woodland (CEGL000700, GU)
- *Juniperus coahuilensis / Canotia holacantha* Woodland (CEGL000701, G3)
- *Juniperus coahuilensis / Quercus turbinella* Woodland (CEGL000702, G4)
- *Juniperus deppeana - Juniperus monosperma - Quercus grisea / Rhus trilobata* Woodland (CEGL000696, G5)
- *Juniperus deppeana - Juniperus monosperma / Cercocarpus montanus - Ceanothus greggii* Woodland (CEGL000695, G5)
- *Juniperus deppeana - Quercus X pauciloba* Woodland (CEGL005370, GNR)
- *Juniperus deppeana / Arctostaphylos pungens* Woodland (CEGL000692, G4)
- *Juniperus deppeana / Muhlenbergia emersleyi* Woodland (CEGL000697, G4)
- *Juniperus deppeana / Panicum obtusum* Woodland (CEGL000698, GNR)
- *Juniperus monosperma - Quercus mohriana* Woodland (CEGL002120, GNR)
- *Juniperus monosperma / Agave lechuguilla* Woodland (CEGL000703, G4)
- *Juniperus monosperma / Larrea tridentata* Woodland (CEGL000717, G5)
- *Juniperus monosperma / Nolina microcarpa - Agave lechuguilla* Woodland (CEGL000718, G4)
- *Juniperus monosperma / Prosopis glandulosa* Woodland (CEGL000719, G5)
- *Juniperus pinchotii / Bouteloua curtipendula - Bouteloua hirsuta* Woodland (CEGL004940, GNR)
- *Juniperus pinchotii / Bouteloua gracilis* Woodland (CEGL002122, G4)
- *Pinus (discolor, cembroides) / Quercus arizonica / Muhlenbergia emersleyi* Woodland (CEGL000769, G3)
- *Pinus cembroides - Quercus gravesii - Juniperus flaccida / Salvia regla / Piptochaetium fimbriatum* Forest (CEGL004600, G2?)
- *Pinus cembroides - Quercus grisea - Juniperus flaccida / Salvia regla / Muhlenbergia emersleyi* Woodland (CEGL004596, G2?)
- *Pinus cembroides - Quercus grisea - Quercus emoryi - Juniperus flaccida / Salvia regla / Bouteloua curtipendula* Woodland (CEGL004597, G2?)
- *Pinus cembroides - Quercus grisea - Quercus emoryi / Mimosa dysocarpa / Bouteloua gracilis* Woodland (CEGL004598, G2?)
- *Pinus cembroides - Quercus grisea / Agave lechuguilla / Bouteloua curtipendula* Woodland (CEGL003551, G2?)
- *Pinus cembroides - Quercus grisea / Muhlenbergia montana - Piptochaetium pringlei* Woodland (CEGL004599, G2?)
- *Pinus discolor / Muhlenbergia emersleyi* Woodland (CEGL000767, G5)
- *Pinus discolor / Piptochaetium fimbriatum* Woodland (CEGL000768, G2)
- *Pinus discolor / Quercus gambelii* Woodland (CEGL000770, G1)
- *Pinus discolor / Quercus hypoleucoides* Woodland (CEGL000771, G2)

- *Pinus discolor / Quercus rugosa* Woodland (CEGL000772, G1)
- *Pinus discolor / Quercus toumeyi* Woodland (CEGL000773, G2)
- *Pinus edulis - Quercus arizonica / Rhus trilobata* Woodland (CEGL000790, G5?)
- *Pinus remota / Juniperus pinchotii - Quercus mohriana* Woodland (CEGL004585, G2G3)
- *Quercus grisea / Juniperus deppeana* Woodland (CEGL003521, GNR)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Madrean Encinal (CES305.795)

DISTRIBUTION

Range: This system occurs in the Sierra Madre Occidentale and Sierra Madre Orientale of Mexico, Trans-Pecos Texas, southern New Mexico and Arizona, generally south of the Mogollon Rim. It occurs on the west side of the Sacramento Mountains but may transition into Southern Rocky Mountain Pinyon-Juniper Woodland (CES306.835) or Southern Rocky Mountain Juniper Woodland and Savanna (CES306.834) on the eastern side.
Divisions: 305:C
Nations: MX, US
Subnations: AZ, NM, TX
Map Zones: 14:C, 15:C, 24:C, 25:C, 26:C, 27:C, 28:?
USFS Ecomap Regions: 313B:CC, 313C:CC, 313D:CP, 315A:CC, 315B:CC, 315H:CC, 321A:CC, 322A:CC, 322B:CC, 331I:??, M313A:CC, M313B:CC, M331F:??
TNC Ecoregions: 22:C, 24:C, 30:C

SOURCES

References: Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722876#references
Description Author: NatureServe Western Ecology Team
Version: 05 Oct 2004 **Stakeholders:** Latin America, Southeast, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

MADREAN UPPER MONTANE CONIFER-OAK FOREST AND WOODLAND (CES305.798)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Sierra Madre (305)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Montane]; Forest and Woodland (Treed); Tropical/Subtropical [Tropical Xeric]; Xeric; F-Patch/Medium Intensity; Abies coahuilensis, Quercus hypoleucoides, Q. rugosa
Non-Diagnostic Classifiers: Sideslope; Toeslope/Valley Bottom; Mesotrophic Soil; Deep Soil; Sand Soil Texture; Long Disturbance Interval
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2026; ESLF 4213; ESP 1026

CONCEPT

Summary: This ecological system occurs at the upper elevations in the Sierra Madre Occidentale and Sierra Madre Orientale of Mexico. In the U.S., it is restricted to north and east aspects at high elevations (1980-2440 m) in the Sky Islands (Chiricahua, Huachuca, Pinaleno, Santa Catalina, and Santa Rita mountains) and along the Nantanes Rim. It is more common in Mexico and does not occur north of the Mogollon Rim. The vegetation is characterized by large- and small-patch forests and woodlands dominated by *Pseudotsuga menziesii*, *Abies coahuilensis*, or *Abies concolor* and Madrean oaks such as *Quercus arizonica*, *Quercus emoryi*, *Quercus grisea*, *Quercus hypoleucoides*, *Quercus rugosa*, and *Quercus toumeyi*. If *Quercus gambelii* is prominent in the shrub layer, then other Madrean elements are present. This system may include stands of *Quercus gravesii* woodlands. It is similar to Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823) which typically lacks Madrean elements.
Classification Comments: Texas experts for mapzone 26 feel that this system does not occur in that zone.
Similar Ecological Systems:
- Madrean Mesic Canyon Forest and Woodland (CES302.454)
- Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)

Component Associations:
- *Juniperus deppeana - Quercus X pauciloba* Woodland (CEGL005370, GNR)
- *Pseudotsuga menziesii / Quercus hypoleucoides* Forest (CEGL000453, G3)
- *Pseudotsuga menziesii / Quercus rugosa* Forest (CEGL000454, G2)

DISTRIBUTION

Range: This system is found in the Sierra Madre Occidentale and Sierra Madre Orientale of Mexico. In the U.S., it is restricted to north and east aspects at high elevations (1980-2440 m) in the Sky Islands (Chiricahua, Huachuca, Pinaleno, Santa Catalina, and Santa Rita mountains) and along the Nantanes Rim.
Divisions: 305:C
Nations: MX, US
Subnations: AZ, MXCH(MX), MXSO(MX), NM
Map Zones: 15:C, 24:?, 25:C, 27:?, 28:?
USFS Ecomap Regions: 313D:??, 321A:CC, 322B:??, M313A:CC, M313B:CC
TNC Ecoregions: 22:C

SOURCES

References: Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722875#references
Description Author: NatureServe Western Ecology Team
Version: 22 Dec 2006 **Stakeholders:** Latin America, Southeast, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

MEDITERRANEAN CALIFORNIA DRY-MESIC MIXED CONIFER FOREST AND WOODLAND (CES206.916)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Lower Montane]; Forest and Woodland (Treed); Mediterranean [Mediterranean Xeric-Oceanic]; Ustic; Needle-Leaved Tree
Non-Diagnostic Classifiers: F-Patch/Low Intensity
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2027; ESLF 4214; ESP 1027

CONCEPT

Summary: These mixed-conifer forests, always with at least two conifer species codominating, occur on all aspects in lower montane zones (600-1800 m elevation in northern California; 1200-2150 m in southern California). This system occurs in a variety of topo-edaphic positions, such as upper slopes at higher elevations, canyon sideslopes, ridgetops, and south- and west-facing slopes which burn relatively frequently. Often, several conifer species co-occur in individual stands. *Pseudotsuga menziesii, Pinus ponderosa*, and *Calocedrus decurrens* are the most common conifers. Other conifers that can occasionally be present include *Pinus jeffreyi, Pinus attenuata*, and *Pinus lambertiana* (not as common in this as in Mediterranean California Mesic Mixed Conifer Forest and Woodland (CES206.915)). Common subcanopy trees include *Quercus chrysolepis* and *Quercus kelloggii*. *Arbutus menziesii* and *Lithocarpus densiflorus* may be common with the oaks in northern areas. *Pseudotsuga macrocarpa* and *Pinus coulteri* can be present but are not dominant species in this system in the Transverse Ranges of southern California. Codominant *Abies concolor - Calocedrus decurrens* communities in southern California are also included in this system. In the Transverse Ranges, where Great Basin and Mojavean elements are transitioning into the montane zones, *Juniperus californica* and *Pinus monophylla* can be mixed with the other conifers. Understories are variable, except in the Sierra Nevada, where in some stands there can be dense understory mats of *Chamaebatia foliolosa* (and other low, spreading shrubs) which foster relatively high-frequency, low-intensity ground fires. In Oregon, shrubs such as *Holodiscus discolor, Toxicodendron rydbergii, Mahonia nervosa, Mahonia aquifolium*, and *Symphoricarpos mollis* are common in addition to graminoids such as *Festuca californica*, *Elymus glaucus*, and *Danthonia californica*. In the north, where *Calocedrus decurrens* and *Pinus ponderosa* drop out, this system shifts to North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland (CES204.845).
Classification Comments: This forest is more dense, with a greater richness of canopy tree species than Mediterranean California Lower Montane Black Oak-Conifer Forest and Woodland (CES206.923).
Similar Ecological Systems:
- Sierran-Intermontane Desert Western White Pine-White Fir Woodland (CES204.101)

Related Concepts:
- Interior Ponderosa Pine: 237 (Eyre 1980) Intersecting
- Pacific Douglas-fir: 229 (Eyre 1980) Intersecting
- Pacific Ponderosa Pine - Douglas-fir: 244 (Eyre 1980) Intersecting
- Pacific Ponderosa Pine: 245 (Eyre 1980) Intersecting
- Sierra Nevada Mixed Conifer: 243 (Eyre 1980) Intersecting
- White Fir: 211 (Eyre 1980) Intersecting

DESCRIPTION

Dynamics: Historically, frequent and low-intensity fires maintained these woodlands. Due to fire suppression, the majority of these forests now have closed canopies, whereas in the past, a moderately high fire frequency (every 20-30 years) formerly maintained an open forest of many conifers.

Component Associations:
- *Abies concolor - Pinus ponderosa / Amelanchier alnifolia* Forest (CEGL000014, G2)
- *Abies concolor / Amelanchier alnifolia / Anemone deltoidea* Forest (CEGL000010, G2?)
- *Pinus lambertiana - Pinus ponderosa - Pseudotsuga menziesii / Festuca californica* Forest (CEGL000065, G1)
- *Pinus ponderosa - Calocedrus decurrens - Quercus chrysolepis / Chamaebatia foliolosa* Forest (CEGL008674, G4?)
- *Pinus ponderosa - Calocedrus decurrens - Quercus kelloggii* Forest (CEGL008673, G4?)
- *Pinus ponderosa - Calocedrus decurrens / Chamaebatia foliolosa* Forest (CEGL008672, G4?)
- *Pinus ponderosa - Quercus kelloggii / Arctostaphylos viscida* Woodland (CEGL008694, G4?)
- *Pseudotsuga menziesii - Abies concolor - Calocedrus decurrens* Forest (CEGL005813, G3?)
- *Pseudotsuga menziesii - Pinus ponderosa - Calocedrus decurrens* Forest (CEGL008684, G3?)
- *Pseudotsuga menziesii - Quercus chrysolepis* Forest (CEGL005814, G3?)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Mediterranean California Mesic Mixed Conifer Forest and Woodland (CES206.915)

Adjacent Ecological System Comments: This system occurs sympatrically with Mediterranean California Mesic Mixed Conifer Forest and Woodland (CES206.915) but is found on lower, drier, warmer, or more exposed sites in comparison to the mesic system.

DISTRIBUTION

Range: This system occurs in lower montane zones (600-1800 m elevation in northern California; 1200-2150 m in southern California), including the eastern Klamath-Siskiyou, interior Coast Ranges, Transverse Ranges and Sierra Nevada.
Divisions: 206:C
Nations: US
Subnations: CA, NV, OR
Map Zones: 2:C, 3:C, 4:C, 6:C, 7:C, 12:P, 13:?
USFS Ecomap Regions: 263A:PP, 322A:PP, 341D:CC, 342B:CC, M242A:CC, M242B:CC, M242C:CC, M261A:CC, M261B:CC, M261C:CC, M261D:CC, M261E:CC, M261F:CC, M261G:CC
TNC Ecoregions: 5:C, 12:C, 14:C, 15:C, 16:C

SOURCES

References: Barbour and Billings 2000, Barbour and Major 1988, Barbour et al. 2007, Comer et al. 2003, Eyre 1980, Fites 1994, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722765#references
Description Author: P. Comer, T. Keeler-Wolf, mod. G. Kittel, M.S. Reid
Version: 12 Jan 2012 **Stakeholders:** West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

MEDITERRANEAN CALIFORNIA LOWER MONTANE BLACK OAK-CONIFER FOREST AND WOODLAND (CES206.923)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Toeslope/Valley Bottom; Franciscan Formation Soils; Deep Soil; Mineral: W/ A-Horizon >10 cm
Non-Diagnostic Classifiers: Montane [Lower Montane]; Lowland [Foothill]; Ustic; Short Disturbance Interval; F-Patch/Low Intensity; Quercus kelloggii
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2030; ESLF 4217; ESP 1030

CONCEPT

Summary: This ecological system is found throughout California's middle and inner North Coast Ranges, as well as the southern and eastern Klamath Mountains from 600-1600 m (1800-4850 feet) elevation, and the lower slopes of the western Sierra Nevada. It occurs in valleys and lower slopes on a variety of parent materials, including granitics, metamorphic and Franciscan metasedimentary parent material and deep, well-developed soils. It is characterized by woodlands or forests of *Pinus ponderosa* with one or more oaks, including *Quercus kelloggii*, *Quercus garryana*, *Quercus wislizeni*, or *Quercus chrysolepis*. *Pseudotsuga menziesii* may co-occur with *Pinus ponderosa*, particularly in the North Coast Ranges and Klamath Mountains. On most sites, the oaks are dominant, forming a dense subcanopy under a more open canopy of the conifers. On many sites, *Quercus kelloggii* is the dominant; in late-seral stands on more mesic sites, conifers such as *Pinus ponderosa* or *Pseudotsuga menziesii* will form a persistent emergent canopy over the oak. Stands may have shrubby understories (in the Klamath Mountains and Sierra Nevada) and, more rarely, grassy understories (in North Coast Ranges). Common shrubs include *Arctostaphylos viscida*, *Arctostaphylos manzanita*, *Ceanothus integerrimus*, and *Toxicodendron diversilobum*. Grasses can include *Festuca californica*, *Festuca idahoensis*, and *Melica* spp. Historical fire in this system was likely high frequency but of low intensity. Conifer species, such as *Pseudotsuga menziesii*, become more abundant with wildfire suppression.
Classification Comments: The floristic and geographic transition from this system to North Pacific Oak Woodland (CES204.852) needs to be further detailed. This system generally has lower tree species richness in the canopy and a lower canopy density than Mediterranean California Dry-Mesic Mixed Conifer Forest and Woodland (CES206.916), although the oaks can form a dense subcanopy in the mixed conifer system.
Similar Ecological Systems:
- California Lower Montane Blue Oak-Foothill Pine Woodland and Savanna (CES206.936)
- Mediterranean California Mixed Evergreen Forest (CES206.919)

Related Concepts:
- California Black Oak: 246 (Eyre 1980) Intersecting
- Interior Ponderosa Pine: 237 (Eyre 1980) Intersecting
- Pacific Ponderosa Pine - Douglas-fir: 244 (Eyre 1980) Intersecting. Douglas-fir and/or Ponderosa over oaks in the Klamaths and south are included in this ecological system.
- Pacific Ponderosa Pine: 245 (Eyre 1980) Intersecting. Ponderosa over oaks in the Klamaths and south are included in this ecological system.

DESCRIPTION

Dynamics: LANDFIRE model information: Historical fire frequency was 5 to 30 years in this type. Fire intensities were probably low in open stands but increased in severity as woodland vegetation transitioned to a denser, closed-canopy type along watercourses. Vegetation is fire-tolerant and therefore fire severity is low. The natural fire regime was a type I regime in the upland. With the more dense vegetation and the occurrence of fuel ladders, fire severity would become mixed. The fire regime may reflect a type III in this more mesic habitat.

Insects and disease may impact individual trees (ponderosa pine) locally. Armillaria root rot, western pine beetle, western oak looper, western tent caterpillar, and the pine engraver have the greatest potential for damage.

Component Associations:
- *Pinus ponderosa - Calocedrus decurrens - Quercus chrysolepis / Chamaebatia foliolosa* Forest (CEGL008674, G4?)
- *Pinus ponderosa - Quercus kelloggii / Arctostaphylos viscida* Woodland (CEGL008694, G4?)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- North Pacific Oak Woodland (CES204.852)

DISTRIBUTION

Range: This system is found throughout California's middle and inner North Coast Ranges, as well as the Klamath Mountains from

600-1600 m (1800-4850 feet) elevation, and the lower slopes of the western Sierra Nevada.
Divisions: 206:C
Nations: US
Subnations: CA, OR
Map Zones: 2:C, 3:C, 4:C, 5:P, 6:C, 7:C, 13:?
USFS Ecomap Regions: 261B:CC, 262A:CC, 263A:CC, 322A:CC, 341D:PP, 342B:PP, M242A:P?, M242B:PP, M261A:CC, M261B:CC, M261C:CC, M261D:CC, M261E:CC, M261F:CC, M261G:CC
TNC Ecoregions: 5:C, 14:C, 15:C

SOURCES

References: Barbour and Billings 2000, Barbour and Major 1988, Barbour et al. 2007, Comer et al. 2003, Eyre 1980, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722758#references
Description Author: P. Comer, T. Keeler-Wolf, mod. G. Kittel
Version: 12 Jan 2012 **Stakeholders:** West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

MEDITERRANEAN CALIFORNIA MESIC MIXED CONIFER FOREST AND WOODLAND (CES206.915)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Lower Montane]; Toeslope/Valley Bottom; Mediterranean [Mediterranean Xeric-Oceanic]; Udic
Non-Diagnostic Classifiers: Long (>500 yrs) Persistence; Forest and Woodland (Treed); F-Patch/Low Intensity; Sequoiadendron giganteum
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2028; ESLF 4215; ESP 1028

CONCEPT

Summary: This ecological system occurs in cool ravines and north-facing slopes (typically with 100-150 cm annual precipitation; 50% as snow). It is found from 800-1000 m (2400-3000 feet) elevation in the Sierra Nevada and 1250-2200 m (3800-6700 feet) in the Klamath Mountains. The most characteristically co-occurring conifers are *Abies concolor var. lowiana, Calocedrus decurrens*, and *Pinus lambertiana*. *Pinus jeffreyi, Pinus ponderosa*, and *Pseudotsuga menziesii* occur frequently but are not dominant. In limited locations in the central Sierra Nevada, *Sequoiadendron giganteum* dominates, usually with *Abies concolor*, and at the highest elevations also with *Abies magnifica*. *Acer macrophyllum* is common in lower elevation mesic pockets; *Chrysolepis chrysophylla* also occurs in the western Klamaths. Common understory species include *Corylus cornuta, Cornus nuttallii*, and at higher elevations *Chrysolepis sempervirens*. In areas of recent fire or other disturbance, *Arctostaphylos patula, Ceanothus integerrimus, Ceanothus cordulatus, Ceanothus parvifolius*, and *Ribes* spp. are more common. Fire of highly variable patch size and return interval maintains the structure of these woodlands
Classification Comments: The presence of *Abies concolor* with other conifers is a strong indicator for this system in central California's Coast and Transverse ranges.
Similar Ecological Systems:
- Sierran-Intermontane Desert Western White Pine-White Fir Woodland (CES204.101)

Related Concepts:
- Pacific Ponderosa Pine: 245 (Eyre 1980) Intersecting
- Sierra Nevada Mixed Conifer: 243 (Eyre 1980) Intersecting
- White Fir: 211 (Eyre 1980) Intersecting. White fir (*Abies concolor ssp. lowiana*) is a major component of this ecological system.

Component Associations:
- *Abies concolor - Calocedrus decurrens - Pinus lambertiana / Adenocaulon bicolor* Forest (CEGL008678, G3?)
- *Abies concolor - Calocedrus decurrens - Pinus lambertiana / Chrysolepis sempervirens / Carex multicaulis* Forest (CEGL008675, G3?)
- *Abies concolor - Calocedrus decurrens - Pinus lambertiana / Cornus nuttallii / Corylus cornuta var. californica* Forest (CEGL008677, GNR)
- *Abies concolor - Pinus lambertiana - Calocedrus decurrens / Symphoricarpos mollis / Kelloggia galioides* Forest (CEGL008676, GNR)
- *Abies concolor - Pinus lambertiana - Pinus jeffreyi* / Sparse Understory Forest (CEGL003155, GNR)
- *Abies concolor - Pinus lambertiana / Maianthemum racemosum - Prosartes hookeri* Forest (CEGL008680, G3?)
- *Abies concolor - Pinus lambertiana* Forest (CEGL008679, G3)
- *Abies concolor - Pinus ponderosa / Amelanchier alnifolia* Forest (CEGL000014, G2)
- *Abies concolor / Ceanothus cordulatus* Forest (CEGL008608, GNR)
- *Pinus jeffreyi - Abies concolor* Woodland (CEGL008630, G4?)
- *Pinus jeffreyi - Abies magnifica* Woodland (CEGL008632, G3?)
- *Sequoiadendron giganteum - Pinus lambertiana / Cornus nuttallii* Forest (CEGL008607, GNR)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Mediterranean California Dry-Mesic Mixed Conifer Forest and Woodland (CES206.916)

DISTRIBUTION

Range: This system is found from 800-1000 m (2400-3000 feet) elevation in the Sierra Nevada and 1250-2200 m (3800-6700 feet) in the Klamath Mountains.
Divisions: 206:C
Nations: US
Subnations: CA, NV, OR
Map Zones: 2:C, 3:C, 4:?, 6:C, 7:C, 12:?

USFS Ecomap Regions: 263A:CC, 342B:PP, M242A:CC, M242B:CC, M242C:CC, M261A:CC, M261B:CC, M261C:CC, M261D:CC, M261E:CC, M261F:CP, M261G:CC
TNC Ecoregions: 5:C, 12:C, 14:C

SOURCES

References: Barbour and Billings 2000, Barbour and Major 1988, Comer et al. 2003, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722766#references

Description Author: P. Comer, T. Keeler-Wolf, mod. G. Kittel
Version: 12 Jan 2012 **Stakeholders:** West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

MEDITERRANEAN CALIFORNIA MIXED EVERGREEN FOREST (CES206.919)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Franciscan Formation Soils; Broad-Leaved Evergreen Tree
Non-Diagnostic Classifiers: Montane [Lower Montane]; Ustic; F-Patch/Low Intensity; Needle-Leaved Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2043; ESLF 4230; ESP 1043

CONCEPT

Summary: This ecological system occurs from the Santa Cruz Mountains (and locally in the Santa Lucia Mountains), California, north into southwestern Oregon throughout the outer and middle Coast Ranges on Franciscan Formation soils (metasedimentary sandstones, schists, and shales) with moderate to high rainfall. This system occurs just inland from the redwood belt of this region. It also occurs in southern California in more mesic, protected, cooler sites of the Transverse and Peninsular ranges. Historic fire frequency in this system was higher than for redwood-dominated systems (every 50-100 years). It is characterized by mixes of coniferous and broad-leaved evergreen trees. Characteristic trees include *Pseudotsuga menziesii, Quercus chrysolepis, Lithocarpus densiflorus, Arbutus menziesii, Umbellularia californica*, and *Chrysolepis chrysophylla*. On the eastern fringe of this system, in the western Siskiyous, other conifers occur such as *Pinus ponderosa* and *Chamaecyparis lawsoniana*. In southern California (Transverse and Peninsular ranges), *Pseudotsuga macrocarpa* replaces *Pseudotsuga menziesii* but co-occurs with *Quercus chrysolepis* and sometimes *Quercus agrifolia*. *Calocedrus decurrens* is occasional. In the southern portion of the range, *Lithocarpus densiflorus, Arbutus menziesii, Umbellularia californica*, and *Chrysolepis chrysophylla* become less important or are absent. In the Santa Lucia Mountains, stands of *Abies bracteata* are included in this system and are an unusual and unique component. These stands are a mixture of *Abies bracteata* and *Quercus chrysolepis*. The more northerly stands tend to have dense or diverse shrub understories, with *Corylus cornuta, Vaccinium ovatum, Rhododendron macrophyllum, Gaultheria shallon, Quercus sadleriana, Mahonia nervosa*, and *Toxicodendron diversilobum* being common. Southern stands are less diverse and more sparse; *Toxicodendron diversilobum* is the most constant shrub, with *Ribes* spp. occasionally present, along with much *Polystichum munitum*. Especially in the south, stands are restricted to fire-protected sites (extremely steep, northerly, mesic slopes and coves) where fires from adjacent chaparral systems do not carry.
Classification Comments: In northern California, especially around Point Reyes, there are stands dominated by *Umbellularia californica*. These nearly pure stands are a part of this system, as it is a disturbance-driven species and grows rapidly with full sunlight. With time and succession, other trees will succeed into the canopy. This is in contrast to small patches or individuals of *Umbellularia californica* in some of the various chaparral systems. Here there are no chaparral shrubs in the understory. The presence of *Lithocarpus densiflorus* in mixed stands of pine and oak is the indicator species for this system in many places in the Coast Ranges throughout northern and central California.
Similar Ecological Systems:
- Mediterranean California Lower Montane Black Oak-Conifer Forest and Woodland (CES206.923)

Related Concepts:
- Douglas-fir - Tanoak - Pacific Madrone: 234 (Eyre 1980) Finer
- Pacific Douglas-fir: 229 (Eyre 1980) Intersecting

Component Associations:
- *Chamaecyparis lawsoniana - Pseudotsuga menziesii / (Rhododendron macrophyllum) / Xerophyllum tenax* Forest (CEGL000044, G1)
- *Pseudotsuga menziesii - Quercus chrysolepis* Forest (CEGL005814, G3?)
- *Pseudotsuga menziesii / Quercus agrifolia* Forest (CEGL003166, G3?)
- *Pseudotsuga menziesii / Umbellularia californica / Frangula californica ssp. californica* Forest (CEGL003167, G4)
- *Pseudotsuga menziesii / Umbellularia californica / Polystichum munitum* Forest (CEGL003168, G4)

DISTRIBUTION

Range: This system occurs from the Santa Lucia and Santa Cruz mountains of California north into southwestern Oregon throughout the outer and middle Coast Ranges and in southern California (Transverse and Peninsular ranges). It occurs in localized areas of the central to northern Sierra Nevada and southern and eastern Klamath Mountains.
Divisions: 206:C
Nations: US
Subnations: CA, OR
Map Zones: 2:C, 3:C, 4:C, 5:?, 6:C, 7:C
USFS Ecomap Regions: 263A:CC, M242A:CC, M242B:C?, M261A:CC, M261B:CC, M261C:CC, M261D:CC, M261E:CC, M261F:CC

TNC Ecoregions: 5:C, 14:C

SOURCES

References: Barbour and Billings 2000, Barbour and Major 1988, Comer et al. 2003, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722762#references

Description Author: P. Comer, T. Keeler-Wolf, mod. M.S. Reid

Version: 23 Jan 2006 **Stakeholders:** West

Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

MEDITERRANEAN CALIFORNIA MIXED OAK WOODLAND (CES206.909)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Lower Montane]; Sideslope; Mediterranean [Mediterranean Xeric-Oceanic]; Shallow Soil; F-Patch/Medium Intensity; Quercus kelloggii; Quercus garryana var. breweri
Non-Diagnostic Classifiers: Forest and Woodland (Treed); Xeric; Intermediate Disturbance Interval; Broad-Leaved Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2029; ESLF 4216; ESP 1029

CONCEPT

Summary: This ecological system is found throughout the Sierra Nevada and Coast Range foothills and lower montane elevations from 600-1600 m (1800-4850 feet) on steep, rocky slopes where snow and cold temperatures occur. Fire frequency and intensity drive composition of this system, with *Quercus chrysolepis* dominant with less frequent fires. With frequent annual burning (at lower elevations and on warmer sites), this system is an open to dense woodland of large oaks with well-developed grassy understories of native perennial bunchgrass. The predominant oaks with the higher frequency fires include *Quercus kelloggii* and *Quercus garryana*, with *Quercus garryana var. garryana* codominant in the central and northern Coast Ranges and *Quercus garryana var. breweri* often codominant in the northwestern Coast Ranges as well as portions of the Sierra Nevada. *Quercus chrysolepis* becomes dominant with less frequent fires (but in Oregon this species is not important and occurs in a different system, either Mediterranean California Mixed Evergreen Forest (CES206.919) or Mediterranean California Dry-Mesic Mixed Conifer Forest and Woodland (CES206.916)). The perennial bunchgrass component includes *Festuca idahoensis, Festuca californica, Elymus glaucus,* and *Danthonia californica* (close to the coast). A variety of native forbs also occur. Other characteristic species include *Toxicodendron diversilobum, Juniperus occidentalis*, and *Ceanothus cuneatus*. This system is similar to North Pacific Oak Woodland (CES204.852) but does not include a conifer component, and *Quercus garryana* is not the only oak.

Similar Ecological Systems:
- North Pacific Oak Woodland (CES204.852)

Related Concepts:
- California Black Oak: 246 (Eyre 1980) Broader
- Canyon Live Oak: 249 (Eyre 1980) Undetermined
- Oregon White Oak: 233 (Eyre 1980) Intersecting. Oregon white oak does occur occasionally as a dominant in this ecological system.

DESCRIPTION

Dynamics: LANDFIRE model information: Fire Regime I, primarily short-interval (e.g., <10 years) surface fires. Surface fires every 3-10 years maintained an open savanna-like structure. Fires can be mixed-severity, especially when closed-canopy conditions or additional species such as conifers and shrubs are present. Native burning was a significant factor in fire frequency of this type, but return intervals may increase significantly with a little distance from native settlements and valley bottoms.

Component Associations:
- *Quercus chrysolepis - Umbellularia californica* Forest (CEGL008604, G4?)
- *Quercus chrysolepis / Arctostaphylos patula* Forest (CEGL008601, G3?)
- *Quercus chrysolepis / Arctostaphylos viscida* Forest (CEGL008602, G4?)
- *Quercus chrysolepis / Dryopteris arguta* Forest (CEGL008603, G3?)
- *Quercus garryana - Quercus kelloggii / Toxicodendron diversilobum* Woodland (CEGL000931, G2)
- *Quercus kelloggii - Calocedrus decurrens* Forest (CEGL008618, G4?)
- *Quercus kelloggii / Arctostaphylos mewukka - Chamaebatia foliolosa* Forest (CEGL008619, G3?)
- *Quercus kelloggii / Arctostaphylos patula* Forest (CEGL008617, G3?)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- North Pacific Oak Woodland (CES204.852)

DISTRIBUTION

Range: This system is found throughout the Sierra Nevada and Coast Range foothills and lower montane of California and Oregon at elevations from 600-1600 m (1800-4850 feet).
Divisions: 206:C
Nations: US
Subnations: CA, OR
Map Zones: 2:C, 3:C, 4:C, 5:C, 6:C, 7:C, 13:?

USFS Ecomap Regions: 261B:CC, 262A:CC, 263A:CC, 322A:CC, 341D:PP, 342B:CC, M242A:??, M261A:CC, M261B:CC, M261C:CC, M261D:CC, M261E:CC, M261F:CC, M261G:CC
TNC Ecoregions: 12:C, 13:C, 14:C, 16:P

SOURCES

References: Barbour and Billings 2000, Barbour and Major 1988, Barbour et al. 2007, Comer et al. 2003, Eyre 1980, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722772#references

Description Author: P. Comer, T. Keeler-Wolf, mod. G. Kittel
Version: 12 Jan 2012 **Stakeholders:** West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

MEDITERRANEAN CALIFORNIA RED FIR FOREST (CES206.913)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Upper Montane]; Forest and Woodland (Treed); Mediterranean [Mediterranean Pluviseasonal-Oceanic]; Deep Soil; Ustic; Long Disturbance Interval; Abies magnifica (= var. magnifica)
Non-Diagnostic Classifiers: Sideslope; Toeslope/Valley Bottom; Sand Soil Texture; F-Patch/High Intensity; W-Patch/High Intensity
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2032; ESLF 4219; ESP 1032

CONCEPT

Summary: This ecological system includes high-elevation (1600-2700 m [4850-9000 feet]) forests and woodlands dominated by *Abies magnifica (= var. magnifica), Abies X shastensis (= Abies magnifica var. shastensis),* and/or *Abies procera*. This system is typically found on deep, well-drained soils throughout this elevation zone from the central Sierra Nevada north and west into southern Oregon. Heavy snowpack is a major source of soil moisture throughout the growing season. The limiting factors can be either cold-air drainages or ponding, or coarser soils (pumice versus ash, for example). Other conifers that can occur in varying mixtures with *Abies magnifica* include *Pinus contorta var. murrayana, Pinus monticola, Tsuga mertensiana, Pinus jeffreyi,* and *Abies concolor*. At warmer and lower sites of the North Coast Ranges and Sierra Nevada, *Abies concolor* can codominate with *Abies magnifica*. *Pinus contorta* in Oregon indicates lower productivity where it intergrades with *Abies X shastensis*. This system ranges from dry to moist, and some sites have mesic indicator species, such as *Ligusticum grayi* or *Thalictrum fendleri*. Common understory species include *Quercus vacciniifolia, Ribes viscosissimum, Chrysolepis sempervirens, Ceanothus cordulatus* (in seral stands), *Vaccinium membranaceum, Symphoricarpos mollis,* and *Symphoricarpos rotundifolius*. Characteristic forbs include *Eucephalus breweri, Pedicularis semibarbata,* and *Hieracium albiflorum*. This system commonly occurs above mixed conifer forests with *Abies concolor* and overlaps in elevation with forests and woodlands of *Pinus contorta var. murrayana*. On volcanic sites of lower productivity, stands may be more open woodland in structure and with poor-site understory species such as *Wyethia mollis*. Driving ecological processes include occasional blow-down, insect outbreaks and stand-replacing fire.

Related Concepts:
- Red Fir: 207 (Eyre 1980) Equivalent

DESCRIPTION

Dynamics: Stand-replacing fire is important but so are moderately frequent (about once every 40 years) low- to moderate-severity fires. The whole system is characterized by a "moderate-severity fire regime" (Agee 1993), i.e., high variability in severity and moderate frequency of fires. See also Chappell and Agee (1996), Pitcher (1987), and Taylor and Halpern (1991) for documentation of fire regime in these forests. Windthrow causes tree-sized gaps that release already established individuals in the understory.

TNC model information: At higher elevations and in the southern Sierra Nevada, fuels are relatively more discontinuous than northern locations because the terrain is broken up by natural breaks such as rock outcrops, lava reefs, wet meadows, etc. Fuels may be more continuous at the northern end of the range, where this vegetation type is found at lower elevations. Primarily Fire Regime Group III, but because of slow fuel accumulation rates, it is possible to have 35- to 150-year frequency surface fire in some classes (lower frequency for these settings as a whole). The discontinuous nature of the fuels limits the extent of fires, and while fires may burn less often, they may burn at high severities. Larger and more frequent moderate-intensity fires occur on average every 60-70 years. High-intensity crown fires are rare, occurring every few hundred years; overall mean fire-return interval is approximately 35-50 years (Pitcher 1987, Skinner 2000, Taylor 2000, Bekker and Taylor 2001). Replacement fire likely varies with slope position (upper slope > midslope > lower slope), and landscapes with greater topographic variation are likely to experience more stand-replacement fires. A considerable range of values has been reported in the literature for mixed and surface fires (Taylor and Halpern 1991, Taylor 1993, Bekker and Taylor 2001, Taylor and Solem 2001).

Component Associations:
- *(Abies concolor) - Abies X shastensis / Symphoricarpos mollis* Forest (CEGL000033, GU)
- *Abies concolor - Abies X shastensis / Rosa gymnocarpa* Forest (CEGL000032, GU)
- *Abies concolor - Picea breweriana / Chimaphila umbellata* Forest (CEGL000050, G2)
- *Abies magnifica - Abies concolor - Pinus jeffreyi* Sierran Montane Chaparral Forest (CEGL008682, G3)
- *Abies magnifica - Abies concolor - Pinus lambertiana* / Sparse Understory Forest (CEGL008683, G3)
- *Abies magnifica - Abies concolor* / Sparse Understory Forest (CEGL008681, G3)
- *Abies magnifica - Pinus contorta var. murrayana / Hieracium albiflorum* Forest (CEGL008612, G3?)
- *Abies magnifica - Pinus monticola - Pinus contorta var. murrayana* Forest (CEGL008616, G3)
- *Abies magnifica - Pinus monticola / Arctostaphylos nevadensis* Forest (CEGL008615, G3)
- *Abies magnifica - Pinus monticola / Chrysolepis sempervirens* Forest (CEGL008614, G3)
- *Abies magnifica - Pinus monticola* Forest (CEGL008613, G3)

- *Abies magnifica / Arctostaphylos nevadensis* Forest (CEGL008611, G3)
- *Abies magnifica* / Sparse Understory Forest (CEGL008609, G4)
- *Abies magnifica / Wyethia mollis* Forest (CEGL008610, G3?)
- *Abies X shastensis - Tsuga mertensiana / Arctostaphylos nevadensis* Forest (CEGL000035, G4)
- *Abies X shastensis / Carex inops ssp. inops* Forest (CEGL000348, G4)
- *Abies X shastensis / Polemonium pulcherrimum* Forest (CEGL000036, G3)
- *Abies X shastensis / Quercus sadleriana* Forest (CEGL000034, G4)
- *Abies X shastensis / Vaccinium membranaceum / Chimaphila umbellata* Forest (CEGL000037, G4)

DISTRIBUTION

Range: This system is typically found on deep, well-drained soils throughout the high-elevation zone (1600-2700 m [4850-8200 feet]) from the central Sierra Nevada north and west into southern Oregon.
Divisions: 206:C
Nations: US
Subnations: CA, NV, OR
Map Zones: 2:C, 3:C, 6:C, 7:C, 12:?
USFS Ecomap Regions: 341D:CC, M242B:CC, M242C:CC, M261A:CC, M261B:CC, M261D:CC, M261E:CC, M261F:CC, M261G:CC
TNC Ecoregions: 5:C, 12:C

SOURCES

References: Agee 1993, Barbour and Billings 2000, Barbour and Major 1988, Bekker and Taylor 2001, Chappell and Agee 1996, Comer et al. 2003, Eyre 1980, Holland and Keil 1995, Pitcher 1987, Sawyer and Keeler-Wolf 1995, Skinner 2000, Taylor 1993, Taylor and Halpern 1991, Taylor and Solem 2001
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722768#references
Description Author: P. Comer, T. Keeler-Wolf, mod. G. Kittel
Version: 12 Jan 2012 **Stakeholders:** West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

MEDITERRANEAN CALIFORNIA SUBALPINE WOODLAND (CES206.910)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Temperate [Temperate Oceanic]; Very Shallow Soil; W-Landscape/High Intensity; Krummholz
Non-Diagnostic Classifiers: Montane [Upper Montane]; Ridge/Summit/Upper Slope
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2033; ESLF 4220; ESP 1033

CONCEPT

Summary: This ecological system occurs on ridges and rocky slopes around timberline at 2900 m (9500 feet) elevation in the southern Sierra Nevada and Transverse and Peninsular ranges, up to 3500 m (11,500 feet) in the Sierra Nevada, and 2450 m (8000 feet) in the southern Cascades. Tree species often occur as krummholz growth forms with a wind-pruned, prostrate, and/or shrublike appearance, but in more protected sites they form true woodland physiognomy. Stands are dominated by *Pinus albicaulis* and/or *Pinus contorta var. murrayana*; other important conifers and locally dominant species include *Pinus balfouriana* (only in the Klamath Mountains and southern Sierra Nevada where it may replace *Pinus albicaulis*), *Pinus flexilis* (but only in small patches on the eastern flank of the Sierra Nevada escarpment when it does occur), *Pinus monticola* (not in Transverse or Peninsular ranges), and *Juniperus occidentalis var. australis* (mostly in the central and southern Sierra Nevada but not in the Klamath Mountains). Important shrubs include *Arctostaphylos nevadensis, Chrysolepis sempervirens*, and *Holodiscus discolor (= Holodiscus microphyllus)*. Grasses and forbs include *Carex rossii, Carex filifolia, Poa wheeleri, Eriogonum incanum, Penstemon newberryi*, and *Penstemon davidsonii*. Due to landscape position and very thin soils, these are harsh sites exposed to desiccating winds with ice and snow blasts, and rocky substrates. In addition, a short growing season limits plant growth. The highest tree diversity occurs in the Klamath Mountains, with sometimes five or more conifers sharing codominance in one stand.

Similar Ecological Systems:
- Sierra Nevada Subalpine Lodgepole Pine Forest and Woodland (CES206.912)

Related Concepts:
- California Mixed Subalpine: 256 (Eyre 1980) Intersecting
- Western Juniper - Big Sagebrush - Bluebunch Wheatgrass (107) (Shiflet 1994) Intersecting. *Juniperus occidentalis var. australis* woodlands are included in this ecological system of the Sierras.
- Western Juniper: 238 (Eyre 1980) Intersecting. *Juniperus occidentalis var. australis* stands are an important compoenent of this ecological system.
- Whitebark Pine: 208 (Eyre 1980) Intersecting. Whitebark pine stands are a component of this ecological system.

Component Associations:
- *Juniperus occidentalis var. australis - Cercocarpus ledifolius / Artemisia tridentata* Woodland (CEGL003150, G3?)
- *Juniperus occidentalis var. australis / Artemisia tridentata* Woodland (CEGL003151, G3?)
- *Juniperus occidentalis var. australis / Holodiscus discolor* Woodland (CEGL003137, GNR)
- *Juniperus occidentalis var. australis* / Sparse Understory Woodland (CEGL003136, GNR)
- *Pinus albicaulis - Pinus contorta var. latifolia / Penstemon laetus* Forest (CEGL000130, G2)
- *Pinus albicaulis / Carex filifolia* Woodland (CEGL003133, G3G4)
- *Pinus albicaulis / Carex rossii* Woodland (CEGL003135, G3?)
- *Pinus contorta var. murrayana - Pinus albicaulis / Carex filifolia* Forest (CEGL008671, G3?)
- *Pinus contorta var. murrayana - Pinus albicaulis / Carex rossii* Forest (CEGL008670, G4)
- *Pinus monticola - Pinus contorta var. murrayana* / Sparse Understory Woodland (CEGL003157, GNR)
- *Pinus monticola / Achnatherum occidentale* Woodland (CEGL008622, G3)

DISTRIBUTION

Range: This system occurs on ridges and rocky slopes around timberline at 2900 m (9500 feet) elevation in the southern Sierra Nevada and Transverse and Peninsular ranges and 2450 m (8000 feet) in the southern Cascades.
Divisions: 204:P; 206:C
Nations: MX, US
Subnations: CA, MXBC(MX), NV, OR
Map Zones: 2:C, 3:C, 4:C, 6:C, 7:C, 12:C, 13:P
USFS Ecomap Regions: 322A:??, 341D:CC, 341F:CC, M242B:CC, M242C:CC, M261A:CC, M261D:CC, M261E:CC, M261G:CC
TNC Ecoregions: 4:C, 5:C, 12:C, 16:C

SOURCES

References: Arno and Hoff 1990, Barbour and Billings 2000, Barbour and Major 1988, Barbour et al. 2007, Comer et al. 2003, Eyre 1980, Fried et al. 2004, Holland and Keil 1995, Logan et al. 2010, Sawyer and Keeler-Wolf 1995, Shiflet 1994

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722771#references

Description Author: P. Comer, T. Keeler-Wolf, mod. G. Kittel

Version: 12 Jan 2012 **Stakeholders:** Latin America, West

Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

MIDDLE ROCKY MOUNTAIN MONTANE DOUGLAS-FIR FOREST AND WOODLAND (CES306.959)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: RM Montane Mesic Mixed Conifer; Moderate (100-500 yrs) Persistence; Montane [Montane]; Montane [Lower Montane]; Forest and Woodland (Treed); Aridic; Intermediate Disturbance Interval; F-Patch/Medium Intensity; F-Landscape/Medium Intensity; Needle-Leaved Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2166; ESLF 4266; ESP 1166

CONCEPT

Summary: This ecological system occurs throughout the middle Rocky Mountains of central and southern Idaho (Lemhi, Beaverhead and Lost River ranges), south and east into the greater Yellowstone region, and south and east into the Wind River, Gros Ventre and Bighorn ranges of Wyoming. It extends north into Montana on the east side of the Continental Divide, north to about the McDonald Pass area, and also into the Rocky Mountain Front region of Montana. This is a *Pseudotsuga menziesii*-dominated system without the maritime floristic composition; these are forests and woodlands occurring in the central Rockies where the southern monsoon influence is less and maritime climate regime is not important. This system includes extensive *Pseudotsuga menziesii* forests, occasionally with *Pinus flexilis* on calcareous substrates, and *Pinus contorta* at higher elevations. True firs, such as *Abies concolor, Abies grandis*, and *Abies lasiocarpa*, are absent in these occurrences, but *Picea engelmannii* can occur in some stands. Understory components include shrubs such as *Physocarpus malvaceus, Juniperus communis, Symphoricarpos oreophilus*, and *Mahonia repens*, and graminoids such as *Calamagrostis rubescens, Carex rossii*, and *Leucopoa kingii*. The fire regime is of mixed severity with moderate frequency. This system often occurs at the lower treeline immediately above valley grasslands, or sagebrush steppe and shrublands. Sometimes there may be a "bath-tub ring" of *Pinus ponderosa* at lower elevations or *Pinus flexilis* between the valley non-forested and the solid *Pseudotsuga menziesii* forest. In the Wyoming Basins, this system occurs as isolated stands of *Pseudotsuga menziesii*, with *Artemisia tridentata, Pseudoroegneria spicata, Leucopoa kingii*, and *Carex rossii*.
Related Concepts:
- Interior Douglas-fir: 210 (Eyre 1980) Broader

Component Associations:
- *Abies concolor - Pseudotsuga menziesii / Carex rossii* Forest (CEGL000431, G2?)
- *Pinus ponderosa - Pseudotsuga menziesii / Calamagrostis rubescens* Woodland (CEGL000210, G2Q)
- *Pseudotsuga menziesii - Pinus flexilis / Leucopoa kingii* Woodland (CEGL000906, G4Q)
- *Pseudotsuga menziesii / Calamagrostis rubescens* Woodland (CEGL000429, G5)
- *Pseudotsuga menziesii / Festuca idahoensis* Woodland (CEGL000900, G4)
- *Pseudotsuga menziesii / Juniperus communis* Forest (CEGL000439, G4)
- *Pseudotsuga menziesii / Juniperus osteosperma* Forest (CEGL000440, G2?)
- *Pseudotsuga menziesii / Juniperus scopulorum* Woodland (CEGL000903, G3)
- *Pseudotsuga menziesii / Leucopoa kingii* Woodland (CEGL000904, G3G4)
- *Pseudotsuga menziesii / Linnaea borealis* Forest (CEGL000441, G4)
- *Pseudotsuga menziesii / Mahonia repens* Forest (CEGL000442, G5)
- *Pseudotsuga menziesii / Osmorhiza berteroi* Forest (CEGL000445, G4G5)
- *Pseudotsuga menziesii / Physocarpus malvaceus* Forest (CEGL000447, G5)
- *Pseudotsuga menziesii / Pseudoroegneria spicata* Woodland (CEGL000908, G4)
- *Pseudotsuga menziesii / Spiraea betulifolia* Forest (CEGL000457, G5)
- *Pseudotsuga menziesii / Symphoricarpos albus* Forest (CEGL000459, G5)
- *Pseudotsuga menziesii / Symphoricarpos oreophilus* Forest (CEGL000462, G5)

DISTRIBUTION

Range: This system occurs throughout the middle Rocky Mountains of central and southern Idaho (Lemhi, Beaverhead and Lost River ranges), south and east into the greater Yellowstone region, and south and east into the Wind River, Gros Ventre and Bighorn ranges of Wyoming. It extends north into Montana on the east side of the Continental Divide to the Rocky Mountain Front and includes all of the Beaverhead Mountains Section (M332E) (Bailey et al. 1994). It may also occur in scattered patches in southeastern Oregon.
Divisions: 304:C; 306:C
Nations: US
Subnations: ID, MT, OR?, WY
Map Zones: 9:?, 10:C, 18:?, 19:C, 20:?, 21:C, 22:C, 29:C
USFS Ecomap Regions: 342A:CC, 342C:CP, 342D:CP, 342J:CP, M331A:CC, M331B:CC, M331D:CP, M331J:CC, M332A:CC,

M332B:CC, M332E:CC, M332F:CC
TNC Ecoregions: 6:P, 7:?, 8:C, 9:C, 10:C

SOURCES

References: Bailey et al. 1994, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.786427#references
Description Author: M.S. Reid
Version: 23 Jan 2006 **Stakeholders:** West
Concept Author: M.S. Reid **ClassifResp:** West

MISSISSIPPI DELTA MARITIME FOREST (CES203.513)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Coast
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Mixed evergreen-deciduous closed tree canopy
National Mapping Codes: EVT 2384; ESLF 4327; ESP 1384

CONCEPT

Summary: This system includes forests on barrier islands and spits formed during the deltaic shifts of the Mississippi River. It also includes the woody vegetation of salt domes in the Mississippi River deltaic plain. Since natural deltaic processes have been altered, barrier islands are no longer being formed in the Mississippi Delta region and existing barrier islands are undergoing subsidence and beach erosion. Some documented stands that apparently pertain to this system are found on Native American middens (shell mounds) located in the salt marshes of Hancock County, Mississippi. This system currently includes one forested beach ridge located at Grande Isle in Louisiana.

Related Concepts:
- Live Oak: 89 (Eyre 1980) Finer

DESCRIPTION

Environment: This system includes forests on barrier islands and spits formed during the deltaic shifts of the Mississippi River. It also includes the woody vegetation of salt domes in the Mississippi River deltaic plain. Some documented stands that apparently pertain to this system are found on Native American middens (shell mounds) located in the salt marshes of Hancock County, Mississippi (Eleuterius and Otvos 1979). This system also includes one forested beach ridge located at Grande Isle in Louisiana.
Dynamics: The maritime environment for these forests is extremely dynamic and may be severely altered or destroyed by geologic processes, including catastrophic destruction by storms. Fire may have naturally occurred infrequently in this system, but probably was not an important factor. Mature *Quercus virginiana* trees are fire-resistant when mature, and their litter also does not easily burn (Stalter and Odum 1993). Maritime forest systems remain subject to periodic severe physical stresses, although less than coastal dune and grassland systems. Vegetation structure and composition are influenced by salt spray (sea salt aerosol) and extreme disturbance events such as hurricanes, erosion, accretion and sand burial. Chronic salt spray, as well as intense salt spray during storms are important influences on vegetation structure and composition; however, the extent to which plant communities found in this system are shaped by salt spray varies. The most heavily salt-influenced examples of these systems may appear pruned or sculpted. Extreme salt spray or saltwater flooding in storms can severely disturb vegetation, though it recovers if the landforms have not been altered.

Hurricanes frequently make landfall in the northern Gulf of Mexico region, and have a significant impact on coastal systems. Even when they do not make landfall, the storm surge and wave action generated by an off-shore storm can have a significant impact. A total of 112 hurricanes made landfall from Wakulla County, Florida, to Hancock County, Mississippi, during the period 1926 to 2005 (Jarrell et al. 1992 with updates). From the period 1851 to 2004, 36 major hurricanes (Category 3 or higher) made landfall along the Gulf Coast from Louisiana to the Florida Panhandle (Blake et al. 2005). Hurricane-associated storm surges can overwash the dune system and cause significant erosion and/or sand burial of maritime forests. Personal observations along coastal areas of the Florida panhandle region in 2005 revealed large areas of vegetation extending several hundred yards inland that were killed or significantly impacted by saltwater inundation (Landfire 2007a).

The role of fire in this system is poorly documented. The majority of this system occurs on narrow barrier islands along the northern Gulf of Mexico. FNAI (1990) indicates that the mesic conditions and insular locations of well-developed maritime hammock communities inhibit natural fires, which occur no more frequently than once every 26 to 100 years. Liu et. al. (2003), in their study of sediment cores from Little Lake, Alabama, suggested that wildfires have been common in the coastal ecosystems in Alabama; however, they offered no frequency estimates. They did suggest a correlation between hurricanes and fire. This correlation was also supported by Meyers and van Lear (1998) who suggest that hurricane-fire interactions once played a major role in the development of ecosystems in the southern U.S., influencing their composition, structure, and pattern on the landscape (Landfire 2007a).

The following fire-return interval estimates were based on the Huffman and Platt (2004) study of fire scars on slash pines on Little St. George Island (Florida) and the return interval in similar ecological systems on the mainland. Fires were primarily light surface fires occurring every four years during the growing season. More intense replacement fires may have occurred following hurricanes, when more fuel was available as a result of storm damage. There is little fuel to sustain surface fires in the *Quercus/Ceratiola ericoides*-dominated ridges. Fires in this vegetation type are typically replacement fires that burn through the shrub crowns. The return interval here was estimated at 25 to 100 years, and may have occurred following a hurricane or other intense storm-related event when more fuel was available and fire intensity was higher (Landfire 2007a).

Component Associations:
- *Quercus virginiana - Magnolia grandiflora - Quercus pagoda - Celtis laevigata / Sabal minor* Forest (CEGL007467, G1)

- *Quercus virginiana* Forest (CEGL007831, G1Q)

DISTRIBUTION

Range: This system is apparently restricted to Louisiana. It is found on barrier islands and spits formed during the deltaic shifts of the Mississippi River.
Divisions: 203:C
Nations: US
Subnations: LA
Map Zones: 98:C
USFS Ecomap Regions: 232E:CC
TNC Ecoregions: 31:C, 42:?

SOURCES

References: Barbour et al. 1985, Bellis 1995, Blake et al. 2005, Comer et al. 2003, Eaton 1979, Eleuterius and Otvos 1979, Eyre 1980, FNAI 1990, Gaddy and Kohlsaat 1987, Huffman and Platt 2004, Jarrell et al. 1992, Johnson and Barbour 1990, Landfire 2007a, Liu et al. 2003, Meyers and van Lear 1998, Morton 2008, NCDENR 2010, Seneca and Broome 1981, Stalter and Odum 1993, Ward 1975, Winner 1975, Winner 1979
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723076#references
Description Author: J. Teague, mod. M. Pyne
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: J. Teague **ClassifResp:** Southeast

MISSISSIPPI RIVER ALLUVIAL PLAIN DRY-MESIC LOESS SLOPE FOREST (CES203.071)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Unglaciated
Non-Diagnostic Classifiers: Forest and Woodland (Treed); Loess; Broad-Leaved Deciduous Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: EVT 2509; ESLF 4155; ESP 1509

CONCEPT

Summary: This system of dry-mesic upland forests occurs most extensively on west-facing loess slopes on southern Crowley's Ridge, with more limited occurrences on northern Crowley's Ridge and in the erosional slopes and hills that bound the Grand Prairie terrace of Arkansas and Macon Ridge in Louisiana and Arkansas. The vegetation is very distinctive from that of the adjacent alluvial plain, and the sites themselves, which occur on distinct slopes that rise above the alluvial plain surface, also contrast sharply with it. Occurrences of this system generally comprise dry-mesic forests that occupy west-facing slopes and narrow, "finger" ridgetops in a highly dissected landscape. In many cases, these slopes provide habitat for plant species that are uncommon in other parts of the alluvial plain. Forests on the ridgetops are dominated by *Quercus alba, Quercus rubra* (Crowley's Ridge only), *Quercus falcata, Quercus pagoda, Quercus stellata, Carya texana, Quercus shumardii*, and *Quercus velutina*.
Classification Comments: This system is best developed on southern Crowley's Ridge where loess is most pronounced and is more isolated and less extensive elsewhere. More associations may need to be developed.
Similar Ecological Systems:
- Crowley's Ridge Mesic Loess Slope Forest (CES203.079)
- Crowley's Ridge Sand Forest (CES203.072)

Related Concepts:
- Dry-mesic Loess/Glacial Till Forest (Nelson 2005) Broader
- Shortleaf Pine - Oak: 76 (Eyre 1980) Finer
- Shortleaf Pine: 75 (Eyre 1980) Finer
- White Oak - Black Oak - Northern Red Oak: 52 (Eyre 1980) Finer

DESCRIPTION

Environment: These forests occur on narrow ridgetops and slopes in a highly dissected environment. The system is best documented from southern Crowley's Ridge, Arkansas (Cross County south through Phillips County), with additional occurrences on the northern ridge, on the eastern border of the Grand Prairie terrace in Arkansas, on Macon Ridge (Louisiana/Arkansas) and probably on other upland sites within the alluvial plain, including Missouri and extreme western Kentucky and Tennessee. Loess soil is a characteristic and diagnostic component of the environment of this system.
Vegetation: This system consists of forests that are typically dominated by oaks and other hardwoods. Depending upon local soil moisture and other factors, canopy composition can vary from *Quercus stellata*- and *Quercus falcata*-dominated on the driest sites to *Quercus alba* and other oaks on more mesic sites. Associated species in the subcanopy and understory vary along this moisture gradient.
Dynamics: These are fire-maintained forests. In Arkansas, they generally lie to the east of hydroxeric Pleistocene terrace flatwoods or prairies (now usually converted to cropland) that burned frequently. Those fires would have continued into these dry to dry-mesic forests. There is presumably also some natural disturbance from the effects of windstorms and collapse of the fragile loess.

This loess forest type is Fire Regime Group III, surface fires with return intervals of 30 to 100 or more years. Mixed-severity fires will occur approximately every 100 years, opening the canopy with increased mortality. This effect may also be achieved by recurrent, severe insect defoliations or droughts. Straight-line winds or microbursts may cause blowdowns on a scale of 1 to 100 acres. Stand-replacement fires happen very infrequently (Landfire 2007a).

Component Associations:
- *Quercus alba - Quercus falcata - Quercus velutina / Ostrya virginiana* Forest (CEGL004068, G1G2)
- *Quercus stellata - Quercus falcata / Ostrya virginiana* Forest (CEGL004064, G1)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Lower Mississippi Alluvial Plain Grand Prairie (CES203.549)

DISTRIBUTION

Range: This system is endemic to well-drained sites on Crowley's Ridge (Arkansas, Missouri) and Macon Ridge (Louisiana/Arkansas), along the eastern slopes of the Grand Prairie terrace in Arkansas, and perhaps other such sites in the Mississippi River Alluvial Plain, including Missouri and extreme western Kentucky and Tennessee.

Divisions: 203:C
Nations: US
Subnations: AR, KY, LA, MO, TN
Map Zones: 45:C, 47:C
USFS Ecomap Regions: 234A:CC, 234D:CC, 234Eb:CCC
TNC Ecoregions: 42:C

SOURCES

References: Clark 1974, Edwards et al. 2013, Engeman et al. 2007, Eyre 1980, Landfire 2007a, NatureServe Ecology - Southeastern U.S. unpubl. data, Nelson 2005, Rentch et al. 2003, Southeastern Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.798104#references
Description Author: T. Foti, D. Zollner, M. Pyne
Version: 14 Jan 2014 **Stakeholders:** Midwest, Southeast
Concept Author: T. Foti and M. Pyne **ClassifResp:** Southeast

MONTANE BOREAL WHITE AND BLACK SPRUCE FOREST (CES105.800)

CLASSIFIERS

Conf.: 3 - Weak **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Boreal [Boreal Continental]; Glaciated; Long Disturbance Interval [Seasonality/Spring Disturbance]
Non-Diagnostic Classifiers: Montane [Montane]; Montane [Lower Montane]; Lowland [Foothill]; Lowland [Lowland]; Acidic Soil
National Mapping Codes: ESLF 4274

CONCEPT

Summary: This ecological system is more common north and west of the Northern Rockies, and is truly a boreal forest type; it is considered only peripheral to the Rocky Mountain Division. The montane *Picea glauca* and *Picea mariana* forests in the Northern Rockies represent the southernmost extent of these expansive boreal forests. The southern limit appears to be related to July mean temperatures exceeding 65 degrees F and maximum of 75 degrees F, and where annual precipitation drops below 38-50 cm (15-20 inches). *Picea glauca* associations found in Banff, Jasper, Kootenay and Yoho national parks occur on gentle to moderate slopes and are generally very mature stands. Canopy ranges from closed to open forests, usually with a shrub understory, although some stands have only an herbaceous carpet. Other tree species that may be codominant in the upper canopy include *Picea mariana, Picea engelmannii X glauca, Pseudotsuga menziesii, Abies lasiocarpa,* and *Larix occidentalis*. Undergrowth components include *Rosa acicularis, Dasiphora fruticosa ssp. floribunda, Shepherdia canadensis, Menziesia ferruginea,* and *Cornus canadensis*. Herbaceous species include *Equisetum arvense* and *Triglochin maritima* and the bryophytes *Abietinella abietina (= Thuidium abietinum)* and *Hylocomium splendens*.
Classification Comments: In Alaska systems classification work, mixed white and black spruce upland forests were combined into Western North American Boreal Mesic Black Spruce Forest (CES105.107).
Similar Ecological Systems:
- Western North American Boreal Mesic Black Spruce Forest (CES105.107)
- Western North American Boreal White Spruce Forest (CES105.104)
- Western North American Boreal White Spruce-Hardwood Forest (CES105.106)

Related Concepts:
- Black Spruce - White Spruce: 253 (Eyre 1980) Broader

DISTRIBUTION

Divisions: 103:C; 105:C; 306:C
Nations: CA
Subnations: AB, BC, YT
TNC Ecoregions: 7:C, 76:P

SOURCES

References: Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722873#references
Description Author: NatureServe Western Ecology Team
Version: 08 Dec 2008 **Stakeholders:** Canada, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

NORTH PACIFIC BROADLEAF LANDSLIDE FOREST AND SHRUBLAND (CES204.846)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Broad-Leaved Deciduous Tree
Non-Diagnostic Classifiers: Montane [Montane]; Lowland [Foothill]; Lowland [Lowland]; Temperate [Temperate Continental]
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Mixed evergreen-deciduous closed tree canopy
National Mapping Codes: EVT 2063; ESLF 4304; ESP 1063

CONCEPT

Summary: These forests and shrublands occur throughout the northern Pacific mountains and lowlands, becoming less prominent in the northern half of this region. They occur on steep slopes and bluffs that are subject to mass movements on a periodic basis. They are found in patches of differing age associated with different landslide events. The vegetation is deciduous broadleaf forests, woodlands, or shrublands, sometimes with varying components of conifers. *Alnus rubra* and *Acer macrophyllum* are the major tree species. *Rubus spectabilis, Rubus parviflorus, Ribes bracteosum,* and *Oplopanax horridus* are some of the major shrub species. Shrublands tend to be smaller in extent than woodlands or forests. Small patches of sparsely vegetated areas or herbaceous-dominated vegetation (especially *Petasites frigidus*) also often occur as part of this system. On earthflows, once stable, vegetation may succeed to dominance by conifers.
Classification Comments: Early-successional shrubby patches dominated by *Alnus* or *Acer* not associated with landslide disturbance are removed from this system and are placed within the forest types they are successional to, for example see North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest (CES204.001). More stable patches generally belong to North Pacific Montane Shrubland (CES204.087). For other disturbance driven shrublands, see North Pacific Avalanche Chute Shrubland (CES204.854). This system has not been determined to occur in Alaska, so for now that state is removed from its distribution.
Related Concepts:
- Red Alder: 221 (Eyre 1980) Intersecting

Component Associations:
- *Acer macrophyllum - Alnus rubra / Polystichum munitum - Tellima grandiflora* Forest (CEGL003334, G2G3)

DISTRIBUTION

Range: This system occurs throughout the northern Pacific mountains and lowlands (latter especially adjacent to coastlines), becoming less prominent in the northern half of this region.
Divisions: 204:C
Nations: CA, US
Subnations: BC, OR, WA
Map Zones: 1:C, 2:C, 3:?, 7:C
USFS Ecomap Regions: 242A:CC, 242B:CC, 342I:??, M242A:CC, M242B:CC, M242C:CC, M242D:CC, M261A:CC, M261D:CC
TNC Ecoregions: 1:C, 3:C, 69:C, 81:C

SOURCES

References: Chappell and Christy 2004, Comer et al. 2003, Franklin and Dyrness 1973
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722828#references
Description Author: C. Chappell, mod. G. Kittel
Version: 25 Apr 2006 **Stakeholders:** Canada, West
Concept Author: C. Chappell **ClassifResp:** West

NORTH PACIFIC DRY DOUGLAS-FIR-(MADRONE) FOREST AND WOODLAND (CES204.845)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); F-Patch/Medium Intensity; Pseudotsuga menziesii; Arbutus menziesii
Non-Diagnostic Classifiers: Lowland [Foothill]; Temperate [Temperate Oceanic]
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2035; ESLF 4222; ESP 1035

CONCEPT

Summary: This system is most common in the Puget Trough - Willamette Valley ecoregion but also occurs in adjacent ecoregions. It occupies small patches associated with dry sites or larger areas in prairie landscapes. This system historically had moderate- to low-severity fires moderately frequently. Historically, these communities were either part of larger forested landscapes or occupied sheltered topographic positions in prairie-dominated landscapes. They now also occur on some sites that formerly supported prairies or tall shrublands (*Corylus cornuta*) with scattered trees. In the mountains, this type occurs locally on dry sites within dry to mesic (for the coastal areas) climates up to about 1220 m (4000 feet) elevation. This is a forest or woodland primarily dominated by the long-lived conifer *Pseudotsuga menziesii*. The evergreen broadleaf *Arbutus menziesii*, the short-lived conifer *Pinus contorta*, the broadleaf deciduous *Acer macrophyllum*, and the shade-tolerant conifer *Abies grandis* are local dominant or codominant species. These sites are too dry and warm or have been too frequently and extensively burned for anything more than small amounts of *Tsuga heterophylla* or *Thuja plicata* to be present as regeneration. *Arbutus menziesii* dominance is favored by high-severity fires on sites where it occurs, and *Pseudotsuga menziesii* can be locally eliminated by logging and hot fire or repeated high-severity fires. *Calocedrus decurrens* is absent. *Abies grandis* can be an important subcanopy or sapling tree, especially in and around the Willamette Valley and in the driest portions of the Georgia Basin (Coastal Douglas-fir Zone).
Classification Comments: Originally named Dry Douglas-Fir and Madrone Forest and Woodland, name changed as many areas occur without madrone. However, note that the description states we can have madrone stands with no Douglas-fir; these are less common than the former.
Related Concepts:
- Grand Fir: 213 (Eyre 1980) Intersecting. Grand fir can occasionally be a dominant in occurrences of this ecological system.
- Interior Ponderosa Pine: 237 (Eyre 1980) Intersecting
- Pacific Douglas-fir: 229 (Eyre 1980) Broader

Component Associations:
- *Arbutus menziesii - Pseudotsuga menziesii - Quercus* spp. / *Toxicodendron diversilobum* Woodland (CEGL000927, G3G4Q)
- *Pinus contorta var. contorta - Pseudotsuga menziesii / Cladina* spp. Forest (CEGL003375, G2)
- *Pinus contorta var. contorta / Gaultheria shallon* Forest (CEGL000150, G1G2)
- *Pseudotsuga menziesii - Abies grandis / Symphoricarpos albus / Melica subulata* Forest (CEGL003350, G1?)
- *Pseudotsuga menziesii - Arbutus menziesii / Gaultheria shallon* Forest (CEGL000421, G3)
- *Pseudotsuga menziesii - Arbutus menziesii / Vicia americana* Forest (CEGL000422, G1G2Q)
- *Pseudotsuga menziesii / Corylus cornuta / Polystichum munitum* Forest (CEGL002616, G3)
- *Pseudotsuga menziesii / Gaultheria shallon - Holodiscus discolor* Forest (CEGL000436, G2G3)
- *Pseudotsuga menziesii / Rosa gymnocarpa - Holodiscus discolor* Forest (CEGL000456, G2G3)
- *Pseudotsuga menziesii / Symphoricarpos albus - Holodiscus discolor* Forest (CEGL000460, G1)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest (CES204.001)
- North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest (CES204.002)

DISTRIBUTION

Range: This system is limited to the foothill transition zone of the Puget Trough - Willamette Valley - Georgia Basin ecoregion.
Divisions: 204:C
Nations: CA, US
Subnations: BC, OR, WA
Map Zones: 1:C, 2:C, 3:?, 7:C
USFS Ecomap Regions: 242A:CC, 242B:CC, 263A:PP, M242A:CC, M242B:CC, M242D:CP, M261A:CC
TNC Ecoregions: 1:C, 2:C

SOURCES

References: Chappell and Christy 2004, Comer et al. 2003, Franklin and Dyrness 1973, Green and Klinka 1994, Western Ecology

Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722829#references
Description Author: C. Chappell
Version: 02 Feb 2007 **Stakeholders:** Canada, West
Concept Author: C. Chappell **ClassifResp:** West

NORTH PACIFIC DRY-MESIC SILVER FIR-WESTERN HEMLOCK-DOUGLAS-FIR FOREST (CES204.098)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Tsuga heterophylla - Abies amabilis
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2174; ESLF 4272; ESP 1174

CONCEPT

Summary: This forested system occurs only in the Pacific Northwest mountains, primarily west of the Cascade Crest. It generally occurs in an elevational band between *Pseudotsuga menziesii - Tsuga heterophylla* forests and *Tsuga mertensiana* forests. It dominates mid-montane dry to mesic maritime and some submaritime climatic zones from northwestern British Columbia to northwestern Oregon. In British Columbia and in the Olympic Mountains, this system occurs on the leeward side of the mountains only. In the Washington Cascades, it occurs on both windward and leeward sides of the mountains (in other words, it laps over the Cascade Crest to the "eastside"). Stand-replacement fires are regular with mean return intervals of about 200-500 years. Fire frequency tends to decrease with increasing elevation and continentality but still remains within this typical range. A somewhat variable winter snowpack that typically lasts for 2-6 months is characteristic. The climatic zone within which it occurs is sometimes referred to as the "rain-on-snow" zone because of the common occurrence of major winter rainfall on an established snowpack. *Tsuga heterophylla* and/or *Abies amabilis* dominate the canopy of late-seral stands, though *Pseudotsuga menziesii* is usually also common because of its long life span, and *Chamaecyparis nootkatensis* can be codominant, especially at higher elevations. *Abies procera* forests (usually mixed with silver fir) are included in this system and occur in the Cascades from central Washington to central Oregon and rarely in the Coast Range of Oregon. *Pseudotsuga menziesii* is a common species (unlike the mesic western hemlock-silver fir forest system) that regenerates after fires and therefore is frequent as a codominant, except at the highest elevations; the prevalence of this species is an important indicator in relation to the related climatically wetter North Pacific Mesic Western Hemlock-Silver Fir Forest (CES204.097). *Abies lasiocarpa* sometimes occurs as a codominant on the east side of the Cascades and in submaritime British Columbia. Understory species that tend to be more common or unique in this type compared to the wetter North Pacific Mesic Western Hemlock-Silver Fir Forest (CES204.097) include *Achlys triphylla*, *Mahonia nervosa*, *Xerophyllum tenax*, *Vaccinium membranaceum*, *Rhododendron macrophyllum*, and *Rhododendron albiflorum*. *Vaccinium ovalifolium*, while still common, only dominates on more moist sites within this type, unlike in the related type where it is nearly ubiquitous.
Classification Comments: Unlike North Pacific Mesic Western Hemlock-Silver Fir Forest (CES204.097), the dominant natural process here is stand-replacing fires which occur on average every 200-500 years. Where old-growth does exist, it is mostly "young old-growth" 200-500 years in age. Natural-origin stands less than 200 years old are also common. More mixed-severity fires occur to the south in this system, so structure, patch size and proportions will be different; further north is more stand-replacing fires. In mapzone 7 this system will get modeled as 2 different BpS because of the differences in regimes. In Oregon there are more mixed-severity fires.

Similar Ecological Systems:
- Alaskan Pacific Maritime Western Hemlock Forest (CES204.840)
- North Pacific Mesic Western Hemlock-Silver Fir Forest (CES204.097)

Related Concepts:
- Coastal True Fir - Hemlock: 226 (Eyre 1980) Broader. includes wet and dry Silver fir
- Pacific Ponderosa Pine - Douglas-fir: 244 (Eyre 1980) Finer
- Western Hemlock: 224 (Eyre 1980) Intersecting. 80% W. Hemlock

DESCRIPTION

Dynamics: Landfire VDDT models: R#ABAMlo; they use *Pseudotsuga menziesii* as an indicator so some of the eastside *Abies amabilis* are included with *Picea engelmannii* or *Pinus monticola*.

Component Associations:
- *Abies amabilis - Abies concolor / Mahonia nervosa* Forest (CEGL000215, G2G3)
- *Abies amabilis - Abies concolor / Maianthemum stellatum* Forest (CEGL000216, G4)
- *Abies amabilis / Mahonia nervosa* Forest (CEGL000217, G4)
- *Abies amabilis / Rhododendron macrophyllum - Gaultheria shallon* Forest (CEGL000222, G4)
- *Abies amabilis / Rhododendron macrophyllum - Mahonia nervosa* Forest (CEGL000218, G4)
- *Abies amabilis / Vaccinium membranaceum - Tiarella trifoliata* Forest (CEGL000237, G4)
- *Abies amabilis / Vaccinium membranaceum / Xerophyllum tenax* Forest (CEGL000239, G4)
- *Abies amabilis / Vaccinium scoparium* Forest (CEGL000238, G4)
- *Chamaecyparis nootkatensis / Vaccinium ovalifolium* Forest (CEGL000351, G4Q)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:

- North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest (CES204.001)
- North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest (CES204.002)

DISTRIBUTION

Range: This system only occurs in the Pacific Northwest mountains, on the leeward side of coastal mountains in both British Columbia and in the Olympic Mountains of Washington. It occurs throughout most of the Washington Cascades on both west and east sides (sporadically on the east) and in the western Cascades of northern to central Oregon. It occurs very sporadically in the Willapa Hills of southwestern Washington and in the northern Oregon Coast Range. This type may also occur on the east side of the Oregon Cascades north of 45 degrees North latitude (Mount Hood National Forest - Hood River and Barlow ranger districts, and possibly the northern edge of Warm Springs Reservation in part of the McQuinn Strip).
Divisions: 204:C
Nations: CA, US
Subnations: BC, OR, WA
Map Zones: 1:C, 2:C, 3:?, 7:C
USFS Ecomap Regions: 242A:CC, 342I:PP, M242A:CC, M242B:CC, M242C:CC, M242D:CC
TNC Ecoregions: 1:C, 3:C, 69:C, 70:C, 81:C

SOURCES

References: DeMeo et al. 1992, DeVelice et al. 1999, Franklin and Dyrness 1973, Martin et al. 1995, Viereck et al. 1992, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.769632#references
Description Author: C. Chappell
Version: 23 Jan 2006 **Stakeholders:** Canada, West
Concept Author: C. Chappell **ClassifResp:** West

NORTH PACIFIC HYPERMARITIME WESTERN RED-CEDAR-WESTERN HEMLOCK FOREST (CES204.842)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Temperate [Temperate Hyperoceanic]; Tsuga heterophylla, Thuja plicata
Non-Diagnostic Classifiers: Lowland [Lowland]
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2178; ESLF 4271; ESP 1178

CONCEPT

Summary: These forests occupy the outer coastal portions of British Columbia, southeastern Alaska, and northwestern Washington. Their center of distribution is the central coast of British Columbia, as *Thuja plicata* approaches its northernmost limit in the southern half of southeastern Alaska. These forests occur mainly on islands but also fringe the mainland. They are generally less than 25 km from saltwater; elevation ranges from 0 to 600 m, and below 245 m in Alaska (above 200 m, *Chamaecyparis nootkatensis* replaces *Thuja plicata*). The climate is hypermaritime, with cool summers, very wet winters, abundant fog, and without a major snowpack. Fire is absent from this system in Alaska and rare throughout the rest of the range. These forests are influenced by gap disturbance processes and intense windstorms and not much by fire. The terrain is mostly gentle to rolling, of low topographic relief, and often rocky. Soils typically have a distinct humus layer overlying mineral horizons or bedrock; where the system is best developed in central British Columbia, the humus layers are very thick (mean 17-35 cm). Soils are often imperfectly drained, but this is not a wetland system. *Thuja plicata* and *Tsuga heterophylla* are the dominant tree species throughout, and *Chamaecyparis nootkatensis* joins them from northern Vancouver Island north. Canopy cover of trees is typically over 60%. *Pinus contorta* and *Tsuga mertensiana* can be present in some locations in the central and northern portion of the range. *Abies amabilis* occurs in British Columbia and northern Washington stands but is not typically found in southeastern Alaska. In Washington, nearly pure stands of *Tsuga heterophylla* are common and seem to be associated with microsites most exposed to intense windstorms. A shrub layer of *Gaultheria shallon*, *Vaccinium ovalifolium*, and *Menziesia ferruginea* is usually well-developed. The fern *Blechnum spicant* in great abundance is typical of hypermaritime conditions. *Oxalis oregana* (absent in Alaska) is important in the understory of moist sites in Washington. *Polystichum munitum* occurs at the northern end of its range in southeastern Alaska on well-drained sites. The abundance of *Thuja plicata* in relation to other conifers is one of the diagnostic characters of these forests; the other is the low abundance of *Pseudotsuga menziesii* (absent in Alaska) and *Picea sitchensis*. Where these forests are best developed, they occur in a mosaic with forested wetlands, bogs, and Sitka spruce forests (the latter in riparian areas and on steep, more productive soils).
Classification Comments: Yellow-cedar usually replaces western red-cedar in southern southeast Alaska at an elevation of about 152 m (500 feet). When yellow-cedar is mixed with western hemlock, and western red-cedar has dropped out, the occurrence is classified as North Pacific Mesic Western Hemlock-Yellow-cedar Forest (CES204.843). Below 152 m elevation, western red-cedar predominates; however, yellow-cedar may be present.
Similar Ecological Systems:
- North Pacific Mesic Western Hemlock-Silver Fir Forest (CES204.097)
- North Pacific Mesic Western Hemlock-Yellow-cedar Forest (CES204.843)
- North Pacific Seasonal Sitka Spruce Forest (CES204.841)

Related Concepts:
- Cw - Devil's club (CWHds1/07) (Steen and Coupe 1997) Intersecting
- Cw - Solomon's-seal (CWHds1/05) (Steen and Coupe 1997) Intersecting
- CwHw - Salal (CWHvh2/01) (Banner et al. 1993) Intersecting
- CwHw - Salal, Lithic (CWHvh2/01) (Banner et al. 1993) Intersecting
- CwHw - Salal, Mineral (CWHvh2/01) (Banner et al. 1993) Intersecting
- CwHw - Salal, Peaty (CWHvh2/01) (Banner et al. 1993) Intersecting
- CwHw - Sword fern (CWHvm1/04) (Banner et al. 1993) Intersecting
- CwHw - Sword fern (CWHvm2/04) (Banner et al. 1993) Intersecting
- CwSs - Skunk cabbage (CWHds1/12) (Steen and Coupe 1997) Intersecting
- CwSs - Skunk cabbage (CWHms1/11) (Steen and Coupe 1997) Intersecting
- CwSs - Skunk cabbage (CWHvm2/11) (Banner et al. 1993) Intersecting
- CwSs - Skunk cabbage (CWHws1/11) (Banner et al. 1993) Intersecting
- CwSs - Skunk cabbage (CWHws2/11) (Banner et al. 1993) Intersecting
- HwCw - Salal (CWHvm1/03) (Banner et al. 1993) Intersecting
- HwCw - Salal (CWHvm2/03) (Banner et al. 1993) Intersecting
- I.A.1.g - Western hemlock-western redcedar (Viereck et al. 1992) Equivalent
- Red Alder: 221 (Eyre 1980) Intersecting. early-successional stage of many PNW forests.
- Western Redcedar - Western Hemlock: 227 (Eyre 1980) Broader. Includes RM

- Western Redcedar: 228 (Eyre 1980) Broader. Includes RM

DESCRIPTION

Environment: These forests occur mainly on islands but also fringe the mainland and coastal fjords. They are generally less than 25 km from saltwater; elevation ranges from 0 to 600 m, and below 245 m in Alaska (above 200 m, *Chamaecyparis nootkatensis* replaces *Thuja plicata*). Climate is characterized by moist mild air from the Pacific. Frequent winter storms produce abundant precipitation as they encounter rising mountain slopes. In summer, large high-pressure areas off the coast produce prolonged spells of fine weather (Taylor 1997). The climate is classified as hypermaritime, with cool summers, very wet winters, abundant fog, and without a major snowpack (Meidinger and Pojar 1991). Rainfall is relatively high for the region at 254-380 cm (100-150 inches) rain annually, rarely as snow (Landfire 2007a). The terrain is mostly gentle to rolling, of low topographic relief, and often rocky. This type generally occurs on relatively old, acidic, humic soils with a distinct humus layer overlying mineral horizons or bedrock; where the system is best developed in central British Columbia, the humus layers are very thick (mean 17-35 cm) (Banner et al. 1993, Green and Klinka 1994, Steen and Coupe 1997). Soils are often imperfectly drained, but this is not a wetland system. Where these forests are best developed, they occur in a mosaic with forested wetlands, bogs, and Sitka spruce forests (the latter in riparian areas and on steep, more productive soils). This system represents the upper end of the productivity gradient within the Cedar-Hemlock Ecological Zone and the lower end of the Western Hemlock Ecological Zone (DeMeo et al. 1992).

Dynamics: Fire is absent from this system in Alaska and rare throughout the rest of the range, e.g., British Columbia's north coast (Banner et al. 1993, Landfire 2007a). These forests are primarily influenced by gap disturbance processes (gaps created by the death of individual trees, or small patches due to disease, insect damage and treefall following mortality). On the most exposed areas of the coastline, occasional hurricane force winds and severe storms result in major windthrow events. Less severe winds may cause breakage or early blowdown of diseased trees. The ground surface often has pit-and-mound microtopography that is formed by windthrow events. Storms are generally from the southwest and sweep across the low country of southwestern Washington, and strike either the front range of the Cascades or the southwest face of the Olympics. Wind damage tends to repeat at certain locations either due to direct exposure or due to the funneling of winds around topographic features. Wind damage tends to be more significant on the coast than further inland. Studies by USFS in southeastern Alaska show lots of broken boles as cause of tree mortality (Hennon 2008).

Component Associations:
- *Tsuga heterophylla - Chamaecyparis nootkatensis / Vaccinium ovalifolium - Menziesia ferruginea* Forest (CEGL003242, G4)
- *Tsuga heterophylla - Chamaecyparis nootkatensis / Vaccinium ovalifolium - Oplopanax horridus* Forest (CEGL003241, G3)
- *Tsuga heterophylla - Chamaecyparis nootkatensis / Vaccinium ovalifolium* Forest (CEGL003239, G5)
- *Tsuga heterophylla - Thuja plicata - Chamaecyparis nootkatensis / Gaultheria shallon / Blechnum spicant* Forest (CEGL002776, GNR)
- *Tsuga heterophylla - Thuja plicata / Polystichum munitum* Forest (CEGL003228, G5)
- *Tsuga heterophylla - Thuja plicata / Vaccinium (alaskaense, ovalifolium) - Gaultheria shallon / Hylocomium splendens* Forest (CEGL002778, G3)
- *Tsuga heterophylla - Thuja plicata / Vaccinium ovalifolium - Tiarella trifoliata* Forest (CEGL003224, G5)
- *Tsuga heterophylla - Thuja plicata / Vaccinium ovalifolium / Lysichiton americanus* Forest (CEGL003223, G5)
- *Tsuga heterophylla - Thuja plicata / Vaccinium ovalifolium* Forest (CEGL003222, G5)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Alaskan Pacific Maritime Sitka Spruce Forest (CES204.151)
- North Pacific Seasonal Sitka Spruce Forest (CES204.841)

DISTRIBUTION

Range: This system is found in the outer coastal portions of British Columbia and southern southeast Alaska, as well as northwestern Washington.
Divisions: 204:C
Nations: CA, US
Subnations: AK, BC, WA
Map Zones: 1:C, 2:C, 78:C
USFS Ecomap Regions: 242A:CC, M242A:CC, M242D:CC
TNC Ecoregions: 1:C, 3:?, 69:C

SOURCES

References: Banner et al. 1993, Bigley and Hull 1995, Comer et al. 2003, DeMeo et al. 1992, DeVelice et al. 1999, Dorner and Wong 2003, Eyre 1980, Green and Klinka 1994, Haughian et al. 2012, Hebda 1997, Hennon 2008, Karl et al. 2009, Landfire 2007a, Littell et al. 2009, Martin et al. 1995, Meidinger and Pojar 1991, Minore 1990, Packee 1990, PRBO Conservation Science 2011, Rodenhuis et al. 2009, Spittlehouse 2008, Steen and Coupe 1997, Taylor 1997, Viereck et al. 1992, Werner 2011, WNHP 2011
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722832#references
Description Author: G. Kittel, mod. C. Chappell and M.S. Reid
Version: 14 Jan 2014 **Stakeholders:** Canada, West
Concept Author: G. Kittel and C. Chappell **ClassifResp:** West

NORTH PACIFIC INTERIOR ASPEN FOREST (CES207.360)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Warm Continental (207)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane
National Mapping Codes: ESLF 4165

CONCEPT

Summary: This ecological system encompasses non-seral *Populus tremuloides* forests of the central interior of British Columbia.
Classification Comments: This ecological system was developed for the purpose of capturing the coarse filter of terrestrial biodiversity in the interior of British Columbia Ecoregional Assessment, conducted by The Nature Conservancy of Canada, with NatureServe's assistance. This system was designed to be equivalent to those developed for neighboring ecoregions: Canadian Rocky Mountains (7), Okanagan (68), Alaska Coastal Forest and Mountains (69), and the North Cascades (3).
Related Concepts:

- $AtEp - Dogwood (ICHmc2/53) (Banner et al. 1993) Intersecting
- At - Anenome (SBSdk/50) (DeLong et al. 1993) Intersecting
- At - Anenome (SBSdk/50) (Banner et al. 1993) Intersecting
- At - Anenome (SBSdk/50) (Steen and Coupe 1997) Intersecting

DISTRIBUTION

Range: This ecological system occurs entirely within central interior British Columbia.
Divisions: 207:C
Nations: CA
Subnations: BC
TNC Ecoregions: 144:C

SOURCES

References: Banner et al. 1993, DeLong et al. 1993, Steen and Coupe 1997, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.820963#references
Description Author: G. Kittel
Version: 26 Jan 2009
Concept Author: G. Kittel
Stakeholders: Canada, West
ClassifResp: West

NORTH PACIFIC INTERIOR DRY DOUGLAS-FIR FOREST (CES207.362)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Warm Continental (207)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland
National Mapping Codes: ESLF 4412

CONCEPT

Summary: This ecological system encompasses forests dominated by *Pseudotsuga menziesii* that are limited to the southern interior region of British Columbia. Sites are generally level to moderately sloping with medium-textured soils. Douglas-fir dominates the overstory and tree regeneration in most stands. *Populus tremuloides* may appear within the matrix of *Pseudotsuga menziesii*. Undergrowth has sparse to moderate shrub cover, and several grass species and low-growing dry-land forbs. Moss cover is typically patchy.
Classification Comments: This ecological system was developed for the purpose of capturing the coarse filter of terrestrial biodiversity in the interior of British Columbia Ecoregional Assessment, conducted by The Nature Conservancy of Canada, with NatureServe's assistance. This system was designed to be equivalent to those developed for neighboring ecoregions: Canadian Rocky Mountains (7), Okanagan (68), Alaska Coastal Forest and Mountains (69), and the North Cascades (3).
Related Concepts:

- Fd - Bluebunch wheatgrass - Needlegrass (IDFdk3/04) (Steen and Coupe 1997) Intersecting
- Fd - Bluebunch wheatgrass - Pasture sage (IDFxm/04) (Steen and Coupe 1997) Intersecting
- Fd - Bluebunch wheatgrass - Penstemon (IDFxm/02) (Steen and Coupe 1997) Intersecting
- Fd - Bluebunch wheatgrass - Penstemon, Shallow (IDFxm/02) (Steen and Coupe 1997) Intersecting
- Fd - Bluebunch wheatgrass - Penstemon, Typic (IDFxm/02) (Steen and Coupe 1997) Intersecting
- Fd - Feathermoss - Step moss (IDFdk3/05) (Steen and Coupe 1997) Intersecting
- Fd - Feathermoss - Step moss (IDFxm/05) (Steen and Coupe 1997) Intersecting
- Fd - Juniper - Kinnikinnick (IDFdk3/02) (Steen and Coupe 1997) Intersecting
- Fd - Juniper - Peltigera (IDFdk3/03) (Steen and Coupe 1997) Intersecting
- Fd - Juniper - Pinegrass (IDFdk1/03) (Steen and Coupe 1997) Intersecting
- Fd - Pinegrass - Aster (IDFdk3/06) (Steen and Coupe 1997) Intersecting
- Fd - Pinegrass - Feathermoss (IDFmw2/03) (Steen and Coupe 1997) Intersecting
- Fd - Pinegrass - Feathermoss (IDFxm/01) (Steen and Coupe 1997) Intersecting
- Fd - Pinegrass - Feathermoss, Cold (IDFxm/01) (Steen and Coupe 1997) Intersecting
- Fd - Pinegrass - Feathermoss, Typic (IDFxm/01) (Steen and Coupe 1997) Intersecting
- Fd - Pinegrass - Yarrow (IDFdk1/04) (Steen and Coupe 1997) Intersecting
- Fd - Prickly rose - Sarsaparilla (IDFxm/07) (Steen and Coupe 1997) Intersecting
- Fd - Ricegrass - Feathermoss (IDFxm/06) (Steen and Coupe 1997) Intersecting
- Fd - Snowberry - Bluebunch wheatgrass (IDFdk1/02) (Steen and Coupe 1997) Intersecting
- Fd - Snowberry - Bluebunch wheatgrass (IDFmw2/02) (Steen and Coupe 1997) Intersecting

DISTRIBUTION

Range: This ecological system occurs entirely within central interior British Columbia.
Divisions: 207:C
Nations: CA
Subnations: BC
TNC Ecoregions: 144:C

SOURCES

References: Steen and Coupe 1997, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.820966#references
Description Author: G. Kittel
Version: 26 Jan 2009 **Stakeholders:** Canada, West
Concept Author: G. Kittel **ClassifResp:** West

NORTH PACIFIC INTERIOR LODGEPOLE PINE-WHITEBARK PINE FOREST (CES207.363)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Warm Continental (207)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane
National Mapping Codes: ESLF 4404

CONCEPT

Summary: This ecological system encompasses dry and cold forests of the central interior of British Columbia dominated by *Pinus contorta* and *Pinus albicaulis*. These occur on rocky upper slopes and crests where soils are skeletal or shallow and drainage is very rapid. This system also occurs on flacio-fluvial deposits on lower slopes and level areas with sandy skeletal soils. Forests consist of stunted and scatted *Pinus albicaulis* with some *Abies lasiocarpa, Tsuga heterophylla*, or *Pinus contorta*. Shrub layers consist only of *Lonicera involucrata* and regenerating *Tsuga heterophylla* and *Abies lasiocarpa*. Herb layers are very sparse. Ground lichens can be codominated by feathermosses. This system is distinguished from North Pacific Sub-boreal Dry Lodgepole Pine Forest (CES207.344) by the presence of *Pinus albicaulis*.
Classification Comments: This ecological system was developed for the purpose of capturing the coarse filter of terrestrial biodiversity in the interior of British Columbia Ecoregional Assessment, conducted by The Nature Conservancy of Canada, with NatureServe's assistance. This system was designed to be equivalent to those developed for neighboring ecoregions: Canadian Rocky Mountains (7), Okanagan (68), Alaska Coastal Forest and Mountains (69), and the North Cascades (3).
Related Concepts:
- Bl - Rhododendron - Crowberry (ESSFxv1/06) (Steen and Coupe 1997) Intersecting
- Bl - Rhododendron - Crowberry (ESSFxv2/06) (Steen and Coupe 1997) Intersecting
- BlPa - Arnica - Twinflower (ESSFxv1/05) (Steen and Coupe 1997) Intersecting
- BlPa - Cladonia (ESSFmk/02) (Banner et al. 1993) Intersecting
- BlPa - Cladonia, Fluvial (ESSFmk/02) (Banner et al. 1993) Intersecting
- BlPa - Cladonia, Lithic (ESSFmk/02) (Banner et al. 1993) Intersecting
- BlPa - Grouseberry (ESSFxv2/05) (Steen and Coupe 1997) Intersecting
- BlPa - Juniper - Cladonia (ESSFxv1/02) (Steen and Coupe 1997) Intersecting
- BlPa - Juniper - Grouseberry (ESSFxv1/04) (Steen and Coupe 1997) Intersecting
- BlPa - Juniper - Kinnikinnick (ESSFxv2/04) (Steen and Coupe 1997) Intersecting
- BlPa - Kinnikinnick (ESSFxv2/03) (Steen and Coupe 1997) Intersecting

DESCRIPTION

Environment: These dry and cold forests of the central interior of British Columbia occur on rocky upper slopes and crests where soils are skeletal or shallow and drainage is very rapid (Banner et al. 1993, Steen and Coupe 1997). This system also occurs on flacio-fluvial deposits on lower slopes and level areas with sandy skeletal soils. The climate is typically very cold in winter and dry in summer. Some sites have little snow accumulation because of high winds and sublimation.
Dynamics: There is very little information available about vegetation dynamics directly related to this ecological system; much of the below has been inferred from the similar system, Northern Rocky Mountain Subalpine Woodland and Parkland (CES306.807), and what is known about lodgepole and whitebark pine ecology and dynamics. The major disturbance processes in this system are fire, insect pests, and possibly windthrow or snow avalanches. Both of the dominant pines are shade-intolerant, post-disturbance (generally fire) colonizers, but their regeneration strategies are quite different.

Pinus contorta is an aggressively colonizing, shade-intolerant conifer which usually occurs in lower subalpine forests in the major ranges of the western United States and Canada. Establishment is episodic and linked to stand-replacing disturbances, primarily fire. The incidence of serotinous cones varies within and among varieties of *Pinus contorta*, being most prevalent in Rocky Mountain populations (*Pinus contorta var. latifolia*). Closed, serotinous cones appear to be strongly favored by fire and allow rapid colonization of fire-cleared substrates (Burns and Honkala 1990a). Hoffman and Alexander (1980, 1983) report that in stands where *Pinus contorta* exhibits a multi-aged population structure, with regeneration occurring, there is typically a higher proportion of trees bearing nonserotinous cones. The dominance of *Pinus contorta* with *Pinus albicaulis* in this system is related to fire history and topo-edaphic conditions (Pfister et al. 1977, Steele et al. 1981). Following stand-replacing fires, *Pinus contorta* will rapidly colonize and develop into dense stands of even-aged trees. Over time, many of these stands can succeed to dominance by other more shade-tolerant conifer species. Where *Pinus contorta* is the dominant in this system, the occurrence is likely to be early- to mid-successional, which developed following fires.

Pinus albicaulis is a slow-growing, long-lived conifer that is common at higher elevations in the upper subalpine zone. It typically occurs in a mosaic of tree islands and meadows where it often colonizes sites and creates habitat for less hardy tree species. In lower subalpine forests, it is a seral species, establishing after a large disturbance such as stand-replacing fire or avalanche, or it is restricted to dry, rocky ridges where it competes well with shade-tolerant tree species. Without disturbance it will be overtopped in 100-120

years by faster growing, shade-tolerant species such as *Abies lasiocarpa*, *Tsuga mertensiana*, and *Tsuga heterophylla*. Although crown fires and hot surface fires kill *Pinus albicaulis*, it tolerates low-intensity surface fires that will kill the shade-tolerant understory. Fire intervals range from 30-300 years.

Birds and small mammals often eat and cache the large, wingless whitebark pine seeds and are responsible for the dispersal of this species. Most important is the Clark's nutcracker (*Nucifraga columbiana*), which can transport the seeds long distances and cache them on exposed windswept and burned-over sites (Tomback et al. 1990, Tomback 1998); *Pinus albicaulis* is one of only 8 pine species in the world with bird-dispersed seeds. This results in the regeneration of pines in clumps from forgotten caches (Eyre 1980, Steele et al. 1983, Burns and Honkala 1990a, Schmidt and McDonald 1990). Nutcrackers tend to cache seeds at some distance from the parent trees, and they are attracted to open sites for seed caching; this results in dispersal of whitebark pine to new sites (Tomback et al. 1990).

DISTRIBUTION

Range: This ecological system occurs entirely within central interior British Columbia.
Divisions: 207:C
Nations: CA
Subnations: BC
TNC Ecoregions: 144:C

SOURCES

References: Banner et al. 1993, BCMFML 2010, Burns and Honkala 1990a, Eyre 1980, Greater Yellowstone Coordinating Committee 2011, Hoffman and Alexander 1980, Hoffman and Alexander 1983, Keane and Parsons 2010, Keane et al. 2011, Kendall and Keane 2001, Littell et al. 2009, Macfarlane et al. 2009, Pfister et al. 1977, Safranyik and Wilson 2006, Schmidt and McDonald 1990, Steele et al. 1981, Steele et al. 1983, Steen and Coupe 1997, Tomback 1998, Tomback et al. 1990, Walton 2009, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.820969#references
Description Author: G. Kittel, mod. M. Reid
Version: 14 Jan 2014 **Stakeholders:** Canada, West
Concept Author: G. Kittel **ClassifResp:** West

NORTH PACIFIC INTERIOR MESIC WESTERN HEMLOCK-WESTERN RED-CEDAR FOREST (CES207.387)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Warm Continental (207)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane
National Mapping Codes: ESLF 4413

CONCEPT

Summary: This ecological system represents the interior analog to the coastal version of this forest. Here *Tsuga heterophylla* and *Thuja plicata* are mixed with *Pinus contorta, Picea galuca X engelmannii* (hybrid white spruce0, and *Abies lasiocarpa*. These forests are located well within the interior, occurring primarily in the Interior Cedar-Hemlock Zone (ICH) of the Prince George Forest Region of British Columbia, in and around the Rocky Mountain Trench. The shrub, forb and grass species in the understory are a mix of Rocky Mountain and interior species such as *Acer glabrum, Spiraea betulifolia*, and *Gymnocarpium dryopteris*.
Classification Comments: This ecological system was developed for the purpose of capturing the coarse filter of terrestrial biodiversity in the interior of British Columbia Ecoregional Assessment, conducted by The Nature Conservancy of Canada, with NatureServe's assistance. This system was designed to be equivalent to those developed for neighboring ecoregions: Canadian Rocky Mountains (7), Okanagan (68), Alaska Coastal Forest and Mountains (69), and the North Cascades (3).
Related Concepts:

- CwSxw - Soopolallie (ICHmm/02) (DeLong 1996) Intersecting
- Hw - Azalea - Cladonia (ICHwk3/02) (Meidinger et al. 1988) Intersecting
- Hw - Wood horsetail - Sphagnum (ICHwk3/07) (Meidinger et al. 1988) Intersecting
- HwCw - Cladonia (ICHwk2/02) (Steen and Coupe 1997) Intersecting
- HwCw - Falsebox - Feathermoss (ICHwk1/04) (Lloyd et al. 1990) Intersecting
- HwCw - Step moss (ICHmm/03) (DeLong 1996) Intersecting
- HwCw - Step moss (ICHwk2/04) (Steen and Coupe 1997) Intersecting
- HwCw - Step moss (ICHwk3/04) (Meidinger et al. 1988) Intersecting
- PlHw - Velvet-leaved blueberry (ICHwk1/03) (Lloyd et al. 1990) Intersecting
- SxwCw - Oak fern (ICHwk2/05) (Steen and Coupe 1997) Intersecting

DISTRIBUTION

Range: This ecological system occurs entirely within central interior British Columbia.
Divisions: 207:C
Nations: CA
Subnations: BC
TNC Ecoregions: 144:C

SOURCES

References: DeLong 1996, Lloyd et al. 1990, Meidinger et al. 1988, Steen and Coupe 1997, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.820972#references
Description Author: G. Kittel
Version: 26 Jan 2009
Concept Author: G. Kittel
Stakeholders: Canada, West
ClassifResp: West

NORTH PACIFIC INTERIOR MESIC-WET ROCHE SPRUCE-MIXED CONIFER FOREST (CES207.388)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Warm Continental (207)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland
National Mapping Codes: ESLF 4414

CONCEPT

Summary: This ecological system encompasses interior forests limited to the Interior Cedar-Hemlock Zone (ICH) very wet and wet cold variants. Forests are dominated by *Tsuga heterophylla* with *Abies lasiocarpa*, Roche spruce, the hybrid of *Picea sitchensis* with either *Picea engelmannii* or *Picea glauca*, and *Pinus contorta*. Understories tend to be rich and very mesic.
Classification Comments: This ecological system was developed for the purpose of capturing the coarse filter of terrestrial biodiversity in the interior of British Columbia Ecoregional Assessment, conducted by The Nature Conservancy of Canada, with NatureServe's assistance. This system was designed to be equivalent to those developed for neighboring ecoregions: Canadian Rocky Mountains (7), Okanagan (68), Alaska Coastal Forest and Mountains (69), and the North Cascades (3).
Related Concepts:

- $SxEp - Devil's club (ICHmc2/54) (Banner et al. 1993) Intersecting
- Sx - Devil's club (ICHvc/03) (Banner et al. 1993) Intersecting
- Sx - Devil's club (ICHwc/05) (Banner et al. 1993) Intersecting
- Sx - Devil's club - Dogwood (ICHvc/04) (Banner et al. 1993) Intersecting
- Sx - Devil's club - Lady fern (ICHmc2/05) (Banner et al. 1993) Intersecting
- Sx - Devil's club, Fluvial (ICHvc/03) (Banner et al. 1993) Intersecting
- Sx - Devil's club, Morainal (ICHvc/03) (Banner et al. 1993) Intersecting
- Sx - Horsetail (ICHvc/06) (Banner et al. 1993) Intersecting
- Sx - Horsetail (ICHwc/08) (Banner et al. 1993) Intersecting

DISTRIBUTION

Range: This ecological system occurs entirely within central interior British Columbia.
Divisions: 207:C
Nations: CA
Subnations: BC
TNC Ecoregions: 144:C

SOURCES

References: Banner et al. 1993, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.820975#references
Description Author: G. Kittel
Version: 26 Jan 2009
Concept Author: G. Kittel
Stakeholders: Canada, West
ClassifResp: West

NORTH PACIFIC LOWLAND MIXED HARDWOOD-CONIFER FOREST (CES204.073)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Needle-Leaved Tree; Broad-Leaved Deciduous Tree
National Mapping Codes: ESLF 4333

CONCEPT

Summary: This lowland mixed hardwood - conifer forest system occurs throughout the Pacific Northwest. It occurs on valley terraces, margins, and slopes at low elevations in the mountains of the Pacific Northwest Coast and interior valleys west of the high Cascade Mountains. These forests are composed of large conifers, including *Pseudotsuga menziesii, Thuja plicata, Abies grandis, Tsuga heterophylla*, and/or *Picea sitchensis*, with deciduous hardwood trees present and usually codominant. Major dominant broadleaf species are *Acer macrophyllum, Quercus garryana, Alnus rubra, Frangula purshiana*, and *Cornus nuttallii*. Conifers tend to increase with succession in the absence of major disturbance although the hardwoods, particularly *Acer macrophyllum*, persist in the overstory. The understory is characterized by deciduous shrubs such as *Acer circinatum, Corylus cornuta, Oemleria cerasiformis, Rubus ursinus, Symphoricarpos albus*, and *Toxicodendron diversilobum*, but evergreen shrubs, including *Gaultheria shallon* and *Mahonia nervosa* and forbs, such as *Polystichum munitum* and *Oxalis oregana*, can be dominant.

DESCRIPTION

Environment: In some places, hardwoods are truly only found in early-seral conditions. This is more true the farther north you get, so in Washington, there are a few places where hardwoods persist, outside of the dry Douglas fir - madrone forests around the Willamette Valley, Puget Trough and the western Oregon Interior Valleys. In the Coast Range and Cascades, there are hardwoods (mostly alder and bigleaf maple) found in most of the valley toeslopes. They also occur in areas with exposed talus, exposed rocks, and in dry places, and often with Oregon white oak and Oregon ash. This mix of deciduous hardwoods and conifers is a climax forest in many areas, while in others it is successional, with the conifers completely overtaking the hardwoods after 200 years or so without disturbance.

Component Associations:
- *Abies grandis - Acer macrophyllum / Symphoricarpos albus* Forest (CEGL000519, G3Q)
- *Acer macrophyllum - Pseudotsuga menziesii / Acer circinatum / Polystichum munitum* Forest (CEGL003394, G4)
- *Acer macrophyllum - Pseudotsuga menziesii / Corylus cornuta / Hydrophyllum tenuipes* Forest (CEGL000517, G3)
- *Acer macrophyllum / Acer circinatum* Forest (CEGL000560, G4G5)
- *Acer macrophyllum / Rubus spectabilis* Forest (CEGL000561, G4)
- *Acer macrophyllum / Rubus ursinus* Forest (CEGL003395, G3)
- *Acer macrophyllum / Symphoricarpos albus / Urtica dioica ssp. gracilis* Forest (CEGL003396, G3)
- *Alnus rubra / Acer circinatum / Claytonia sibirica* Forest (CEGL003298, G4G5)
- *Alnus rubra / Elymus glaucus* Forest (CEGL003398, G4)
- *Alnus rubra / Oxalis (oregana, trilliifolia)* Forest (CEGL003400, G4)
- *Alnus rubra / Rubus parviflorus* Forest (CEGL003402, G4)
- *Quercus garryana - (Fraxinus latifolia) / Symphoricarpos albus* Forest (CEGL003299, G2)
- *Tsuga heterophylla - (Thuja plicata) / Oplopanax horridus / Polystichum munitum* Forest (CEGL000497, G4)

DISTRIBUTION

Range: This system occurs throughout the Pacific Northwest elevationally below the Silver Fir Zone.
Divisions: 204:C
Nations: CA, US
Subnations: BC, OR, WA
TNC Ecoregions: 1:C, 69:C, 81:C

SOURCES

References: Chappell and Christy 2004, Franklin and Dyrness 1973, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.807316#references
Description Author: J. Kagan
Version: 29 Oct 2007
Concept Author: J. Kagan
Stakeholders: Canada, West
ClassifResp: West

NORTH PACIFIC MARITIME DRY-MESIC DOUGLAS-FIR-WESTERN HEMLOCK FOREST (CES204.001)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Temperate [Temperate Oceanic]; Tsuga heterophylla, Pseudotsuga menziesii
Non-Diagnostic Classifiers: Montane
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2037; ESLF 4224; ESP 1037

CONCEPT

Summary: This ecological system comprises much of the major lowland forests of western Washington, northwestern Oregon, eastern Vancouver Island, and the southern Coast Ranges in British Columbia. In southwestern Oregon, it becomes local and more small-patch in nature. It occurs throughout low-elevation western Washington, except on extremely dry or moist to very wet sites. In Oregon, it occurs on the western slopes of the Cascades, around the margins of the Willamette Valley, and in the Coast Ranges. These forests occur on the drier to intermediate moisture habitats and microhabitats within the Western Hemlock Zone of the Pacific Northwest. Climate is relatively mild and moist to wet. Mean annual precipitation is mostly 90-254 cm (35-100 inches) (but as low as 20 inches in the extreme rainshadow) falling predominantly as winter rain. Snowfall ranges from rare to regular, and summers are relatively dry. Elevation ranges from sea level to 610 m (2000 feet) in northern Washington to 1067 m (3500 feet) in Oregon. Topography ranges from relatively flat glacial tillplains to steep mountainous terrain. This is generally the most extensive forest in the lowlands on the west side of the Cascades and forms the matrix within which other systems occur as patches. Throughout its range it occurs in a mosaic with North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest (CES204.002); in dry areas it occurs adjacent to or in a mosaic with North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland (CES204.845), and at higher elevations it intermingles with either North Pacific Dry-Mesic Silver Fir-Western Hemlock-Douglas-fir Forest (CES204.098) or North Pacific Mesic Western Hemlock-Silver Fir Forest (CES204.097).

Overstory canopy is dominated by *Pseudotsuga menziesii*, with *Tsuga heterophylla* generally present in the subcanopy or as a canopy dominant in old-growth stands. *Abies grandis*, *Thuja plicata*, and *Acer macrophyllum* codominants are also represented. In the driest climatic areas, *Tsuga heterophylla* may be absent, and *Thuja plicata* takes its place as a late-seral or subcanopy tree species. *Gaultheria shallon*, *Mahonia nervosa*, *Rhododendron macrophyllum*, *Linnaea borealis*, *Achlys triphylla*, and *Vaccinium ovatum* typify the poorly to well-developed shrub layer. *Acer circinatum* is a common codominant with one or more of these other species. The fern *Polystichum munitum* can be codominant with one or more of the evergreen shrubs on sites with intermediate moisture availability (mesic). If *Polystichum munitum* is thoroughly dominant or greater than about 40-50% cover, then the stand is probably in the more moist North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest (CES204.002). Young stands may lack *Tsuga heterophylla* or *Thuja plicata*, especially in the Puget Lowland. *Tsuga heterophylla* is generally the dominant regenerating tree species. Other common associates include *Acer macrophyllum*, *Abies grandis*, and *Pinus monticola*. In southwestern Oregon, *Pinus lambertiana*, *Calocedrus decurrens*, and occasionally *Pinus ponderosa* may occur in these forests. Soils are generally well-drained and are mesic to dry for much of the year. This is in contrast to North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest (CES204.002), which occurs on sites where soils remain moist to subirrigated for much of the year and fires were less frequent. Fire is (or was) the major natural disturbance. In the past (pre-1880), fires were less commonly high-severity, typically mixed-severity or moderate-severity, with natural return intervals of 100 years or less in the driest areas, to a few hundred years in areas with more moderate to wet climates. In the drier climatic areas (central Oregon Cascades, Puget Lowlands, Georgia Basin), this system was typified by a (mixed) moderate-severity fire regime involving occasional stand-replacing fires and more frequent moderate-severity fires. This fire regime would create a complex mosaic of stand structures across the landscape.

Similar Ecological Systems:
- North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest (CES204.002)

Related Concepts:
- Douglas-fir - Western Hemlock: 230 (Eyre 1980) Broader. include both wet and dry
- Grand Fir: 213 (Eyre 1980) Intersecting
- Pacific Douglas-fir: 229 (Eyre 1980) Broader. 80% Doug-fir
- Red Alder: 221 (Eyre 1980) Intersecting. early successsional stage of many PNW Forests
- Western Hemlock: 224 (Eyre 1980) Broader. 80% W. Hemlock cover

DESCRIPTION

Environment: This system occurs throughout low-elevation western Washington, except on extremely dry or moist to very wet sites. These forests occur on the drier to intermediate moisture habitats and microhabitats within the Western Hemlock Zone of the Pacific Northwest. Climate is relatively mild and moist to wet. Mean annual precipitation is mostly 90-254 cm (35-100 inches) (but as low as 50 cm [20 inches] in the extreme rainshadow) falling predominantly as winter rain. Snowfall ranges from rare to regular, and summers are relatively dry. Elevation ranges from sea level to 610 m (2000 feet) in northern Washington to 1067 m (3500 feet) in Oregon.

Topography ranges from relatively flat glacial tillplains to steep mountainous terrain. This is generally the most extensive forest in the lowlands on the west side of the Cascades and forms the matrix within which other systems occur as patches.
Dynamics: Fire is (or was) the major natural disturbance process. In the past (pre-1880), fires were high-severity or, less commonly, moderate-severity, with natural return intervals of 100 years or less in the driest areas, to a few hundred years in areas with more moderate to wet climates. In the drier climatic areas (central Oregon Cascades, Puget Lowlands, Georgia Basin), this system was typified by a (mixed) moderate-severity fire regime involving occasional stand-replacement fires and more frequent moderate-severity fires. This fire regime would create a complex mosaic of stand structures across the landscape. Landfire VDDT models: #RDFHEdry Douglas-fir Hemlock dry mesic describes general successional stage relationship with bias to OR (Landfire 2007a).

Component Associations:
- *Abies concolor - Picea breweriana / Chimaphila umbellata* Forest (CEGL000050, G2)
- *Pseudotsuga menziesii - (Tsuga heterophylla) / Rhododendron macrophyllum* Forest (CEGL000086, G3)
- *Pseudotsuga menziesii - Tsuga heterophylla / Holodiscus discolor* Forest (CEGL000067, G3)
- *Pseudotsuga menziesii - Tsuga heterophylla / Mahonia nervosa* Forest (CEGL000083, G2)
- *Pseudotsuga menziesii - Tsuga heterophylla / Rhododendron macrophyllum - Vaccinium ovatum - Gaultheria shallon* Forest (CEGL002615, G2)
- *Pseudotsuga menziesii - Tsuga heterophylla / Vaccinium ovatum* Forest (CEGL002614, G2)
- *Pseudotsuga menziesii / Gaultheria shallon / Polystichum munitum* Forest (CEGL000070, G4)
- *Thuja plicata - Pseudotsuga menziesii - Abies grandis / Mahonia nervosa / Polystichum munitum* Forest (CEGL002848, G1)
- *Thuja plicata - Tsuga heterophylla / Whipplea modesta* Forest (CEGL000486, G2G3)
- *Tsuga heterophylla / Acer glabrum var. douglasii / Linnaea borealis* Forest (CEGL002608, G3Q)
- *Tsuga heterophylla / Chrysolepis chrysophylla* Forest (CEGL000099, G3)
- *Tsuga heterophylla / Linnaea borealis* Forest (CEGL000104, G3)
- *Tsuga heterophylla / Mahonia nervosa / Linnaea borealis* Forest (CEGL000097, G3Q)
- *Tsuga heterophylla / Vaccinium membranaceum / Linnaea borealis* Forest (CEGL000119, G4)
- *Tsuga heterophylla / Vaccinium membranaceum / Xerophyllum tenax* Forest (CEGL000120, G3)
- *Tsuga heterophylla / Vaccinium ovatum* Forest (CEGL000121, G3)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- East Cascades Mesic Montane Mixed-Conifer Forest and Woodland (CES204.086)
- North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland (CES204.845)
- North Pacific Dry-Mesic Silver Fir-Western Hemlock-Douglas-fir Forest (CES204.098)
- North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest (CES204.002)
- North Pacific Mesic Western Hemlock-Silver Fir Forest (CES204.097)

Adjacent Ecological System Comments: In dry areas it occurs adjacent to or in a mosaic with North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland (CES204.845) and at higher, moister elevations intermingles with either North Pacific Dry-Mesic Silver Fir-Western Hemlock-Douglas-fir Forest (CES204.098) or North Pacific Mesic Western Hemlock-Silver Fir Forest (CES204.097). Throughout its range it occurs in a mosaic with North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest (CES204.002).

DISTRIBUTION

Range: This system comprises the major lowland and low montane forests of western Washington, northwestern Oregon, and southwestern British Columbia. In British Columbia and Washington, it is uncommon to absent on the windward side of the coastal mountains where fire is rare. It also occurs locally in far southwestern Oregon (Klamath ecoregion) as small to large patches.
Divisions: 204:C
Nations: CA, US
Subnations: BC, OR, WA
Map Zones: 1:C, 2:C, 7:C
USFS Ecomap Regions: 242A:CC, 242B:CC, 342I:PP, M242A:CC, M242B:CC, M242C:CC, M242D:CC, M261A:CC
TNC Ecoregions: 1:C, 3:C, 5:C, 69:C, 81:C

SOURCES

References: Cadrin pers. comm., Eyre 1980, Haughian et al. 2012, Karl et al. 2009, Landfire 2007a, Littell et al. 2009, Packee 1990, PRBO Conservation Science 2011, Spittlehouse 2008, Werner 2011, Western Ecology Working Group n.d., WNHP 2011
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.738966#references
Description Author: G. Kittel, mod. C. Chappell
Version: 14 Jan 2014 **Stakeholders:** Canada, West
Concept Author: G. Kittel and C. Chappell **ClassifResp:** West

NORTH PACIFIC MARITIME MESIC SUBALPINE PARKLAND (CES204.837)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Late-lying snowpack; Montane [Upper Montane]; Tsuga mertensiana
Non-Diagnostic Classifiers: Forest and Woodland (Treed); Temperate [Temperate Continental]
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2038; ESLF 4225; ESP 1038

CONCEPT

Summary: This ecological system occurs throughout the mountains of the Pacific Northwest, from the southern Cascades of Oregon to the mountains of southeastern Alaska bordering British Columbia. It occurs at the transition zone of forest to alpine, forming a subalpine forest-meadow ecotone. Mountain hemlock forests, as they approach treeline, become open patches of mature-height trees surrounded by mesic and wet meadows rich in dwarf-shrubs and forbs. Clumps of trees to small patches of forest interspersed with low shrublands and meadows characterize this system. Krummholz often occurs near the upper elevational limit of this system where it grades into alpine vegetation. Associations include woodlands, forested, and subalpine meadow types. It occurs on the west side of the Cascade Mountains and is a transitional open forest into the true alpine on the interior side of the Coastal Mountains of British Columbia where deep, late-lying snowpack is the primary environmental factor. Major tree species are *Tsuga mertensiana, Abies amabilis, Chamaecyparis nootkatensis*, and *Abies lasiocarpa*. This system includes British Columbia Hypermaritime and Maritime Parkland (*Tsuga mertensiana*). Dominant dwarf-shrubs include *Phyllodoce empetriformis, Cassiope mertensiana*, and *Vaccinium deliciosum*. Dominant herbaceous species include *Lupinus arcticus ssp. subalpinus, Valeriana sitchensis, Carex spectabilis*, and *Polygonum bistortoides*. There is very little disturbance, either windthrow or fire. The major process controlling vegetation is the very deep long-lasting snowpacks (deepest in the North Pacific region) limiting tree regeneration. Trees get established only in favorable microsites (mostly adjacent to existing trees) or during drought years with low snowpack. It is distinguished from more interior dry parkland primarily by the presence of *Tsuga mertensiana* or *Abies amabilis* and absence or paucity of *Pinus albicaulis* and *Larix lyallii*.
Classification Comments: This system includes what the Alaska Natural Heritage Program called Maritime Subalpine Fir-Mountain Hemlock Forest. It is very localized in its occurrence in Alaska, occurring in the eastern portion of the panhandle at high elevations.
Related Concepts:
- II.A.1.b - Subalpine fir scrub (Viereck et al. 1992) Equivalent
- Mountain Hemlock: 205 (Eyre 1980) Intersecting. Mountain hemlock stands are a component of subalpine parklands.

Component Associations:
- *Carex spectabilis - Polygonum bistortoides* Herbaceous Vegetation (CEGL001828, G4)
- *Carex spectabilis - Potentilla flabellifolia* Herbaceous Vegetation (CEGL001829, G4Q)
- *Carex spectabilis* Herbaceous Vegetation (CEGL001827, G5)
- *Cassiope mertensiana / Luetkea pectinata* Dwarf-shrubland (CEGL001397, G3G4)
- *Chamaecyparis nootkatensis* Subalpine Parkland Woodland (CEGL000350, G3)
- *Luetkea pectinata - Saxifraga tolmiei* Herbaceous Vegetation (CEGL001918, G5)
- *Lupinus arcticus ssp. subalpinus - Carex spectabilis* Herbaceous Vegetation (CEGL001973, G4)
- *Phyllodoce empetriformis / Lupinus latifolius* Dwarf-shrubland (CEGL001406, G4?)
- *Phyllodoce empetriformis / Vaccinium deliciosum* Dwarf-shrubland (CEGL001407, G4)
- *Phyllodoce empetriformis* Parkland Dwarf-shrubland (CEGL001404, G5)
- *Potentilla flabellifolia - Polygonum bistortoides* Herbaceous Vegetation (CEGL001981, G4Q)
- *Saussurea americana - Heracleum maximum* Herbaceous Vegetation (CEGL001945, G3G4)
- *Tsuga mertensiana / Cassiope mertensiana* Woodland (CEGL003251, G5)
- *Vaccinium deliciosum* Parkland Dwarf-shrubland (CEGL001427, G4G5)
- *Vaccinium membranaceum - Vaccinium deliciosum* Dwarf-shrubland (CEGL001428, G4?Q)
- *Valeriana sitchensis - Carex spectabilis* Herbaceous Vegetation (CEGL001996, G4)
- *Valeriana sitchensis - Ligusticum grayi* Herbaceous Vegetation (CEGL001997, G3G4Q)
- *Valeriana sitchensis - Veratrum viride* Herbaceous Vegetation (CEGL001998, G4)

DISTRIBUTION

Range: This system occurs throughout the mountains of the Pacific Northwest, from the central Oregon Cascades (Diamond Peak, 30 miles north of Crater Lake National Park), north to the Coast Ranges of British Columbia, where it can occur on the east side, facing the interior of British Columbia, as well as north to the mountains along the border of Alaska.
Divisions: 204:C; 207:C; 306:C
Nations: CA, US

Subnations: AK, BC, OR, WA
Map Zones: 1:C, 7:P, 78:C
USFS Ecomap Regions: 242A:CC, M242A:CC, M242B:CC, M242C:CP, M242D:CC
TNC Ecoregions: 1:C, 4:C, 7:C, 69:?, 70:C, 81:C, 144:C

SOURCES

References: Banner et al. 1993, BCMF 2006, Comer et al. 2003, Franklin and Dyrness 1973, Green and Klinka 1994
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722837#references
Description Author: G. Kittel, mod. C. Chappell
Version: 06 Feb 2009 **Stakeholders:** Canada, West
Concept Author: G. Kittel **ClassifResp:** West

NORTH PACIFIC MARITIME MESIC-WET DOUGLAS-FIR-WESTERN HEMLOCK FOREST (CES204.002)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch, Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Temperate [Temperate Oceanic]; Tsuga heterophylla, Pseudotsuga menziesii
Non-Diagnostic Classifiers: Montane
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2039; ESLF 4226; ESP 1039

CONCEPT

Summary: This ecological system is a significant component of the lowland and low montane forests of western Washington, northwestern Oregon, and southwestern British Columbia. It occurs throughout low-elevation western Washington, except on extremely dry sites and in the hypermaritime zone near the outer coast where it is rare. In Oregon, it occurs on the western slopes of the Cascades, around the margins of the Willamette Valley, and on the west side of the Coast Ranges, and is reduced to locally small patches in southwestern Oregon. In British Columbia, it occurs on the eastern (leeward) side of Vancouver Island, commonly and rarely on the windward side, and in the southern Coast Ranges. These forests occur on moist habitats and microhabitats, mainly lower slopes or valley landforms, within the Western Hemlock Zone of the Pacific Northwest. They differ from North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest (CES204.001) primarily in having more hydrophilic undergrowth species, moist to subirrigated soils, high abundance of shade- and moisture-tolerant canopy trees, as well as higher stand productivity, due to higher soil moisture and lower fire frequency. Climate is relatively mild and moist to wet. Mean annual precipitation is mostly 90-254 cm (35-100 inches) (but as low as 20 inches in the extreme rainshadow) predominantly as winter rain. Snowfall ranges from rare to regular (but consistent winter snowpacks are absent or minimal), and summers are relatively dry. Elevation ranges from sea level to 610 m (2000 feet) in northern Washington to 1067 m (3500 feet) in Oregon. Topography ranges from relatively flat glacial tillplains to steep mountainous terrain. This is an extensive forest in the lowlands on the west side of the Cascades. In some wetter climatic areas, it forms the matrix within which other systems occur as patches, especially riparian wetlands. In many rather drier climatic areas, it occurs as small to large patches within a matrix of North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest (CES204.001); in dry areas, it can occur adjacent to or in a mosaic with North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland (CES204.845), and at higher elevations it intermingles with either North Pacific Dry-Mesic Silver Fir-Western Hemlock-Douglas-fir Forest (CES204.098) or North Pacific Mesic Western Hemlock-Silver Fir Forest (CES204.097).

Overstory canopy is dominated by *Pseudotsuga menziesii*, *Tsuga heterophylla*, and/or *Thuja plicata*, as well as *Chamaecyparis lawsoniana* in western Oregon, away from the coast. *Pseudotsuga menziesii* is usually at least present to more typically codominant or dominant. *Acer macrophyllum* and *Alnus rubra* (the latter primarily where there has been historic logging disturbance) are commonly found as canopy or subcanopy codominants, especially at lower elevations. In a natural landscape, small patches can be dominated in the canopy by these broadleaf trees for several decades after a severe fire. *Polystichum munitum, Oxalis oregana, Rubus spectabilis*, and *Oplopanax horridus* typify the poorly to well-developed herb and shrub layers. *Gaultheria shallon, Mahonia nervosa, Rhododendron macrophyllum*, and *Vaccinium ovatum* are often present but are generally not as abundant as the aforementioned indicators; except where *Chamaecyparis lawsoniana* is a canopy codominant, they may be the dominant understory. *Acer circinatum* is a very common codominant as a tall shrub. Forested stands with abundant *Lysichiton americanus*, an indicator of seasonally flooded or saturated soils, belong in North Pacific Hardwood-Conifer Swamp (CES204.090). Stands included are best represented on lower mountain slopes of the coastal ranges with high precipitation, long frost-free periods, and low fire frequencies. Young stands may lack *Tsuga heterophylla* or *Thuja plicata*, especially in the Puget Lowland. *Tsuga heterophylla* is generally the dominant regenerating tree species. Other common associates include *Abies grandis*, which can be a codominant especially in the Willamette Valley - Puget Trough - Georgia Basin ecoregion. Soils are moist to somewhat wet but not saturated for much of the year and are well-drained to somewhat poorly drained. Typical soils for *Polystichum* sites would be deep, fine- to moderately coarse-textured, and for *Oplopanax* sites, soils typically have an impermeable layer at a moderate depth. Both types of soils are well-watered from upslope sources, seeps, or hyperheic sources. This is in contrast to North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest (CES204.001), which occurs on well-drained soils, south-facing slopes, and dry ridges and slopes where soils remain mesic to dry for much of the year. Fire is (or was) the major natural disturbance in all but the wettest climatic areas. In the past (pre-1880), fires were less commonly high-severity, typically mixed-severity or moderate-severity, with natural return intervals of a few hundred to several hundred years. This system was formerly supported by occasional, stand-replacing fires. More frequent moderate-severity fires would generally not burn these moister microsites.

Classification Comments: Stands dominated or codominated with *Chamaecyparis lawsoniana* that are within 25 km (15 miles) of the coast are part of either California Coastal Redwood Forest (CES206.921) (extreme southern Oregon and northern California) or North Pacific Seasonal Sitka Spruce Forest (CES204.841) (central and northern coastal Oregon). Stands in these areas may or may not have redwood or Sitka spruce present. Stands away for the coast and not on serpentine soils are considered part of North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest (CES204.002).

Similar Ecological Systems:

- North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest (CES204.001)

Related Concepts:
- Douglas-fir - Western Hemlock: 230 (Eyre 1980) Broader. Includes both wet and dry stands
- Fd - Fairybells (CWHds1/04) (Steen and Coupe 1997) Intersecting
- FdHw - Falsebox (CWHds1/03) (Steen and Coupe 1997) Intersecting
- FdHw - Falsebox (CWHms1/03) (Steen and Coupe 1997) Intersecting
- FdPl - Kinnikinnick (CWHds1/02) (Steen and Coupe 1997) Intersecting
- FdPl - Kinnikinnick (CWHms1/02) (Steen and Coupe 1997) Intersecting
- Hw - Queen's cup (CWHds1/06) (Steen and Coupe 1997) Intersecting
- HwFd - Cat's-tail moss (CWHds1/01) (Steen and Coupe 1997) Intersecting
- no data (CWHds2/01) (BCMF 2006) Intersecting
- Pacific Douglas-fir: 229 (Eyre 1980) Broader. 80% Doug-fir
- Port Orford-Cedar: 231 (Eyre 1980) Broader. not serpentine, not in stika spruce zone, and not swamps
- Red Alder: 221 (Eyre 1980) Intersecting. early successsional stage of many PNW Forests
- Western Hemlock: 224 (Eyre 1980) Broader. 80% W. Hemlock

DESCRIPTION

Dynamics: Fire is (or was) the major natural disturbance in all but the wettest climatic areas. In the past (pre-1880), fires were high-severity or, less commonly, moderate-severity, with natural return intervals of a few hundred to several hundred years. This system was formerly supported by occasional, stand-replacing fires. More frequent moderate-severity fires would generally not burn these moister microsites. Wind may be equally as important as fire, and in the Bull Run Watershed more important.

Component Associations:
- *Abies concolor - Chamaecyparis lawsoniana / Quercus sadleriana / Leucothoe davisiae - Rhododendron macrophyllum* Forest (CEGL000042, G2)
- *Abies grandis - Tsuga heterophylla / Polystichum munitum* Forest (CEGL000287, G2)
- *Acer macrophyllum / Acer circinatum* Forest (CEGL000560, G4G5)
- *Alnus rubra / Polystichum munitum* Forest (CEGL000638, G4)
- *Pseudotsuga menziesii / Acer circinatum* Forest (CEGL000417, G5?)
- *Thuja plicata - Pseudotsuga menziesii - Abies grandis / Mahonia nervosa / Polystichum munitum* Forest (CEGL002848, G1)
- *Thuja plicata - Tsuga heterophylla / Oxalis oregana* Forest (CEGL000483, G2)
- *Thuja plicata - Tsuga heterophylla / Whipplea modesta* Forest (CEGL000486, G2G3)
- *Thuja plicata / Gaultheria shallon* Forest (CEGL000475, G1G2)
- *Thuja plicata / Linnaea borealis* Forest (CEGL000089, G2)
- *Tsuga heterophylla - (Thuja plicata) / Oplopanax horridus / Polystichum munitum* Forest (CEGL000497, G4)
- *Tsuga heterophylla - (Thuja plicata, Pseudotsuga menziesii) / Polystichum munitum - Blechnum spicant* Forest (CEGL002843, G2G3)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland (CES204.845)
- North Pacific Dry-Mesic Silver Fir-Western Hemlock-Douglas-fir Forest (CES204.098)
- North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest (CES204.001)
- North Pacific Mesic Western Hemlock-Silver Fir Forest (CES204.097)

Adjacent Ecological System Comments: In some wetter climatic areas, it forms the matrix within which other systems occur as patches, especially riparian wetlands. In many rather drier climatic areas, it occurs as small to large patches within a matrix of North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest (CES204.001). In dry areas, it can occur adjacent to or in a mosaic with North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland (CES204.845) and at higher elevations intermingles with either North Pacific Dry-Mesic Silver Fir-Western Hemlock-Douglas-fir Forest (CES204.098) or North Pacific Mesic Western Hemlock-Silver Fir Forest (CES204.097).

DISTRIBUTION

Range: This system is a significant component of the lowland and low montane forests of western Washington, northwestern Oregon, and southwestern British Columbia. This system may also occur as very small patches in northern California, in the northern Coast Ranges.

Divisions: 204:C
Nations: CA, US
Subnations: BC, OR, WA
Map Zones: 1:C, 2:C, 3:?, 7:C, 9:C
USFS Ecomap Regions: 242A:CC, 242B:CC, 263A:CC, 342I:??, M242A:CC, M242B:CC, M242C:CC, M242D:CC, M261A:CC
TNC Ecoregions: 1:C, 3:C, 5:C, 69:C, 81:C

SOURCES

References: BCMF 2006, Eyre 1980, Steen and Coupe 1997, Western Ecology Working Group n.d.
Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.738967#references
Description Author: G. Kittel, mod. C. Chappell and M.S. Reid
Version: 23 Jan 2006 **Stakeholders:** Canada, West
Concept Author: G. Kittel and C. Chappell **ClassifResp:** West

NORTH PACIFIC MESIC WESTERN HEMLOCK-SILVER FIR FOREST (CES204.097)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane; Forest and Woodland (Treed); Temperate [Temperate Oceanic]; Tsuga heterophylla - Abies amabilis
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2042; ESLF 4229; ESP 1042

CONCEPT

Summary: This forested system occurs only in the Pacific Northwest mountains entirely west of the Cascade Crest from coastal British Columbia to Washington, and probably occurs in southeastern Alaska. It generally occurs in an elevational band between *Pseudotsuga menziesii - Tsuga heterophylla* or hypermaritime zone forests and *Tsuga mertensiana* forests. It dominates mid-montane maritime climatic zones on the windward side of Vancouver Island, the Olympic Peninsula, and the wettest portions of the North Cascades in Washington (north of Snoqualmie River). A somewhat variable winter snowpack that typically lasts for 2-6 months is characteristic. The climatic zone within which it occurs is sometimes referred to as the "rain-on-snow" zone because of the common occurrence of major winter rainfall on an established snowpack. *Tsuga heterophylla* and/or *Abies amabilis* dominate the canopy of late-seral stands, and *Chamaecyparis nootkatensis* can be codominant, especially at higher elevations. *Thuja plicata* is also common and sometimes codominates in British Columbia. In Alaska, *Abies amabilis* occurs in nearly pure stands and in mixture with *Picea sitchensis* and *Tsuga heterophylla*. *Pseudotsuga menziesii* is relatively rare to absent in this system, as opposed to the similar but drier North Pacific Dry-Mesic Silver Fir-Western Hemlock-Douglas-fir Forest (CES204.098). The major understory dominant species is *Vaccinium ovalifolium*. Understory species that help distinguish this system from the drier silver fir system (they are much more common here) include *Oxalis oregana, Blechnum spicant,* and *Rubus pedatus*. Windthrow is a common small-scale disturbance in this system, and gap creation and succession are important processes.
Classification Comments: Jan Henderson suggests using 90 inches mean precipitation at sea level (with modification for topographic moisture) to distinguish wet and dry silver fir systems. Fire regime is significantly different at regional scale between the dry and mesic; this difference appears to be consistent throughout the range of the types. The mesic rarely, if ever, burns; it is dominated by what is sometimes called "old old-growth" stands that run from 700 to over 1000 years in age. Research in British Columbia indicates these coastal rainforests may burn an average of once every 2000 years. The major processes then are small-scale gap dynamics, not stand-replacement fires. This difference is related to climate, not site moisture, with the mesic having a very wet climate that is more coastal, less continental, with cooler summers, and warmer winters on average.
Similar Ecological Systems:
- Alaskan Pacific Maritime Western Hemlock Forest (CES204.840)
- North Pacific Dry-Mesic Silver Fir-Western Hemlock-Douglas-fir Forest (CES204.098)
- North Pacific Hypermaritime Western Red-cedar-Western Hemlock Forest (CES204.842)

Related Concepts:
- BaCw - Devil's club (CWHms1/06) (Steen and Coupe 1997) Intersecting
- BaCw - Devil's club (CWHws1/06) (Banner et al. 1993) Intersecting
- BaCw - Devil's club (CWHws2/06) (Banner et al. 1993) Intersecting
- BaCw - Foamflower (CWHvm1/05) (Banner et al. 1993) Intersecting
- BaCw - Foamflower (CWHvm2/05) (Banner et al. 1993) Intersecting
- BaCw - Oak fern (CWHms1/04) (Steen and Coupe 1997) Intersecting
- BaCw - Oak fern (CWHws1/04) (Banner et al. 1993) Intersecting
- BaCw - Oak fern (CWHws2/04) (Banner et al. 1993) Intersecting
- BaCw - Salmonberry (CWHvm1/07) (Banner et al. 1993) Intersecting
- BaCw - Salmonberry (CWHvm2/07) (Banner et al. 1993) Intersecting
- Coastal True Fir - Hemlock: 226 (Eyre 1980) Broader. includes moist and dry silver fir
- Douglas-fir - Western Hemlock: 230 (Eyre 1980) Intersecting
- HwBa - Blueberry (CWHvm1/01) (Banner et al. 1993) Intersecting
- HwBa - Blueberry (CWHvm2/01) (Banner et al. 1993) Intersecting
- HwBa - Blueberry, Lithic (CWHvm1/01) (Banner et al. 1993) Intersecting
- HwBa - Blueberry, Lithic (CWHvm2/01) (Banner et al. 1993) Intersecting
- HwBa - Blueberry, Mineral (CWHvm1/01) (Banner et al. 1993) Intersecting
- HwBa - Blueberry, Mineral (CWHvm2/01) (Banner et al. 1993) Intersecting
- HwBa - Bramble (CWHws1/01) (Banner et al. 1993) Intersecting
- HwBa - Bramble (CWHws2/01) (Banner et al. 1993) Intersecting
- HwBa - Bramble, Glaciofluvial (CWHws1/01) (Banner et al. 1993) Intersecting

- HwBa - Bramble, Typic (CWHws1/01) (Banner et al. 1993) Intersecting
- HwBa - Deer fern (CWHvm1/06) (Banner et al. 1993) Intersecting
- HwBa - Deer fern (CWHvm2/06) (Banner et al. 1993) Intersecting
- HwBa - Deer fern, Lithic (CWHvm1/06) (Banner et al. 1993) Intersecting
- HwBa - Deer fern, Mineral (CWHvm1/06) (Banner et al. 1993) Intersecting
- HwBa - Queen's cup (CWHms1/05) (Steen and Coupe 1997) Intersecting
- HwBa - Queen's cup (CWHws1/05) (Banner et al. 1993) Intersecting
- HwBa - Queen's cup (CWHws2/05) (Banner et al. 1993) Intersecting
- HwBa - Step moss (CWHms1/01) (Steen and Coupe 1997) Intersecting
- I.A.1.h - Silver fir-western hemlock (Viereck et al. 1992) Equivalent
- Western Hemlock: 224 (Eyre 1980) Intersecting. 80% W. Hemlock

DESCRIPTION

Dynamics: Stand-replacing fires are relatively infrequent to absent, with return intervals of several hundred or more years. More mixed-severity fires occur in the southern parts of this system, so that forest structure, patch size and proportions will be different from northern stands. Further north, stand-replacing fires are also infrequent but are a more common fire event.

Component Associations:
- *Abies amabilis / Menziesia ferruginea* Forest (CEGL000224, G4)
- *Abies amabilis / Oplopanax horridus* Forest (CEGL000004, G5)
- *Abies amabilis / Polystichum munitum* Forest (CEGL000006, G4)
- *Abies amabilis / Rhododendron albiflorum* Forest (CEGL000225, G5)
- *Abies procera / Oxalis oregana* Forest (CEGL003444, G1)
- *Tsuga heterophylla - Abies amabilis - (Chamaecyparis nootkatensis) / Vaccinium alaskaense* Forest (CEGL002850, G3?)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Alaskan Pacific Maritime Western Hemlock Forest (CES204.840)
- East Cascades Mesic Montane Mixed-Conifer Forest and Woodland (CES204.086)
- North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest (CES204.001)
- North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest (CES204.002)

DISTRIBUTION

Range: This system occurs only in the Pacific Northwest mountains (Coastal and westside Cascades). It occurs on the windward side of coastal mountains in both British Columbia and in the Olympic Mountains and north Cascade Range of Washington. It may also extend north to about 56 degrees north latitude in southeastern Alaska. *Abies amabilis* has a limited distribution in Alaska, apparently confined to the extreme southern mainland and a few islands south of 56 degrees north latitude.
Divisions: 204:C
Nations: CA, US
Subnations: AK?, BC, WA
Map Zones: 1:C, 2:C, 3:?, 7:C, 78:C
USFS Ecomap Regions: 242A:??, M242A:CC, M242B:CC, M242C:CC, M242D:CC
TNC Ecoregions: 1:C, 3:C, 69:P, 81:C

SOURCES

References: Banner et al. 1993, DeMeo et al. 1992, DeVelice et al. 1999, Eyre 1980, Franklin and Dyrness 1973, Martin et al. 1995, Steen and Coupe 1997, Viereck et al. 1992, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.769626#references
Description Author: G. Kittel, mod. C. Chappell and M.S. Reid
Version: 22 Aug 2008 **Stakeholders:** Canada, West
Concept Author: G. Kittel, mod. C. Chappell **ClassifResp:** West

NORTH PACIFIC MESIC WESTERN HEMLOCK-YELLOW-CEDAR FOREST (CES204.843)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Temperate [Temperate Oceanic]; Chamaecyparis nootkatensis
Non-Diagnostic Classifiers: Lowland
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2040; ESLF 4227; ESP 1040

CONCEPT

Summary: This system occurs throughout southeastern Alaska but appears to be more common in central southeastern Alaska. It is more common on the islands than on the mainland and is less common on northern Chichagof Island than on southern Chichagof and Baranof islands. It occurs at all elevations below the Mountain Hemlock Zone and is most abundant on somewhat poorly to moderately drained slopes. In the southern part of southeastern Alaska, this system generally occupies the upper edge of the Western Hemlock Zone, from 305-610 m (1000-2000 feet) elevation. On non-alluvial low-elevation sites, *Chamaecyparis nootkatensis* abundance increases as soil drainage becomes poorer. Poor drainage results in fewer trees and, therefore, more understory light, allowing yellow-cedar to survive and reproduce despite competition from western hemlock. *Chamaecyparis nootkatensis* is more tolerant of poor soil drainage than *Tsuga heterophylla*. *Chamaecyparis nootkatensis* is a codominant with *Tsuga heterophylla* in stands with moderately open (50-70%) canopies. Yellow-cedar cover typically ranges from 5-50% and rarely dominates the overstory. *Picea sitchensis* may be an overstory component. The canopy is typically multilayered, with *Tsuga heterophylla* dominating the lower layers. This system intergrades with *Tsuga mertensiana* forests, and *Tsuga mertensiana* may occur in transitional stands. The shrub layer is relatively well-developed (>50%) in late-seral stands and includes *Vaccinium ovalifolium* and *Menziesia ferruginea*, with *Lysichiton americanus* and *Coptis* spp. as consistently present herbaceous species. *Blechnum spicant* is the most common fern, while *Dryopteris expansa* is nearly absent from this type. This system is distinguished by the codominance of *Chamaecyparis nootkatensis* and *Tsuga heterophylla* and the absence or rarity of *Thuja plicata*, *Picea sitchensis*, and *Abies amabilis*.
Classification Comments: This system is found only in southeastern Alaska. Poorly drained, low-productivity woodlands of *Chamaecyparis nootkatensis* are placed into a different system.
Similar Ecological Systems:
- Alaskan Pacific Maritime Western Hemlock Forest (CES204.840)
- North Pacific Hypermaritime Western Red-cedar-Western Hemlock Forest (CES204.842)

Related Concepts:
- CwYc - Goldthread (CWHvh2/11) (Banner et al. 1993) Intersecting
- CwYc - Goldthread (CWHvm1/12) (Banner et al. 1993) Intersecting
- CwYc - Salal (CWHvh2/03) (Banner et al. 1993) Intersecting
- CwYc - Salal, Lithic (CWHvh2/03) (Banner et al. 1993) Intersecting
- CwYc - Salal, Mineral (CWHvh2/03) (Banner et al. 1993) Intersecting
- HmYc - Deer-cabbage (MHmm1/06) (Banner et al. 1993) Intersecting
- HmYc - Deer-cabbage (MHmm2/06) (Banner et al. 1993) Intersecting
- HmYc - Deer-cabbage (MHmm2/06) (Steen and Coupe 1997) Intersecting
- HmYc - Deer-cabbage (MHwh1/06) (Banner et al. 1993) Intersecting
- HmYc - Goldthread (MHwh1/04) (Banner et al. 1993) Intersecting
- HmYc - Mountain-heather (MHwh1/02) (Banner et al. 1993) Intersecting
- HmYc - Sphagnum (MHmm1/08) (Banner et al. 1993) Intersecting
- HmYc - Sphagnum (MHmm2/08) (Steen and Coupe 1997) Intersecting
- HmYc - Sphagnum (MHmm2/08) (Banner et al. 1993) Intersecting
- HmYc - Sphagnum (MHwh1/08) (Banner et al. 1993) Intersecting
- I.A.1.e - Western hemlock-Alaska-cedar (Viereck et al. 1992) Broader
- PlYc - Rhacomitrium (CWHvh2/02) (Banner et al. 1993) Intersecting
- PlYc - Sphagnum (CWHvh2/12) (Banner et al. 1993) Intersecting
- YcHm - Hellebore (MHmm1/07) (Banner et al. 1993) Intersecting
- YcHm - Hellebore (MHmm2/07) (Steen and Coupe 1997) Intersecting
- YcHm - Hellebore (MHmm2/07) (Banner et al. 1993) Intersecting
- YcHm - Hellebore (MHwh1/07) (Banner et al. 1993) Intersecting
- YcHm - Skunk cabbage (CWHvm1/15) (Banner et al. 1993) Intersecting
- YcHm - Skunk cabbage (CWHvm2/12) (Banner et al. 1993) Intersecting
- YcHm - Skunk cabbage (MHmm1/09) (Banner et al. 1993) Intersecting
- YcHm - Skunk cabbage (MHmm2/09) (Banner et al. 1993) Intersecting

- YcHm - Skunk cabbage (MHmm2/09) (Steen and Coupe 1997) Intersecting
- YcHm - Skunk cabbage (MHwh1/09) (Banner et al. 1993) Intersecting
- YcHm - Twistedstalk (MHwh1/05) (Banner et al. 1993) Intersecting

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Alaskan Pacific Maritime Western Hemlock Forest (CES204.840)

DISTRIBUTION

Range: This system occurs throughout southeastern Alaska.
Divisions: 204:C
Nations: US
Subnations: AK
Map Zones: 78:C
TNC Ecoregions: 69:C

SOURCES

References: Banner et al. 1993, Comer et al. 2003, DeMeo et al. 1992, DeVelice et al. 1999, Hannon and Tremmer 2001, Martin et al. 1995
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722831#references
Description Author: G. Kittel, mod. M.S. Reid
Version: 22 Aug 2008 **Stakeholders:** West
Concept Author: G. Kittel **ClassifResp:** West

NORTH PACIFIC MOUNTAIN HEMLOCK FOREST (CES204.838)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Temperate [Temperate Oceanic]; Tsuga mertensiana
Non-Diagnostic Classifiers: Montane [Upper Montane]; Montane [Montane]
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2041; ESLF 4228; ESP 1041

CONCEPT

Summary: This forested ecological system occurs throughout the mountains of the North Pacific, from the southern Cascades of Oregon north to southwestern British Columbia. It is the predominant forest of subalpine elevations in the coastal mountains of British Columbia, western Washington and western Oregon. It also occurs on mountain slopes on the outer coastal islands of British Columbia. It lies between the Western Hemlock, Pacific Silver Fir, or Shasta Red Fir zones and the Subalpine Parkland or Alpine Tundra Zone, at elevations ranging from 300 to 2300 m (1000-7500 feet). The lower and upper elevational limits decrease from south to north and from east to west. The climate is generally characterized by short, cool summers, rainy autumns and long, cool, wet winters with heavy snow cover for 5-9 months. The heavy snowpack is ubiquitous, but at least in southern Oregon and perhaps the eastern Cascades, summer drought is more significant. Fire is very rare or absent across the majority of the range of the system. *Tsuga mertensiana* is one of the dominant tree species throughout, and *Abies amabilis* becomes an important associated species in the southern portion of the range (British Columbia, Washington, and northwestern Oregon). *Tsuga heterophylla* often occurs at lower elevations in this system but is much less abundant than *Tsuga mertensiana*. *Chamaecyparis nootkatensis* occurs in the more coastal portions, while *Abies lasiocarpa* is found inland and becomes increasingly common near the transition to the Subalpine Fir-Engelmann Spruce Zone in the Cascades and British Columbia. On the leeward side of the Cascades, this is usually a dense canopy composed of *Abies lasiocarpa* and *Tsuga mertensiana*, with some *Picea engelmannii* or *Abies amabilis*. In the Cascades of central to southern Oregon, *Abies X shastensis* is typically present and often codominant. *Picea sitchensis* and *Thuja plicata* are occasionally present. Deciduous trees are rare. Common understory species include *Vaccinium ovalifolium, Menziesia ferruginea, Elliottia pyroliflorus*, and *Blechnum spicant*. Parklands (open woodlands or sparse trees with dwarf-shrub or herbaceous vegetation) are not part of this system but of North Pacific Maritime Mesic Subalpine Parkland (CES204.837) or Alaskan Pacific Maritime Subalpine Mountain Hemlock Woodland (CES204.143).

Classification Comments: Farther inland, *Tsuga mertensiana* becomes limited to the coldest and wettest pockets of the more continental subalpine fir forests, described from the eastern Cascades and northern Rocky Mountains. In the northern Rocky Mountains of northern Idaho and Montana, *Tsuga mertensiana* occurs as patches within the matrix of Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland (CES306.830) only in the most maritime of environments and is included in the spruce-fir system. In the northern Rocky Mountains, this forest system is codominated by *Abies lasiocarpa* and/or *Picea engelmannii*. Mountain hemlock forests in Alaska are placed into Alaskan Pacific Maritime Mountain Hemlock Forest (CES204.142) or Alaskan Pacific Maritime Subalpine Mountain Hemlock Woodland (CES204.143).

Similar Ecological Systems:
- Alaskan Pacific Maritime Mountain Hemlock Forest (CES204.142)
- Alaskan Pacific Maritime Sitka Spruce Forest (CES204.151)
- Alaskan Pacific Maritime Subalpine Mountain Hemlock Woodland (CES204.143)

Related Concepts:
- BaHm - Oak fern (MHmm1/03) (Banner et al. 1993) Intersecting
- BaHm - Oak fern (MHmm2/03) (Steen and Coupe 1997) Intersecting
- BaHm - Oak fern (MHmm2/03) (Banner et al. 1993) Intersecting
- BaHm - Twistedstalk (MHmm1/05) (Banner et al. 1993) Intersecting
- BaHm - Twistedstalk (MHmm2/05) (Banner et al. 1993) Intersecting
- BaHm - Twistedstalk (MHmm2/05) (Steen and Coupe 1997) Intersecting
- BlHm - Cladonia (ESSFmk/03) (Banner et al. 1993) Intersecting
- BlHm - Oak fern (ESSFmk/04) (Banner et al. 1993) Intersecting
- BlHm - Twistedstalk (ESSFmk/01) (Banner et al. 1993) Intersecting
- CwYc - Goldthread (CWHvm2/09) (Banner et al. 1993) Intersecting
- EW Subalpine Fir - Mountain Hemlock Wet Forested (Ecosystems Working Group 1998) Broader
- HmBa - Blueberry (MHmm1/01) (Banner et al. 1993) Intersecting
- HmBa - Blueberry (MHmm2/01) (Steen and Coupe 1997) Intersecting
- HmBa - Blueberry (MHmm2/01) (Banner et al. 1993) Intersecting
- HmBa - Bramble (MHmm1/04) (Banner et al. 1993) Intersecting
- HmBa - Bramble (MHmm2/04) (Banner et al. 1993) Intersecting

- HmBa - Bramble (MHmm2/04) (Steen and Coupe 1997) Intersecting
- HmBa - Mountain-heather (MHmm1/02) (Banner et al. 1993) Intersecting
- HmBa - Mountain-heather (MHmm2/02) (Banner et al. 1993) Intersecting
- HmBa - Mountain-heather (MHmm2/02) (Steen and Coupe 1997) Intersecting
- HmSs - Blueberry (MHwh1/01) (Banner et al. 1993) Intersecting
- Hw - Sphagnum (CWHwm/08) (Banner et al. 1993) Intersecting
- MF Mountain Hemlock - Amabilis fir Forested (Ecosystems Working Group 1998) Broader
- Mountain Hemlock: 205 (Eyre 1980) Broader
- SsHm - Reedgrass (MHwh1/03) (Banner et al. 1993) Intersecting

DESCRIPTION

Dynamics: In the more summer-dry climatic areas (Cascades), occasional high-severity fires occur, with return intervals of 400-600 years (J. Kertis pers. comm. 2006, K. Kopper pers. comm. 2006). On drier sites, *Abies lasiocarpa* and *Pinus contorta* can be the first forests to develop after stand-replacing fire. These early-seral stages, with lodgepole pine dominant in the upper canopy, could be classified and mapped as Rocky Mountain Lodgepole Pine Forest (CES306.820) but should be considered part of this system if other tree species listed above are present, as it will succeed as a mixed pine type, then mountain hemlock becomes characteristic. Landfire VDDT models: R#ABAMup.

Component Associations:
- *Abies lasiocarpa - (Pinus contorta) / Lupinus arcticus ssp. subalpinus* Woodland (CEGL000316, G2)
- *Tsuga mertensiana - Abies amabilis / Caltha leptosepala ssp. howellii* Forest (CEGL000501, G3)
- *Tsuga mertensiana - Abies amabilis / Elliottia pyroliflorus* Woodland (CEGL000503, G3G4)
- *Tsuga mertensiana - Abies amabilis / Oplopanax horridus* Forest (CEGL000507, G3G4)
- *Tsuga mertensiana - Abies amabilis / Rhododendron albiflorum* Forest (CEGL002632, G5)
- *Tsuga mertensiana - Abies amabilis / Rhododendron macrophyllum* Forest (CEGL000124, G4)
- *Tsuga mertensiana - Abies amabilis / Vaccinium membranaceum - Xerophyllum tenax* Forest (CEGL000515, G4)
- *Tsuga mertensiana - Abies amabilis / Vaccinium ovalifolium - Maianthemum dilatatum* Forest (CEGL002617, G3G4)
- *Tsuga mertensiana - Abies amabilis / Xerophyllum tenax* Forest (CEGL000500, G3)
- *Tsuga mertensiana / Chimaphila umbellata* Forest (CEGL000502, G4)
- *Tsuga mertensiana / Luzula glabrata var. hitchcockii* Forest (CEGL000505, G5)
- *Tsuga mertensiana / Quercus sadleriana / Orthilia secunda* Forest (CEGL000123, G3G4)
- *Tsuga mertensiana* / Sparse Understory Forest (CEGL008685, G3G4)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- East Cascades Mesic Montane Mixed-Conifer Forest and Woodland (CES204.086)

DISTRIBUTION

Range: This system occurs from coastal British Columbia to the southern Cascades of Oregon.
Divisions: 204:C; 306:C
Nations: CA, US
Subnations: BC, OR, WA
Map Zones: 1:C, 2:C, 3:?, 6:C, 7:C
USFS Ecomap Regions: 242A:??, M242A:CC, M242B:CC, M242C:CC, M242D:CC, M261A:CC, M261D:C?, M261G:C?
TNC Ecoregions: 1:C, 3:C, 69:C, 81:C

SOURCES

References: Banner et al. 1993, Comer et al. 2003, Eyre 1980, Franklin 1988, Kertis pers. comm., Klinka and Chourmouzis 2002, Kopper pers. comm., Steen and Coupe 1997
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722836#references
Description Author: G. Kittel, mod. C. Chappell and M.S. Reid
Version: 08 Dec 2008 **Stakeholders:** Canada, West
Concept Author: G. Kittel and C. Chappell **ClassifResp:** West

NORTH PACIFIC OAK WOODLAND (CES204.852)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Temperate [Temperate Oceanic]; Quercus garryana
Non-Diagnostic Classifiers: Lowland [Foothill]; Lowland [Lowland]
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Deciduous open tree canopy
National Mapping Codes: EVT 2008; ESLF 4101; ESP 1008

CONCEPT

Summary: This ecological system is limited to the southern portions of the North Pacific region. It occurs primarily in the Puget Trough and Willamette Valley but trickles down into the Klamath ecoregion and into California. This system is associated with dry, predominantly low-elevation sites and/or sites that experienced frequent presettlement fires. In the Willamette Valley, soils are mesic yet well-drained, and the type is clearly large patch in nature. In the Puget Lowland and Georgia Basin, this system is primarily found on dry sites, typically either shallow bedrock soils or deep gravelly glacial outwash soils. It occurs on various soils in the interior valleys of the Klamath Mountains, and on shallow soils of "bald hill" toward the coast. Even where more environmentally limited, the system is strongly associated with a pre-European settlement, low-severity fire regime. Succession in the absence of fire tends to favor increased shrub dominance in the understory, increased tree density, and increased importance of conifers, with the end result being conversion to a conifer forest. The vegetation ranges from savanna and woodland to forest dominated by deciduous broadleaf trees, mostly *Quercus garryana*. Codominance by the evergreen conifer *Pseudotsuga menziesii* is common, and *Pinus ponderosa* is important in some stands. In the south, common associates also include *Quercus kelloggii* and *Arbutus menziesii*. This system merges into Mediterranean California Lower Montane Black Oak-Conifer Forest and Woodland (CES206.923) on sites that support more conifer cover, and into Mediterranean California Mixed Oak Woodland (CES206.909) in the southern portion of its distribution. This system is borderline between small patch and large patch in its dynamics.
Classification Comments: East of the Cascade Crest is a different system dominated by Oregon white oak (i.e., East Cascades Oak-Ponderosa Pine Forest and Woodland (CES204.085)). While *Quercus garryana* does occur in California, it is uncertain that this system (a Garry oak-dominated woodland) does not occur that far south. Garry oak in California may be mostly shrubby form around the edges of balds or else mixed into woodlands dominated by other species; this needs further review.
Similar Ecological Systems:
- Mediterranean California Mixed Oak Woodland (CES206.909)

Related Concepts:
- Oregon White Oak: 233 (Eyre 1980) Equivalent

DESCRIPTION

Environment: This type is associated with dry, predominantly low-elevation sites and/or sites that experienced frequent presettlement fires. In the Willamette Valley, soils are mesic yet well-drained, and the type is clearly large patch in nature. In the Puget Lowland and Georgia Basin, this system is primarily found on dry sites, typically either on shallow bedrock soils or deep gravelly glacial outwash soils. It occurs on various soils in the interior valleys of the Klamath Mountains, and on shallow soils of "bald hills" toward the coast.
Dynamics: Even where more environmentally limited, the system is strongly associated with a pre-European settlement, low-severity fire regime. Succession in the absence of fire tends to favor increased shrub dominance in the understory, increased tree density, and increased importance of conifers, with the end result being conversion to a conifer forest. Landfire (2007a) model: Fire Regime I, primarily short-interval (e.g., <10 years) surface fires. Surface fires every 3-10 years maintained an open savanna-like structure. Fires can be mixed-severity especially when closed-canopy conditions or additional species such as conifers and shrubs are present. Native American burning was a significant factor in fire frequency of this type, but fire frequency may have decreased significantly with a little distance from native settlements and valley bottoms. Landfire VDDT models: #R OWOA Oregon White Oak applies to southern occurrences. Dissemination of acorns by squirrels and chipmunks is thought to be the most important long-distance dispersal mechanism for the oaks (WNHP 2011).

Component Associations:
- *Pseudotsuga menziesii - Quercus garryana / Melica subulata* Forest (CEGL003355, G1)
- *Pseudotsuga menziesii - Quercus garryana / Symphoricarpos albus* Woodland (CEGL000929, G2G3)
- *Quercus garryana / Carex inops - Camassia quamash* Woodland (CEGL000548, G1)
- *Quercus garryana / Ceanothus cuneatus / Festuca idahoensis* Woodland (CEGL000930, G2)
- *Quercus garryana / Symphoricarpos albus / Carex inops* Woodland (CEGL003358, G2)
- *Quercus garryana / Symphoricarpos albus / Polystichum munitum* Forest (CEGL003353, G2)
- *Quercus garryana / Toxicodendron diversilobum / Elymus glaucus* Woodland (CEGL000932, G2)
- *Quercus garryana / Viburnum ellipticum - Toxicodendron diversilobum* Woodland (CEGL003354, G1)

Spatial Characteristics

Spatial Summary: This system is borderline between small patch and large patch in its dynamics.

Adjacent Ecological Systems:

- Mediterranean California Lower Montane Black Oak-Conifer Forest and Woodland (CES206.923)
- Mediterranean California Mixed Oak Woodland (CES206.909)

Adjacent Ecological System Comments: This system merges into Mediterranean California Lower Montane Black Oak-Conifer Forest and Woodland (CES206.923) on sites that support more conifer cover, and into Mediterranean California Mixed Oak Woodland (CES206.909) in the southern portion of its distribution.

Distribution

Range: This system occurs primarily in the Puget Trough and Willamette Valley and extends southward at low elevations in the Klamath Mountains on both sides of the Oregon/California stateline.

Divisions: 204:C

Nations: CA, US

Subnations: BC, CA, OR, WA

Map Zones: 1:C, 2:C, 3:C, 6:?, 7:C

USFS Ecomap Regions: 242A:CC, 242B:CC, 263A:??, M242A:CC, M242B:CC, M242C:CP, M242D:CP, M261A:CC, M261D:CC

TNC Ecoregions: 1:C, 2:C, 5:C, 14:C

Sources

References: Alverson 2009, Chappell and Christy 2004, Chappell and Kagan 2001, Comer et al. 2003, Eyre 1980, Franklin and Dyrness 1973, Fuchs 2001, Landfire 2007a, Littell et al. 2009, Pike 1973, Thysell and Carey 2001, WNHP 2011

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722822#references

Description Author: C. Chappell, mod. G. Kittel and M.S. Reid

Version: 14 Jan 2014 **Stakeholders:** Canada, West

Concept Author: C. Chappell **ClassifResp:** West

NORTH PACIFIC SEASONAL SITKA SPRUCE FOREST (CES204.841)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Temperate [Temperate Hyperoceanic]; Picea sitchensis
Non-Diagnostic Classifiers: Lowland [Foothill]; Lowland [Lowland]
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2036; ESLF 4223; ESP 1036

CONCEPT

Summary: This ecological system is restricted to the hypermaritime climatic areas near the Pacific Coast from Point Arena, California, north to northern Vancouver Island, British Columbia. These forests are typically dominated or codominated by *Picea sitchensis* and often have a mixture of other conifers present, such as *Tsuga heterophylla, Thuja plicata, Pseudotsuga menziesii*, or *Chamaecyparis nootkatensis*. *Tsuga heterophylla* is very often codominant. In the southern extent (in Oregon, but not in California), *Abies grandis, Acer circinatum, Alnus rubra, Acer macrophyllum, Chamaecyparis lawsoniana*, and *Frangula purshiana (= Rhamnus purshiana)* can be associates, while *Chamaecyparis nootkatensis* is completely absent. Wet coastal environments that support stands of *Chamaecyparis lawsoniana* in the absence of *Picea sitchensis* are also part of this system. The understory is rich with shade-tolerant shrubs and ferns, including *Gaultheria shallon, Vaccinium ovatum, Polystichum munitum, Dryopteris* spp., and *Blechnum spicant*, as well as a high diversity of mosses and lichens. This ecological system is restricted to the hypermaritime climatic areas near the Pacific Coast from Point Arena, California, north to northern Vancouver Island and Smith Sound on the mainland coast of British Columbia. They are generally limited to areas within 25 km or so of saltwater and are most abundant along the coast of Vancouver Island, southern portions of coastal mainland British Columbia, and the Olympic Peninsula of Washington. This ecosystem is defined as the "Seasonal Rain Forest" by Wolf et al. (1995), as the climate has abundant rainfall in the winter months and very little in the summer months. At the northern boundary this Sitka spruce forest ecosystem merges into Alaska Maritime Sitka Spruce (CES204.151) which has more continuous year-round rainfall and lacks Douglas-fir. North Pacific Seasonal Sitka Spruce Forest (CES204.841) occurs on outermost coastal fringe where salt spray is prominent, riparian terraces and valley bottoms near the coast where there is major fog accumulation, and on steep, well-drained productive slopes not directly adjacent to the outer coast but within the hypermaritime zone. Annual precipitation ranges from 65 to 550 cm, with the majority falling as rain. Winter rains can be heavy. When summer drought occurs it is typically short in duration and ameliorated by frequent, dense coastal fog and cloud cover. In fact the fog belt becomes more and more important in the southern half of this ecosystem's distribution. In Washington and Oregon, it is found mostly below 300 m elevation. It also occurs as a very narrow strip or localized patches along the southern Oregon and northern California coasts. The disturbance regime is mostly small-scale windthrow or other gap mortality processes (though there are occasional widespread intense windstorms) and very few fires, the latter mainly in Oregon.

Classification Comments: Stands dominated or codominated with *Chamaecyparis lawsoniana* that are within 25 km (15 miles) of the coast are part of either California Coastal Redwood Forest (CES206.921) (extreme southern Oregon and northern California) or North Pacific Seasonal Sitka Spruce Forest (CES204.841) (central and northern coastal Oregon). Stands in these areas may or may not have redwood or Sitka spruce present. Stands away for the coast and not on serpentine soils are considered part of North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest (CES204.002).

Similar Ecological Systems:
- North Pacific Hypermaritime Western Red-cedar-Western Hemlock Forest (CES204.842)

Related Concepts:
- BaSs - Devil's club (CWHvm1/08) (Banner et al. 1993) Intersecting
- BaSs - Devil's club (CWHvm2/08) (Banner et al. 1993) Intersecting
- CwSs - Devil's club (CWHvh2/07) (Banner et al. 1993) Intersecting
- CwSs - Devil's club, Lithic (CWHvh2/07) (Banner et al. 1993) Intersecting
- CwSs - Devil's club, Mineral (CWHvh2/07) (Banner et al. 1993) Intersecting
- CwSs - Foamflower (CWHvh2/06) (Banner et al. 1993) Intersecting
- CwSs - Skunk cabbage (CWHvh2/13) (Banner et al. 1993) Intersecting
- CwSs - Skunk cabbage (CWHvm1/14) (Banner et al. 1993) Intersecting
- CwSs - Skunk cabbage, Mineral (CWHvh2/13) (Banner et al. 1993) Intersecting
- CwSs - Skunk cabbage, Peaty (CWHvh2/13) (Banner et al. 1993) Intersecting
- CwSs - Sword fern (CWHvh2/05) (Banner et al. 1993) Intersecting
- CwSs - Sword fern, Lithic (CWHvh2/05) (Banner et al. 1993) Intersecting
- CwSs - Sword fern, Mineral (CWHvh2/05) (Banner et al. 1993) Intersecting
- HwSs - Blueberry (CWHwm/01) (Banner et al. 1993) Intersecting
- HwSs - Blueberry, Lithic (CWHwm/01) (Banner et al. 1993) Intersecting
- HwSs - Blueberry, Mineral (CWHwm/01) (Banner et al. 1993) Intersecting

- HwSs - Lanky moss (CWHvh2/04) (Banner et al. 1993) Intersecting
- HwSs - Lanky moss, Lithic (CWHvh2/04) (Banner et al. 1993) Intersecting
- HwSs - Lanky moss, Mineral (CWHvh2/04) (Banner et al. 1993) Intersecting
- HwSs - Step moss (CWHwm/02) (Banner et al. 1993) Intersecting
- Port Orford-Cedar: 231 (Eyre 1980) Intersecting. Coastal Port Orford-cedar stands occur in this system.
- Red Alder: 221 (Eyre 1980) Intersecting. early-successional stage of many PNW forests.
- Sitka Spruce: 223 (Eyre 1980) Finer. 80% spruce
- Ss - Kindbergia (CWHvh2/15) (Banner et al. 1993) Intersecting
- Ss - Lily-of-the-valley (CWHvh2/08) (Banner et al. 1993) Intersecting
- Ss - Pacific crab apple (CWHvh2/19) (Banner et al. 1993) Intersecting
- Ss - Reedgrass (CWHvh2/16) (Banner et al. 1993) Intersecting
- Ss - Salal (CWHvh2/14) (Banner et al. 1993) Intersecting
- Ss - Salmonberry (CWHds1/08) (Steen and Coupe 1997) Intersecting
- Ss - Salmonberry (CWHms1/07) (Steen and Coupe 1997) Intersecting
- Ss - Salmonberry (CWHvm1/09) (Banner et al. 1993) Intersecting
- Ss - Salmonberry (CWHwm/05) (Banner et al. 1993) Intersecting
- Ss - Salmonberry (CWHws1/07) (Banner et al. 1993) Intersecting
- Ss - Salmonberry (CWHws2/07) (Banner et al. 1993) Intersecting
- Ss - Skunk cabbage (CWHwm/09) (Banner et al. 1993) Intersecting
- Ss - Slough sedge (CWHvh2/18) (Banner et al. 1993) Intersecting
- Ss - Sword fern (CWHvh2/17) (Banner et al. 1993) Intersecting
- Ss - Trisetum (CWHvh2/09) (Banner et al. 1993) Intersecting
- SsHw - Devil's club (CWHwm/04) (Banner et al. 1993) Intersecting
- SsHw - Oak fern (CWHwm/03) (Banner et al. 1993) Intersecting
- Western Hemlock - Sitka Spruce: 225 (Eyre 1980) Finer. equal cover hemlock and spruce

DESCRIPTION

Environment: From Vancouver Island south, the forest is not confined to fjords, but a marked orographic effect from the Coast and Cascade ranges limits its interior extent. At its southern extent, the zone narrows again, confined to the fog belt not by mountains but by moisture. It is restricted to the hypermaritime climatic areas (Meidinger and Pojar 1991) near the Pacific coast, along a fog belt from Point Arena, California, north to northern Vancouver Island, British Columbia. These forests are generally restricted to areas within 25 km of saltwater and are most abundant along the coast of Vancouver Island, southern portions of coastal British Columbia, and the Olympic Peninsula of Washington. Sites include the outermost coastal fringe where salt spray is prominent, riparian terraces and valley bottoms near the coast where there is major fog accumulation, and in the northern half of its range starting in central British Columbia, steep, well-drained productive slopes not directly adjacent to the outer coast but within the hypermaritime zone (Banner et al. 1993, Green and Klinka 1994, Steen and Coupe 1997). Annual precipitation ranges from 65 to 550 cm, with the majority falling as rain. Winter rains can be heavy. The climate has more seasonal rainfall than coastal areas to the north, with a pronounced drought in summer months. Summer drought does occur, but it is typically short in duration and ameliorated by frequent, dense coastal fog and cloud cover. This forest type also dominates lower elevations (to 350 m) on the leeward side of the Queen Charlotte Islands in British Columbia. In Washington and Oregon, it is found mostly below 300 m elevation. It also occurs as a very narrow strip or localized patches along the southern Washington, Oregon and northern California coasts.

Dynamics: The disturbance regime is mostly small-scale windthrow or other gap mortality processes (though there are occasional widespread intense windstorms) and very few fires, the latter mainly in Oregon. Sitka spruce acts as an early colonizer of disturbed sites, such as land slumps, fluvial deposits, recently deglaciated areas. Seeds germinate best on bare mineral soil, a mixture of mineral soil and organic soil, and nurse-logs (Sawyer et al. 2009). Landfire (2007a) model: The disturbance regime is mostly small-scale windthrow or other gap mortality processes (though there are occasional widespread intense windstorms) and very few fires, the latter mainly in Oregon. Where fire does occur, it is usually stand-replacing, with a fire return interval of 300-1000 years or longer. In most of the range of the type, windthrow is a more significant catastrophic disturbance than wildfire. Windthrow "rotation" is estimated to be between 100-200 years, (but can be up to 1000 years due to patchiness). The effects of windthrow are strongly correlated with topography and adjacent land use (e.g., clearcuts). Landfire VDDT models: R#SSHE Sitka spruce - hemlock.

Component Associations:
- *Chamaecyparis lawsoniana - Picea sitchensis / Vaccinium ovatum - Rhododendron macrophyllum* Forest (CEGL000054, G1)
- *Chamaecyparis lawsoniana / Vaccinium ovatum* Forest (CEGL000048, G1)
- *Picea sitchensis - Tsuga heterophylla / Rhododendron macrophyllum - Vaccinium ovatum* Forest (CEGL002603, G1)
- *Picea sitchensis / Gaultheria shallon - Rubus spectabilis* Forest (CEGL000402, G3)
- *Picea sitchensis / Menziesia ferruginea - Vaccinium parvifolium* Forest (CEGL000056, G3)
- *Picea sitchensis / Rubus spectabilis* Forest (CEGL000060, G3)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- California Coastal Closed-Cone Conifer Forest and Woodland (CES206.922)
- California Coastal Redwood Forest (CES206.921)
- North Pacific Hypermaritime Western Red-cedar-Western Hemlock Forest (CES204.842)

Adjacent Ecological System Comments: From Washington north, it occurs as patches within a matrix or mosaic of North Pacific Hypermaritime Western Red-cedar-Western Hemlock Forest (CES204.842) and wetlands. In California, it occurs adjacent to California Coastal Redwood Forest (CES206.921) and California Coastal Closed-Cone Conifer Forest and Woodland (CES206.922).

DISTRIBUTION

Range: This ecological system is restricted to the hypermaritime climatic areas near the Pacific coast from Point Arena, California, north to northern Vancouver Island and Smith Sound on the mainland coast of British Columbia (S. Saunders pers. comm. 2013), where it merges with its northern counterpart, Alaskan Pacific Maritime Sitka Spruce Forest (CES204.151).
Divisions: 204:C
Nations: CA, US
Subnations: BC, CA, OR, WA
Map Zones: 1:C, 2:C, 3:C
USFS Ecomap Regions: 242A:CC, M242A:CC, M242D:CC, M261A:??
TNC Ecoregions: 1:C, 69:C

SOURCES

References: Agee 1993, Dorner and Wong 2003, Eyre 1980, Franklin and Dyrness 1973, Green and Klinka 1994, Harcombe et al. 2004, Harris 1990, Haughian et al. 2012, Henderson et al. 1989, Holland and Keil 1995, Karl et al. 2009, Landfire 2007a, Littell et al. 2009, McCain and Diaz 2002a, Meidinger and Pojar 1991, Packee 1990, PRBO Conservation Science 2011, Rodenhuis et al. 2009, Saunders pers. comm., Sawyer et al. 2009, Spittlehouse 2008, Steen and Coupe 1997, Werner 2011, Western Ecology Working Group n.d., WNHP 2011, Wolf et al. 1995
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722833#references
Description Author: G. Kittel, P. Comer, D. Vanderschaaf, mod. C. Chappell, T. Keeler-Wolf, M.S. Reid
Version: 14 Jan 2014 **Stakeholders:** Canada, West
Concept Author: G. Kittel, P. Comer, D. Vanderschaaf **ClassifResp:** West

NORTH PACIFIC SUB-BOREAL MESIC HYBRID WHITE SPRUCE-DOUGLAS-FIR FOREST (CES207.350)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Warm Continental (207)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Plateau
National Mapping Codes: ESLF 4410

CONCEPT

Summary: This ecological system encompasses forests of the southern interior occurring in southern positions and lower elevations with respect to the other variants. Winter precipitation is relatively low for the region, with snowpacks generally accumulating up to about 2 m in depth. Forests are dominated by a combination of *Pseudotsuga menziesii*, *Pinus contorta*, and *Picea glauca X engelmannii* (hybrid white spruce). In the interior portions of British Columbia, Douglas-fir may increase with global warming. This system may be a subset of the mesic hybrid white spruce system, but it is separated due to the predominance of Douglas-fir and as a warmer climate indicator. Undergrowth is rich, with 30% shrub cover, 80% moss cover and 50% herbaceous layer.
Classification Comments: This ecological system was developed for the purpose of capturing the coarse filter of terrestrial biodiversity in the interior of British Columbia Ecoregional Assessment, conducted by The Nature Conservancy of Canada, with NatureServe's assistance. This system was designed to be equivalent to those developed for neighboring ecoregions: Canadian Rocky Mountains (7), Okanagan (68), Alaska Coastal Forest and Mountains (69), and the North Cascades (3).
Related Concepts:

- $At - Kinnikinnick (SBSdk/04) (Banner et al. 1993) Intersecting
- $At - Kinnikinnick (SBSdk/04) (Steen and Coupe 1997) Intersecting
- $At - Kinnikinnick (SBSdk/04) (DeLong et al. 1993) Intersecting
- $At - Saskatoon - Snowberry (SBSdk/04) (DeLong et al. 1993) Intersecting
- $At - Saskatoon - Snowberry (SBSdk/04) (Steen and Coupe 1997) Intersecting
- $At - Saskatoon - Snowberry (SBSdk/04) (Banner et al. 1993) Intersecting
- $Ep - Douglas maple (SBSdk/04) (Banner et al. 1993) Intersecting
- $Ep - Douglas maple (SBSdk/04) (DeLong et al. 1993) Intersecting
- $Ep - Douglas maple (SBSdk/04) (Steen and Coupe 1997) Intersecting
- Fd - Douglas maple - Step moss (SBSmh/04) (Steen and Coupe 1997) Intersecting
- Fd - Douglas maple - Step moss (SBSmh/04) (DeLong 2003) Intersecting
- Fd - Soopolallie - Feathermoss (SBSdk/04) (Banner et al. 1993) Intersecting
- Fd - Soopolallie - Feathermoss (SBSdk/04) (DeLong et al. 1993) Intersecting
- Fd - Soopolallie - Feathermoss (SBSdk/04) (Steen and Coupe 1997) Intersecting
- FdBl - Huckleberry (SBSmw/02) (Steen and Coupe 1997) Intersecting
- FdBl - Huckleberry (SBSmw/02) (DeLong 2003) Intersecting
- Pl - Huckleberry - Velvet-leaved blueberry (SBSmw/03) (DeLong 2003) Intersecting
- Sxw - Prickly rose - Coltsfoot (IDFxw/07) (Steen and Coupe 1997) Intersecting
- Sxw - Water birch (IDFxw/06) (Steen and Coupe 1997) Intersecting
- SxwFd - Birch-leaved spirea - Feathermoss (SBSwk3a/04) (DeLong 2004) Intersecting
- SxwFd - Cat's-tail moss (SBSdw2/05) (Steen and Coupe 1997) Intersecting
- SxwFd - Cat's-tail moss (SBSdw2/05) (DeLong et al. 1993) Intersecting
- SxwFd - Coltsfoot (SBSmh/06) (DeLong 2003) Intersecting
- SxwFd - Coltsfoot (SBSmh/06) (Steen and Coupe 1997) Intersecting
- SxwFd - Falsebox (SBSmw/01) (DeLong 2003) Intersecting
- SxwFd - Falsebox (SBSmw/01) (Steen and Coupe 1997) Intersecting
- SxwFd - Feathermoss (SBSmh/05) (DeLong 2003) Intersecting
- SxwFd - Feathermoss (SBSmh/05) (Steen and Coupe 1997) Intersecting
- SxwFd - Gooseberry - Feathermoss (IDFdk1/05) (Steen and Coupe 1997) Intersecting
- SxwFd - Hazelnut (SBSmh/01) (Steen and Coupe 1997) Intersecting
- SxwFd - Hazelnut (SBSmh/01) (DeLong 2003) Intersecting
- SxwFd - Knight's plume (SBSmw/04) (Steen and Coupe 1997) Intersecting
- SxwFd - Knight's plume (SBSmw/04) (DeLong 2003) Intersecting
- SxwFd - Knight's plume (SBSwk1/04) (Steen and Coupe 1997) Intersecting
- SxwFd - Knight's plume (SBSwk1/04) (DeLong 2003) Intersecting
- SxwFd - Pinegrass (SBSdw1/01) (DeLong 2003) Intersecting
- SxwFd - Pinegrass (SBSdw1/01) (Steen and Coupe 1997) Intersecting
- SxwFd - Pinegrass (SBSdw2/01) (Steen and Coupe 1997) Intersecting

- SxwFd - Pinegrass (SBSdw2/01) (DeLong et al. 1993) Intersecting
- SxwFd - Pinegrass (SBSdw3/01) (DeLong et al. 1993) Intersecting
- SxwFd - Pinegrass (SBSdw3/01) (Banner et al. 1993) Intersecting
- SxwFd - Prickly rose - Sarsaparilla (IDFdk3/08) (Steen and Coupe 1997) Intersecting
- SxwFd - Prickly rose - Sedge (IDFdk3/07) (Steen and Coupe 1997) Intersecting
- SxwFd - Purple peavine (SBSwk3/03) (MacKinnon et al. 1990) Intersecting
- SxwFd - Purple peavine (SBSwk3/03) (Banner et al. 1993) Intersecting
- SxwFd - Purple peavine (SBSwk3a/03) (DeLong 2004) Intersecting
- SxwFd - Ricegrass (SBSdh1/01) (DeLong 1996) Intersecting
- SxwFd - Ricegrass (SBSdw1/05) (DeLong 2003) Intersecting
- SxwFd - Ricegrass (SBSdw1/05) (Steen and Coupe 1997) Intersecting
- SxwFd - Ricegrass (SBSdw3/04) (DeLong et al. 1993) Intersecting
- SxwFd - Ricegrass (SBSdw3/04) (Banner et al. 1993) Intersecting
- SxwFd - Step moss (SBPSmk/05) (Steen and Coupe 1997) Intersecting
- SxwFd - Thimbleberry (SBSdh1/06) (DeLong 1996) Intersecting
- SxwFd - Thimbleberry (SBSdw1/06) (Steen and Coupe 1997) Intersecting
- SxwFd - Thimbleberry (SBSdw1/06) (DeLong 2003) Intersecting

DISTRIBUTION

Range: This ecological system occurs entirely within central interior British Columbia.
Divisions: 207:C
Nations: CA
Subnations: BC
TNC Ecoregions: 144:C

SOURCES

References: Banner et al. 1993, DeLong 1996, DeLong 2003, DeLong 2004, DeLong et al. 1993, MacKinnon et al. 1990, Steen and Coupe 1997, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.820954#references
Description Author: G. Kittel
Version: 26 Jan 2009 **Stakeholders:** Canada, West
Concept Author: G. Kittel **ClassifResp:** West

NORTH PACIFIC SUB-BOREAL SUBALPINE FIR-HYBRID WHITE SPRUCE PARKLAND (CES207.358)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Warm Continental (207)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Upper Montane]
National Mapping Codes: ESLF 4411

CONCEPT

Summary: This ecological system encompasses forests of the central interior subalpine altitudes transitioning into the alpine. Parklands are clumps of full-height trees of *Picea glauca X engelmannii* (hybrid white spruce) and *Abies lasiocarpa*, with wet and mesic meadows in the openings between tree patches.
Classification Comments: This ecological system was developed for the purpose of capturing the coarse filter of terrestrial biodiversity in the interior of British Columbia Ecoregional Assessment, conducted by The Nature Conservancy of Canada, with NatureServe's assistance. This system was designed to be equivalent to those developed for neighboring ecoregions: Canadian Rocky Mountains (7), Okanagan (68), Alaska Coastal Forest and Mountains (69), and the North Cascades (3).
Related Concepts:

- no data (ESSFmvp/) (BCMF 2006) Intersecting
- no data (ESSFwcp/) (BCMF 2006) Intersecting

DISTRIBUTION

Range: This ecological system occurs entirely within central interior British Columbia.
Divisions: 207:C
Nations: CA
Subnations: BC
TNC Ecoregions: 144:C

SOURCES

References: BCMF 2006, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.820960#references
Description Author: G. Kittel
Version: 26 Jan 2009
Concept Author: G. Kittel
Stakeholders: Canada, West
ClassifResp: West

NORTH PACIFIC WOODED VOLCANIC FLOWAGE (CES204.883)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Rock Outcrops/Barrens/Glades; Very Shallow Soil; Lava Flow
Non-Diagnostic Classifiers: Escarpment; Long (>500 yrs) Persistence; Montane [Upper Montane]; Montane [Montane]; Montane [Lower Montane]; Lowland [Foothill]; Temperate [Temperate Continental]; Butte
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2173; ESLF 4329; ESP 1173

CONCEPT

Summary: This ecological system is found from foothill to subalpine elevations and includes woodland to sparsely vegetated landscapes (generally >10% plant cover) on recent lava flows, excessively well-drained lahars, debris avalanches and pyroclastic flows. The characteristic feature of this system is the substrate limiting characteristic that creates an environment for a more open vegetation than the surrounding closed matrix forest. Examples are recent lava flows (3500-8200 years ago) on the north side of Mount Adams (andecite) and the big lava beds (basalt) south of Indian Heaven west of Mount Adams, Washington, and lahars (200-2000 years old) at Old Maid Flat west of Mount Hood, Oregon. These areas support open to sparse tree cover; characteristic species include *Pseudotsuga menziesii, Pinus contorta, Pinus monticola,* and *Abies lasiocarpa*. Tree cover can range from scattered (5%) up to 70% or occasionally even more. There may be scattered to dense shrubs present, such as *Acer circinatum, Vaccinium membranaceum, Arctostaphylos uva-ursi* (very characteristic), *Mahonia nervosa, Amelanchier alnifolia,* and *Xerophyllum tenax*. Soil development is limited, and mosses and lichens often cover the soil or rock surface.
Classification Comments: This system will include areas that fit the sparsely vegetated system type definition but are included here and delineated by the boundary of lava or other volcanic flowage. Elevation range (>3350 m) for this system is great, but the specialized substrate is the overriding factor defining it. These are mid-stages of primary succession that differ in degree of forest cover, soil development and productivity. Early primary succession on these substrates are included in North Pacific Active Volcanic Rock and Cinder Land (CES204.092). Later primary succession stages (increased soil development) are included in appropriate matrix forest systems.
Related Concepts:
- Lodgepole Pine: 218 (Eyre 1980) Intersecting

SPATIAL CHARACTERISTICS

Size: Big lava bed in Washington approx. 16,000 acres; Mount Adams north side approx. 8000 acres. Can also be quite small, e.g., lahar at Longmire on Mount Rainier less than 100 acres.

DISTRIBUTION

Range: This uncommon system is found in the east and west Cascades of Washington and Oregon, and may occur in small patches in northern California in the vicinity of Mount Lassen or Mount Shasta.
Divisions: 204:C
Nations: US
Subnations: CA?, OR, WA
Map Zones: 1:C, 2:P, 6:P, 7:C
USFS Ecomap Regions: 242A:CC, 342I:PP, M242B:CC, M242C:CC, M242D:CP, M261D:CP, M261G:CC
TNC Ecoregions: 3:P, 4:C, 81:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.767990#references
Description Author: R. Crawford
Version: 31 Aug 2005
Stakeholders: West
Concept Author: R. Crawford
ClassifResp: West

NORTH-CENTRAL INTERIOR BEECH-MAPLE FOREST (CES202.693)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Non-Diagnostic Classifiers: Forest and Woodland (Treed); Glaciated; Acer saccharum - Fagus grandifolia
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: EVT 2313; ESLF 4119; ESP 1313

CONCEPT

Summary: This system is found primarily along the southern Great Lakes ranging from central Indiana to southern Ontario. It is typically found on flat to rolling uplands to steep slopes with rich loam soils over glacial till. This system is characterized by a dense tree canopy that forms a thick layer of humus and leaf litter leading to a dense and rich herbaceous layer. *Acer saccharum* and *Fagus grandifolia* comprise up to 80% of the canopy. Canopy associates can include *Quercus rubra*, *Tilia americana*, and *Liriodendron tulipifera* with *Carpinus caroliniana* and *Ostrya virginiana* common in the understory and subcanopy. The relative dominance of sugar maple compared to other tree species varies across the range of this system based on regional climate and microclimate. The herbaceous layer is very diverse and typically includes spring ephemerals. Some common species include *Arisaema triphyllum*, *Osmorhiza claytonii*, *Polygonatum biflorum*, and *Trillium grandiflorum*. The primary natural disturbance influencing this system includes wind-driven gap dynamics. Conversion to agriculture has significantly decreased the range of this system, and very few large stands remain intact.
Classification Comments: North-Central Interior Wet Flatwoods (CES202.700) may co-occur in close proximity to this system on clay-plain landscapes. This is on richer sites than the corresponding Appalachian (Hemlock)-Northern Hardwood Forest (CES202.593).
Similar Ecological Systems:
- Appalachian (Hemlock)-Northern Hardwood Forest (CES202.593)--occurs on poorer sites.
- Laurentian-Acadian Northern Hardwood Forest (CES201.564)--can have inclusions of richer stands. Eastern rich forests CEGL005008 are placed in CES201.564, and range for that system includes Mapzones 41, 50, 51.
- North-Central Interior Maple-Basswood Forest (CES202.696)--less beech.
- South-Central Interior Mesophytic Forest (CES202.887)-- present system is in glaciated landscape; this one (CES202.887) is not.

Related Concepts:
- Beech - Sugar Maple: 60 (Eyre 1980) Finer
- Sugar Maple - Beech - Yellow Birch: 25 (Eyre 1980) Finer

DESCRIPTION

Environment: This system is typically found on flat to rolling uplands to steep slopes with rich loam soils over glacial till. It occurs principally on medium- or fine-textured ground moraine, medium- or fine-textured end moraine, and silty/clayey glacial lakeplains. Sand dunes and sandy lakeplains can support these systems where proximity to the Great Lakes modifies local climate (within 10-20 miles of the shore, evapotranspiration conditions are suitable for mesic forest). Prevalent topographic positions of this community are gentle to moderate slopes and level areas with moderate to good drainage. Where mesic southern forest occurs on steeper slopes, it is often associated with northern to eastern exposures which receive low amounts of direct sunlight and are characterized by a cool, moist microclimate.

It can occur on a variety of soil types, but loam is the predominant texture. The diversity of soils which can support this system include sand, sandy loam, loamy sand, loam, silt loam, silty clay loam, clay loam, and clay. Soils are typically well-drained with high water-holding capacity and high nutrient and soil organism content. High soil fertility is maintained by nutrient inputs from the decomposition of deciduous leaves which enrich the top layer of soil (Cohen 2004).
Dynamics: Small-gap development and replacement due to tree death is the prevalent disturbance factor influencing this system. Catastrophic fire and/or wind can impact this system over long return intervals but are rare. Tree canopy tends to be closed so understory plants receive little light after leaf-out in the spring. This system could form large stands or be part of a large forested landscape in conjunction with other forested types, resulting in a relatively high proportion of forest interior to forest edge.

Component Associations:
- *Acer saccharum - Fagus grandifolia - Betula* spp. / *Maianthemum canadense* Forest (CEGL005004, G4G5)
- *Fagus grandifolia - Acer saccharum* Glaciated Midwest Forest (CEGL005013, G2G3)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- North-Central Interior Wet Flatwoods (CES202.700)

Adjacent Ecological System Comments: North-Central Interior Wet Flatwoods (CES202.700) may co-occur in close proximity to this system on clay-plain landscapes.

DISTRIBUTION

Range: This system is located in the southern Great Lakes from central Indiana north into southern Ontario, and east to northwestern Pennsylvania and western New York.
Divisions: 202:C
Nations: CA, US
Subnations: IN, MI, NY, OH, ON, PA
Map Zones: 47:C, 49:C, 51:C, 52:C, 62:P, 63:C
USFS Ecomap Regions: 221F:CC, 222H:CC, 222Ia:CCC, 222Ja:CCC, 222Jb:CCC, 222Jc:CCC, 222Je:CCC, 222Jg:CCC, 222Jh:CCC, 222Ji:CCC, 222K:CC, 222L:CC, 222M:CC, 222Ua:CCC, 222Ud:CCC, 222Ue:CCC, 223G:PP, 251D:CC
TNC Ecoregions: 36:C, 45:C, 47:P, 48:C

SOURCES

References: Barbour and Billings 1988, Barnes 1991, Beaman 1970, Brewer 1980, Cain 1935, Cohen 2004, Comer and Albert 1997, Comer et al. 1995a, Comer et al. 1998, Comer et al. 2003, Curtis 1959, Donnelly and Murphy 1987, Eyre 1980, Horsley et al. 2003, Howell et al. 2005, Kost et al. 2007, Palik and Murphy 1990, Parker 1989, Parker et al. 1985, Robertson and Robertson 1995, Rooney and Waller 2003, Witter et al. 2005
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722966#references
Description Author: S. Menard, mod. S.C. Gawler and J. Drake
Version: 14 Jan 2014 **Stakeholders:** Canada, East, Midwest, Southeast
Concept Author: S. Menard **ClassifResp:** Midwest

NORTH-CENTRAL INTERIOR DRY OAK FOREST AND WOODLAND (CES202.047)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Outwash plain; Forest and Woodland (Treed); Sand Soil Texture; Intermediate Disturbance Interval; F-Patch/Medium Intensity
Non-Diagnostic Classifiers: Outwash terrace; Acidic Soil; Ustic; Xeric
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Deciduous open tree canopy
National Mapping Codes: EVT 2311; ESLF 4117; ESP 1311

CONCEPT

Summary: This system is found throughout the glaciated regions of the Midwest, typically in gently rolling to flat landscapes. It can occur on uplands within the prairie matrix or within the context of dry-mesic oak-hickory forests and oak savannas. These are common on rolling glacial moraines and outwash plains. Soils are typically well-drained to excessively drained Mollisols or Alfisols that range from sand to sandy loam in texture. Historically, this type was quite extensive in Michigan, Indiana, Illinois, Missouri, Iowa, Wisconsin, and Minnesota. It is distinguished from other forested systems within the region by a dry edaphic condition that is transitional between dry prairies, oak barrens, or savannas and dry-mesic oak-hickory forests and woodlands. Forest cover can range from dense to moderately open canopy. Fire-resistant oak species, in particular *Quercus velutina, Quercus macrocarpa, Quercus coccinea*, and *Quercus ellipsoidalis*, dominate the overstory. *Carya glabra, Prunus serotina*, and *Sassafras albidum* are also common in portions of the range of this system. Depending on range of distribution and overstory canopy density, the understory may include species such as *Gaylussacia baccata* (in Michigan, Wisconsin, and Minnesota), *Vaccinium angustifolium*, and *Rhus aromatica*, and/or a mixture of woodland and grassland species, including *Schizachyrium scoparium, Deschampsia flexuosa*, and *Carex pensylvanica*. Extreme drought, along with periodic ground and crown fire events, constitute the main natural processes for this type and likely maintained a more open canopy structure that supported oak regeneration. In fact, many current examples of this type have resulted from long-term fire suppression and conversion of oak barrens to these forests and woodlands. Fire suppression may also account for examples of this system with the more dry-mesic understory. It likely has allowed for other associates such as *Quercus rubra* and *Fraxinus americana* to become more prevalent. Extensive conversion for agriculture in the surrounding landscape with more productive soils has fragmented and isolated examples of this system. It is found primarily within the "corn belt" of the United States, and remaining large areas of this system are likely under considerable pressure due to conversion to pastureland and urban development.

Classification Comments: This system is related to North-Central Interior Dry-Mesic Oak Forest and Woodland (CES202.046), which has white oak, red oak, and bur oak, and occurs on somewhat deeper soils; the present system has oak savannas and oak-hickory and occurs on sandplains. Applying this concept difference to drawing lines on the ground can be tricky.

Similar Ecological Systems:
- North-Central Interior Dry-Mesic Oak Forest and Woodland (CES202.046)

Related Concepts:
- Northern Pin Oak: 14 (Eyre 1980) Finer
- White Oak - Black Oak - Northern Red Oak: 52 (Eyre 1980) Finer

DESCRIPTION

Environment: This system can occur on uplands within the prairie matrix or within the context of dry-mesic oak-hickory forests and oak savannas. These are common on rolling glacial moraines and outwash plains and, less frequently, old dunes. Soils are typically well-drained to excessively drained Mollisols or Alfisols that range from sand to sandy loam in texture. Dry soils or landscape position (steep slopes, upper slopes, south- or west-facing aspect) favor the formation of this system. Historically, this type was quite extensive in Michigan, Indiana, Illinois, Missouri, Iowa, Wisconsin, and Minnesota. It is distinguished from other forested systems within the region by a dry edaphic condition that is transitional between dry prairies, oak barrens, or savannas and dry-mesic oak-hickory forests and woodlands.

Vegetation: Forest cover can range from a dense to moderately open canopy. Fire-resistant oak species, in particular *Quercus velutina, Quercus macrocarpa, Quercus coccinea*, and *Quercus ellipsoidalis*, dominate the overstory. *Carya glabra, Prunus serotina*, and *Sassafras albidum* are also common in portions of the range of this system. Depending on range of distribution and overstory canopy density, the understory may include species such as *Gaylussacia baccata* (in MI, WI, and MN), *Vaccinium angustifolium*, and *Rhus aromatica*, and/or a mixture of woodland and grassland species, including *Schizachyrium scoparium, Deschampsia flexuosa*, and *Carex pensylvanica*.

Dynamics: Extreme drought, along with periodic ground and crown fire events, constitute the main natural processes for this type and likely maintained a more open canopy structure that supported oak regeneration. In fact, many current examples of this type have resulted from long-term fire suppression and conversion of oak barrens to these forests and woodlands. Frequency of fires necessary to maintain this system varied, largely depending on soil fertility and drainage, with more fertile and mesic sites requiring more frequent

fires. Fire-return intervals of 5-20 years would typically maintain a woodland or oak grub shrubland, while fire-return intervals of 20-50 years would typically maintain a closed canopy oak forest (Landfire 2007a). Fire suppression may also account for examples of this system with the more dry-mesic understory. It likely has allowed for other associates such as *Quercus rubra* and *Fraxinus americana* to become more prevalent.

Component Associations:
- *Quercus ellipsoidalis - (Quercus macrocarpa)* Forest (CEGL002077, G4?)
- *Quercus velutina - (Quercus ellipsoidalis) - Quercus alba / Deschampsia flexuosa* Woodland (CEGL005029, GNR)
- *Quercus velutina - Quercus alba - Carya (glabra, ovata)* Forest (CEGL002076, G4?)
- *Quercus velutina - Quercus alba / Vaccinium (angustifolium, pallidum) / Carex pensylvanica* Forest (CEGL005030, G4?)
- *Quercus velutina / Carex pensylvanica* Forest (CEGL002078, G4?)

DISTRIBUTION

Range: Found throughout the glaciated regions of the Midwest.
Divisions: 202:C; 205:P
Nations: US
Subnations: IL, IN, MI, MN, MO, ND, OH, WI
Map Zones: 38:P, 39:P, 40:P, 41:C, 42:C, 43:C, 44:P, 47:P, 49:C, 50:C, 51:C, 52:C
USFS Ecomap Regions: 212H:CC, 222H:CC, 222Ja:CCC, 222Jc:CCC, 222Je:CCC, 222Jg:CCC, 222Jh:CCC, 222Ji:CCC, 222Ua:CCC, 223A:CP, 223G:CC, 251B:CC, 251C:CC, 251D:CC, 251E:CC, 251G:CC, 251H:CC, 255A:CC, 331F:CC, 331M:CC, 332B:PP
TNC Ecoregions: 35:P, 36:C, 37:?, 44:?, 45:C, 46:C, 47:?, 48:C

SOURCES

References: Abrams 1992, Archambault et al. 1989, Archambault et al. 1990, Comer and Albert 1997, Comer et al. 1995a, Comer et al. 1999, Comer et al. 2003, Davidson et al. 2001, Eyre 1980, Healy 1997, Kost et al. 2007, Landfire 2007a, MNNHP 1993, Nowacki and Abrams 2008, Rooney 2001, Stroke and Anderson 1992
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722662#references
Description Author: P. Comer, K. Kindscher, S. Menard, D. Faber-Langendoen, mod. J. Drake
Version: 14 Jan 2014 **Stakeholders:** Midwest, Southeast
Concept Author: P. Comer, K. Kindscher, S. Menard, D. Faber-Langendoen **ClassifResp:** Midwest

NORTH-CENTRAL INTERIOR DRY-MESIC OAK FOREST AND WOODLAND (CES202.046)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Udic; F-Patch/Low Intensity; Quercus - Carya
Non-Diagnostic Classifiers: Footslope; Glaciated uplands; Kame moraine; Lakeplain; Moraine; Temperate [Temperate Continental]; Mesotrophic Soil; Loam Soil Texture
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: EVT 2310; ESLF 4116; ESP 1310

CONCEPT

Summary: This system is found throughout the glaciated regions of the Midwest, typically in gently rolling landscapes. It can occur on uplands within the prairie matrix and near floodplains, or on rolling glacial moraines and among kettle-kame topography. Soils are typically well-drained Mollisols or Alfisols that range from loamy to sandy loam or even coarse sands in texture. Historically, this type was quite extensive in Michigan, Indiana, Illinois, Missouri, Iowa, Wisconsin, and Minnesota. Well over 700,000 hectares likely occurred in southern Michigan alone (ca. 1800). It is distinguished from other forested systems within the region by a dry-mesic edaphic condition that is transitional between dry oak forests and woodlands and mesic hardwood forests, such as maple-basswood forests. Forest cover can range from a dense to moderately open canopy and there is commonly a dense shrub layer. Fire-resistant oak species, in particular *Quercus macrocarpa, Quercus rubra*, and/or *Quercus alba*, dominate the overstory. *Carya* spp., including *Carya ovata, Carya cordiformis*, and *Carya alba (= Carya tomentosa)*, are diagnostic in portions of the range of this system. Depending on site location and overstory canopy density, the understory may include species such as *Amelanchier* spp., *Aralia nudicaulis, Corylus americana, Desmodium glutinosum, Maianthemum stellatum, Osmunda claytoniana, Phryma leptostachya, Trillium grandiflorum*, and *Viburnum acerifolium*. Occasionally, prairie grasses such as *Andropogon gerardii* and *Panicum virgatum* may be present. Fire constitutes the main natural process for this type and likely maintained a more open canopy structure to support oak regeneration. Historic fire frequency was likely highest in the prairie-forest border areas. Fire suppression may account for the more closed oak forest examples of this system with the more mesic understory. It likely has allowed for other associates, such as *Acer saccharum, Acer rubrum, Celtis occidentalis, Liriodendron tulipifera, Ostrya virginiana*, and *Juglans nigra*, to become more prevalent, especially in upland areas along floodplains. Periodic drought, intensified by local conditions, such as slope, southern exposure, or sandy soil, also inhibit growth of mesophytic trees. Extensive conversion for agriculture has fragmented this system. Continued fire suppression has also resulted in succession to mesic hardwoods, such that in many locations, no oak species are regenerating. Remaining large areas of this system are likely under considerable pressure due to conversion to agriculture, pastureland, and urban development.
Classification Comments: This is the predominant oak system for the upper Midwest, and is more extensive on the landscape than the related North-Central Interior Dry Oak Forest and Woodland (CES202.047).
Similar Ecological Systems:
- North-Central Interior Dry Oak Forest and Woodland (CES202.047)
- Southern Interior Low Plateau Dry-Mesic Oak Forest (CES202.898)

Related Concepts:
- Bur Oak: 42 (Eyre 1980) Finer
- Eastern Dry-Mesic Bur Oak Forest and Woodland (Rolfsmeier and Steinauer 2010) Intersecting
- Eastern Upland Oak Bluff Forest (Rolfsmeier and Steinauer 2010) Intersecting
- Northern Red Oak: 55 (Eyre 1980) Finer
- White Oak - Black Oak - Northern Red Oak: 52 (Eyre 1980) Finer
- White Oak: 53 (Eyre 1980) Finer

DESCRIPTION

Environment: This system can occur on uplands within the prairie matrix and near floodplains, or on rolling glacial moraines and kettle-kame topography. Soils are typically well-drained Mollisols or Alfisols that range from loamy to sandy loam or even coarse sands in texture. Historically, this type was quite extensive in Michigan, Indiana, Illinois, Missouri, Iowa, Wisconsin, and Minnesota. Well over 700,000 hectares likely occurred in southern Michigan alone (ca. 1800). It is distinguished from other forested systems within the region by a dry-mesic edaphic condition that is transitional between dry oak forests and woodlands and mesic hardwood forests, such as maple-basswood forests.
Vegetation: Forest cover can range from a dense to moderately open canopy and there is commonly a dense shrub layer. Fire-resistant oak species, in particular *Quercus macrocarpa, Quercus rubra*, and/or *Quercus alba*, dominate the overstory. *Carya* spp., including *Carya ovata*, *Carya cordiformis*, and *Carya alba (= Carya tomentosa)*, are diagnostic in portions of the range of this system. Depending on site location and overstory canopy density, the understory may include species such as *Corylus americana, Amelanchier* spp., *Maianthemum stellatum, Caulophyllum thalictroides, Laportea canadensis, Trillium grandiflorum, Aralia nudicaulis*, and *Urtica dioica*. Occasionally, prairie grasses such as *Andropogon gerardii* and *Panicum virgatum* may be present. Fire

suppression likely has allowed for other associates, such as *Acer saccharum, Celtis occidentalis, Liriodendron tulipifera, Ostrya virginiana,* and *Juglans nigra,* to become more prevalent, especially in upland areas along floodplains.
Dynamics: Fire constitutes the main natural process for this type and frequent surface fires combined with uncommon crown fires maintained a more open canopy and subcanopy structure to allow oak regeneration. Historic fire frequency was highest in the prairie-forest border areas and declined further from prairies and behind natural firebreaks. Frequency of fires necessary to maintain this system varied, largely depending on soil fertility and drainage, with more fertile and mesic sites requiring more frequent fires. Fire-return intervals of 15-25 years would typically maintain a woodland, while fire-return intervals of 25-50 years would typically maintain a closed-canopy oak forest (Landfire 2007a). Fire suppression accounts for many of the more closed oak forest examples of this system with the more mesic understory (Abrams 1992, Lorimer 2001). Fire suppression has allowed for other associates, such as *Acer saccharum, Celtis occidentalis, Juglans nigra, Liriodendron tulipifera, Ostrya virginiana,* and invasive shrubs, to become more prevalent, especially in more mesic upland areas or along floodplains (Rogers et al. 2008). Periodic drought, intensified by local conditions like slope, southern exposure, or sandy soil, also inhibit growth of mesophytic trees. Some stands currently in this system were more open savanna stands but fire suppression has allowed them to succeed to the more close-canopy oak woodland or forest. A continued lack of fire in many of those stands will result in succession to more mesophytic forest types. Gap-phase dynamics producing multi-structured, uneven-aged stands operate most noticeably in North-Central Interior Beech-Maple Forest (CES202.693) but also influence succession in this system. Canopy gap formation originates through localized stem breakage resulting from wind (Runkle 1982), glaze or ice storms (Lemon 1961), attack by oak wilt fungus (*Chalara quercina*), and episodic defoliation caused by insects such as gypsy moth (*Lymantria dispar*).

Component Associations:
- *Acer saccharum - Quercus muehlenbergii* Forest (CEGL005010, GNR)
- *Quercus alba - (Carya ovata) / Carex pensylvanica* Glaciated Woodland (CEGL002134, G1Q)
- *Quercus alba - (Quercus velutina) - Carya ovata / Ostrya virginiana* Forest (CEGL002011, G3)
- *Quercus alba - Quercus macrocarpa - Quercus rubra / Corylus americana* Woodland (CEGL002142, G3G4)
- *Quercus alba - Quercus rubra - Acer saccharum - Carya cordiformis / Lindera benzoin* Forest (CEGL002058, G3?)
- *Quercus alba - Quercus rubra - Carya ovata* Glaciated Forest (CEGL002068, G4?)
- *Quercus bicolor - (Quercus macrocarpa, Quercus stellata)* Woodland (CEGL005181, G1)
- *Quercus macrocarpa / Andropogon gerardii - Panicum virgatum* Woodland (CEGL002052, G1G2)
- *Quercus macrocarpa / Cornus drummondii / Aralia nudicaulis* Forest (CEGL002072, G4)
- *Quercus macrocarpa / Corylus americana - Amelanchier alnifolia* Woodland (CEGL000556, G3)
- *Quercus rubra - Quercus alba - (Quercus velutina, Acer rubrum) / Viburnum acerifolium* Forest (CEGL002462, GNR)

DISTRIBUTION

Range: This system is found throughout the glaciated regions of the Midwest south of the tension zone.
Divisions: 202:C; 205:C
Nations: US
Subnations: IA, IL, IN, KS, MI, MN, MO, ND, NE, OH, SD, WI
Map Zones: 31:C, 38:C, 39:C, 40:C, 41:?, 42:C, 43:C, 44:C, 47:P, 49:C, 50:C, 51:C, 52:C
USFS Ecomap Regions: 222H:CC, 222Ja:CCC, 222Jb:CCC, 222Jc:CCC, 222Je:CCC, 222Jg:CCC, 222Jh:CCC, 222Ji:CCC, 222K:CC, 222L:CC, 222M:CC, 222Ua:CCC, 222Ue:CCC, 223G:CC, 251B:CC, 251C:CC, 251D:CC, 251H:CC
TNC Ecoregions: 35:C, 36:C, 44:?, 45:C, 46:C, 47:?, 48:C

SOURCES

References: Abrams 1986, Abrams 1992, Archambault et al. 1989, Archambault et al. 1990, Comer and Albert 1997, Comer et al. 1995a, Comer et al. 2003, Davidson et al. 2001, Eyre 1980, Healy 1997, Landfire 2007a, Lemon 1961, Lorimer 2001, MNNHP 1993, Nowacki and Abrams 2008, Rogers et al. 2008, Rolfsmeier and Steinauer 2010, Rooney 2001, Runkle 1982, Stroke and Anderson 1992
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722663#references
Description Author: P. Comer, K. Kindscher, S. Menard, D. Faber-Langendoen, mod. J. Drake
Version: 14 Jan 2014 **Stakeholders:** Midwest, Southeast
Concept Author: P. Comer, K. Kindscher, S. Menard, D. Faber-Langendoen **ClassifResp:** Midwest

NORTH-CENTRAL INTERIOR MAPLE-BASSWOOD FOREST (CES202.696)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Non-Diagnostic Classifiers: Forest and Woodland (Treed); Sideslope; Toeslope/Valley Bottom; Mesotrophic Soil; Deep Soil; Loam Soil Texture
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: EVT 2314; ESLF 4120; ESP 1314

CONCEPT

Summary: This system is primarily found in the prairie forest border region of Minnesota, Wisconsin, and Iowa, but it can range north into northern Minnesota and Wisconsin and south to central Illinois, central Missouri, and eastern Kansas. This forest system is distinguished by underlying mesic soils and the predominance of mesic deciduous species forming a moderately dense to dense canopy. Examples of this system occur on valley slopes and bottoms often with northern or eastern aspects. Soils are moderately well-drained, fertile, and medium to deep loams that have developed from glacial till or loess parent material. *Acer saccharum* typifies this system, with *Tilia americana, Quercus rubra*, and *Ostrya virginiana* as common associates. The dense canopy allows for a rich mixture of shrub and herbaceous species in the understory. Examples of common herbaceous species include *Anemone quinquefolia, Adiantum pedatum, Arisaema triphyllum*, and *Sanicula* spp. Spring ephemeral herbaceous species are characteristic of this system, including *Aplectrum hyemale, Cardamine* spp., *Claytonia virginica, Dicentra cucullaria, Diplazium pycnocarpon, Erythronium americanum, Hydrastis canadensis, Phlox divaricata*, and *Trillium flexipes*. Dynamic processes such as wind and fire can impact this system over long return cycles; however, the most immediate threats to remaining examples of this system are grazing, unsustainable logging, and conversion to agriculture.
Classification Comments: Where *Quercus alba* is prominent in the upper Midwest, this system can be difficult to separate from related oak-dominated systems [see Effigy Mounds NPS map (Hop et al. 2005)]. *Quercus alba* in combination with *Acer saccharum*, and with a more mesic understory, is classified as the present system.
Similar Ecological Systems:
- North-Central Interior Beech-Maple Forest (CES202.693)

Related Concepts:
- Eastern Upland Oak Bluff Forest (Rolfsmeier and Steinauer 2010) Broader
- Northern Red Oak: 55 (Eyre 1980) Finer
- Sugar Maple - Basswood: 26 (Eyre 1980) Finer

DESCRIPTION

Environment: This system is found primarily on mesic soils that are moderately well-drained and fertile. These are mostly moderate to deep loams that have developed from glacial till or loess. This system occurs near the prairie-forest border, and the closer to this border, the stronger the association this system has with natural firebreaks. These sites are typically on the east and north sides of rivers, lakes, and wetlands and topographically protected areas on valley slopes and bottoms often with northern or eastern aspects (Kucera and McDermott 1955, Grimm 1984, Moran n.d.).
Vegetation: Mesic deciduous trees form a moderately dense to dense canopy in examples of this system. *Acer saccharum* is the most common tree species forming the majority of the canopy and sapling layers. Common associates include *Tilia americana, Quercus rubra*, and *Ostrya virginiana*. The understory contains a rich mixture of shrub and herbaceous species such as *Anemone quinquefolia, Adiantum pedatum, Arisaema triphyllum*, and *Sanicula* spp. This system is found west and north of where *Fagus grandifolia* is a reliable and dominant member of the canopy.
Dynamics: Wind and fire can impact this system over long return intervals but are rare. Small-gap development and replacement due to tree death is more frequent than catastrophic fire or wind (Bray 1956, Grimm 1984). Tree canopy tends to be closed so understory plants receive little light after leaf-out in the spring. Old-growth stands may not vary greatly in species composition from mature managed forest but have different structural characteristics, including more snags, coarse woody debris, and large trees (McHale et al. 1999). This provides different habitats for wildlife and other non-plant species. This system could form large stands or be part of a large forested landscape in conjunction with other forested types, resulting in a relatively high proportion of forest interior to forest edge.

Component Associations:
- *Acer saccharum - Acer nigrum - Tilia americana - Quercus rubra / Ostrya virginiana* Forest (CEGL002061, G3G4)
- *Acer saccharum - Tilia americana / Ostrya virginiana - Carpinus caroliniana* Forest (CEGL002062, G3G4)
- *Quercus rubra - (Acer saccharum, Quercus alba)* Forest (CEGL005017, G4?)

DISTRIBUTION

Range: This system ranges from northern Minnesota and Wisconsin south to eastern Kansas and Nebraska and southeast to central

Illinois, Missouri, and possibly western Indiana.
Divisions: 201:C; 202:C; 205:C
Nations: US
Subnations: IA, IL, IN, KS, MI, MN, MO, NE, WI
Map Zones: 39:C, 40:C, 41:C, 42:C, 43:C, 44:P, 49:C, 50:C, 51:C, 52:C
USFS Ecomap Regions: 212J:CP, 212Q:CC, 212S:CP, 212T:CP, 212X:CP, 212Y:C?, 212Z:CP, 222K:CC, 222L:CC, 222M:CC, 222R:CC, 251B:CC, 251G:CC, 251H:CC
TNC Ecoregions: 36:C, 37:C, 38:?, 45:C, 46:C, 47:C, 48:C

SOURCES

References: Alverson et al. 1988, Augustine and Frelich 1998, Barbour and Billings 1988, Bohlen et al. 2004, Bray 1956, Comer et al. 2003, Eyre 1980, Grimm 1984, Groffman et al. 2004, Gundale 2002, Hale et al. 2005, Hop et al. 2005, Howell et al. 2005, Kourtev et al. 1999, Kucera and McDermott 1955, McHale et al. 1999, Moran n.d., Rolfsmeier and Steinauer 2010, Rooney and Waller 2003, SuÃ¡rez et al. 2004, Wiegmann and Waller 2006
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722963#references
Description Author: S. Menard and K. Kindscher, mod. J. Drake
Version: 14 Jan 2014 **Stakeholders:** Midwest, Southeast
Concept Author: S. Menard and K. Kindscher **ClassifResp:** Midwest

NORTHEASTERN INTERIOR DRY-MESIC OAK FOREST (CES202.592)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Lowland; Forest and Woodland (Treed); Acidic Soil; Quercus - Carya
Non-Diagnostic Classifiers: Sideslope; Toeslope/Valley Bottom; Mineral: W/ A-Horizon >10 cm; Loam Soil Texture; Ustic; F-Patch/Medium Intensity; Broad-Leaved Deciduous Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: EVT 2303; ESLF 4109; ESP 1303

CONCEPT

Summary: These oak-dominated forests are one of the matrix forest systems in the northeastern and north-central U.S. Occurring in dry-mesic settings, they are typically closed-canopy forests, though there may be areas of patchy-canopy woodlands. They cover large expanses at low to mid elevations, where the topography is flat to gently rolling, occasionally steep. Soils are mostly acidic and relatively infertile but not strongly xeric. Local areas of calcareous bedrock, or colluvial pockets, may support forests typical of richer soils. Oak species characteristic of dry-mesic conditions (e.g., *Quercus rubra, Quercus alba, Quercus velutina*, and *Quercus coccinea*) and *Carya* spp. are dominant in mature stands. *Quercus prinus* may be present but is generally less important than the other oak species. *Castanea dentata* was a prominent tree before chestnut blight eradicated it as a canopy constituent. *Acer rubrum, Betula lenta*, and *Betula alleghaniensis* may be common associates; *Acer saccharum* is occasional. With a long history of human habitation, many of the forests are early- to mid-successional, where *Pinus strobus, Pinus virginiana*, or *Liriodendron tulipifera* may be dominant or codominant. Within these forests, hillslope pockets with impeded drainage may support small isolated wetlands, including non-forested seeps or forested wetlands with *Acer rubrum, Quercus bicolor*, or *Nyssa sylvatica* characteristic.
Classification Comments: The oak-dominated forest matrix in this region spans a range of elevational and moisture regimes, reflected in different ecological systems. Those in drier settings, within the general range of this system, are placed in either Allegheny-Cumberland Dry Oak Forest and Woodland (CES202.359) or Central Appalachian Dry Oak-Pine Forest (CES202.591).
Similar Ecological Systems:
- Allegheny-Cumberland Dry Oak Forest and Woodland (CES202.359)--is somewhat more xeric and confined to the Southern Unglaciated Allegheny Plateau.
- Central Appalachian Dry Oak-Pine Forest (CES202.591)--is also more xeric and with *Quercus prinus* generally more important.
- Southern Appalachian Oak Forest (CES202.886)--is an equivalent system to the south (in the Southern Blue Ridge, EPA 66).

Related Concepts:
- Beech - Sugar Maple: 60 (Eyre 1980) Finer
- Black Oak: 110 (Eyre 1980) Finer
- Eastern White Pine: 21 (Eyre 1980) Finer
- Northern Red Oak: 55 (Eyre 1980) Finer
- White Oak - Black Oak - Northern Red Oak: 52 (Eyre 1980) Finer
- White Oak: 53 (Eyre 1980) Finer

DESCRIPTION

Environment: These oak-dominated forests are one of the matrix forest systems in the northeastern and north-central U.S. Occurring in dry-mesic settings, they are typically closed-canopy forests, though there may be areas of patchy-canopy woodlands. They cover large expanses at low to mid elevations, where the topography is flat to gently rolling, occasionally steep. The typical landscape position is midslope to toeslope, transitioning to more xeric systems on the upper slopes and ridges. Soils are acidic and relatively infertile but not strongly xeric.
Vegetation: Mature stands are dominated by oak species characteristic of dry-mesic conditions (e.g., *Quercus rubra, Quercus alba, Quercus velutina*, and *Quercus coccinea*), along with various *Carya* spp. *Quercus prinus* may be present but is generally less important than the other oak species. *Castanea dentata* was a prominent tree before chestnut blight eradicated it as a canopy constituent. *Acer rubrum* and *Betula lenta* are frequently common associates. Local areas of calcareous bedrock may support forests typical of richer soils (e.g., with *Acer saccharum* and/or *Quercus muehlenbergii*). Common shrubs include *Viburnum acerifolium, Hamamelis virginiana, Corylus* spp., and *Smilax* spp., as well as heaths such as *Kalmia latifolia, Vaccinium* spp., and *Gaylussacia* spp. Herbs, forbs, and ferns are usually sparse to moderate in density.
Dynamics: This system is naturally dominated by stable, uneven-aged forests, with canopy dynamics dominated by gap-phase regeneration. Most oaks are long-lived, with typical age of mortality ranging from 200 to 400 years. *Quercus coccinea* and *Quercus velutina* are shorter-lived with typical ages being approximately 50 to 100 years, while *Quercus alba* can live as long as 600 years. Extreme wind or ice storms occasionally create larger canopy openings.

This forest system is characterized by low-severity surface fires that cause variable structure and composition based on fire frequency and intensity. The great majority of historical fires were generated by Native Americans.

Open woodlands developed within a moderate burning regime, (fire-return intervals of 5 to 15 years), and canopy closure occurred with greater fire-return intervals. Shade-tolerant, fire-sensitive trees such as *Acer saccharum* regenerated beneath oak-hickory canopies when fire was excluded over several decades. With continued fire exclusion, *Acer saccharum* and other late-successional species gradually replaced overstory oaks and hickories as forest gaps closed (Sutherland et al. 2003), generating a mosaic of vegetation types formed with varying fire history (Cutter and Guyette 1994). A recent study on fire history of a *Quercus rubra* stand in West Virginia revealed that fire intervals ranged from 7 to 32 years from 1846 to 2002, in contrast to intervals of 7 to 15 years prior to the fire control era. These results were consistent with previous research in the oak forests of Ohio, Maryland, and Missouri (Schuler and McClain 2003).

Component Associations:
- *Fagus grandifolia - Betula lenta - Quercus (alba, rubra) / Carpinus caroliniana* Forest (CEGL006921, GNR)
- *Liriodendron tulipifera - Pinus strobus - Tsuga canadensis - Quercus (rubra, alba) / Polystichum acrostichoides* Forest (CEGL006304, G4?)
- *Pinus strobus - Quercus (rubra, velutina) - Fagus grandifolia* Forest (CEGL006293, G5)
- *Quercus (alba, rubra, velutina) - Carya* spp. / *Viburnum acerifolium* Forest (CEGL006336, G4G5)
- *Quercus (rubra, velutina, alba) - Betula lenta - (Pinus strobus)* Forest (CEGL006454, G4G5)
- *Quercus alba - Carya glabra - Fraxinus americana / Cercis canadensis / Muhlenbergia sobolifera - Elymus hystrix* Forest (CEGL006216, G3)
- *Quercus alba - Quercus rubra - Carya (alba, ovata) / Cornus florida* Acidic Forest (CEGL002067, G3)
- *Quercus alba - Quercus rubra - Carya alba / Cornus florida / Vaccinium stamineum / Desmodium nudiflorum* Piedmont Forest (CEGL008475, G4G5)
- *Quercus alba - Quercus rubra - Carya ovata* Glaciated Forest (CEGL002068, G4?)
- *Quercus alba - Quercus rubra - Quercus prinus - Acer saccharum / Lindera benzoin* Forest (CEGL002059, GNR)
- *Quercus bicolor / Vaccinium corymbosum / Carex stipata* Forest (CEGL006241, GNR)
- *Quercus muehlenbergii - Quercus (alba, rubra) - Carya cordiformis / Viburnum prunifolium* Forest (CEGL004793, G3G4)
- *Quercus prinus - Quercus rubra - Carya ovalis / Carex pensylvanica - (Calamagrostis porteri)* Forest (CEGL008516, G3G4)
- *Quercus prinus - Quercus rubra / Hamamelis virginiana* Forest (CEGL006057, G5)
- *Quercus rubra - Acer saccharum / Ostrya virginiana / Cardamine concatenata* Forest (CEGL008517, G4)
- *Quercus rubra - Carya (glabra, ovata) / Ostrya virginiana / Carex lucorum* Forest (CEGL006301, G4)
- *Quercus rubra - Carya (ovata, ovalis) - Fraxinus americana / Actaea racemosa - Hydrophyllum virginianum* Forest (CEGL008518, G3G4)
- *Quercus rubra - Quercus prinus - Carya ovalis / (Cercis canadensis) / Solidago (caesia, curtisii)* Forest (CEGL008514, G3G4)
- *Tilia americana - Fraxinus americana / Acer pensylvanicum - Ostrya virginiana / Parthenocissus quinquefolia - Impatiens pallida* Woodland (CEGL008528, G3)

SPATIAL CHARACTERISTICS

Spatial Summary: These were historically among the most important matrix forests of the Northeast. They cover extensive areas where conditions are not extreme. Upslope they may grade into more xeric oak ridge systems or rocky oak-pine forests/woodlands. Mesic cove forest systems may be embedded within this matrix in protected draws. Small pocket wetlands, not discriminated as separate systems, may also occur within these forests.

Adjacent Ecological Systems:
- Appalachian (Hemlock)-Northern Hardwood Forest (CES202.593)
- Central Appalachian Dry Oak-Pine Forest (CES202.591)
- Southern and Central Appalachian Cove Forest (CES202.373)

Adjacent Ecological System Comments: Dry-mesic oak forests often occur on hilltops and sideslopes. Though often contiguous, patches of this system are often interdigitated with other systems, especially Southern and Central Appalachian Cove Forest (CES202.373) and Central Appalachian Dry Oak-Pine Forest (CES202.591). At the highest elevations, this system may grade into Appalachian (Hemlock)-Northern Hardwood Forest (CES202.593). Small patches of other communities, such as rock outcrops and mountain wetlands, are sometimes embedded within this system.

DISTRIBUTION

Range: This system is found from southern New York west through Ohio and Pennsylvania and south to Virginia. It does not extend to the southernmost part of Virginia, except in the Ridge and Valley.

Divisions: 202:C

Nations: US

Subnations: MD, NJ, NY, OH, PA, VA, WV

Map Zones: 53:C, 57:C, 60:C, 61:C, 62:C, 63:C, 64:C

USFS Ecomap Regions: 211E:CC, 211F:CC, 211G:CC, 221A:CC, 221B:CC, 221D:CC, 221F:CC, M221A:CC, M221B:CC, M221Da:CCC

TNC Ecoregions: 49:C, 52:C, 59:C, 60:C, 61:C

SOURCES

References: Braun 1950, Comer et al. 2003, Cutter and Guyette 1994, Eyre 1980, Greller 1988, Landfire 2007a, Schuler and McClain 2003, Sutherland et al. 2003, USFS 1995, Vanderhorst and Streets 2006

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723014#references
Description Author: S.C. Gawler, mod. L.A. Sneddon
Version: 23 Jan 2012 **Stakeholders:** East, Midwest, Southeast
Concept Author: S.C. Gawler **ClassifResp:** East

NORTHEASTERN INTERIOR PINE BARRENS (CES202.590)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Sandplains/Glacial Outwash or Flats; Glaciated; Oligotrophic Soil; Acidic Soil; Sand Soil Texture; F-Landscape/Medium Intensity; Pinus rigida
Non-Diagnostic Classifiers: Lowland; Forest and Woodland (Treed); Ustic
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2354; ESLF 4257; ESP 1354

CONCEPT

Summary: These pine barrens occur on glacial sandplains of the inland regions of the northeastern U.S., with a disjunction to the distinctive till plain shrublands in the Poconos of eastern Pennsylvania. Substrates include outwash plains, stabilized sand dunes, and glacial till. The soils are consequently coarse-textured, acidic, mostly well-drained to xeric, and low in nutrients. *Pinus rigida* is the usual dominant, and cover may range from closed-canopy forest to (more typically) open woodlands. *Quercus rubra, Pinus strobus,* and *Betula populifolia* are common associates. A tall-shrub layer of *Quercus ilicifolia* and/or *Quercus prinoides* is commonly present, although portions of some barrens (or occasionally the entire barrens) lack the scrub oak component. A well-developed low-shrub layer is typical, with lowbush *Vaccinium* spp., *Gaylussacia baccata,* and *Comptonia peregrina* characteristic, with *Rhododendron canadense* characteristic on the slightly more mesic microsites of the Poconos. The system is often a physiognomic patchwork, ranging from nearly closed-canopy forest to open pine woodlands, to scrub oak shrublands, to herbaceous/dwarf-shrub frost pockets. Grassy areas dominated by *Schizachyrium scoparium* with *Lupinus perennis, Lespedeza capitata,* and other forbs provide habitat for several rare invertebrates. Small changes in elevation can create pockets with saturated soil, where shrubs such as *Corylus americana, Cephalanthus occidentalis, Vaccinium corymbosum,* and *Alnus* spp. form dense cover. These barrens always have a history of recurrent fires, and fire is required to maintain them.
Classification Comments: This system can include patches, or sometimes larger areas, of mesic pitch pine - shrub vegetation. For instance, Pennsylvania's "mesic till barrens" are somewhat less dry than the typical barrens in this system, but fit otherwise. Elsewhere in these barrens, wet pitch pine pockets can occur in (usually small) topographic depressions.
Similar Ecological Systems:
- Laurentian Pine-Oak Barrens (CES201.718)--is centered around the Great Lakes.
- Northern Atlantic Coastal Plain Pitch Pine Barrens (CES203.269)

Related Concepts:
- Bear Oak: 43 (Eyre 1980) Finer
- Eastern White Pine: 21 (Eyre 1980) Finer
- Pitch Pine - Heath Barren (Gawler and Cutko 2010) Finer
- Pitch Pine - Scrub Oak Barren (Gawler and Cutko 2010) Finer
- Pitch Pine: 45 (Eyre 1980) Finer

DESCRIPTION

Environment: This system is confined to flat to gently rolling plains with sandy soils that are coarse-textured, acidic, mostly well-drained to xeric, and low in nutrients.
Dynamics: Fire regime includes frequent stand-replacing events and lower intensity surface fires. Periodic severe wildfires with 40- to 100-year intervals have produced oak-pine mixtures over extensive areas of uplands, while more frequent severe fires have created mixtures of pitch pine and shrub oaks. Pitch pine younger than 20-40 years may produce stump sprouts after top-killing fire (Andresen 1959). If not top-killed, pines may recover from fire by sprouting from branches and trunk. Pitch pine has. Additionally, pitch pine is quick to maturity and to produce seeds. Frequent fires of moderate to high intensity/severity eventually eliminate all other tree species except for scrub oak and pitch pine, which has thick, fire-resistant bark and is a prolific seed producer. Fires, especially large wildfires, have been a major factor in the development of the present differences among forest stands on similar sites in the Pine Barrens. Abandoned upland sites generally progress from a grass or shrubland (MFRI of 2-3? years) to pitch pine/scrub oak woodland (5-25 years) to pure pitch pine forest with heath/oak scrublands (30-60 years) to pitch pine/tree-sized oak forest (60-100 years) to oak-hickory forest (100-200 years) (Landfire 2007a).

Component Associations:
- *Pinus rigida - Quercus (velutina, prinus)* Forest (CEGL006290, GNR)
- *Pinus rigida - Quercus ilicifolia - Rhododendron canadense* Woodland (CEGL006157, G1)
- *Pinus rigida / Quercus ilicifolia / Lespedeza capitata* Woodland (CEGL006025, G2)
- *Pinus rigida / Quercus ilicifolia / Piptatherum pungens* Woodland (CEGL006203, G2)
- *Pinus rigida / Vaccinium* spp. - *Gaylussacia baccata* Woodland (CEGL005046, G3G5)
- *Pinus strobus - Pinus resinosa - Pinus rigida* Forest (CEGL006259, G4G5)

- *Vaccinium angustifolium / Schizachyrium scoparium - Carex lucorum* Shrub Herbaceous Vegetation (CEGL006393, GNR)

Spatial Characteristics

Size: As an order of magnitude, generally a few hundred to a 1000-2000 acres.
Adjacent Ecological System Comments: Wetland pockets are common, and vary from small to large. Outwash Plain Pondshores and Basin Peatlands are characteristic wetland systems that may be embedded in pine barrens.

Distribution

Range: This system is restricted to interior south-central New England; Colchester, Vermont; eastern New York; and the Pennsylvania Poconos.
Divisions: 202:C
Nations: US
Subnations: CT, MA, ME, NH, NY, PA, RI, VT
Map Zones: 64:C, 65:C, 66:C
USFS Ecomap Regions: 211E:CC, 211Fd:CCC, 221Af:CCC, 221Ai:CCC, 221Al:CCC, 221Bc:CCC
TNC Ecoregions: 60:C, 61:C, 63:C, 64:C

Sources

References: Andresen 1959, Burns and Honkala 1990a, Comer et al. 2003, Copenheaver et al. 2000, Eberhardt and Latham 2000, Fike 1999, Forman 1979, Gray and Dawson 2004, Kurczewski and Boyle 2000, Landfire 2007a, Latham et al. 1996, Latham et al. n.d., Little 1979c, Maurice et al. 2004, McCormick 1979, Meilleur et al. 1997, MNHESP 2007, Motzkin et al. 1999, Motzkin et al. 2002, NatureServe 2005b, Olsvig 1980, Petraitis and Latham 1999, Schweitzer and Rawinski 1988, Seischab and Bernard 1996, Swain and Kearsley 2011, Thompson 1995, USFS 2002b, Wibiralske et al. 2004
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723016#references
Description Author: S.C. Gawler, mod. L.A. Sneddon
Version: 14 Jan 2014 **Stakeholders:** East
Concept Author: Schweitzer and Rawinski (1988) **ClassifResp:** East

NORTHERN ATLANTIC COASTAL PLAIN HARDWOOD FOREST (CES203.475)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Long Disturbance Interval; Broad-Leaved Deciduous Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: EVT 2324; ESLF 4130; ESP 1324

CONCEPT

Summary: This ecological system is comprised of dry hardwood forests largely dominated by oaks, ranging from sandy glacial and outwash deposits of Cape Cod, Massachusetts, and Long Island, New York, south to the Coastal Plain portions of Maryland and Virginia south to about the James River. *Quercus alba, Quercus prinus, Quercus coccinea,* and *Quercus rubra* are typical, and *Ilex opaca* is sometimes present. *Pinus* species may be codominant in some areas, for example the mixture of oaks with *Pinus virginiana* or *Pinus echinata* on very xeric, relict inland dunes. In the northern half of the range, conditions can grade to dry-mesic, reflected in the local abundance of *Fagus grandifolia*. These forests occur on acidic, sandy to gravelly soils with a thick duff layer, often with an ericaceous shrub layer. From New Jersey south to Virginia, this system also includes oak-beech/heath forests on steep slopes.
Classification Comments: This system grades into other hardwood types of the northeastern U.S. as one moves inland and northward. North of Cape Cod, similar forests are treated as part of Central Appalachian Dry Oak-Pine Forest (CES202.591). In Delaware and New York these coastal forests are apparently distinct (fauna, flora and substrate are distinct) from more inland forests. The southern part of this type's range overlaps with Southern Atlantic Coastal Plain Mesic Hardwood Forest (CES203.242); where they overlap, they are separated based on moisture regime, with the drier forests (often with an ericaceous shrub layer) going to this type.

Similar Ecological Systems:
- Central Appalachian Dry Oak-Pine Forest (CES202.591)--similar forests found north of Cape Cod.
- Southern Atlantic Coastal Plain Mesic Hardwood Forest (CES203.242)

Related Concepts:
- Beech - Sugar Maple: 60 (Eyre 1980) Finer
- Chestnut Oak: 44 (Eyre 1980) Finer
- Eastern White Pine: 21 (Eyre 1980) Finer
- Northern Red Oak: 55 (Eyre 1980) Finer
- Pitch Pine: 45 (Eyre 1980) Finer
- Shortleaf Pine - Oak: 76 (Eyre 1980) Finer
- White Oak - Black Oak - Northern Red Oak: 52 (Eyre 1980) Finer
- White Oak: 53 (Eyre 1980) Finer
- White Pine - Chestnut Oak: 51 (Eyre 1980) Finer
- White Pine - Northern Red Oak - Red Maple: 20 (Eyre 1980) Finer

Component Associations:
- *Fagus grandifolia - Quercus (alba, rubra) - Liriodendron tulipifera / (Ilex opaca var. opaca) / Polystichum acrostichoides* Forest (CEGL006075, G5)
- *Fagus grandifolia - Quercus (alba, velutina, prinus) / Kalmia latifolia* Forest (CEGL006919, G4)
- *Fagus grandifolia - Quercus alba - Quercus rubra* Forest (CEGL006377, GNR)
- *Pinus echinata / Quercus (falcata, nigra) / Vaccinium pallidum* Forest (CEGL006851, G3)
- *Pinus strobus - Quercus alba / Ilex glabra* Forest (CEGL006382, GNR)
- *Pinus virginiana - Quercus falcata - Carya pallida* Forest (CEGL006354, GNR)
- *Quercus (alba, rubra, velutina) - Carya* spp. / *Viburnum acerifolium* Forest (CEGL006336, G4G5)
- *Quercus (alba, velutina, stellata, falcata) / Carya pallida - Quercus prinoides / Carex pensylvanica* Woodland (CEGL006954, GNR)
- *Quercus alba - Quercus (coccinea, velutina, prinus) / Gaylussacia baccata* Forest (CEGL008521, G5)
- *Quercus alba - Quercus falcata - (Carya pallida) / Gaylussacia frondosa* Forest (CEGL006269, G4G5)
- *Quercus alba - Quercus rubra - Carya alba / Cornus florida / Vaccinium stamineum / Desmodium nudiflorum* Piedmont Forest (CEGL008475, G4G5)
- *Quercus coccinea - Quercus velutina / Sassafras albidum / Vaccinium pallidum* Forest (CEGL006375, GNR)
- *Quercus prinus / Deschampsia flexuosa - Solidago bicolor* Forest (CEGL006490, GNR)
- *Quercus rubra - Betula alleghaniensis / Osmunda cinnamomea* Forest (CEGL006000, GNR)
- *Quercus velutina - Quercus coccinea - Quercus prinus / Kalmia latifolia* Forest (CEGL006374, GNR)
- *Quercus velutina / Ilex opaca* Forest (CEGL006378, GNR)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:

- Southern Atlantic Coastal Plain Mesic Hardwood Forest (CES203.242)

DISTRIBUTION

Range: This system ranges from sandy glacial and outwash deposits of Massachusetts and Long Island, New York, south to the Coastal Plain portions of Maryland and Virginia, south to about the James River, with historic occurrences (and possibly some extant remnants) in eastern Pennsylvania.
Divisions: 202:C; 203:C
Nations: US
Subnations: CT, DC, DE, MA, MD, NJ, NY, PA, VA
Map Zones: 60:C, 65:C, 66:C
USFS Ecomap Regions: 221A:CC, 221D:CC
TNC Ecoregions: 52:P, 58:C, 61:C, 62:C

SOURCES

References: Comer et al. 2003, Eyre 1980
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723111#references
Description Author: R. Evans, mod. S.C. Gawler and J. Teague
Version: 05 Feb 2009 **Stakeholders:** East, Southeast
Concept Author: R. Evans **ClassifResp:** East

NORTHERN ATLANTIC COASTAL PLAIN MARITIME FOREST (CES203.302)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Forest and Woodland (Treed); Coast
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Mixed evergreen-deciduous closed tree canopy
National Mapping Codes: EVT 2379; ESLF 4322; ESP 1379

CONCEPT

Summary: This system encompasses a range of woody vegetation present on barrier islands, maritime shores and near-coastal strands, from Fisherman's Island, Virginia (the northern range limit of *Quercus virginiana*) northward to the extent of the Atlantic Coastal Plain. It includes forests and shrublands whose structure and composition are influenced by proximity to marine environments, including both upland and wetland. Vegetation includes narrow bands of forests with often stunted trees with contorted branches and dense vine layers. A range of trees may be present depending upon actual location and degree of protection from most extreme maritime influences. Common trees include *Prunus serotina, Pinus taeda, Ilex opaca, Quercus stellata, Juniperus virginiana, Pinus rigida, Pinus virginiana, Amelanchier canadensis*, and *Celtis occidentalis*. These trees are also found in less extreme or non-maritime settings; this system is distinguished as much by the structure of the vegetation as its composition. *Morella pensylvanica* is a characteristic shrub, and *Smilax rotundifolia* and *Vitis rotundifolia* are characteristic vines. *Morella cerifera* is often present south of central New Jersey.
Classification Comments: In New York this concept includes Maritime Holly Forest, Maritime Post Oak Forest, Maritime Beech Forest, Maritime Red Cedar Forest (Edinger et al. 2002).
Similar Ecological Systems:
- Central Atlantic Coastal Plain Maritime Forest (CES203.261)
- Northern Atlantic Coastal Plain Dune and Swale (CES203.264)

Related Concepts:
- Beech - Sugar Maple: 60 (Eyre 1980) Finer
- Black Oak: 110 (Eyre 1980) Finer
- Eastern Redcedar: 46 (Eyre 1980) Finer
- Loblolly Pine - Hardwood: 82 (Eyre 1980) Finer
- Loblolly Pine: 81 (Eyre 1980) Finer
- Northern Red Oak: 55 (Eyre 1980) Finer
- Pitch Pine: 45 (Eyre 1980) Finer
- Sassafras - Persimmon: 64 (Eyre 1980) Finer
- White Oak - Black Oak - Northern Red Oak: 52 (Eyre 1980) Finer
- White Oak: 53 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs in marine coastal areas on sandy soils, usually in low interdunal areas behind primary or secondary dunes. In the glaciated portion of the range, it also occurs on till or morainal bluffs fronting the ocean, or on drowned drumlins on coastal islands. Examples also occur on sill or sand deposits in salt marsh islands. Soils range from well-drained on higher topographic positions to mesic in lower positions.
Vegetation: Vegetation includes narrow bands of forest with often stunted trees with contorted branches and wilted leaves and dense vine layers (Edinger et al. 2002). A range of trees may be present depending upon actual location and degree of protection from most extreme maritime influences. Species range from deciduous hardwoods to pitch pine and Virginia pine. A rare pitch pine variant is found in Delaware (Cape Henlopen) and New York.
Dynamics: Salt spray, high winds, dune deposition, sand shifting and blasting, and occasional overwash during extreme disturbance events.

Component Associations:
- *Acer rubrum / Rhododendron viscosum - Clethra alnifolia* Forest (CEGL006156, GNR)
- *Amelanchier canadensis - Viburnum* spp. - *Morella pensylvanica* Scrub Forest (CEGL006379, GNR)
- *Fagus grandifolia / Smilax rotundifolia* Forest (CEGL006043, G1)
- *Ilex opaca / Morella pensylvanica* Forest (CEGL006376, G1)
- *Juniperus virginiana var. virginiana / Morella pensylvanica* Woodland (CEGL006212, G2)
- *Morella pensylvanica - Prunus maritima* Shrubland (CEGL006295, G4)
- *Pinus rigida / Hudsonia tomentosa* Woodland (CEGL006117, G2G3)
- *Pinus rigida / Quercus ilicifolia / Morella pensylvanica* Woodland (CEGL006315, G3)
- *Pinus taeda - Quercus (falcata, nigra) / Morella cerifera / Vitis rotundifolia* Forest (CEGL006040, G2)

- *Pinus taeda / Hudsonia tomentosa* Woodland (CEGL006052, G1G2)
- *Pinus taeda / Morella cerifera / Osmunda regalis var. spectabilis* Forest (CEGL006137, G3)
- *Pinus taeda / Morella cerifera / Spartina patens* Tidal Woodland (CEGL006849, GNR)
- *Prunus serotina - Sassafras albidum - Amelanchier canadensis - Quercus velutina / Smilax rotundifolia* Forest (CEGL006145, G2G3)
- *Prunus serotina / Morella cerifera / Smilax rotundifolia* Scrub Forest (CEGL006319, G1G2)
- *Quercus stellata - Quercus velutina / Morella pensylvanica / Deschampsia flexuosa* Forest (CEGL006373, GNR)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Northern Atlantic Coastal Plain Dune and Swale (CES203.264)

DISTRIBUTION

Range: This system ranges from Fisherman's Island, Virginia northward to Massachusetts along the extent of the Atlantic Coastal Plain.
Divisions: 203:C
Nations: US
Subnations: DE, MA, MD, NJ, NY, VA
Map Zones: 60:C, 65:C
USFS Ecomap Regions: 221Ab:CCC, 221Ad:CCC, 221An:CCC
TNC Ecoregions: 58:C, 62:C

SOURCES

References: Backman 1984, Busby and Motzkin 2009, Clark 1986b, Comer et al. 2003, Edinger et al. 2002, Elliman 2005, Foster and Motzkin 1999, NYNHP 2013a
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723189#references
Description Author: R. Evans, G. Fleming, P. Coulling, L.A. Sneddon
Version: 14 Jan 2014 **Stakeholders:** East, Southeast
Concept Author: R. Evans, G. Fleming, P. Coulling, L. Sneddon **ClassifResp:** East

NORTHERN ATLANTIC COASTAL PLAIN PITCH PINE BARRENS (CES203.269)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Xeric; F-Patch/High Intensity; Needle-Leaved Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2355; ESLF 4258; ESP 1355

CONCEPT

Summary: This system is comprised of a group of dry pitch pine woodlands and forests of deep sandy soils ranging from Cape Cod (Massachusetts) south through Long Island (New York) and the famous Pine Barrens of the New Jersey Coastal Plain, with occasional occurrences north to southernmost Maine and south to the Anacostia watershed (Maryland). The vegetation is characterized by a tree canopy of *Pinus rigida* with a tall-shrub layer dominated by *Quercus ilicifolia* and a low-shrub layer characterized by *Vaccinium pallidum* and/or *Vaccinium angustifolium*. The system is heavily influenced by fire, the composition and structure of its components varying with fire frequency. In general, tree oaks are more prevalent in those stands having a longer fire-return interval; fire frequencies of 8-10 years foster the growth of "pine plains," i.e., dwarf pine stands 1 m in height. Pine barrens with a history of more-or-less biennial burns for lowbush blueberry production may have very few trees and be characterized as sandplain grasslands. Dwarf-shrubs such as *Arctostaphylos uva-ursi*, *Vaccinium angustifolium*, *Vaccinium pallidum*, and *Hudsonia ericoides* typify the field layer of pine plains and sandplain grasslands. *Schizachyrium scoparium* is the most common grass (in close proximity to the coast, it may be represented by its close relative *Schizachyrium littorale*).

Scrub oak stands may occur without pine cover, particularly in low-lying areas that do not intersect the water table, where cold-air drainage inhibits pine growth. North of the glacial boundary, heathlands characterized by *Arctostaphylos uva-ursi*, *Corema conradii*, and *Morella pensylvanica*, and grasslands characterized by *Schizachyrium littorale*, *Schizachyrium scoparium*, and *Danthonia spicata* occur as small (or occasionally large) patches. The Pine Barrens of New Jersey are very similar in structure and composition to those north of the glacial boundary but are characterized by additional species, such as *Quercus marilandica*, *Quercus stellata*, *Pyxidanthera barbulata*, *Leiophyllum buxifolium*, and others. Where the water table is close to the surface, pitch pine lowland vegetation (described as a separate system) occurs.

Classification Comments: This system includes the New Jersey Pine Barrens, the uniqueness of which has long been recognized, and the system is well-studied and summarized in a number of recent treatments (Forman 1979, Buckhholz and Good 1982, Gibson et al. 1999).

Similar Ecological Systems:
- Northeastern Interior Pine Barrens (CES202.590)--occurs farther inland and lacks coastal elements.
- Northern Atlantic Coastal Plain Heathland and Grassland (CES203.895)

Related Concepts:
- Bear Oak: 43 (Eyre 1980) Finer
- Chestnut Oak: 44 (Eyre 1980) Finer
- Little Bluestem - Blueberry Sandplain Grassland (Gawler and Cutko 2010) Finer
- Pitch Pine: 45 (Eyre 1980) Finer
- Post Oak - Blackjack Oak: 40 (Eyre 1980) Finer
- White Oak - Black Oak - Northern Red Oak: 52 (Eyre 1980) Finer

DESCRIPTION

Environment: This system typically occurs on deep well-drained sand deposits. In the coastal regions of the glaciated Northeast, it occurs on outwash plains and morainal deposits. In New Jersey, it occurs on Cohansey sand, which is sometimes overlain with hilltop gravel deposits.

Vegetation: The uniqueness of the New Jersey Pine Barrens flora has long been recognized (Stone 1911, Harshberger 1916). More recent treatments by Forman (1979) and Buckhholz and Good (1982) have compiled much of the available information. *Pinus rigida* is the dominant and characteristic species of this system. It may be found in well-developed tree form or as a short-statured, shrubby ecotype. *Pinus rigida* may occur as the sole dominant or occur with a variety of oak species, especially *Quercus marilandica*, *Quercus stellata*, and *Quercus ilicifolia*. In some examples *Pinus echinata* may co-occur.

Dynamics: Different fire frequencies and intensities interrupt succession, accounting for variations in forest composition. Periodic severe wildfires with 40- to 100-year intervals have produced oak-pine mixtures over extensive areas of uplands, while more frequent severe fires have created mixtures of pitch pine and shrub oaks. The most frequent and severe fires have created the pine plains (Landfire 2007a).

Component Associations:
- *Gaylussacia baccata - Vaccinium angustifolium - Arctostaphylos uva-ursi / Schizachyrium littorale* Dwarf-shrubland (CEGL006066, G3)

- *Morella pensylvanica / Schizachyrium littorale - Danthonia spicata* Shrub Herbaceous Vegetation (CEGL006067, G2)
- *Pinus (rigida, echinata) - Quercus coccinea / Ilex opaca* Woodland (CEGL006115, GNR)
- *Pinus rigida - (Pinus echinata) / Quercus (marilandica, ilicifolia) / Vaccinium pallidum* Woodland (CEGL006383, G2?)
- *Pinus rigida - Quercus coccinea - Quercus falcata / (Quercus marilandica) / Gaylussacia frondosa* Woodland (CEGL006329, G2G3)
- *Pinus rigida - Quercus coccinea / Vaccinium pallidum - (Morella pensylvanica)* Woodland (CEGL006381, GNR)
- *Pinus rigida - Quercus ilicifolia / Arctostaphylos uva-ursi* Shrubland (CEGL006097, G1Q)
- *Pinus rigida - Quercus marilandica / Corema conradii* Shrubland (CEGL006148, G2)
- *Pinus rigida / Carex pensylvanica* Woodland (CEGL006385, GNR)
- *Pinus rigida / Quercus (marilandica, ilicifolia) / Pyxidanthera barbulata* Woodland (CEGL006051, G2)
- *Pinus rigida / Quercus ilicifolia - Kalmia angustifolia / Pyxidanthera barbulata* Woodland (CEGL006384, G1)
- *Pinus rigida / Quercus ilicifolia / Morella pensylvanica* Woodland (CEGL006315, G3)
- *Quercus ilicifolia - Quercus prinoides* Shrubland (CEGL006111, GNR)
- *Quercus prinus - Quercus velutina / Gaylussacia frondosa* Forest (CEGL006334, GNR)
- *Vaccinium angustifolium / Schizachyrium scoparium - Carex lucorum* Shrub Herbaceous Vegetation (CEGL006393, GNR)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Northern Atlantic Coastal Plain Basin Peat Swamp (CES203.522)
- Northern Atlantic Coastal Plain Pond (CES203.518)
- Northern Atlantic Coastal Plain Riverine Peat Swamp (CES203.070)

Adjacent Ecological System Comments: Coastal Plain ponds and Atlantic white-cedar swamps may be embedded in these pine barrens.

DISTRIBUTION

Range: This system is found in the Atlantic Coastal Plain from Delaware Bay northward through the New Jersey Coastal Plain and Long Island (New York) to Cape Cod, Massachusetts, with peripheral occurrences in Pennsylvania (historic), New Hampshire (historic), and southern Maine (Kennebunk Plains and Wells Barren).
Divisions: 203:C
Nations: US
Subnations: DE, MA, MD, ME, NH, NJ, NY, PA, RI
Map Zones: 60:C, 65:C
USFS Ecomap Regions: 221Ab:CCC, 221Ac:CCP, 221Ak:CCC, 232A:CC, 232Hc:CCC
TNC Ecoregions: 58:C, 62:C

SOURCES

References: Backman 1984, Buckhholz and Good 1982, Comer et al. 2003, Finton 1998, Forman 1979, Gibson et al. 1999, Givnish 1981, Harshberger 1916, Jordan et al. 2003, Landfire 2007a, Motzkin and Foster 2002, Stone 1911, Swain and Kearsley 2011, Wacker 1979, Walker and Solecki 1999, Windisch 1990, Windisch 1994, Windisch 1999
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723217#references
Description Author: R. Evans, mod. S.C. Gawler and L.A. Sneddon
Version: 14 Jan 2014 **Stakeholders:** East, Southeast
Concept Author: L. Sneddon and K. Straskosch Walz **ClassifResp:** East

NORTHERN CALIFORNIA MESIC SUBALPINE WOODLAND (CES206.911)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Upper Montane]; Temperate [Temperate Oceanic]; Udic
Non-Diagnostic Classifiers: Forest and Woodland (Treed); Sideslope
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2044; ESLF 4231; ESP 1044

CONCEPT

Summary: This ecological system occurs on ridges and rocky slopes around timberline at 2600 m (7900 feet) elevation in the central Sierra Nevada and 2450 m (8000 feet) in the southern Cascades. These woodlands are found on concave or mesic slopes in areas with long-lasting snowpack and better soil development than other drier and more exposed subalpine woodlands. The tree canopy is characterized by *Tsuga mertensiana* and may include *Abies magnifica, Abies procera, Pinus albicaulis,* and *Pinus monticola*. Mesic-site shrubs will include *Cassiope mertensiana, Phyllodoce breweri, Phyllodoce empetriformis, Vaccinium membranaceum*, and others. *Juniperus communis* is found in most stands of the northern Sierra Nevada. *Penstemon davidsonii*, as well as patches of grasses, sedges, and forbs grade into adjacent meadows.

Similar Ecological Systems:
- Sierra Nevada Subalpine Lodgepole Pine Forest and Woodland (CES206.912)

Related Concepts:
- California Mixed Subalpine: 256 (Eyre 1980) Intersecting
- Mountain Hemlock: 205 (Eyre 1980) Intersecting. Mountain hemlock stands are a component of subalpine parklands.
- Whitebark Pine: 208 (Eyre 1980) Intersecting. Whitebark pine stands are a component of this ecological system.

Component Associations:
- *Pinus albicaulis - Tsuga mertensiana* / Mixed Herbaceous Woodland (CEGL003132, G2G4)
- *Pinus albicaulis / Penstemon davidsonii* Woodland (CEGL003134, G3G4)
- *Tsuga mertensiana - Pinus contorta var. murrayana - Pinus albicaulis* Forest (CEGL008692, GNR)
- *Tsuga mertensiana - Pinus contorta var. murrayana - Pinus monticola* Forest (CEGL008691, G3?)
- *Tsuga mertensiana - Pinus contorta var. murrayana / Carex rossii* Forest (CEGL008690, G3?)
- *Tsuga mertensiana - Pinus contorta var. murrayana / Phyllodoce breweri* Forest (CEGL008689, G3?)
- *Tsuga mertensiana - Pinus contorta var. murrayana* Forest (CEGL008688, G3G4)
- *Tsuga mertensiana - Pinus monticola* Forest (CEGL008687, G3)
- *Tsuga mertensiana / Arabis platysperma* Forest (CEGL008686, GNR)
- *Tsuga mertensiana* / Sparse Understory Forest (CEGL008685, G3G4)

DISTRIBUTION

Range: This system occurs on ridges and rocky slopes around timberline at 2600 m (7900 feet) elevation in the central Sierra Nevada and 2450 m (8000 feet) in the southern Cascades.
Divisions: 204:C; 206:C
Nations: US
Subnations: CA, NV, OR
Map Zones: 6:C, 7:C
USFS Ecomap Regions: 341D:CC, M242B:??, M261E:CC
TNC Ecoregions: 4:C, 5:P, 12:C, 81:P

SOURCES

References: Barbour and Billings 2000, Barbour and Major 1988, Comer et al. 2003, Eyre 1980, Holland and Keil 1995, Means 1990, Peterson and Peterson 2001, Potter 1994, Sawyer and Keeler-Wolf 1995
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722770#references
Description Author: P. Comer, T. Keeler-Wolf
Version: 07 Oct 2005
Stakeholders: West
Concept Author: P. Comer, T. Keeler-Wolf
ClassifResp: West

NORTHERN DRY JACK PINE-RED PINE-HARDWOOD WOODLAND (CES103.424)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Land Cover Class: Forest and Woodland
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
National Mapping Codes: ESLF 4278

CONCEPT

Summary: This conifer woodland is found throughout the eastern southern or hemi-boreal regions of eastern Canada, extending into the Upper Midwest and Northeast parts of the United States. It occurs on dry nutrient-poor sand plains and along rocky ridges, often adjacent to rivers and lakes, and along talus slopes. The canopy ranges from patchy to continuous and is dominated by a mix of primarily conifer and hardwood species. In some examples, canopy trees may be stunted. *Pinus banksiana* is the most frequent conifer species, although *Pinus resinosa, Pinus strobus, Picea mariana,* or *Picea glauca* can be common and may dominate some sites. Hardwood species vary in cover from 25-90% of the canopy. *Quercus ellipsoidalis* is a restricted dominant in the Midwest part of the range of this system, along with *Quercus macrocarpa* and *Quercus rubra*. More common are *Betula papyrifera* and *Populus* spp. In areas of open bedrock, species typical of bedrock outcrops and shallow soils can be found and include *Danthonia spicata, Poa alsodes, Elymus trachycaulus (= Agropyron trachycaulum), Maianthemum canadense, Schizachne purpurascens*, and *Oryzopsis asperifolia*. The nonvascular layer can be absent or present with up to 30% cover. In the open bedrock areas, this layer consists mainly of the lichens and mosses. Infrequent fire is the primary dynamic, with catastrophic fires occurring approximately every 150-200 years with surface fires every 50-200 years.

Similar Ecological Systems:
- Central Boreal Jack Pine-Black Spruce Dry Woodland (CES103.429)
- Eastern Boreal Jack Pine-Black Spruce Dry Woodland (CES103.423)
- Laurentian-Acadian Sub-boreal Dry-Mesic Pine-Black Spruce-Hardwood Forest (CES103.425)

Related Concepts:
- FDn12 Northern Dry-Sand Pine Woodland (Minnesota DNR 2003) Finer
- FDn22 Northern Dry-Bedrock Pine (Oak) Woodland (Minnesota DNR 2003) Finer

DESCRIPTION

Environment: Examples of this system occur on rocky ridgetops, high slopes, and terraces sometimes along rivers or lakeshores, including Great Lakes shorelines. These areas are dry, well-drained sites, often with exposed bedrock. Soils range from bare bedrock and talus slopes to rocky, shallow loams and deep sands. Those stands on bedrock may have occasional cracks in the underlying bedrock resulting in pockets of relatively deep (15-20 cm) soil. Bare rock (with crustose lichens) can cover up to 50% of the area.
Vegetation: The canopy ranges from scattered trees to a moderately dense canopy. Stands are a mix of conifer species, occasionally with hardwood species. In some examples, canopy trees may be stunted. The conifers in most examples are dominated by *Pinus banksiana*. *Pinus resinosa, Pinus strobus, Picea mariana,* or *Picea glauca* can be common and may dominate some sites. Hardwood species vary in cover from 25-90% of the canopy. *Quercus ellipsoidalis* is a restricted dominant in the Midwest part of the range, with *Quercus macrocarpa* or *Quercus rubra, Betula papyrifera,* and *Populus* spp. occurring more commonly. Shrubs may be absent to dense and include *Amelanchier* spp., *Diervilla lonicera, Corylus cornuta, Juniperus communis, Prunus pensylvanica, Salix bebbiana,* and *Vaccinium angustifolium.* Herbaceous species vary across the range of this type. Some typical species include *Danthonia spicata, Poa alsodes, Elymus trachycaulus (= Agropyron trachycaulum), Maianthemum canadense, Schizachne purpurascens*, and *Oryzopsis asperifolia*. The nonvascular layer can be absent or present with up to 30% cover. In the open bedrock areas, this layer consists mainly of the lichens and mosses. Lichen species may include *Cladina rangiferina (= Cladonia rangiferina)* and *Cladina mitis (= Cladonia mitis)*. Mosses include *Dicranum* spp., *Pleurozium schreberi,* and *Polytrichum* spp.

DISTRIBUTION

Range: This system ranges in Canada from northwestern Ontario (possibly eastern Manitoba) to eastern Canada's Atlantic provinces and extending into the U.S. in northeastern Minnesota, Isle Royale, and near-coastal areas of Lake Superior shores in northern Wisconsin and Michigan.
Nations: CA, US
Subnations: LB?, MB?, MI, MN, NB, NF, ON, QC, WI
TNC Ecoregions: 47:C, 48:C, 63:C

SOURCES

References: Faber-Langendoen et al. 2013a, Kost et al. 2007, Midwestern Ecology Working Group n.d., Minnesota DNR 2003, NatureServe n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.878439#references
Description Author: S. Menard, mod. D. Faber-Langendoen
Version: 29 Aug 2012
Stakeholders: Canada, East, Midwest
Concept Author: Faber-Langendoen, in Faber-Langendoen et al. (2012)
ClassifResp: Midwest

NORTHERN ROCKY MOUNTAIN DRY-MESIC MONTANE MIXED CONIFER FOREST (CES306.805)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Montane]; Forest and Woodland (Treed); Ustic; Short Disturbance Interval; F-Patch/Low Intensity; Needle-Leaved Tree; Abies grandis - Mixed
Non-Diagnostic Classifiers: Moderate (100-500 yrs) Persistence; Montane [Lower Montane]; Sideslope; Toeslope/Valley Bottom; Temperate [Temperate Continental]; Mesotrophic Soil
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2045; ESLF 4232; ESP 1045

CONCEPT

Summary: This ecological system is composed of highly variable montane coniferous forests found in the interior Pacific Northwest, from southernmost interior British Columbia, eastern Washington, eastern Oregon, northern Idaho, western and north-central Montana, and south along the east slope of the Cascades in Washington and Oregon. In central Montana it occurs on mountain islands (the Snowy Mountains). This system is associated with a submesic climate regime with annual precipitation ranging from 50 to 100 cm, with a maximum in winter or late spring. Winter snowpacks typically melt off in early spring at lower elevations. Elevations range from 460 to 1920 m. Most occurrences of this system are dominated by a mix of *Pseudotsuga menziesii* and *Pinus ponderosa* (but there can be one without the other) and other typically seral species, including *Pinus contorta, Pinus monticola* (not in central Montana), and *Larix occidentalis* (not in central Montana). *Picea engelmannii* (or *Picea glauca* or their hybrid) becomes increasingly common towards the eastern edge of the range. The nature of this forest system is a matrix of large patches dominated or codominated by one or combinations of the above species; *Abies grandis* (a fire-sensitive, shade-tolerant species not occurring in central Montana) has increased on many sites once dominated by *Pseudotsuga menziesii* and *Pinus ponderosa*, which were formerly maintained by low-severity wildfire. Presettlement fire regimes may have been characterized by frequent, low-intensity ground fires that maintained relatively open stands of a mix of fire-resistant species. Under present conditions the fire regime is mixed severity and more variable, with stand-replacing fires more common, and the forests are more homogeneous. With vigorous fire suppression, longer fire-return intervals are now the rule, and multi-layered stands of *Pseudotsuga menziesii, Pinus ponderosa*, and/or *Abies grandis* provide fuel "ladders," making these forests more susceptible to high-intensity, stand-replacing fires. They are very productive forests which have been priorities for timber production. They rarely form either upper or lower timberline forests. Understories are dominated by graminoids, such as *Pseudoroegneria spicata, Calamagrostis rubescens, Carex geyeri*, and *Carex rossii*, that may be associated with a variety of shrubs, such as *Acer glabrum, Juniperus communis, Physocarpus malvaceus, Symphoricarpos albus, Spiraea betulifolia*, or *Vaccinium membranaceum* on mesic sites. *Abies concolor* and *Abies grandis X concolor* hybrids in central Idaho (the Salmon Mountains) are included here but have very restricted range in this area. *Abies concolor* and *Abies grandis* in the Blue Mountains of Oregon are probably hybrids of the two and mostly *Abies grandis*.
Classification Comments: Need to re-assess the concept of this system in relation to Northern Rocky Mountain Western Larch Savanna (CES306.837) and East Cascades Mesic Montane Mixed-Conifer Forest and Woodland (CES204.086). In PNV (PAGs) concept, this is mostly *Pseudotsuga menziesii*, moist *Pinus ponderosa* series, dry *Abies grandis* or warm, dry *Abies lasiocarpa* series in the Canadian Rockies, northern Middle Rockies, East Cascades and Okanagan ecoregions. Everett et al. (2000) indicate that in the eastern Cascades of Washington this system forms fire polygons due to abrupt north and south topography with presettlement fire-return intervals of 11-12 years typically covering less than 810 ha. Currently, fires have 40- to 45-year return intervals with thousands of hectares in size. Northern Rocky Mountain Western Larch Savanna (CES306.837) is a large-patch type that occurs typically within this matrix or Northern Rocky Mountain Mesic Montane Mixed Conifer Forest (CES306.802) matrix. We need to define the percent cover of larch over 50% or over 75% relative cover of all trees for an occurrence to be placed in Northern Rocky Mountain Western Larch Savanna (CES306.837). This needs to be relative because these look(ed) like ponderosa savanna in places. East Cascades Mesic Montane Mixed-Conifer Forest and Woodland (CES204.086) has North Pacific floristic composition, and is mostly east Cascades ecoregion, peripheral in Okanagan ecoregion, and west Cascades. PAGs most of the *Abies grandis*, dry western red-cedar and western hemlock in the east Cascades. Environmentally, it is equivalent to Northern Rocky Mountain Mesic Montane Mixed Conifer Forest (CES306.802). Contrasting this system (CES306.805) with Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland (CES306.828) and Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland (CES306.830) is important in the Middle Rockies ecoregion and Oregon.
Similar Ecological Systems:
- East Cascades Mesic Montane Mixed-Conifer Forest and Woodland (CES204.086)
- North Pacific Interior Dry-Mesic Mixed Conifer Forest (CES207.152)
- Northern Rocky Mountain Western Larch Savanna (CES306.837)
- Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland (CES306.828)
- Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland (CES306.830)
- Sierran-Intermontane Desert Western White Pine-White Fir Woodland (CES204.101)

Related Concepts:
- Fd - Feathermoss (IDFxw/05) (Steen and Coupe 1997) Intersecting
- Fd - Juniper - Bluebunch wheatgrass (IDFxw/01) (Steen and Coupe 1997) Intersecting
- FdPy - Bluebunch wheatgrass - Balsamroot (IDFxw/04) (Steen and Coupe 1997) Intersecting
- FdPy - Bluebunch wheatgrass - Pinegrass (IDFxw/02) (Steen and Coupe 1997) Intersecting
- FdPy - Western snowberry - Bluebunch wheatgrass (IDFxw/03) (Steen and Coupe 1997) Intersecting
- Grand Fir: 213 (Eyre 1980) Intersecting. Grand fir stands are an important component of this ecological system.
- Interior Douglas-fir: 210 (Eyre 1980) Intersecting
- Interior Ponderosa Pine: 237 (Eyre 1980) Intersecting
- Western Larch: 212 (Eyre 1980) Intersecting. Western larch stands are an important component of this ecological system.
- Western White Pine: 215 (Eyre 1980) Intersecting
- White Fir: 211 (Eyre 1980) Intersecting. White fir is a minor component of this ecological system, primarily in southern Idaho and southern Oregon, where it hybridizes with grand fir.

DESCRIPTION

Dynamics: Landfire VDDT models: R#MCONdy.

Component Associations:
- *Abies concolor - Pseudotsuga menziesii / Carex rossii* Forest (CEGL000431, G2?)
- *Abies grandis / Acer glabrum* Forest (CEGL000267, G3)
- *Abies grandis / Arctostaphylos nevadensis* Woodland (CEGL000915, G2G3)
- *Abies grandis / Bromus vulgaris* Forest (CEGL002601, G3)
- *Abies grandis / Calamagrostis rubescens* Woodland (CEGL000916, G4?)
- *Abies grandis / Carex geyeri* Woodland (CEGL000917, G3)
- *Abies grandis / Linnaea borealis* Forest (CEGL000275, G3)
- *Abies grandis / Physocarpus malvaceus* Forest (CEGL000277, G3)
- *Abies grandis / Spiraea betulifolia* Forest (CEGL000281, G2)
- *Abies grandis / Symphoricarpos albus* Forest (CEGL000282, G3?)
- *Pinus monticola / Clintonia uniflora* Forest (CEGL000176, G1Q)
- *Pinus ponderosa - Pseudotsuga menziesii / Arctostaphylos nevadensis* Woodland (CEGL000208, G2)
- *Pinus ponderosa - Pseudotsuga menziesii / Arctostaphylos patula* Woodland (CEGL000209, G3)
- *Pinus ponderosa - Pseudotsuga menziesii / Calamagrostis rubescens* Woodland (CEGL000210, G2Q)
- *Pinus ponderosa - Pseudotsuga menziesii / Carex geyeri* Forest (CEGL000211, GNRQ)
- *Pinus ponderosa - Pseudotsuga menziesii / Penstemon fruticosus* Woodland (CEGL000212, G2G3)
- *Pinus ponderosa - Pseudotsuga menziesii / Physocarpus malvaceus* Forest (CEGL000213, GNRQ)
- *Pinus ponderosa - Pseudotsuga menziesii / Pseudoroegneria spicata ssp. inermis* Woodland (CEGL000207, G3Q)
- *Pinus ponderosa - Pseudotsuga menziesii / Purshia tridentata* Woodland (CEGL000214, G3)
- *Pseudotsuga menziesii / Arctostaphylos uva-ursi - Purshia tridentata* Forest (CEGL000426, G3?)
- *Pseudotsuga menziesii / Arctostaphylos uva-ursi* Cascadian Forest (CEGL000425, G3G4)
- *Pseudotsuga menziesii / Arctostaphylos uva-ursi* Forest (CEGL000424, G4)
- *Pseudotsuga menziesii / Arnica cordifolia* Forest (CEGL000427, G4)
- *Pseudotsuga menziesii / Bromus ciliatus* Forest (CEGL000428, G4)
- *Pseudotsuga menziesii / Calamagrostis rubescens* Woodland (CEGL000429, G5)
- *Pseudotsuga menziesii / Carex geyeri* Forest (CEGL000430, G4?)
- *Pseudotsuga menziesii / Clintonia uniflora - Xerophyllum tenax* Forest (CEGL005854, G4G5)
- *Pseudotsuga menziesii / Clintonia uniflora* Forest (CEGL005850, G4G5)
- *Pseudotsuga menziesii / Festuca occidentalis* Forest (CEGL000434, G2)
- *Pseudotsuga menziesii / Heracleum maximum* Forest (CEGL005853, G2?)
- *Pseudotsuga menziesii / Linnaea borealis* Forest (CEGL000441, G4)
- *Pseudotsuga menziesii / Menziesia ferruginea / Clintonia uniflora* Forest (CEGL005851, G3?)
- *Pseudotsuga menziesii / Osmorhiza berteroi* Forest (CEGL000445, G4G5)
- *Pseudotsuga menziesii / Paxistima myrsinites* Forest (CEGL000446, G2G3)
- *Pseudotsuga menziesii / Physocarpus malvaceus - Linnaea borealis* Forest (CEGL000448, G4)
- *Pseudotsuga menziesii / Symphoricarpos albus / Hieracium cynoglossoides* Forest (CEGL000458, G2)
- *Pseudotsuga menziesii / Symphoricarpos occidentalis* Forest (CEGL000461, G3?)
- *Pseudotsuga menziesii / Symphoricarpos oreophilus* Forest (CEGL000462, G5)
- *Pseudotsuga menziesii / Vaccinium caespitosum* Forest (CEGL000465, G5)
- *Pseudotsuga menziesii / Vaccinium membranaceum / Xerophyllum tenax* Forest (CEGL005852, G4G5)
- *Pseudotsuga menziesii / Vaccinium* spp. Forest (CEGL000464, G4Q)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- East Cascades Mesic Montane Mixed-Conifer Forest and Woodland (CES204.086)

DISTRIBUTION

Range: This system is found in the interior Pacific Northwest, from southern interior British Columbia south and east into Oregon, Idaho (including north and central Idaho, down to the Boise Mountains), and western Montana, and south along the east slope of the Cascades in Washington and Oregon.
Divisions: 204:C; 304:P; 306:C
Nations: CA, US
Subnations: BC, ID, MT, OR, WA
Map Zones: 1:C, 7:C, 8:C, 9:C, 10:C, 16:?, 17:?, 18:P, 19:C, 20:C
USFS Ecomap Regions: 331A:CC, 331D:C?, 341G:PP, 342C:CC, 342D:CC, 342H:CC, 342I:CC, M242B:CC, M242C:CC, M242D:CC, M331A:CC, M331D:CC, M332A:CC, M332B:CC, M332D:CP, M332E:CC, M332F:CC, M332G:CC, M333A:CC, M333B:CC, M333C:CC, M333D:CC
TNC Ecoregions: 2:P, 4:C, 6:C, 7:C, 8:C, 26:C, 68:C

SOURCES

References: Comer et al. 2003, Cooper et al. 1987, Crawford and Johnson 1985, Daubenmire and Daubenmire 1968, Lillybridge et al. 1995, NCC 2002, Pfister et al. 1977, Steele and Geier-Hayes 1995, Steele et al. 1981, Topik 1989, Topik et al. 1988, Williams and Lillybridge 1983
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722868#references
Description Author: R. Crawford, C. Chappell and M.S. Reid
Version: 23 Jan 2006 **Stakeholders:** Canada, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

NORTHERN ROCKY MOUNTAIN MESIC MONTANE MIXED CONIFER FOREST (CES306.802)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Long (>500 yrs) Persistence; Forest and Woodland (Treed); Udic; Very Long Disturbance Interval; F-Landscape/Medium Intensity; Needle-Leaved Tree; Tsuga heterophylla and Thuja plicata
Non-Diagnostic Classifiers: Montane [Montane]; Montane [Lower Montane]; Lowland [Foothill]; Sideslope; Toeslope/Valley Bottom; Temperate [Temperate Continental]; Glaciated; Mesotrophic Soil
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2047; ESLF 4234; ESP 1047

CONCEPT

Summary: This ecological system occurs in the northern Rockies of western Montana west into northeastern Washington and southern British Columbia. These are vegetation types dominated by *Tsuga heterophylla* and *Thuja plicata* in most cases, found in areas influenced by incursions of mild, wet, Pacific maritime air masses. Much of the annual precipitation occurs as rain, but where snow does occur, it can generally be melted by rain during warm winter storms. Occurrences generally are found on all slopes and aspects but grow best on sites with high soil moisture, such as toeslopes and bottomlands. At the periphery of its distribution, this system is confined to moist canyons and cooler, moister aspects. Generally these are moist, non-flooded or upland sites that are not saturated yearlong. Along with *Tsuga heterophylla* and *Thuja plicata*, *Pseudotsuga menziesii* commonly shares the canopy, and *Pinus monticola*, *Pinus contorta*, *Abies grandis*, *Taxus brevifolia*, and *Larix occidentalis* are major associates. Mesic *Abies grandis* associations are included in this system, and *Abies grandis* is often the dominant in these situations; *Tsuga heterophylla* and *Thuja plicata* can both be absent. *Cornus nuttallii* may be present in some situations. *Picea engelmannii*, *Abies lasiocarpa*, and *Pinus ponderosa* may be present but only on the coldest or warmest and driest sites. *Linnaea borealis*, *Paxistima myrsinites*, *Alnus incana*, *Acer glabrum*, *Spiraea betulifolia*, *Symphoricarpos hesperius (= Symphoricarpos mollis ssp. hesperius)*, *Cornus canadensis*, *Rubus parviflorus*, *Menziesia ferruginea*, and *Vaccinium membranaceum* are common shrub species. The composition of the herbaceous layer reflects local climate and degree of canopy closure; it is typically highly diverse in all but closed-canopy conditions. Important forbs and ferns include *Actaea rubra*, *Anemone piperi*, *Aralia nudicaulis*, *Asarum caudatum*, *Clintonia uniflora*, *Coptis occidentalis*, *Thalictrum occidentale*, *Tiarella trifoliata*, *Trientalis borealis*, *Trillium ovatum*, *Viola glabella*, *Gymnocarpium dryopteris*, *Polystichum munitum*, and *Adiantum pedatum*. Typically, stand-replacement, fire-return intervals are 150-500 years, with moderate-severity fire intervals of 50-100 years.

Similar Ecological Systems:
- North Pacific Interior Dry-Mesic Mixed Conifer Forest (CES207.152)

Related Concepts:
- Grand Fir: 213 (Eyre 1980) Intersecting. Grand fir stands are an important component of this ecological system.
- Western Hemlock: 224 (Eyre 1980) Intersecting. Moist western slopes of the northern Rocky Mountains, in northern ID, northwest MT, and northeast WA.
- Western Redcedar - Western Hemlock: 227 (Eyre 1980) Intersecting. NW MT, N ID
- Western Redcedar: 228 (Eyre 1980) Intersecting
- Western White Pine: 215 (Eyre 1980) Intersecting

Component Associations:
- *Abies grandis / Asarum caudatum* Forest (CEGL000269, G4)
- *Abies grandis / Clintonia uniflora* Forest (CEGL000272, G5)
- *Abies grandis / Coptis occidentalis* Forest (CEGL000273, G2)
- *Abies grandis / Linnaea borealis* Forest (CEGL000275, G3)
- *Abies grandis / Taxus brevifolia* Forest (CEGL000283, G2)
- *Pinus monticola / Clintonia uniflora* Forest (CEGL000176, G1Q)
- *Thuja plicata / Adiantum pedatum* Forest (CEGL000470, G2?)
- *Thuja plicata / Aralia nudicaulis* Forest (CEGL000471, G2)
- *Thuja plicata / Asarum caudatum* Forest (CEGL000472, G5)
- *Thuja plicata / Clintonia uniflora - Xerophyllum tenax* Forest (CEGL005930, G4?)
- *Thuja plicata / Clintonia uniflora* Forest (CEGL000474, G4)
- *Thuja plicata / Gymnocarpium dryopteris* Forest (CEGL000476, G3)
- *Thuja plicata / Taxus brevifolia / Asarum caudatum* Forest (CEGL000480, G2)
- *Thuja plicata / Vaccinium membranaceum* Forest (CEGL000487, G3G4)
- *Tsuga heterophylla / Aralia nudicaulis* Forest (CEGL000488, G3)
- *Tsuga heterophylla / Asarum caudatum* Forest (CEGL000490, G4)

- *Tsuga heterophylla / Clintonia uniflora* Forest (CEGL000493, G4)
- *Tsuga heterophylla / Gymnocarpium dryopteris* Forest (CEGL000494, G3G4)
- *Tsuga heterophylla / Menziesia ferruginea* Forest (CEGL000496, G2)
- *Tsuga heterophylla / Rubus pedatus* Forest (CEGL000113, G2)
- *Tsuga heterophylla / Xerophyllum tenax* Forest (CEGL000499, G2)

DISTRIBUTION

Range: This system occurs in the northern Rockies of western Montana west into northeastern Washington and southern British Columbia.
Divisions: 306:C
Nations: CA, US
Subnations: BC, ID, MT, OR, WA, WY?
Map Zones: 1:C, 8:P, 9:C, 10:C, 19:C
USFS Ecomap Regions: 331A:CC, M331A:PP, M332A:CC, M332B:CP, M332E:C?, M332F:C?, M332G:CC, M333A:CC, M333B:CC, M333C:CC, M333D:CC
TNC Ecoregions: 7:C, 8:C, 68:C

SOURCES

References: Comer et al. 2003, Cooper et al. 1987, Daubenmire and Daubenmire 1968, Meidinger and Pojar 1991, NCC 2002, Pfister et al. 1977
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722871#references
Description Author: M.S. Reid
Version: 23 Jan 2006 **Stakeholders:** Canada, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

NORTHERN ROCKY MOUNTAIN PONDEROSA PINE WOODLAND AND SAVANNA (CES306.030)

CLASSIFIERS

Classification Status: Standard

Primary Division: Rocky Mountain (306)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Ridge/Summit/Upper Slope; Very Shallow Soil; Mineral: W/ A-Horizon <10 cm; Sand Soil Texture; Aridic; Intermediate Disturbance Interval [Periodicity/Polycyclic Disturbance]; F-Patch/Medium Intensity; Needle-Leaved Tree; Graminoid; Pinus ponderosa with grassy understory; Pinus ponderosa with shrubby understory
Non-Diagnostic Classifiers: Short (50-100 yrs) Persistence; Montane [Montane]; Montane [Lower Montane]; Forest and Woodland (Treed); Temperate [Temperate Continental]; Circumneutral Soil; F-Landscape/Low Intensity
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2053; ESLF 4240; ESP 1053

CONCEPT

Summary: This inland Pacific Northwest ecological system occurs in the foothills of the northern Rocky Mountains in the Columbia Plateau region and west along the foothills of the Modoc Plateau and eastern Cascades into southern interior British Columbia. These woodlands and savannas occur at the lower treeline/ecotone between grasslands or shrublands and more mesic coniferous forests typically in warm, dry, exposed sites. Elevations range from less than 500 m in British Columbia to 1600 m in the central Idaho mountains. Occurrences are found on all slopes and aspects; however, moderately steep to very steep slopes or ridgetops are most common. This ecological system generally occurs on glacial till, glacio-fluvial sand and gravel, dune, basaltic rubble, colluvium, to deep loess or volcanic ash-derived soils, with characteristic features of good aeration and drainage, coarse textures, circumneutral to slightly acidic pH, an abundance of mineral material, rockiness, and periods of drought during the growing season. In the Oregon "pumice zone" this system occurs as matrix-forming, extensive woodlands on rolling pumice plateaus and other volcanic deposits. These woodlands in the eastern Cascades, Okanagan and northern Rockies regions receive winter and spring rains, and thus have a greater spring "green-up" than the drier woodlands in the central Rockies. *Pinus ponderosa* (primarily *var. ponderosa*) is the predominant conifer; *Pseudotsuga menziesii* may be present in the tree canopy but is usually absent. In southern interior British Columbia, *Pseudotsuga menziesii* or *Pinus flexilis* may form woodlands or fire-maintained savannas with and without *Pinus ponderosa var. ponderosa* at the lower treeline transition into grassland or shrub-steppe. The understory can be shrubby, with *Artemisia tridentata, Arctostaphylos patula, Arctostaphylos uva-ursi, Cercocarpus ledifolius, Physocarpus malvaceus, Purshia tridentata, Symphoricarpos oreophilus* or *Symphoricarpos albus, Prunus virginiana, Amelanchier alnifolia,* and *Rosa* spp. common species. Understory vegetation in the true savanna occurrences is predominantly fire-resistant grasses and forbs that resprout following surface fires; shrubs, understory trees and downed logs are uncommon. These more open stands support grasses such as *Pseudoroegneria spicata, Hesperostipa* spp., *Achnatherum* spp., dry *Carex* species (*Carex inops*), *Festuca idahoensis,* or *Festuca campestris.* The more mesic portions of this system may include *Calamagrostis rubescens* or *Carex geyeri*, species more typical of Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest (CES306.805). Mixed fire regimes and surface fires of variable return intervals maintain these woodlands typically with a shrub-dominated or patchy shrub layer, depending on climate, degree of soil development, and understory density. This includes the northern race of Interior Ponderosa Pine old-growth (USFS Region 6, USFS Region 1). Historically, many of these woodlands and savannas lacked the shrub component as a result of 3- to 7-year fire-return intervals.
Classification Comments: Hot, dry Douglas-fir types with grass are included here. Rocky Mountain Ponderosa Pine Woodland (CES306.827) and Southern Rocky Mountain Ponderosa Pine Savanna (CES306.826) contain mostly *Pinus ponderosa var. scopulorum* and *Pinus arizonica var. arizonica (= Pinus ponderosa var. arizonica).* The FRIS site describes different varieties of *Pinus ponderosa* and associated species. Johansen and Latta (2003) have mapped the distribution of the two varieties using mitochondrial DNA. They hybridize along the Continental Divide in Montana backing up the FRIS information. Another ponderosa pine system remains to be defined and described for the woodlands and savannas occurring in central and eastern Montana and the Black Hills region. These "northwestern Great Plains ponderosa pine woodlands" are likely to have a floristic component that is more northern Great Plains mixedgrass in nature, as well as being open woodlands generally found in a grassland matrix. Further work is need to identify the geographic and conceptual boundaries between Northern Rocky Mountain Ponderosa Pine Woodland and Savanna (CES306.030) and the northwestern Great Plains system.

Meeting of Pacific Northwest ecologists for Landfire concluded that the "true savanna" of high-frequency / low-intensity fires and grassy understories is now minimally in existence. Most areas that may have been savanna in the past are now more nearly closed-canopy woodlands/forests. Conclusion was that these true savannas should be included with this woodland system, rather than with the climatically-edaphically controlled Northern Rocky Mountain Foothill Conifer Wooded Steppe (CES306.958). Hence, the "true fire-maintained savanna" is included in this woodland system.

Louisa Evers (pers. comm. 2006) notes that she has not found any evidence that ponderosa pine savanna existed historically in north-central and central Oregon. In north-central Oregon, the savanna would have been oak or pine-oak. In central Oregon, it may well have been western juniper. Condition surveys of the Cascades Forest Reserve and General Land Office survey notes suggest that

ponderosa pine formed a woodland with grassy understories, but still was often referred to as open-parklike. Conversely pine-oak and Douglas-fir-oak savannas appeared to have once been quite common in the Willamette Valley (and are classified in North Pacific Oak Woodland (CES204.852)).

Similar Ecological Systems:

- Northwestern Great Plains-Black Hills Ponderosa Pine Woodland and Savanna (CES303.650)
- Southern Rocky Mountain Ponderosa Pine Savanna (CES306.649)
- Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648)

Related Concepts:

- Interior Ponderosa Pine: 237 (Eyre 1980) Broader
- Ponderosa Pine - Grassland (110) (Shiflet 1994) Intersecting
- Ponderosa Pine - Shrubland (109) (Shiflet 1994) Intersecting

DESCRIPTION

Environment: This ecological system within the region occurs at the lower treeline/ecotone between grasslands or shrublands and more mesic coniferous forests typically in warm, dry, exposed sites at elevations ranging from 500-1600 m (1600-5248 feet). These woodlands receive winter and spring rains, and thus have a greater spring "green-up" than the drier ponderosa woodlands in the Colorado and New Mexico Rockies. In eastern Washington, precipitation varies from 36-76 cm (14-30 inches) with most occurring as snowfall (WNHP 2011). It can occur on all slopes and aspects; however, it commonly occurs on moderately steep to very steep slopes or ridgetops. This ecological system generally occurs on most geological substrates from weathered rock to glacial deposits to eolian deposits (e.g., glacial till, glacio-fluvial sand and gravel, dunes, basaltic rubble, colluvium, to deep loess or volcanic ash-derived soils) (WNHP 2011). Characteristic soil features include good aeration and drainage, coarse textures, circumneutral to slightly acidic pH, an abundance of mineral material, and periods of drought during the growing season. Some occurrences may occur as edaphic climax communities on very skeletal, infertile and/or excessively drained soils, such as pumice, cinder or lava fields, and scree slopes. In the Oregon "pumice zone" this system occurs as matrix-forming, extensive woodlands on rolling pumice plateaus and other volcanic deposits. Surface textures are highly variable in this ecological system ranging from sand to loam and silt loam. Exposed rock and bare soil consistently occur to some degree in all the associations.

Dynamics: Summer drought and frequent, low-severity fires create woodlands composed of widely spaced, large trees with small scattered clumps of dense, even-aged stands which regenerated in forest gaps or were protected from fire due to higher soil moisture or topographic protection. Closed-canopy or dense stands were also part of the historical range of stand variability but under natural disturbance regimes are a minor component of that landscape. Mixed fire regimes and surface fires of variable return intervals maintain these woodlands typically with a shrub-dominated or patchy shrub layer, depending on climate, degree of soil development, and understory density. Historically, many of these woodlands and savannas lacked the shrub component as a result of low-severity but high-frequency fires (2 - to 10-year fire-return intervals). Some sites, because of low productivity, naturally lacked a dense shrub understory. Mixed-severity fires had a return interval of 25-75 years while stand-replacing fire occurred at an interval of >100 years (Arno 1980, Fischer and Bradley 1987). The latter two intervals only occurred on 20-25% of stands within the landscape while surface fires were the dominant fire regime on over 75% of stands (Landfire 2007a). Presettlement fires were triggered by lightning strikes or deliberately set fires by Native Americans. Landfire VDDT models: R#PIPOm.

Pinus ponderosa is a drought-resistant, shade-intolerant conifer which usually occurs at lower treeline in the major ranges of the western United States. Establishment of ponderosa pine is erratic and believed to be linked to periods of adequate soil moisture and good seed crops as well as fire frequencies, which allow seedlings to reach sapling size.

Western pine beetle is another significant disturbance and especially affects larger trees. Bark beetle outbreaks are highly related to stand density. Denser stands in relation to site capacity will favor outbreaks, which will decrease as trees are thinned (Landfire 2007a). Mistletoe can cause tree mortality in young and small trees. Fires and insect outbreaks resulted in a landscape consisting of a mosaic of open forests of large trees (most abundant patch), small denser patches of trees, and openings (Franklin et al. 2008). White-headed woodpecker, pygmy nuthatch, and flammulated owl are indicators of healthy ponderosa pine woodlands. All of these birds prefer mature trees in an open woodland setting (Jones 1998, Levad 1998 Winn 1998, as cited in Rondeau 2001).

Component Associations:

- *Artemisia tridentata ssp. vaseyana / Achnatherum occidentale* Shrubland (CEGL001033, G2)
- *Pinus ponderosa - Pseudotsuga menziesii / Pseudoroegneria spicata ssp. inermis* Woodland (CEGL000207, G3Q)
- *Pinus ponderosa / Arctostaphylos patula - Arctostaphylos viscida* Forest (CEGL000061, G2Q)
- *Pinus ponderosa / Arctostaphylos patula - Ceanothus velutinus* Woodland (CEGL000062, G1)
- *Pinus ponderosa / Arctostaphylos patula - Purshia tridentata* Woodland (CEGL000063, G3)
- *Pinus ponderosa / Artemisia arbuscula* Woodland (CEGL000845, G2G3Q)
- *Pinus ponderosa / Artemisia tridentata ssp. vaseyana / Poa nervosa* Woodland (CEGL000180, G2G3)
- *Pinus ponderosa / Calamagrostis rubescens* Forest (CEGL000181, G2Q)
- *Pinus ponderosa / Carex geyeri* Woodland (CEGL000182, G3G4)
- *Pinus ponderosa / Ceanothus velutinus - Purshia tridentata* Woodland (CEGL000064, G4)
- *Pinus ponderosa / Cercocarpus ledifolius* Woodland (CEGL000850, G4)
- *Pinus ponderosa / Elymus glaucus* Forest (CEGL000184, G2)
- *Pinus ponderosa / Festuca idahoensis* Woodland (CEGL000857, G4)
- *Pinus ponderosa / Hesperostipa comata* Woodland (CEGL000879, G1)

- *Pinus ponderosa / Juniperus communis* Woodland (CEGL000859, G4?)
- *Pinus ponderosa / Mahonia repens* Forest (CEGL000187, G3Q)
- *Pinus ponderosa / Physocarpus malvaceus* Forest (CEGL000189, G2)
- *Pinus ponderosa / Pseudoroegneria spicata* Woodland (CEGL000865, G4)
- *Pinus ponderosa / Purshia tridentata / Achnatherum occidentale* Woodland (CEGL000198, G2)
- *Pinus ponderosa / Purshia tridentata / Carex geyeri* Woodland (CEGL002606, G3)
- *Pinus ponderosa / Purshia tridentata / Carex inops ssp. inops* Forest (CEGL000193, G2)
- *Pinus ponderosa / Purshia tridentata / Carex rossii* Woodland (CEGL000194, G2G3)
- *Pinus ponderosa / Purshia tridentata / Festuca idahoensis* Woodland (CEGL000195, G3)
- *Pinus ponderosa / Purshia tridentata / Pseudoroegneria spicata* Woodland (CEGL000197, G3)
- *Pinus ponderosa / Ribes montigenum* Woodland (CEGL000200, G2Q)
- *Pinus ponderosa / Spiraea betulifolia* Forest (CEGL000202, G1G2)
- *Pinus ponderosa / Symphoricarpos albus* Forest (CEGL000203, G4?)
- *Pinus ponderosa / Symphoricarpos oreophilus* Forest (CEGL000205, G3)
- *Pinus ponderosa / Vaccinium caespitosum* Woodland (CEGL005841, G3?)
- *Pinus ponderosa / Wyethia mollis* Woodland (CEGL000206, G2Q)
- *Pseudotsuga menziesii / Festuca campestris* Woodland (CEGL000901, G4)
- *Pseudotsuga menziesii / Festuca idahoensis* Woodland (CEGL000900, G4)
- *Pseudotsuga menziesii / Pseudoroegneria spicata* Woodland (CEGL000908, G4)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- California Montane Jeffrey Pine-(Ponderosa Pine) Woodland (CES206.918)

DISTRIBUTION

Range: This system is found in the Fraser River drainage of southern British Columbia south along the Cascades and northern Rocky Mountains of Washington, Oregon and California. In the northeastern part of its range, it extends across the northern Rocky Mountains west of the Continental Divide into northwestern Montana, south to the Snake River Plain in Idaho, and east into the foothills of western Montana.
Divisions: 204:C; 304:C; 306:C
Nations: CA, US
Subnations: BC, ID, MT, NV?, OR, WA, WY
Map Zones: 1:C, 2:C, 7:C, 8:C, 9:C, 10:C, 18:P, 19:C, 20:?, 30:?
USFS Ecomap Regions: 331A:CC, 342B:CC, 342C:CC, 342D:CP, 342H:CC, 342I:CC, M242B:CC, M242C:CC, M242D:CC, M261A:C?, M261D:CC, M261G:CC, M331A:PP, M331J:PP, M332A:CC, M332B:CC, M332D:CP, M332E:CC, M332F:CC, M332G:CC, M333A:CC, M333B:CC, M333C:CC, M333D:CC
TNC Ecoregions: 4:C, 6:C, 7:C, 8:C, 9:C, 10:C, 26:?, 33:?, 68:C

SOURCES

References: Arno 1980, Camp et al. 1997, Cooper et al. 1987, Daubenmire and Daubenmire 1968, Everett et al. 2000, Evers pers. comm., Eyre 1980, Fischer and Bradley 1987, Franklin and Dyrness 1973, Franklin et al. 2008, Hessburg et al. 2005, Johansen and Latta 2003, Landfire 2007a, Littell et al. 2009, Mauk and Henderson 1984, Mehl 1992, Meidinger and Pojar 1991, NCC 2002, Pfister et al. 1977, Reid et al. 1999, Rice et al. 2012, Rondeau 2001, Shiflet 1994, USFS 1993, Western Ecology Working Group n.d., WNHP 2011, Youngblood and Mauk 1985
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.754393#references
Description Author: M.S. Reid, mod. C. Chappell and R. Crawford
Version: 14 Jan 2014 **Stakeholders:** Canada, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

NORTHERN ROCKY MOUNTAIN SUBALPINE WOODLAND AND PARKLAND (CES306.807)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Upper Treeline; Long (>500 yrs) Persistence; Montane [Upper Montane]; Forest and Woodland (Treed); Ridge/Summit/Upper Slope; Oligotrophic Soil; Very Short Disturbance Interval; W-Patch/High Intensity; W-Patch/Medium Intensity; W-Landscape/Medium Intensity; Larix lyallii
Non-Diagnostic Classifiers: Glaciated uplands; Moraine; Mountainside; Temperate [Temperate Continental]; Glaciated; Mesotrophic Soil; Shallow Soil; Ustic; Cirque headwall
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2046; ESLF 4233; ESP 1046

CONCEPT

Summary: This ecological system of the Northern Rockies, Cascade Range, and northeastern Olympic Mountains is typically a high-elevation mosaic of stunted tree clumps, open woodlands, and herb- or dwarf-shrub-dominated openings, occurring above closed forest ecosystems and below alpine communities. It includes open areas with clumps of *Pinus albicaulis*, as well as woodlands dominated by *Pinus albicaulis* or *Larix lyallii*. In the Cascade Range and northeastern Olympic Mountains, the tree clump pattern is one manifestation, but these are also woodlands with an open canopy, without a tree clump/opening patchiness to them; in fact, that is quite common with *Pinus albicaulis*. The climate is typically very cold in winter and dry in summer. In the Cascades and Olympic Mountains, the climate is more maritime in nature and wind is not as extreme. The upper and lower elevational limits, due to climatic variability and differing topography, vary considerably; in interior British Columbia, this system occurs between 1000 and 2100 m elevation, and in northwestern Montana, it occurs up to 2380 m. Landforms include ridgetops, mountain slopes, glacial trough walls and moraines, talus slopes, landslides and rockslides, and cirque headwalls and basins. Some sites have little snow accumulation because of high winds and sublimation. *Larix lyallii* stands generally occur at or near upper treeline on north-facing cirques or slopes where snowfields persist until June or July. In this harsh, often windswept environment, trees are often stunted and flagged from damage associated with wind and blowing snow and ice crystals, especially at the upper elevations of the type. The stands or patches often originate when *Picea engelmannii, Larix lyallii*, or *Pinus albicaulis* colonize a sheltered site such as the lee side of a rock. *Abies lasiocarpa* can then colonize in the shelter of the *Picea engelmannii* and may form a dense canopy by branch-layering. Major disturbances are windthrow and snow avalanches. Fire is known to occur infrequently in this system, at least where woodlands are present; lightning damage to individual trees is common, but sparse canopies and rocky terrain limit the spread of fire.

These high-elevation coniferous woodlands are dominated by *Pinus albicaulis, Abies lasiocarpa,* and/or *Larix lyallii*, with occasional *Picea engelmannii*. In the Cascades and Olympics, *Abies lasiocarpa* sometimes dominates the tree layer without *Pinus albicaulis*, though in this dry parkland *Tsuga mertensiana* and *Abies amabilis* are largely absent. The undergrowth is usually somewhat depauperate, but some stands support a near sward of heath plants, such as *Phyllodoce glanduliflora, Phyllodoce empetriformis, Empetrum nigrum, Cassiope mertensiana,* and *Kalmia polifolia,* and can include a slightly taller layer of *Ribes montigenum, Salix brachycarpa, Salix glauca, Salix planifolia, Vaccinium membranaceum, Vaccinium myrtillus,* or *Vaccinium scoparium* that may be present to codominant. The herbaceous layer is sparse under dense shrub canopies or may be dense where the shrub canopy is open or absent. *Vahlodea atropurpurea (= Deschampsia atropurpurea), Luzula glabrata var. hitchcockii,* and *Juncus parryi* are the most commonly associated graminoids.

In the mountains of northwestern and west-central Wyoming, where this upper-treeline system reaches the edge of its geographic range, the vegetation usually has the form of an open woodland, and only rarely as scattered groves of trees. At the highest elevations, *Pinus albicaulis* usually has a wind-stunted shrub form. On lower, more favorable sites, upright but wind-shaped *Pinus albicaulis* forms woodlands, sometimes with *Pinus contorta* as a codominant or even the dominant species. With decrease in altitude, where this system merges into the subalpine forests, *Picea engelmannii* and *Abies lasiocarpa* become common tree species as well.
Classification Comments: There is a proposal to either split the dry, subalpine *Pinus albicaulis* woodlands of the Blue Mountains (Oregon) and northern Nevada into a different system; or else to include them in Rocky Mountain Subalpine-Montane Limber-Bristlecone Pine Woodland (CES306.819). For Landfire, these *Pinus albicaulis* woodlands were included in this subalpine parkland system, but ecologically and floristically they are more similar to Rocky Mountain dry subalpine woodlands. In addition, there is a proposal and discussion that tree ribbon spruce-fir woodlands in scattered ranges of southern Wyoming are more ecologically "parklands"; possibly those areas could be included in this system.
Related Concepts:
- Engelmann Spruce - Subalpine Fir: 206 (Eyre 1980) Intersecting
- FP Engelmann Spruce - Subalpine Fir Parkland (Ecosystems Working Group 1998) Broader
- WB Whitebark Pine Subalpine (Ecosystems Working Group 1998) Broader
- Whitebark Pine: 208 (Eyre 1980) Finer

DESCRIPTION

Environment: The climate is typically very cold in winter and dry in summer. In the Cascades and Olympic Mountains, the climate is more maritime in nature and wind is not as extreme. The upper and lower elevational limits, due to climatic variability and differing topography, vary considerably; in interior British Columbia, this system occurs between 1000 and 2100 m elevation, and in northwestern Montana, it occurs up to 2380 m. Landforms include ridgetops, mountain slopes, glacial trough walls and moraines, talus slopes, landslides and rockslides, and cirque headwalls and basins. Some sites have little snow accumulation because of high winds and sublimation. In west-central Wyoming, this system occurs on various landforms over an elevational range from 2230 to 3200 m. It is not tied to particular aspects (Steele et al. 1983).

Dynamics: In this harsh, often windswept environment, trees are often stunted and flagged from damage associated with wind and blowing snow and ice crystals, especially at the upper elevations of the type. The stands or patches often originate when *Picea engelmannii*, *Larix lyallii*, or *Pinus albicaulis* colonize a sheltered site such as the lee side of a rock. *Abies lasiocarpa* can then colonize in the shelter of the *Picea engelmannii* and may form a dense canopy by branch-layering. Major disturbances are windthrow and snow avalanches. Fire is known to occur infrequently in this system, at least where woodlands are present; lightning damage to individual trees is common, but sparse canopies and rocky terrain limit the spread of fire. *Larix lyallii* is a very slow-growing, long-lived tree, with individuals up to 1000 years in age. It is generally shade-intolerant; however, extreme environmental conditions limit potentially competing trees. In the Cascades and Olympic Mountains, the climate is more maritime in nature and wind is not as extreme, but summer drought is a more important process than in the related North Pacific Maritime Mesic Subalpine Parkland (CES204.837). In northwestern and west-central Wyoming, *Pinus albicaulis* is the initial colonizer, and trees of other species become established in the micro-sites that it creates (Callaway 1998, cited in Greater Yellowstone Coordinating Committee 2011). In the highest-elevation stands where *Pinus albicaulis* usually is the only tree present, vegetation dynamics are relatively simple: stands start out with rather dense overstories and sparse undergrowths, and develop more open overstories and denser undergrowths over time. At lower elevations, *Pinus contorta* dominates some stands soon after fire, and the long-lived, more shade-tolerant *Pinus albicaulis* become dominant over time (Steele et al. 1983). As in the Pacific Northwest, fire has, in the past, been a minor process (compared to the subalpine forests at lower elevations): lightning starts many fires, but they rarely spread (Steele et al. 1983).

Component Associations:

- *Abies lasiocarpa - Picea engelmannii* Krummholz Shrubland (CEGL000985, G4)
- *Abies lasiocarpa - Picea engelmannii* Tree Island Forest (CEGL000329, GUQ)
- *Abies lasiocarpa - Pinus albicaulis / Arctostaphylos uva-ursi* Woodland (CEGL000751, G2Q)
- *Abies lasiocarpa - Pinus albicaulis / Vaccinium scoparium* Woodland (CEGL000752, G5?)
- *Larix lyallii / Vaccinium deliciosum* Woodland (CEGL000952, G3)
- *Larix lyallii / Vaccinium scoparium / Luzula glabrata var. hitchcockii* Woodland (CEGL000951, G2G3)
- *Pinus albicaulis - (Abies lasiocarpa) / Carex geyeri* Woodland (CEGL000754, G2G3)
- *Pinus albicaulis - (Picea engelmannii) / Dryas octopetala* Woodland (CEGL005840, G2G3)
- *Pinus albicaulis - Abies lasiocarpa / Menziesia ferruginea / Xerophyllum tenax* Woodland (CEGL005836, G3?)
- *Pinus albicaulis - Abies lasiocarpa / Vaccinium membranaceum / Xerophyllum tenax* Woodland (CEGL005837, G3?)
- *Pinus albicaulis - Abies lasiocarpa / Vaccinium scoparium / Luzula glabrata var. hitchcockii* Woodland (CEGL005839, G3?)
- *Pinus albicaulis - Abies lasiocarpa / Vaccinium scoparium / Xerophyllum tenax* Woodland (CEGL005838, G3?)
- *Pinus albicaulis - Abies lasiocarpa* Woodland (CEGL000128, G5?)
- *Pinus albicaulis / Calamagrostis rubescens* Woodland (CEGL000753, G2)
- *Pinus albicaulis / Carex rossii* Forest (CEGL000129, G3)
- *Pinus albicaulis / Festuca idahoensis* Woodland (CEGL000755, G4)
- *Pinus albicaulis / Juniperus communis* Woodland (CEGL000756, G4?)
- *Pinus albicaulis / Luzula glabrata var. hitchcockii* Woodland (CEGL000758, G3)
- *Pinus albicaulis / Vaccinium scoparium* Forest (CEGL000131, G4)

DISTRIBUTION

Range: This system occurs in the northern Rocky Mountains, west into the Cascade Mountains and northeastern Olympic Mountains, and east into the mountain "islands" of central Montana.

Divisions: 204:C; 306:C

Nations: CA, US

Subnations: AB, BC, ID, MT, WA, WY

Map Zones: 1:C, 7:?, 9:P, 10:C, 12:C, 16:?, 18:C, 19:C, 20:C, 21:C, 22:?, 29:?

USFS Ecomap Regions: 342A:CC, 342F:CP, 342H:CC, 342I:CC, M242A:CC, M242C:CC, M242D:CC, M331A:CC, M331B:CP, M331D:CC, M332A:CC, M332B:CC, M332D:CC, M332E:CC, M332F:CC, M332G:CC, M333A:CC, M333B:CC, M333C:CC, M333D:CC

TNC Ecoregions: 3:C, 7:C, 8:C, 9:P, 26:C, 68:C

SOURCES

References: Arno 1970, Arno and Habeck 1972, Burns and Honkala 1990a, Callaway 1998, Comer et al. 2003, Cooper et al. 1999, Ecosystems Working Group 1998, Eyre 1980, Greater Yellowstone Coordinating Committee 2011, Johnson 2004, Johnson and Swanson 2005, Keane and Parsons 2010, Kendall and Keane 2001, Landfire 2007a, Lillybridge et al. 1995, Littell et al. 2009, Macfarlane et al. 2009, Meidinger and Pojar 1991, NCC 2002, Rice et al. 2012, Steele et al. 1983, Williams and Lillybridge 1983, Williams and Smith 1990, WNDD 2013, WNHP 2011

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722866#references
Description Author: C. Chappell, R. Crawford, G. Kittel, mod. M.S. Reid, K.A. Schulz, G.P. Jones
Version: 10 Jan 2014 **Stakeholders:** Canada, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

NORTHERN ROCKY MOUNTAIN WESTERN LARCH SAVANNA (CES306.837)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Moderate (100-500 yrs) Persistence; Forest and Woodland (Treed); Udic; Very Long Disturbance Interval; F-Landscape/Medium Intensity; Other Floristics/Dominants [User-defined]
Non-Diagnostic Classifiers: Montane [Montane]; Montane [Lower Montane]; Lowland [Foothill]; Sideslope; Toeslope/Valley Bottom; Temperate [Temperate Continental]; Mesotrophic Soil
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Deciduous open tree canopy
National Mapping Codes: EVT 2010; ESLF 4103; ESP 1010

CONCEPT

Summary: This ecological system is restricted to the interior montane zone of the Pacific Northwest in northern Idaho and adjacent Montana, Washington, Oregon, and in southeastern interior British Columbia. It also appears in the east Cascades of Washington. Winter snowpacks typically melt off in early spring at lower elevations. Elevations range from 680 to 2195 m (2230-7200 feet), and sites include drier, lower montane settings of toeslopes and ash deposits. This system is composed of open-canopied "savannas" of the deciduous conifer *Larix occidentalis*, which may have been initiated following stand-replacing crownfires of other conifer systems, but are maintained by a higher frequency, surface-fire regime. These savannas are found in settings where low-intensity, high-frequency fires create open larch woodlands, often with the undergrowth dominated by low-growing *Arctostaphylos uva-ursi, Calamagrostis rubescens, Linnaea borealis, Spiraea betulifolia, Vaccinium caespitosum*, or *Xerophyllum tenax*. Less frequent or absence of fire creates mixed-dominance stands with often shrubby undergrowth; *Vaccinium caespitosum* is common, and taller shrubs can include *Acer glabrum, Ceanothus velutinus, Shepherdia canadensis, Physocarpus malvaceus, Rubus parviflorus*, or *Vaccinium membranaceum*. Fire suppression has led to invasion of the more shade-tolerant tree species *Abies grandis, Abies lasiocarpa, Picea engelmannii*, or *Tsuga* spp. and loss of much of the single-story canopy woodlands.
Classification Comments: Stands initiated following crownfires in areas with stand-replacing fire frequencies greater than 150 years are included in the more mesic adjacent forest systems (Northern Rocky Mountain Mesic Montane Mixed Conifer Forest (CES306.802) and Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest (CES306.805)). This is a fire-dependant system and was much more extensive in the past; it is now very patchy in distribution. Most *Larix occidentalis* is a seral component of the dry-mesic mixed montane forest.
Similar Ecological Systems:
- Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest (CES306.805)

Related Concepts:
- Western Larch: 212 (Eyre 1980) Broader

DESCRIPTION

Dynamics: *Larix occidentalis* is a long-lived species (in excess of 700 years in the northern Rocky Mountains), and thus stands fitting this concept are themselves long-persisting; the life of *Larix*-dominated stands probably does not much exceed 250 years due to various mortality sources and the ingrowth of shade-tolerant species. Occurrences of this ecological system are generated by stand-replacing fire, the fire-return interval for which is speculated to be on the order of 80 to 200 years. These sites may be maintained in a seral status for hundreds of years due to the fact that *Larix occidentalis* is a long-lived species and the understory is often dominated by *Pseudotsuga*, which will grow into the upper canopy. The potential dominants *Abies lasiocarpa, Picea engelmannii*, or *Abies grandis* are slow to establish on these sites and grow slowly presenting the distinct probability, given the fire-return intervals for this type, that the "climax" (long-term stable) condition is never realized.

It has been noted in northern Idaho that, following disturbance (particularly logging) in some mesic-site occurrences, *Larix occidentalis* does not necessarily succeed itself, the first tree-dominated successional stages being dominated by *Pseudotsuga menziesii*, *Pinus contorta*, or less frequently by more shade-tolerant species (Cooper et al. 1987); this response is a consequence of the episodic nature of favorable cone crop years in *Larix occidentalis*.

Landfire VDDT models: #RMCONm and #RMCONdy classes B, C, & D.

Component Associations:
- *Larix occidentalis / Clintonia uniflora - Xerophyllum tenax* Forest (CEGL005881, GNR)
- *Larix occidentalis / Clintonia uniflora* Forest (CEGL005880, GNR)
- *Larix occidentalis / Vaccinium caespitosum / Clintonia uniflora* Forest (CEGL005883, GNR)
- *Larix occidentalis / Vaccinium caespitosum* Forest (CEGL005882, GNR)

DISTRIBUTION

Range: This ecological system is restricted to the interior montane zone of the Pacific Northwest in northern Idaho and adjacent Montana, Washington, Oregon, and in southeastern interior British Columbia. It also appears in the east Cascades of Washington.

Divisions: 204:C; 306:C
Nations: CA? , US
Subnations: BC?, ID, MT, OR, WA
Map Zones: 1:C, 7:C, 8:P, 9:P, 10:C, 19:C
USFS Ecomap Regions: 331A:CC, 342I:??, M242D:CC, M332A:CC, M332B:CP, M332E:C?, M332F:C?, M332G:CC, M333A:CC, M333B:CC, M333C:CC, M333D:CC
TNC Ecoregions: 3:C, 4:C, 6:P, 7:C, 8:P, 68:C

SOURCES

References: Agee 1993, Cooper et al. 1987, Daubenmire and Daubenmire 1968, Driscoll et al. 1984, Hessburg et al. 1999, Hessburg et al. 2000, Johnson and Clausnitzer 1992, Johnson and Simon 1987, Leavell 2000, Lillybridge et al. 1995, Pfister et al. 1977, Steele et al. 1981, Western Ecology Working Group n.d., Williams et al. 1995
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.742829#references
Description Author: R.C. Crawford and M.S. Reid
Version: 01 Sep 2005 **Stakeholders:** Canada, West
Concept Author: R.C. Crawford and M.S. Reid **ClassifResp:** West

NORTHWESTERN GREAT PLAINS HIGHLAND WHITE SPRUCE WOODLAND (CES303.957)

CLASSIFIERS

Classification Status: Standard

Primary Division: Western Great Plains (303)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Temperate [Temperate Continental]; Picea glauca
Non-Diagnostic Classifiers: Montane [Montane]; Forest and Woodland (Treed); Needle-Leaved Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2048; ESLF 4235; ESP 1048

CONCEPT

Summary: This uncommon system is limited to relatively high-elevation outliers of montane environments in the northwestern Great Plains. Best known areas of this system are small portions of the Black Hills of Wyoming and South Dakota and the Cypress Upland of southern Alberta and Saskatchewan. These highland areas have a cooler climate than surrounding mixedgrass prairie. In the Black Hills, these woodlands occur as small or large patches within the ponderosa pine matrix, from about 1740 to 2135 m (5700-7000 feet); at lower elevations, they are restricted to north-facing slopes. At the higher elevations, they are found on level or gently sloping areas. In other locations, this woodland system is limited to sideslopes and depressions, likely adjoining riparian zones, where snow is well-retained. Soils vary widely from deep to quite shallow. *Picea glauca* is the characteristic conifer, but other trees can include *Pinus ponderosa, Populus tremuloides*, and *Betula papyrifera*. Undergrowth shrubs typically include *Arctostaphylos uva-ursi, Juniperus communis, Linnaea borealis, Symphoricarpos albus*, and *Vaccinium scoparium*. Disturbance regimes are not well-documented for this system, but likely include periodic windthrow as well as fire spreading from adjacent, lower elevation woodlands and grasslands.

DESCRIPTION

Environment: This system is limited to relatively high-elevation outliers of montane environments in the northwestern Great Plains of the U.S. and southern Canada. These highland areas have a cooler and more mesic climate than surrounding mixedgrass prairie. In the Black Hills, these woodlands occur as small or large patches within the ponderosa pine matrix, from about 1740 to 2135 m (5700-7000 feet) elevation; at lower elevations, they are restricted to north-facing slopes. At the higher elevations, they are found on level or gently sloping areas. In other locations, this woodland system is limited to sideslopes and depressions, likely adjoining riparian zones, where snow is well-retained. Geology is generally dominated by limestone, granite, slate and schist. Soils vary widely from deep to quite shallow. In the Cypress Hills of Alberta and Saskatchewan, the elevations where this system is found range up to 1466 m; generally these woodlands occur on north-facing slopes or near small springs and seeps.
Dynamics: Disturbance regimes are not well-documented for this system, but likely include periodic windthrow as well as fire spreading from adjacent, lower elevation or drier woodlands and grasslands. There is some debate about whether mixed-severity fire would have occurred in this type based on tree-ring and historical evidence; estimated at a 100-year return interval (Landfire 2007a). Stand-replacing disturbances are primarily associated with climatic fluctuations and include fire and insect (in late-development classes only, mountain pine beetles create larger patch sizes; Ips beetles create smaller patches). Snowbreak and windthrow events may occur. The majority of the insect outbreaks generally occur in late-development stands but in periods of drought (such as that which the forest is currently experiencing), tree mortality is occurring in ponderosa pine that are less than 18 cm (7 inches) dbh. Surface and stand-replacing fire events occur in this system. Stand-replacing fires were likely most common in higher elevation and northern slopes that were primarily dominated by spruce, with surface fires occurring most often in the moist ponderosa pine.

Component Associations:
- *Picea glauca / Linnaea borealis* Forest (CEGL000382, G2G3)
- *Picea glauca / Vaccinium scoparium* Forest (CEGL000383, G1G2)
- *Picea glauca* Alluvial Black Hills Forest (CEGL002057, G2G3)

DISTRIBUTION

Range: This system is limited to relatively high-elevation outliers of montane environments in the northwestern Great Plains. Best known areas of this system are small portions of the Black Hills of Wyoming and South Dakota and the Cypress Upland of southern Alberta and Saskatchewan. It may also occur in very small stands of the Bighorn Mountains of north-central Wyoming and south-central Montana.
Divisions: 303:C; 306:C
Nations: CA, US
Subnations: AB, MT?, SD, SK, WY
Map Zones: 29:C, 30:?, 31:?
USFS Ecomap Regions: M331B:CP, M334A:CC
TNC Ecoregions: 25:C, 26:C

SOURCES

References: Baker and Ehle 2001, Barrow 2009, Brown 2003, Brown 2006, Comer et al. 2003, ESWG 1995, Graves 1899, Henderson et al. 2002, Hoffman and Alexander 1987, Landfire 2007a, Marriott and Faber-Langendoen 2000, Marriott et al. 1999, Rogers 1982, Shinneman and Baker 1997, WNHP 2011

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722724#references

Description Author: P. Comer, mod. M.S. Reid

Version: 14 Jan 2014 **Stakeholders:** Canada, Midwest, West

Concept Author: P. Comer **ClassifResp:** West

NORTHWESTERN GREAT PLAINS-BLACK HILLS PONDEROSA PINE WOODLAND AND SAVANNA (CES303.650)

CLASSIFIERS

Classification Status: Standard

Primary Division: Western Great Plains (303)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Ridge/Summit/Upper Slope; Very Shallow Soil; Mineral: W/ A-Horizon <10 cm; Sand Soil Texture; Aridic; Intermediate Disturbance Interval [Periodicity/Polycyclic Disturbance]; F-Patch/Medium Intensity; Needle-Leaved Tree; Pinus ponderosa with grassy understory; Pinus ponderosa with shrubby understory
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2179; ESLF 4280; ESP 1179

CONCEPT

Summary: This system occurs throughout the Great Plains Division along areas that border the Rocky Mountain Division and into the central Great Plains. The expansion of this system into the central Great Plains may be due to fire suppression. These can be physiognomically variable, ranging from very sparse patches of trees on drier sites, to nearly closed-canopy forest stands on north slopes or in draws where available soil moisture is higher. This system occurs primarily on gentle to steep slopes along escarpments, buttes, canyons, rock outcrops or ravines and can grade into one of the Great Plains canyon systems or the surrounding prairie system. Soils typically range from well-drained loamy sands to sandy loams formed in colluvium, weathered sandstone, limestone, scoria or eolian sand. This system is primarily dominated by *Pinus ponderosa* but may include a sparse to relatively dense understory of *Juniperus scopulorum, Thuja*, or *Cercocarpus* with just a few scattered trees. Deciduous trees are an important component in some areas (western Dakotas, Black Hills) and are sometimes codominant with the pines, including *Fraxinus pennsylvanica, Betula papyrifera, Quercus macrocarpa, Ulmus americana, Acer negundo*, and *Populus tremuloides*. Along the Missouri Breaks in north-central Montana, woodlands dominated by *Pseudotsuga menziesii* are in similar ecological settings as *Pinus ponderosa* in the Great Plains and are included in this system. In the breaks where it occurs, *Pseudotsuga menziesii* has a very open canopy over grassy undergrowth, predominantly composed of *Pseudoroegneria spicata*, with little to no shrubs present. Important or common shrub species with ponderosa pine can include *Arctostaphylos uva-ursi, Mahonia repens, Yucca glauca, Symphoricarpos* spp., *Prunus virginiana, Juniperus communis, Juniperus horizontalis, Amelanchier alnifolia, Rhus trilobata*, and *Physocarpus monogynus*. The herbaceous understory can range from sparse to a dense layer with species typifying the surrounding prairie system, with mixedgrass species common, such as *Andropogon gerardii, Bouteloua curtipendula, Carex inops ssp. heliophila, Carex filifolia, Danthonia intermedia, Koeleria macrantha, Nassella viridula, Oryzopsis asperifolia, Pascopyrum smithii, Piptatherum micranthum*, and *Schizachyrium scoparium*. Timber cutting and other disturbances have degraded many examples of this system within the Great Plains, however, some good examples may occur along the Pine Ridge escarpment and Pine Ridge district of the Nebraska National Forest in Nebraska.
Classification Comments: In this Great Plains region, what were previously called Northern Rocky Mountain Foothill Conifer Wooded Steppe (CES306.958), Southern Rocky Mountain Ponderosa Pine Woodland (CES303.648) and Southern Rocky Mountain Ponderosa Pine Savanna (CES306.826) are now included in this new system. Physiognomically, this is a variable system, with everything from sparse woodlands on breaks and scoria bluffs to dense closed-canopy stands in the Black Hills included.

Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648) is now defined to occur in the montane zones of the Bighorns (USFS section M331B) and Laramie Range (USFS section M331I) and to the west and south of these mountains. It will also occur in other isolated mountain ranges of central Wyoming, but not in eastern Wyoming. It does not occur farther north than Wyoming; all Montana ponderosa pine woodlands are placed into either this Northwest Great Plains system or into Northern Rocky Mountain Ponderosa Pine Woodland and Savanna (CES306.030), as appropriate. The southern extent is hard to determine, but farther south in Colorado, there is more *Juniperus, Pinus edulis*, and *Quercus gambelii*. This system certainly occurs in New Mexico, but stands at the Black Mesa in western Oklahoma and in southeastern Colorado may also be viewed as having the southwestern affinities.

In the Pine Escarpments of Nebraska, pine communities can range from open canopies with grassy understories to more closed canopies. Included within these areas are also several rocky outcrops, which probably should be included within the system as they are often intermingled with the savanna. The more closed-canopy examples may be more similar to Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648) but are included in this system for now.
Similar Ecological Systems:
- Northern Rocky Mountain Foothill Conifer Wooded Steppe (CES306.958)
- Northern Rocky Mountain Ponderosa Pine Woodland and Savanna (CES306.030)
- Southern Rocky Mountain Ponderosa Pine Savanna (CES306.649)
- Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648)

Related Concepts:
- Interior Ponderosa Pine: 237 (Eyre 1980) Intersecting
- Northwestern Great Plains Pine Woodland (Rolfsmeier and Steinauer 2010) Equivalent

DESCRIPTION

Dynamics: Marriot and Faber-Langendoen (2000) report different fire regimes for ponderosa pine communities in the Black Hills, with their "Dry Group" more typically having frequent surface fires and the "Mesic Group" having infrequent catastrophic fires (every 100-200 years). The Dry Group of associations includes lower elevation foothill savanna associations, and the mesic group somewhat higher elevation, north-slope, swale associations. K. Kindscher (pers. comm. 2007) believes that almost all of the stands in Nebraska were there at the time of settlement and are not a result of pine expansion due to fire suppression; in addition, at least some have disappeared, such as the one in southern Nebraska (Franklin County). It is possible, however, that some areas of this system have expanded in size due to fire suppression, but this needs substantiation.

Component Associations:
- *Pinus ponderosa / Carex inops ssp. heliophila* Woodland (CEGL000849, G3G4)
- *Pinus ponderosa / Juniperus horizontalis* Woodland (CEGL000860, G3?)
- *Pinus ponderosa / Oryzopsis asperifolia* Woodland (CEGL002123, G3G4Q)
- *Pinus ponderosa / Pascopyrum smithii* Woodland (CEGL000188, G3G4)
- *Pinus ponderosa / Physocarpus monogynus* Forest (CEGL000190, G3)
- *Pinus ponderosa / Prunus virginiana* Forest (CEGL000192, G3G4)
- *Pinus ponderosa / Quercus macrocarpa* Woodland (CEGL000873, G3)
- *Pinus ponderosa / Schizachyrium scoparium* Woodland (CEGL000201, G3G4)
- *Pinus ponderosa / Symphoricarpos occidentalis* Forest (CEGL000204, G3)

SPATIAL CHARACTERISTICS

Spatial Summary: These ponderosa pine occurrences are typically found in the matrix of the Great Plains grassland systems. They are often surrounded by mixedgrass or tallgrass prairie, in places where available soil moisture is higher or soils are more coarse and rocky. In some cases, these woodlands or savannas may occur where fire suppression has allowed trees to become established (in areas where deciduous trees are more abundant (Girard et al. 1987)). These are typically not in the same setting as Rocky Mountain ponderosa pine, where ponderosa pine forms woodlands at lower treeline and grades into mixed montane conifer systems at higher elevations (it did not make sense to keep Black Hills ponderosa woodlands with the Rocky Mountain system, so they are included here).

Floristically, these pine stands have a graminoid component that is strongly related to mixedgrass or tallgrass Great Plains floristics. The shrub component is not very diagnostic, as most of the important shrubs are commonly also important in Rocky Mountain ponderosa pine or Douglas-fir systems.

DISTRIBUTION

Range: This system is found in central and eastern Montana, the western Dakotas, eastern Wyoming (east of the Bighorns), the Black Hills, and south into the Sand Hills of Nebraska and northeastern Colorado (north of Pawnee National Grasslands to Cedar Point near Limon and south). In Montana, it occurs along the Missouri River breaks, around the Little Belts and Snowy mountains, in south-central Montana between the Bighorns and the Black Hills (along the Tongue and Powder rivers), and other areas of eastern Montana. In Wyoming, it is found around the Black Hills and Bear Lodge Mountains, and in isolated areas of eastern Wyoming on bluffs and rock outcrops, and along "breaks." Whether this system occurs in Kansas is uncertain.
Divisions: 303:C; 306:C
Nations: US
Subnations: CO, KS?, MT, ND, NE, SD, WY
Map Zones: 20:C, 29:C, 30:C, 31:C, 33:C, 39:?, 40:?
USFS Ecomap Regions: 331C:C?, 331D:CC, 331E:CC, 331F:CC, 331G:CC, 331H:CC, 331K:CC, 331L:CC, 331M:CC, 331N:CC, 332A:C?, 332B:C?, 332C:CC, 332D:C?, 332E:C?, M334A:CC
TNC Ecoregions: 25:C, 26:C, 27:C, 33:C, 34:?

SOURCES

References: Bock and Bock 1984, Girard 1985, Girard et al. 1987, Girard et al. 1989, Hansen and Hoffman 1988, Hoffman and Alexander 1987, Marriott and Faber-Langendoen 2000, Thilenius 1972, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.797971#references
Description Author: M.S. Reid
Version: 25 Jan 2007 **Stakeholders:** Midwest, West
Concept Author: M.S. Reid **ClassifResp:** West

OUACHITA MONTANE OAK FOREST (CES202.306)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane; Forest and Woodland (Treed); Ozark/Ouachita; Broad-Leaved Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: EVT 2312; ESLF 4118; ESP 1312

CONCEPT

Summary: This system represents hardwood forests of the highest elevations of the Ouachita, Rich, and Black Fork mountains of Arkansas and Oklahoma (about 790-850 m [2600-2800 feet]). Vegetation consists of either forests or open woodlands dominated by *Quercus alba* or *Quercus stellata*. Canopy trees are often stunted due to the effects of ice, wind and cold conditions, in combination with fog, shallow soils over rock, and periodic severe drought. Some stands form almost impenetrable thickets.
Classification Comments: *Quercus alba - Carya alba / Ostrya virginiana / Carex pensylvanica - Schizachyrium scoparium* Forest (CEGL007818) is taller and less influenced by wind and ice. It is no longer included in this system.
Related Concepts:
- Eastern Redcedar: 46 (Eyre 1980) Finer
- Post Oak - Blackjack Oak: 40 (Eyre 1980) Finer
- White Oak: 53 (Eyre 1980) Finer

DESCRIPTION

Environment: This system is restricted to the highest elevations of the Ouachita, Rich, and Black Fork mountains of Arkansas and Oklahoma (about 790-850 m [2600-2800 feet]). Ecological factors include the effects of ice, wind and cold, in combination with fog, shallow soils over rock, and periodic severe drought.
Vegetation: The vegetation of this system consists of either forests or open woodlands dominated by *Quercus alba* or *Quercus stellata*. Some examples may have *Quercus marilandica var. ashei*; herb layers may contain *Carex pensylvanica* and/or *Carex ouachitana*. In addition, *Quercus rubra, Quercus stellata, Carya texana,* and *Quercus marilandica* may occur as minor components of the canopy. Associated woody species of minor importance include *Amelanchier arborea, Acer rubrum var. rubrum, Sassafras albidum, Vaccinium pallidum, Vaccinium stamineum, Rubus* spp., *Nyssa sylvatica, Hamamelis virginiana, Rhus copallinum, Rhus glabra, Pinus echinata, Chionanthus virginicus, Ulmus alata, Smilax* spp., and *Rubus* spp. The ground layer may have a mosaic of sedge-dominated and lichen/moss-dominated areas. In addition to *Carex pensylvanica* and *Carex ouachitana*, herbaceous species include *Carex albicans var. albicans, Carex nigromarginata, Deschampsia flexuosa, Schizachyrium scoparium, Elymus* spp., *Maianthemum racemosum, Hypericum* sp., *Baptisia* sp., *Cynoglossum virginianum var. virginianum, Agalinis* sp., *Dichanthelium* spp., *Solidago ulmifolia*, and *Solidago* spp.
Dynamics: Canopy trees are often stunted due to the effects of ice, wind and cold conditions, in combination with fog, shallow soils over rock, and periodic severe drought.

Component Associations:
- *Quercus alba / Carex pensylvanica - Carex ouachitana* Dwarf Forest (CEGL002433, G1)
- *Quercus stellata - Quercus marilandica var. ashei* Interior Highlands Scrub Woodland (CEGL003884, G2)

DISTRIBUTION

Range: This system is found at the highest elevations of the Ouachita, Rich, and Black Fork mountains of Arkansas and Oklahoma (about 790-850 m [2600-2800 feet]).
Divisions: 202:C
Nations: US
Subnations: AR, OK
Map Zones: 44:C
USFS Ecomap Regions: M231A:CC
TNC Ecoregions: 39:C

SOURCES

References: Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723186#references
Description Author: T. Foti and R. Evans, mod. M. Pyne
Version: 23 Feb 2010
Concept Author: T. Foti and R. Evans
Stakeholders: Southeast
ClassifResp: Southeast

OZARK-OUACHITA DRY OAK WOODLAND (CES202.707)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Ozark/Ouachita
Non-Diagnostic Classifiers: Forest and Woodland (Treed); Woody-Herbaceous
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Mixed evergreen-deciduous open tree canopy
National Mapping Codes: EVT 2364; ESLF 4306; ESP 1364

CONCEPT

Summary: This system occurs in the Ozark and Ouachita Highlands and far western portions of the Interior Low Plateau regions along gentle to steep slopes and over bluff escarpments with southerly to westerly aspects. Parent material can range from calcareous to acidic with very shallow, well- to excessively well-drained soils, sometimes with a fragipan that causes "xero-hydric" moisture conditions. Historically, this system primarily exhibited a woodland structure with related composition and processes, but now most stands have a more closed canopy. Oak species such as *Quercus stellata*, *Quercus marilandica*, and *Quercus coccinea* dominate this system with an understory of grassland species such as *Schizachyrium scoparium* and shrub species such as *Vaccinium arboreum*. Drought stress is the major dynamic influencing and maintaining this system. Some examples are flatwoods with fragipans; in these examples *Quercus stellata* is the major dominant. In addition, *Quercus alba, Quercus falcata*, and/or *Carya texana* may be present in some stands.
Classification Comments: Dry-mesic to mesic oaks were separated from dry oak per the suggestion of Missouri [see Ozark-Ouachita Dry-Mesic Oak Forest (CES202.708)]. This separation may need to be further reviewed.
Similar Ecological Systems:
- Ouachita Novaculite Glade and Woodland (CES202.314)
- Ozark-Ouachita Dry-Mesic Oak Forest (CES202.708)
- Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland (CES202.313)

Related Concepts:
- Eastern Redcedar: 46 (Eyre 1980) Finer
- Post Oak - Blackjack Oak: 40 (Eyre 1980) Finer
- White Oak - Black Oak - Northern Red Oak: 52 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs along gentle to steep slopes and over bluff escarpments with southerly to westerly aspects in the Ozark and Ouachita Highlands and far western portions of the Interior Low Plateau regions. Parent material can range from calcareous to acidic with very shallow, well- to excessively well-drained soils, sometimes with a fragipan that causes "xero-hydric" moisture conditions. Conditions are drier than those of the dry oak woodlands.
Vegetation: Oak species such as *Quercus stellata, Quercus marilandica*, and *Quercus coccinea* dominate this system with an understory of grassland species such as *Schizachyrium scoparium* and shrub species such as *Vaccinium arboreum*. Drought stress is the major dynamic influencing and maintaining this system. On flatwoods with fragipans, *Quercus stellata* is the major dominant. *Quercus alba, Quercus falcata*, and/or *Carya texana* may be present in some stands. Other species that may be present include *Schizachyrium scoparium, Ulmus alata*, and *Vaccinium arboreum*.

Component Associations:
- *Quercus alba - Quercus stellata - Quercus velutina / Schizachyrium scoparium* Woodland (CEGL002150, G2G3)
- *Quercus falcata - Quercus alba - Quercus stellata - Quercus velutina* Forest (CEGL005018, G3G5)
- *Quercus marilandica / Vaccinium arboreum / Danthonia spicata* Scrub Woodland (CEGL002425, G3G4)
- *Quercus stellata - Quercus marilandica - Carya (glabra, texana) / Vaccinium arboreum* Forest (CEGL002075, G4)
- *Quercus stellata - Quercus marilandica - Quercus velutina - Carya texana / Schizachyrium scoparium* Woodland (CEGL002149, G2G3)
- *Quercus velutina - Carya (alba, glabra) / Vaccinium arboreum* Forest (CEGL004987, G2G3Q)
- *Quercus velutina - Quercus coccinea - Carya texana* Ozark Forest (CEGL002399, GNR)

DISTRIBUTION

Range: This system occurs in the Western Interior Highlands of the Ozark, Ouachita, and western Interior Low Plateau regions.
Divisions: 202:C
Nations: US
Subnations: AR, IL, MO, OK
Map Zones: 43:C, 44:C, 49:P
USFS Ecomap Regions: 223A:CC, 231E:CC, 231G:CC, M223A:CC, M231A:CC

TNC Ecoregions: 38:C, 39:C, 44:C

SOURCES

References: Comer et al. 2003, Nelson 1985

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722953#references

Description Author: S. Menard and T. Nigh, mod. M. Pyne

Version: 18 Apr 2012 **Stakeholders:** Midwest, Southeast

Concept Author: S. Menard and T. Nigh **ClassifResp:** Midwest

OZARK-OUACHITA DRY-MESIC OAK FOREST (CES202.708)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Ozark/Ouachita
Non-Diagnostic Classifiers: Forest and Woodland (Treed); Quercus - Carya
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: EVT 2304; ESLF 4110; ESP 1304

CONCEPT

Summary: This system is found throughout the Ozark and Ouachita Highlands ranging to the western edge of the Interior Low Plateau. It is the matrix system of this region and occurs on dry-mesic to mesic, gentle to moderately steep slopes. Soils are typically moderately to well-drained and more fertile than those associated with oak woodlands. A closed canopy of oak species (*Quercus rubra* and *Quercus alba*) often associated with hickory species (*Carya* spp.) typifies this system. *Acer saccharum* (or *Acer barbatum* to the south) may occur on more mesic examples of this system. Wind, drought, lightning, and occasional fires can influence this system.
Classification Comments: Dry-mesic to mesic oaks were separated from dry oak (Ozark-Ouachita Dry Oak Woodland (CES202.707)) per the suggestion of Missouri. This separation may need to be further reviewed. Likewise, the distribution of this system versus the one farther north (North-Central Interior Dry-Mesic Oak Forest and Woodland (CES202.046)) needs to be reviewed. Currently the glacial line separates the two systems.
Similar Ecological Systems:
- Ouachita Novaculite Glade and Woodland (CES202.314)
- Ozark-Ouachita Dry Oak Woodland (CES202.707)
- Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland (CES202.313)

Related Concepts:
- Eastern Redcedar: 46 (Eyre 1980) Finer
- Sugar Maple: 27 (Eyre 1980) Finer
- White Oak - Black Oak - Northern Red Oak: 52 (Eyre 1980) Finer
- White Oak: 53 (Eyre 1980) Finer

DESCRIPTION

Environment: This is the matrix system of this region and occurs on dry-mesic to mesic, gentle to moderately steep slopes. Soils are typically moderately to well-drained and more fertile than those associated with oak woodlands.
Vegetation: A closed canopy of oak species (*Quercus rubra, Quercus muehlenbergii,* and *Quercus alba*) often associated with hickory species (*Carya* spp.) typifies this system. *Acer saccharum* (or *Acer barbatum* to the south) may occur in more mesic examples. Some stands in the western edge of the Interior Low Plateau (eastern range limit of the system) may contain *Quercus prinus*. Some other species which may be present include *Carex pensylvanica, Carya alba, Carya cordiformis, Carya glabra, Carya ovata, Cercis canadensis, Cornus florida, Fagus grandifolia, Fraxinus americana, Gleditsia triacanthos, Gymnocladus dioicus, Hybanthus concolor, Juglans nigra, Juniperus virginiana, Lindera benzoin, Liquidambar styraciflua, Maclura pomifera, Ostrya virginiana, Quercus alba, Quercus falcata, Quercus marilandica, Quercus shumardii, Quercus velutina, Schizachyrium scoparium, Smilax* spp., *Ulmus americana, Ulmus serotina,* and *Vitis aestivalis*.
Dynamics: Wind, drought, lightning, and occasional fires can influence this system.

Component Associations:
- *Acer saccharum - Quercus muehlenbergii / Cotinus obovatus* Forest (CEGL004795, G2G3Q)
- *Juniperus virginiana - Quercus (alba, stellata) - Carya texana* Forest (CEGL004803, GNR)
- *Quercus alba - Carya alba / Ostrya virginiana / Carex pensylvanica - Schizachyrium scoparium* Forest (CEGL007818, G3Q)
- *Quercus alba - Quercus rubra - Carya (alba, ovata) / Cornus florida* Acidic Forest (CEGL002067, G3)
- *Quercus alba - Quercus rubra - Quercus muehlenbergii / Cercis canadensis* Forest (CEGL002070, G4G5)
- *Quercus alba - Quercus velutina - Carya alba / Desmodium nudiflorum* Ozark Forest (CEGL004270, G4)
- *Quercus alba / Cornus florida* Unglaciated Forest (CEGL002066, G4?)
- *Quercus falcata - Carya alba - Carya ovata* Forest (CEGL004543, G3Q)
- *Quercus muehlenbergii - Quercus shumardii* Forest (CEGL004602, G2G4)
- *Quercus prinus / Smilax* spp. Forest (CEGL005022, G4)
- *Quercus rubra - Quercus shumardii* Forest (CEGL004796, G3?)
- *Quercus velutina - Quercus alba - Carya (glabra, ovata)* Forest (CEGL002076, G4?)
- *Vitis aestivalis* Vine-Shrubland (CEGL003890, G2G3)

DISTRIBUTION

Range: This system is found throughout the Ozark and Ouachita Highlands, reaching to the western Interior Low Plateau of Illinois.
Divisions: 202:C
Nations: US
Subnations: AR, IL, KS?, MO, OK
Map Zones: 32:P, 43:?, 44:C, 49:C
USFS Ecomap Regions: 223A:CC, 231E:CC, 231G:CC, M223A:CC, M231A:CC
TNC Ecoregions: 37:P, 38:C, 39:C, 44:C

SOURCES

References: Comer et al. 2003, Nelson 1985
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722952#references
Description Author: S. Menard, mod. M. Pyne
Version: 18 Apr 2012 **Stakeholders:** Midwest, Southeast
Concept Author: S. Menard **ClassifResp:** Midwest

OZARK-OUACHITA MESIC HARDWOOD FOREST (CES202.043)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Ozark/Ouachita
Non-Diagnostic Classifiers: Lowland [Foothill]; Lowland [Lowland]; Toeslope/Valley Bottom
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: EVT 2334; ESLF 4140; ESP 1334

CONCEPT

Summary: This system is found on lower slopes, toeslopes and valley bottoms within the Ozark and Ouachita regions, as well as on north slopes. In the Ozarks, *Quercus rubra* increases in abundance compared to dry-mesic habitats, and *Acer saccharum* is sometimes a leading dominant. On more alkaline moist soils, *Quercus muehlenbergii, Tilia americana,* and *Cercis canadensis* may be common. In the Boston Mountains, mesic forests may also be common on protected slopes and terraces next to streams. Here, *Fagus grandifolia* may be the leading dominant, with codominants of *Acer saccharum, Liquidambar styraciflua, Tilia americana, Magnolia acuminata, Magnolia tripetala,* and others. Similar habitats occur in the western Ouachita Mountains.

Similar Ecological Systems:
- South-Central Interior Mesophytic Forest (CES202.887)

Related Concepts:
- Beech - Sugar Maple: 60 (Eyre 1980) Finer
- Northern Red Oak: 55 (Eyre 1980) Finer
- Sugar Maple: 27 (Eyre 1980) Finer

DESCRIPTION

Environment: This system may be found on a wide range of topographic positions. It includes mixed mesophytic forests, seeps/springs and smaller riparian areas. This system is found on primarily north- and east-facing aspects, lower slopes, toeslopes, small valley bottoms and terraces, as well as other protected slopes and ravines along intermittent and/or ephemeral streams. Distribution is influenced by local conditions affecting moisture, aspect, elevation and soil productivity. Closed conditions are multiple canopy usually late-seral forests. Stands of this system are generally small, isolated, and/or disjunct and are generally "embedded" in a larger landscape matrix. These communities are maintained primarily through naturally occurring circumstances such as aspect, elevation, soil moisture conditions, and soil productivity, except for mortality or other disturbance-induced openings or gaps.

Vegetation: Dominant or characteristic trees in examples of this system may include *Quercus alba, Quercus rubra, Acer barbatum, Acer saccharum, Fagus grandifolia, Liquidambar styraciflua, Quercus muehlenbergii,* and *Tilia americana*. The understory may contain *Cercis canadensis, Magnolia tripetala,* and/or *Magnolia acuminata*. Some common shrubs include *Asimina triloba* and *Lindera benzoin*. Stands will typically have diverse ground layers. Some typical herbs include *Podophyllum peltatum* and *Hybanthus concolor*.

Dynamics: This type has a lower fire frequency than drier (uphill) types and experiences primarily low-intensity surface fire with occasional mosaic (mixed-severity) or replacement fire. Mean fire-return interval (MFI) is about 25 years with wide year-to-year and within-type variation related to moisture cycles, degree of sheltering and proximity to more fire-prone types. Anthropogenic fire is considered and contributes to within-type MFRI variation. Drought and moisture cycles play a strong role interacting with fire and insect and disease damage. Other natural disturbances may include wind and ice (Landfire 2007a).

Component Associations:
- *Acer (barbatum, saccharum) - Juglans nigra - Fraxinus americana / Hybanthus concolor* Forest (CEGL007811, G2)
- *Acer (saccharum, barbatum) - Quercus rubra - Carya cordiformis / Asimina triloba* Forest (CEGL002060, G3)
- *Fagus grandifolia - Acer saccharum - Liriodendron tulipifera* Unglaciated Forest (CEGL002411, G4?)
- *Fagus grandifolia - Quercus rubra - Tilia americana var. caroliniana / Magnolia tripetala / Podophyllum peltatum* Forest (CEGL007823, G3G4)
- *Quercus alba - Quercus rubra - Acer saccharum - Carya cordiformis / Lindera benzoin* Forest (CEGL002058, G3?)
- *Quercus muehlenbergii - Acer saccharum* Southeastern Oklahoma Forest (CEGL004662, G2G4)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Ozark-Ouachita Shortleaf Pine-Bluestem Woodland (CES202.325)
- Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland (CES202.313)

DISTRIBUTION

Range: This system is found within the Ozarks and Ouachita Mountains of Missouri, Arkansas, and Oklahoma.

Divisions: 202:C
Nations: US
Subnations: AR, MO, OK
Map Zones: 44:C, 49:P
USFS Ecomap Regions: 223A:CC, 231E:CC, 231G:CC, M223A:CC, M231A:CC
TNC Ecoregions: 38:C, 39:C

SOURCES

References: Arkansas Forestry Commission 2010, Barnes 1991, Comer et al. 2003, Engeman et al. 2007, Eyre 1980, Foti and Glenn 1990, Landfire 2007a, Nelson 1985

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722666#references

Description Author: R. Evans and D. Faber-Langendoen, mod. M. Pyne
Version: 14 Jan 2014 **Stakeholders:** Midwest, Southeast
Concept Author: R. Evans, D. Faber-Langendoen **ClassifResp:** Southeast

OZARK-OUACHITA SHORTLEAF PINE-BLUESTEM WOODLAND (CES202.325)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Ozark/Ouachita; Very Short Disturbance Interval; Needle-Leaved Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2507; ESLF 4281; ESP 1507

CONCEPT

Summary: This system represents woodlands of the Ouachita and Ozark mountains region of Arkansas, adjacent Oklahoma, and southern Missouri in which *Pinus echinata* is the canopy dominant, and the understory is characterized by *Andropogon gerardii*, *Schizachyrium scoparium*, and other prairie plants. Although examples of this system occur throughout this region, there is local variation in the extent to which they were present. The center of distribution is the northern and western Ouachita Mountains, and it is best developed in large, dry, and flat to gently undulating portions of the landscape which carry fire well, creating extensive natural fire compartments. In the Ouachitas, the system occurs on the northern Hogback Ridges excluding the Novaculite areas to the south. These are large, gently sloping, east/west-trending ridges of sandstone and shale, the south-facing slopes of which constitute large fire compartments. In nearly all examples, *Pinus echinata* occurs with a variable mixture of hardwood species. The exact composition of the hardwoods is much more closely related to aspect and topographic factors than is the pine component. In the Ozark Highlands this system is less extensive but was historically prominent where sandstone-derived soils are common. In Missouri and Oklahoma, this system occurs on gently dissected upland cherty plains (in addition to sandstone ridges).
Classification Comments: This system is primarily confined to gently to moderately sloping, upland plains and is distinguished from Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland (CES202.313), which occurs on more steeply dissected ridges and steep southwest-facing slopes. The abundance of prairie flora also distinguishes this system from the shortleaf pine-oak woodland.
Similar Ecological Systems:
- East Gulf Coastal Plain Interior Shortleaf Pine-Oak Forest (CES203.506)
- Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland (CES202.313)
- Southern Appalachian Low-Elevation Pine Forest (CES202.332)

Related Concepts:
- Shortleaf Pine - Oak: 76 (Eyre 1980) Intersecting
- Shortleaf Pine: 75 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs throughout the Ouachita and Ozark mountains region, and there is some local variation in the extent to which it is present. The system is best developed in large portions of the landscape which are flat to gently undulating and which would carry fire well, creating extensive natural fire compartments. In the Ouachitas, the system occurs on the northern Hogback Ridges, which are large, gently sloping, east/west-trending ridges of sandstone and shale, the south-facing slopes of which constitute large fire compartments. In nearly all examples, *Pinus echinata* occurs with a variable mixture of hardwood species. The exact composition of the hardwoods is much more closely related to aspect and topographic factors than is the pine component. In the Ozark Highlands this system is less extensive but was historically prominent where sandstone-derived soils are common. In Missouri and Oklahoma, this system occurs on gently dissected upland cherty plains (in addition to sandstone ridges). This system is primarily confined to gently to moderately sloping, upland plains (larger fire compartments) and is thereby distinguished from shortleaf pine-oak woodland, which occurs on more steeply dissected ridges and steep southwest-facing slopes (smaller fire compartments). In the Ouachitas, the primary pine-bluestem landscape lies to the north of the two tallest ridges, Blackfork Mountain and Rich Mountain, which form a rainshadow by orographic lifting of the moisture-laden winds from the Gulf of Mexico that strongly influence the climate of this region; precipitation on those ridges can be as high as 147 cm (58 inches) annually, while just to the north, it may fall to 117 cm (46 inches) (T. Foti pers. comm. 2013).
Vegetation: In the northern part of this geographic area *Pinus echinata*, xeric oaks and some hickory dominate the overstory with a high percentage of oak on steep north slopes and on *Quercus stellata* flats. Associated species include *Quercus marilandica* and *Carya alba* on drier sites and to the west *Carya texana*. In some examples of this system, the aggregate importance of hardwoods may be greater than pine, especially on subxeric and mesic sites (Dale and Ware 1999). Pine is often the canopy emergent on upper slopes. Stand density increases with available moisture. Typical shrubs may include *Vaccinium arboreum*, *Vaccinium pallidum*, and *Vaccinium stamineum*, but these patches are rare. Various bluestem grasses, legumes and other forbs dominate the understory (herbaceous layer).
Dynamics: This system is Fire Regime Group I (Landfire 2007a), with frequent surface fires. Area fire frequency is 3 to 4 years, and the mean fire-return interval ranges from 1 to 12 years (Masters et al. 1995). Annual fire was common historically, such as in the 1800s. Replacement and mixed-severity fires are infrequent, every 100 to 1000 years. Stand-replacement fires occurred mostly under extreme drought conditions during the growing season. The impact of native ungulate grazing (buffalo and elk) was negligible, but

fire generally maintained these open woodlands. Drought and moist cycles play a strong role interacting with both fire and native grazing. Other disturbance types include ice storms, wind events, and insect infestations. These disturbances can add significantly to downed woody debris, which can add fuel and increase fire intensity when that downed material is dry and burns. *Pinus echinata* has shorter needles and is not as susceptible to ice as *Pinus taeda*, which is more common further south in Arkansas.

Fire is an important dynamic process, which maintains open woodland conditions and can promote oak and pine regeneration. Today the region consists largely of closed-canopy forests, though relatively frequent fires prior to Euro-American settlement created and maintained forests, woodlands, savannas and glades (Stambaugh and Guyette 2006). Prior to 1820, fires were most frequent in areas with low topographic roughness, such as flat or gently sloping lands away from ravines and creeks (Stambaugh and Guyette 2008). For the next hundred years, fires increased as population increased (Stambaugh and Guyette 2006, 2008), until about 1930 when very effective fire-suppression practices began (Guldin et al. 2005). During the 1800s, these fires helped maintain *Pinus echinata* woodlands with floristically rich understory vegetation of prairie grasses and forbs (Hedrick et al. 2007). There is a very low rate of fire ignitions from lightning strikes in the area, nearly all ignitions are caused by people (Stambaugh and Guyette 2006).

Component Associations:
- *Pinus echinata - Quercus alba / Schizachyrium scoparium* Woodland (CEGL002394, G3G4)
- *Pinus echinata - Quercus stellata - Quercus marilandica / Schizachyrium scoparium* Woodland (CEGL002393, G2G3)
- *Pinus echinata* / Rock Outcrop Interior Highland Woodland (CEGL002402, G2G3)
- *Pinus echinata / Schizachyrium scoparium - Solidago ulmifolia - Monarda russeliana - Echinacea pallida* Woodland (CEGL007815, G1G2)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Ozark-Ouachita Mesic Hardwood Forest (CES202.043)
- Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland (CES202.313)

DISTRIBUTION

Range: This system occurs in the Ouachita and Ozark mountains region of Arkansas, adjacent Oklahoma, and southern Missouri.
Divisions: 202:C
Nations: US
Subnations: AR, MO, OK
Map Zones: 44:C
USFS Ecomap Regions: 223A:CC, M223A:CC, M231A:CC
TNC Ecoregions: 38:C, 39:C

SOURCES

References: Dale and Ware 1999, Eyre 1980, Foti pers. comm., Guldin et al. 2005, Hedrick et al. 2007, Landfire 2007a, Masters et al. 1995, Southeastern Ecology Working Group n.d., Stambaugh and Guyette 2006, Stambaugh and Guyette 2008, USFS 1999
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.798083#references
Description Author: T. Foti and R. Masters, mod. M. Melnechuk, B. Hoagland, C. Nordman
Version: 14 Jan 2014 **Stakeholders:** Midwest, Southeast
Concept Author: T. Foti, R. Masters, D. Zollner **ClassifResp:** Southeast

OZARK-OUACHITA SHORTLEAF PINE-OAK FOREST AND WOODLAND (CES202.313)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Ozark/Ouachita; Short Disturbance Interval; Needle-Leaved Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Mixed evergreen-deciduous closed tree canopy
National Mapping Codes: EVT 2367; ESLF 4310; ESP 1367

CONCEPT

Summary: This system represents forests and woodlands of the Ouachita and Ozark mountains region of Arkansas, adjacent Oklahoma, and southern Missouri in which *Pinus echinata* is an important or dominant component. Although examples of this system occur throughout this region, there is local variation in the extent to which they were present. For example, in the Ozark Highlands, this system was historically prominent only in the southeastern part where sandstone-derived soils were common, and in the southern part on soils derived from chert, being excluded from or diminished in other areas by non-conducive soils. In contrast, pine was virtually ubiquitous in the historical forests of the Ouachitas. In nearly all cases (at least in the Ouachitas), *Pinus echinata* occurs with a variable mixture of hardwood species. The exact composition of the hardwoods is much more closely related to aspect and topographic factors than is the pine component. In some examples of this system, the aggregate importance of hardwoods may be greater than pine, especially on subxeric and mesic sites.
Classification Comments: This system (CES202.313) is distinguished from the equivalent Appalachian system (CES202.332) at its western extent in central Tennessee by the absence of *Pinus virginiana* and *Quercus prinus*, which do not cross the Mississippi River.
Similar Ecological Systems:
- East Gulf Coastal Plain Interior Shortleaf Pine-Oak Forest (CES203.506)
- Ouachita Novaculite Glade and Woodland (CES202.314)
- Ozark-Ouachita Dry Oak Woodland (CES202.707)
- Ozark-Ouachita Dry-Mesic Oak Forest (CES202.708)
- Ozark-Ouachita Shortleaf Pine-Bluestem Woodland (CES202.325)
- Southern Appalachian Low-Elevation Pine Forest (CES202.332)

Related Concepts:
- Shortleaf Pine - Oak: 76 (Eyre 1980) Intersecting
- Shortleaf Pine: 75 (Eyre 1980) Finer

DESCRIPTION

Environment: In the Ozark Highlands, this system was historically prominent only in the southeastern part, where sandstone derived soils were common (USFS 1999) and in the southern part on soils derived from chert; being limited in other areas by non-conducive soils. In contrast, pine was "virtually ubiquitous in the historical forests of the Ouachitas" (USFS 1999). In nearly all cases (at least in the Ouachitas), Pinus echinata occurs with a variable mixture of hardwood species. The exact composition of the hardwoods is much more closely related to aspect and topographic factors than is the pine component (Dale and Ware 1999).
Vegetation: Stands of this system typically contain *Pinus echinata* with various oak species, including *Quercus alba, Quercus rubra, Quercus falcata, Quercus stellata, Quercus velutina,* and *Quercus marilandica*. In some examples of this system, the aggregate importance of hardwoods may be greater than pine, especially on subxeric and mesic sites (Dale and Ware 1999). Typical shrubs include *Vaccinium arboreum, Vaccinium pallidum,* and *Vaccinium stamineum*. Characteristic herbs include *Schizachyrium scoparium, Chasmanthium sessiliflorum, Solidago ulmifolia, Monarda russeliana,* and *Echinacea pallida*.
Dynamics: Fire is an important dynamic process, which maintains open woodland conditions and can promote oak and pine regeneration. Fires have historically occurred more frequently than once every 10 years (Hedrick et al. 2007). Today the region consists largely of closed-canopy forests, though relatively frequent fires prior to Euro-American settlement created and maintained forests, woodlands, savannas and glades (Stambaugh and Guyette 2006). Prior to 1820, fires were most frequent in areas with relatively low topographic roughness, such as flat or gently sloping lands away from ravines and creeks (Stambaugh and Guyette 2008). For the next hundred years, fires increased as population increased (Stambaugh and Guyette 2006, 2008), until about 1930 when very effective fire-suppression practices began (Guldin et al. 2005). During the 1800s, these fires helped maintain *Pinus echinata* and hardwood forests with floristically rich understory vegetation of grasses and forbs (Hedrick et al. 2007). There is a very low rate of fire ignitions from lightning strikes in the Ozark Highlands area, nearly all ignitions are caused by people (Stambaugh and Guyette 2006). However, fires started by lightning could become very large, since ignitions may occur associated with drought, high winds, drying fuels, and decreasing humidity. The number of lightning strike-initiated wildfires is higher in the Ouachita Mountains and Boston Mountains. In these areas, presettlement wildland fires were ignited by Native Americans and by lightning (Foti and Glenn 1990). Other disturbances include wind, tornados, drought, and ice storms. These disturbances can open forest canopies and add significantly to downed woody debris, which can add fuel and lead to increased fire intensity when that downed material is dry and burns. *Pinus echinata* has shorter needles and is not as susceptible to ice as *Pinus taeda*, which is more common further south in

Arkansas.

Component Associations:
- *Pinus echinata - Quercus (alba, rubra) / Vaccinium (arboreum, pallidum) / Schizachyrium scoparium - Chasmanthium sessiliflorum - Solidago ulmifolia* Forest (CEGL007489, G3G4)
- *Pinus echinata - Quercus alba - Quercus falcata* Forest (CEGL004444, G3?Q)
- *Pinus echinata - Quercus alba / Schizachyrium scoparium* Woodland (CEGL002394, G3G4)
- *Pinus echinata - Quercus stellata - Quercus marilandica / Schizachyrium scoparium* Woodland (CEGL002393, G2G3)
- *Pinus echinata - Quercus velutina - Quercus stellata / Vaccinium* spp. Forest (CEGL002401, G3)
- *Pinus echinata* / Rock Outcrop Interior Highland Woodland (CEGL002402, G2G3)
- *Pinus echinata / Schizachyrium scoparium - Solidago ulmifolia - Monarda russeliana - Echinacea pallida* Woodland (CEGL007815, G1G2)
- *Pinus echinata / Vaccinium (arboreum, pallidum, stamineum)* Forest (CEGL002400, G3G4)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Interior Highlands Unglaciated Flatwoods (CES202.454)
- Ozark-Ouachita Mesic Hardwood Forest (CES202.043)
- Ozark-Ouachita Shortleaf Pine-Bluestem Woodland (CES202.325)

DISTRIBUTION

Range: This system occurs in the Ouachita and Ozark mountains region of Arkansas, adjacent Oklahoma, and southern Missouri.
Divisions: 202:C
Nations: US
Subnations: AR, MO, OK
Map Zones: 32:C, 44:C, 49:P
USFS Ecomap Regions: 223A:CC, 231Ee:CCC, 231Gc:CCC, M223A:CC, M231A:CC
TNC Ecoregions: 38:C, 39:C

SOURCES

References: Comer et al. 2003, Dale and Ware 1999, Eyre 1980, Foti and Glenn 1990, Guldin et al. 2005, Hedrick et al. 2007, Stambaugh and Guyette 2006, Stambaugh and Guyette 2008, USFS 1999
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723183#references
Description Author: T. Foti and R. Evans, mod. M. Pyne and C. Nordman
Version: 14 Jan 2014 **Stakeholders:** Midwest, Southeast
Concept Author: T. Foti and R. Evans **ClassifResp:** Southeast

PIEDMONT HARDPAN WOODLAND AND FOREST (CES202.268)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Clay Soil Texture; Broad-Leaved Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Deciduous open tree canopy
National Mapping Codes: EVT 2342; ESLF 4149; ESP 1342

CONCEPT

Summary: This system of the southern Piedmont occurs in places where a particularly dense clay hardpan has developed over a range of typically mafic rocks, sometimes with more limited areas of shallow glade-like vegetation. In the deeper soil portions of this system, the density of the clay, in combination with its shrink-swell properties, limits water and root penetration into the soil and creates xeric conditions for plants despite the presence of deep soil. Possibly most typical expression of this system in North Carolina is an open forest or woodland of *Quercus stellata*, with *Quercus marilandica* as a characteristic associate. The open canopy leads to a better developed herb layer than in most Piedmont forests, one that is usually grassy. In Virginia, typical canopy trees include *Quercus alba, Carya glabra*, and *Fraxinus americana*. Some of these sites may have once supported open prairies or prairie savannas when they burned more frequently. Fire was probably once the most important natural dynamic process, but the universal elimination of fire in the Piedmont makes this difficult to observe on most of the modern landscape.
Classification Comments: This system is distinguished from others in the Piedmont by occurrence on distinctive substrates. These include hardpan soils in the Triassic basins, as well as on soils derived from gabbro and on acidic metasediments in the Carolina Slate Belt. Despite the contrast in vegetation, this system will sometimes grade quite gradually into Piedmont Upland Depression Swamp (CES202.336), with which it often co-occurs.
Similar Ecological Systems:
- Piedmont Upland Depression Swamp (CES202.336)

Related Concepts:
- Eastern Redcedar: 46 (Eyre 1980) Finer
- Piedmont Flatwoods (Wharton 1978) Finer
- Piedmont Hardpan Forests (Fleming et al. 2005) Equivalent
- Post Oak - Blackjack Oak: 40 (Eyre 1980) Finer
- Shortleaf Pine - Oak: 76 (Eyre 1980) Finer
- Shortleaf Pine: 75 (Eyre 1980) Finer
- White Oak - Black Oak - Northern Red Oak: 52 (Eyre 1980) Finer
- White Oak: 53 (Eyre 1980) Finer
- Xeric Hardpan Forest (Schafale and Weakley 1990) Equivalent

DESCRIPTION

Environment: This system occurs in places in the southern Piedmont where a particularly dense clay hardpan, typically composed of Montmorillonite, has developed. The substrate is typically mafic igneous or metamorphic rock (gabbro, basalt, diabase, or amphibolite) but occasionally is slate. The density of the clay, or its shrink-swell properties, limits penetration of water into the soil and limits penetration of roots, creating xeric conditions for plants despite the presence of deep soil. These areas generally occur on unusually flat uplands but may occur on tops of narrower ridges. Only a minority of these substrates form the distinctive soil conditions of this system. Local topography that promotes runoff is important to forming this system. Areas with these soil conditions but with concave topography perch water and support Piedmont depressional wetlands. Soils in most examples are basic or circumneutral, but those formed from slate are somewhat acidic. In Virginia and adjacent Maryland, this system occupies one of the largest Triassic basins in eastern North America. It includes a mix of sedimentary rocks, especially siltstone, mixed with igneous intrusions. The igneous rocks weather to form more mafic soils, while the sedimentary rocks are more acidic. The local landscape may best be thought of as a lowland, in comparison with the surrounding and prevailing topography.
Vegetation: Vegetation consists of xerophytic species, most typically consisting of open forests or woodlands of *Quercus stellata*, with *Quercus marilandica* as a characteristic associate in North Carolina. In Virginia and adjacent Maryland, *Quercus alba, Fraxinus americana*, and *Carya glabra* are common canopy components. The open canopy leads to a better developed herb layer than in most Piedmont forests, one that is usually grassy. Some of these sites may have once supported open prairies or prairie savannas when they burned more frequently. A significant flora of shade-intolerant herbs with prairie affinities is present in open areas on these soils to support this idea. In contrast to upland forests of adjacent portions of the Virginia Piedmont, there is a pronounced difference in the abundance of hickory present (Farrell and Ware 1991, Ware 1992).
Dynamics: Fire was probably once the most important natural dynamic process, but the universal elimination of fire in the Piedmont makes this difficult to determine. Both the drier character of the sites and the distinctive soil conditions interact with one another to retard woody succession. These factors would presumably have interacted with the fire regime to promote more open vegetation on

these sites. This would presumably lead to a greater probability that these open woodland conditions would prevail for a longer period than they would on more typical soils. Fire would have kept canopies open by limiting the growth of trees and would have promoted a more diverse, grass-dominated herb layer. Bison may have once been a significant influence on this system. These sites are now of more limited extent and it is harder to determine how these factors operated in the larger landscape.

Component Associations:
- *Carya glabra - Quercus (rubra, prinus) - Fraxinus americana / Viburnum rafinesquianum / Piptochaetium avenaceum* Forest (CEGL006209, G1G2)
- *Fraxinus americana - Juniperus virginiana / Talinum teretifolium - Polygonum tenue - Opuntia humifusa* Wooded Herbaceous Vegetation (CEGL006294, G1)
- *Pinus echinata - (Quercus stellata, Quercus marilandica) / Schizachyrium scoparium - Salvia urticifolia* Woodland (CEGL008492, G2?)
- *Quercus alba - Carya glabra - Fraxinus americana / Cercis canadensis / Muhlenbergia sobolifera - Elymus hystrix* Forest (CEGL006216, G3)
- *Quercus alba - Quercus rubra - Carya alba / Cornus florida / Vaccinium stamineum / Desmodium nudiflorum* Piedmont Forest (CEGL008475, G4G5)
- *Quercus phellos - Quercus (alba, stellata) - Carya carolinae-septentrionalis* Hardpan Forest (CEGL004037, G2?)
- *Quercus stellata - (Pinus echinata) / Schizachyrium scoparium - Echinacea laevigata - Oligoneuron album* Woodland (CEGL003558, G1)
- *Quercus stellata - (Pinus echinata) / Schizachyrium scoparium - Symphyotrichum georgianum* Woodland (CEGL003711, G1)
- *Quercus stellata - (Quercus marilandica) / Gaylussacia frondosa* Acidic Hardpan Woodland (CEGL004413, G2)
- *Quercus stellata - Carya (carolinae-septentrionalis, glabra) - (Quercus marilandica) / Ulmus alata / (Schizachyrium scoparium, Piptochaetium avenaceum)* Woodland (CEGL003714, G2G3)
- *Quercus stellata - Carya carolinae-septentrionalis / Acer leucoderme / Piptochaetium avenaceum - Danthonia spicata* Woodland (CEGL003713, G2)
- *Sporobolus vaginiflorus var. ozarkanus - Diodia teres - Croton willdenowii - Ruellia humilis* Herbaceous Vegetation (CEGL004276, G1)

SPATIAL CHARACTERISTICS

Spatial Summary: Large-patch system.
Size: Occurs in large patches, ranging up to dozens of acres.
Adjacent Ecological Systems:
- Piedmont Upland Depression Swamp (CES202.336)
- Southern Piedmont Dry Oak-(Pine) Forest (CES202.339)

Adjacent Ecological System Comments: Piedmont Upland Depression Swamp (CES202.336) occurs on similar soils with topography that limits runoff of rainwater. Most are surrounded by basic soil associations of Southern Piedmont Dry Oak-(Pine) Forest (CES202.339) on less extreme soils.

DISTRIBUTION

Range: As currently known, this system is found in the Piedmont of Maryland, Virginia, North Carolina, South Carolina and Georgia. Its status in Alabama is not known. Its occurrence may be more frequent in the Triassic basins, but it is not restricted to them.
Divisions: 202:C
Nations: US
Subnations: GA, MD, NC, SC, VA
Map Zones: 54:C, 59:C, 60:C, 61:C
USFS Ecomap Regions: 221B:CC, 221D:CC, 221J:CC, 231A:CC, 231D:CC, 231I:CC, M221A:CC, M221B:CC
TNC Ecoregions: 52:C, 61:C

SOURCES

References: Edwards et al. 2013, Engeman et al. 2007, EPA 2004, Eyre 1980, Farrell and Ware 1991, Fleming et al. 2005, Nordman 2013, Schafale and Weakley 1990, Southeastern Ecology Working Group n.d., Ware 1992, Wharton 1978
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723218#references
Description Author: M. Schafale, R. Evans, G. Fleming, M. Pyne, mod. J. Teague
Version: 14 Jan 2014 **Stakeholders:** East, Southeast
Concept Author: M. Schafale, R. Evans, G. Fleming, M. Pyne **ClassifResp:** Southeast

ROCKY MOUNTAIN ASPEN FOREST AND WOODLAND (CES306.813)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Long Disturbance Interval; F-Patch/Medium Intensity; F-Landscape/Medium Intensity; Broad-Leaved Deciduous Tree; Populus tremuloides
Non-Diagnostic Classifiers: Montane [Upper Montane]; Montane [Montane]; Temperate [Temperate Continental]; Mesotrophic Soil; Shallow Soil; Mineral: W/ A-Horizon <10 cm; Ustic
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Deciduous open tree canopy
National Mapping Codes: EVT 2011; ESLF 4104; ESP 1011

CONCEPT

Summary: This widespread ecological system is more common in the southern and central Rocky Mountains but occurs in the montane and subalpine zones throughout much of the western U.S. and north into Canada. An eastern extension occurs along the Rocky Mountains foothill front and in mountain "islands" in Montana (Big Snowy and Highwood mountains), and the Black Hills of South Dakota. In California, this system is only found on the east side of the Sierra Nevada adjacent to the Great Basin. Large stands are found in the Inyo and White mountains, while small stands occur on the Modoc Plateau. In western Alberta, it occurs only in the Upper Foothills subregion, and north of there transitions to Western North American Boreal Mesic Birch-Aspen Forest (CES105.108). Elevations generally range from 1525 to 3050 m (5000-10,000 feet), but occurrences can be found at lower elevations in some regions, especially in the Canadian Rockies. Distribution of this ecological system is primarily limited by adequate soil moisture required to meet its high evapotranspiration demand. Secondarily, it is limited by the length of the growing season or low temperatures. These are upland forests and woodlands dominated by *Populus tremuloides* without a significant conifer component (<25% relative tree cover). The understory structure may be complex with multiple shrub and herbaceous layers, or simple with just an herbaceous layer. The herbaceous layer may be dense or sparse, dominated by graminoids or forbs. In California, *Symphyotrichum spathulatum (= Aster occidentalis)* is a common forb. Associated shrub species include *Symphoricarpos* spp., *Rubus parviflorus, Amelanchier alnifolia*, and *Arctostaphylos uva-ursi*. Occurrences of this system originate and are maintained by stand-replacing disturbances such as avalanches, crown fire, insect outbreak, disease and windthrow, or clearcutting by man or beaver, within the matrix of conifer forests. It differs from Northwestern Great Plains Aspen Forest and Parkland (CES303.681), which is limited to plains environments.
Classification Comments: The scattered occurrences in Trans-Pecos of Texas are of interest as they represent disjunct outliers of the type occurring under highly limited circumstances.
Similar Ecological Systems:
- Northwestern Great Plains Aspen Forest and Parkland (CES303.681)--is limited to plains environments.

Related Concepts:
- Aspen Woodland (411) (Shiflet 1994) Broader
- Aspen: 217 (Eyre 1980) Broader

DESCRIPTION

Environment: Climate is temperate with a relatively long growing season, typically cold winters and deep snow. Mean annual precipitation is greater than 15 inches and typically greater than 20 inches, except in semi-arid environments where occurrences are restricted to mesic microsites such as seeps or large snow drifts. Distribution of this ecological system is primarily limited by adequate soil moisture required to meet its high evapotranspiration demand (Mueggler 1988). Secondarily, its range is limited by the length of the growing season or low temperatures (Mueggler 1988). Topography is variable, sites range from level to steep slopes. Aspect varies according to the limiting factors. Occurrences at high elevations are restricted by cold temperatures and are found on warmer southern aspects. At lower elevations occurrences are restricted by lack of moisture and are found on cooler north aspects and mesic microsites. The soils are typically deep and well developed with rock often absent from the soil. Soil texture ranges from sandy loam to clay loams. Parent materials are variable and may include sedimentary, metamorphic or igneous rocks, but it appears to grow best on limestone, basalt, and calcareous or neutral shales (Mueggler 1988).
Vegetation: Occurrences have a somewhat closed canopy of trees of 5-20 m tall that is dominated by the cold-deciduous, broad-leaved tree *Populus tremuloides*. Conifers that may be present but never codominant include *Abies concolor, Abies lasiocarpa, Picea engelmannii, Picea pungens, Pinus ponderosa*, and *Pseudotsuga menziesii*. Conifer species may contribute up to 15% of the tree canopy before the occurrence is reclassified as a mixed occurrence. Because of the open growth form of *Populus tremuloides*, enough light can penetrate for lush understory development. Depending on available soil moisture and other factors like disturbance, the understory structure may be complex with multiple shrub and herbaceous layers, or simple with just an herbaceous layer. The herbaceous layer may be dense or sparse, dominated by graminoids or forbs. Common shrubs include *Acer glabrum, Amelanchier alnifolia, Artemisia tridentata, Juniperus communis, Prunus virginiana, Rosa woodsii, Shepherdia canadensis, Symphoricarpos oreophilus*, and the dwarf-shrubs *Mahonia repens* and *Vaccinium* spp. The herbaceous layers may be lush and diverse. Common

graminoids may include *Bromus carinatus, Calamagrostis rubescens, Carex siccata (= Carex foenea), Carex geyeri, Carex rossii, Elymus glaucus, Elymus trachycaulus, Festuca thurberi, Hesperostipa comata*, and *Leymus innovatus* in northern occurrences. Associated forbs may include *Achillea millefolium, Eucephalus engelmannii (= Aster engelmannii), Delphinium* spp., *Geranium viscosissimum, Heracleum sphondylium, Ligusticum filicinum, Lupinus argenteus, Osmorhiza berteroi (= Osmorhiza chilensis), Pteridium aquilinum, Rudbeckia occidentalis, Thalictrum fendleri, Valeriana occidentalis, Wyethia amplexicaulis*, and many others. Exotic grasses such as the perennials *Poa pratensis* and *Bromus inermis* and the annual *Bromus tectorum* are often common in occurrences disturbed by grazing.

Dynamics: Occurrences in this ecological system often originate, and are likely maintained, by stand-replacing disturbances such as crown fire, disease and windthrow, or clearcutting by man or beaver. The stems of these thin-barked, clonal trees are easily killed by ground fires, but they can quickly and vigorously resprout in densities of up to 30,000 stems per hectare (Knight 1993). The stems are relatively short-lived (100-150 years), and the occurrence will succeed to longer-lived conifer forest if undisturbed. Occurrences are favored by fire in the conifer zone (Mueggler 1988). With adequate disturbance a clone may live many centuries. Although *Populus tremuloides* produces abundant seeds, seedling survival is rare because of the long moist conditions required to establish are rare in the habitats that it occurs in. Superficial soil drying will kill seedlings (Knight 1993).

Component Associations:

- *Ceanothus velutinus* Shrubland (CEGL002167, GNR)
- *Populus tremuloides - Ceanothus fendleri / Carex* spp. Shrubland (CEGL005504, GNR)
- *Populus tremuloides* - Conifer / *Spiraea betulifolia - Symphoricarpos albus* Forest (CEGL005911, G3?)
- *Populus tremuloides / Acer glabrum* Forest (CEGL000563, G1G2)
- *Populus tremuloides / Amelanchier alnifolia - Symphoricarpos oreophilus / Bromus carinatus* Forest (CEGL000566, G3G5)
- *Populus tremuloides / Amelanchier alnifolia - Symphoricarpos oreophilus / Calamagrostis rubescens* Forest (CEGL000567, G4)
- *Populus tremuloides / Amelanchier alnifolia - Symphoricarpos oreophilus* / Mixed Graminoid Forest (CEGL002816, GNR)
- *Populus tremuloides / Amelanchier alnifolia - Symphoricarpos oreophilus* / Tall Forbs Forest (CEGL000568, G5)
- *Populus tremuloides / Amelanchier alnifolia - Symphoricarpos oreophilus / Thalictrum fendleri* Forest (CEGL000569, G5)
- *Populus tremuloides / Amelanchier alnifolia / Pteridium aquilinum* Forest (CEGL000565, G2G3)
- *Populus tremuloides / Amelanchier alnifolia* / Tall Forbs Forest (CEGL000570, G3G5)
- *Populus tremuloides / Amelanchier alnifolia / Thalictrum fendleri* Forest (CEGL000571, G3G4)
- *Populus tremuloides / Amelanchier alnifolia* Forest (CEGL000564, G4)
- *Populus tremuloides / Artemisia tridentata / Monardella odoratissima - Kelloggia galioides* Forest (CEGL003146, GNR)
- *Populus tremuloides / Artemisia tridentata* Forest (CEGL000572, G3G4)
- *Populus tremuloides / Bromus carinatus* Forest (CEGL000573, G5)
- *Populus tremuloides / Calamagrostis rubescens* Forest (CEGL000575, G5?)
- *Populus tremuloides / Carex geyeri* Forest (CEGL000579, G4)
- *Populus tremuloides / Carex rossii* Forest (CEGL000580, G5)
- *Populus tremuloides / Carex siccata* Forest (CEGL000578, G4)
- *Populus tremuloides / Ceanothus velutinus* Forest (CEGL000581, G2)
- *Populus tremuloides / Corylus cornuta* Forest (CEGL000583, G3)
- *Populus tremuloides / Festuca thurberi* Forest (CEGL000585, G4)
- *Populus tremuloides / Heracleum maximum* Forest (CEGL000595, G3)
- *Populus tremuloides / Heracleum sphondylium* Forest (CEGL000586, G4Q)
- *Populus tremuloides / Hesperostipa comata* Forest (CEGL000608, G2G4)
- *Populus tremuloides / Juniperus communis / Carex geyeri* Forest (CEGL000588, G4G5)
- *Populus tremuloides / Juniperus communis / Lupinus argenteus* Forest (CEGL000589, G3G4)
- *Populus tremuloides / Juniperus communis* Forest (CEGL000587, G4)
- *Populus tremuloides / Ligusticum filicinum* Forest (CEGL000591, G4Q)
- *Populus tremuloides / Lonicera involucrata* Forest (CEGL000592, G3)
- *Populus tremuloides / Lupinus argenteus* Forest (CEGL000593, GNR)
- *Populus tremuloides / Mahonia repens* Forest (CEGL000594, G3)
- *Populus tremuloides* / Mixed Shrubs / Cinder Woodland (CEGL005034, GNR)
- *Populus tremuloides / Monardella odoratissima* Forest (CEGL003145, G3)
- *Populus tremuloides / Prunus virginiana* Forest (CEGL000596, G3G4)
- *Populus tremuloides / Pteridium aquilinum* Forest (CEGL000597, G4)
- *Populus tremuloides / Quercus gambelii / Symphoricarpos oreophilus* Forest (CEGL000598, GNR)
- *Populus tremuloides / Ribes montigenum* Forest (CEGL000600, G2)
- *Populus tremuloides / Robinia neomexicana* Woodland (CEGL005503, GNR)
- *Populus tremuloides / Rosa woodsii* Forest (CEGL003149, GNR)
- *Populus tremuloides / Rubus parviflorus* Forest (CEGL000602, G2)
- *Populus tremuloides / Rudbeckia occidentalis* Forest (CEGL000603, GNRQ)
- *Populus tremuloides / Salix scouleriana* Forest (CEGL000604, G4)
- *Populus tremuloides / Sambucus racemosa* Forest (CEGL000605, G2G3)
- *Populus tremuloides / Shepherdia canadensis* Forest (CEGL000606, G3G4)
- *Populus tremuloides / Spiraea betulifolia* Forest (CEGL000607, G4Q)

- *Populus tremuloides / Symphoricarpos albus / Elymus glaucus* Woodland (CEGL000946, G3)
- *Populus tremuloides / Symphoricarpos albus* Forest (CEGL000609, G3?)
- *Populus tremuloides / Symphoricarpos oreophilus / Bromus carinatus* Forest (CEGL000611, G5)
- *Populus tremuloides / Symphoricarpos oreophilus / Calamagrostis rubescens* Forest (CEGL000612, G3G5)
- *Populus tremuloides / Symphoricarpos oreophilus / Carex rossii* Forest (CEGL000613, G3G4)
- *Populus tremuloides / Symphoricarpos oreophilus / Festuca thurberi* Forest (CEGL000614, G3?)
- *Populus tremuloides / Symphoricarpos oreophilus* / Tall Forbs Forest (CEGL000615, G3G5)
- *Populus tremuloides / Symphoricarpos oreophilus / Thalictrum fendleri* Forest (CEGL000616, G5)
- *Populus tremuloides / Symphoricarpos oreophilus / Wyethia amplexicaulis* Forest (CEGL000617, G4Q)
- *Populus tremuloides / Symphoricarpos oreophilus* Forest (CEGL000610, G5)
- *Populus tremuloides* / Tall Forbs Forest (CEGL000618, G5)
- *Populus tremuloides / Thalictrum fendleri* Forest (CEGL000619, G5)
- *Populus tremuloides / Urtica dioica* Forest (CEGL005849, G2G3)
- *Populus tremuloides / Vaccinium myrtillus* Forest (CEGL000620, G3)
- *Populus tremuloides / Wyethia amplexicaulis* Forest (CEGL000622, G3)

SPATIAL CHARACTERISTICS

Size: This system is not actually very extensive in the Oregon Cascades and probably non-existent in the Coast Ranges. It is not very extensive in western Washington either. Most patches may be too small to map. Many may be relict stands from another climate, just barely hanging on. In the Cascades this system occurs as a small-patch type, not large-patch.

Adjacent Ecological Systems:

- Rocky Mountain Bigtooth Maple Ravine Woodland (CES306.814)

DISTRIBUTION

Range: This system is more common in the central and southern Rocky Mountains extending south to the Sacramento Mountains, however, it occurs in the montane and subalpine zones throughout much of the western U.S. and north into Canada, as well as west into California. Elevations generally range from 1525 to 3050 m (5000-10,000 feet), but occurrences can be found at lower elevations in some regions. Very small occurrences may be found in a few scattered locations of the Trans-Pecos of Texas.

Divisions: 204:C; 206:P; 304:C; 306:C

Nations: CA, US

Subnations: AB, AZ, BC, CA, CO, ID, MT, NM, NV, OR, SD, TX, UT, WA, WY

Map Zones: 1:C, 3:C, 6:C, 7:C, 8:?, 9:C, 10:C, 12:C, 13:?, 15:C, 16:C, 17:C, 18:C, 19:C, 20:C, 21:C, 22:C, 23:C, 24:P, 25:C, 26:C, 27:C, 28:C, 29:C

USFS Ecomap Regions: 313A:CC, 313B:CC, 313D:CC, 315H:PP, 321A:CC, 322A:CC, 331A:CC, 331F:CC, 331G:CC, 331I:C?, 331J:CC, 331K:CP, 331N:CP, 332F:??, 341A:CC, 341B:CC, 341C:CC, 341D:CC, 341E:CC, 341F:CC, 341G:CC, 342A:CC, 342B:CC, 342C:CC, 342D:CC, 342E:CC, 342F:CC, 342G:CC, 342H:CC, 342I:CP, 342J:CC, M242B:CP, M242C:CC, M242D:CC, M261D:CC, M261E:CC, M261G:CC, M313A:CC, M313B:CC, M331A:CC, M331B:CC, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M331J:CC, M332A:CC, M332B:CP, M332D:CC, M332E:CC, M332F:CC, M332G:CC, M333A:CC, M333B:CC, M333C:CP, M333D:CC, M334A:CC, M341A:CC, M341B:CC, M341C:CC, M341D:CC

TNC Ecoregions: 1:P, 3:C, 4:P, 5:P, 7:C, 8:C, 9:C, 11:C, 12:P, 18:C, 19:C, 20:C, 21:P, 25:C, 26:C, 81:P

SOURCES

References: Bartos 1979, Bartos and Campbell 1998, Bartos and Mueggler 1979, Comer et al. 2002, Comer et al. 2003, DeByle and Winokur 1985, DeVelice et al. 1986, Eyre 1980, Henderson et al. 1977, Hess and Wasser 1982, Johnston and Hendzel 1985, Keammerer 1974a, Mueggler 1988, Natural Regions Committee 2006, NCC 2002, Neely et al. 2001, Powell 1988a, Shiflet 1994, Tuhy et al. 2002, Willoughby 2007, Youngblood and Mauk 1985

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722860#references

Description Author: M.S. Reid, mod. G. Kittel

Version: 30 Mar 2010 **Stakeholders:** Canada, Midwest, Southeast, West

Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

ROCKY MOUNTAIN BIGTOOTH MAPLE RAVINE WOODLAND (CES306.814)

CLASSIFIERS

Conf.: 3 - Weak **Classification Status:** Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Ravine; Stream terrace (undifferentiated); Toeslope; Mineral: W/ A-Horizon <10 cm; Unconsolidated; Broad-Leaved Deciduous Tree; Acer grandidentatum; Colluvial slope
Non-Diagnostic Classifiers: Montane [Montane]; Montane [Lower Montane]; Forest and Woodland (Treed); Toeslope/Valley Bottom; Temperate [Temperate Continental]; Mesotrophic Soil; Landslide
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Deciduous open tree canopy
National Mapping Codes: EVT 2012; ESLF 4105; ESP 1012

CONCEPT

Summary: This ecological system occurs in cool ravines, on toeslopes and slump benches associated with riparian areas in the northern and central Wasatch Range and Tavaputs Plateau extending into southern Idaho, as well as in scattered localities in southwestern Utah, central Arizona and New Mexico and the Trans-Pecos of Texas. Substrates are typically rocky colluvial or alluvial soils with favorable soil moisture. These woodlands are dominated by *Acer grandidentatum* but may include mixed stands codominated by *Quercus gambelii* or with scattered conifers. Some stands may include *Acer negundo* or *Populus tremuloides* as minor components. It also occurs on steeper, north-facing slopes at higher elevations, often adjacent to Rocky Mountain Gambel Oak-Mixed Montane Shrubland (CES306.818) or Rocky Mountain Aspen Forest and Woodland (CES306.813).
Classification Comments: In the Trans-Pecos of Texas, this system is a cool ravine woodland type generally occupying lower slope positions. It forms a patchy narrow band on lower slopes that may include *Quercus muehlenbergii*, *Acer grandidentatum*, *Fraxinus* sp., *Prunus serotina*, and *Arbutus xalapensis*. Some of these stands may be included in North American Warm Desert Lower Montane Riparian Woodland and Shrubland (CES302.748) or the broader group North American Warm Desert Riparian Systems (CES302.612). Also look at Madrean Lower Montane Pine-Oak Forest and Woodland (CES305.796).
Similar Ecological Systems:
- Madrean Mesic Canyon Forest and Woodland (CES302.454)

Related Concepts:
- Bigtooth Maple (418) (Shiflet 1994) Equivalent

Component Associations:
- *Abies concolor / Acer grandidentatum* Forest (CEGL000241, G4)
- *Acer grandidentatum - Quercus gravesii* Forest (CEGL004548, G2)
- *Acer grandidentatum - Quercus muehlenbergii* Forest (CEGL004547, G2?)
- *Acer grandidentatum / Calamagrostis rubescens* Forest (CEGL000558, G2Q)
- *Acer grandidentatum / Quercus gambelii* Forest (CEGL000559, G4G5)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Rocky Mountain Aspen Forest and Woodland (CES306.813)
- Rocky Mountain Gambel Oak-Mixed Montane Shrubland (CES306.818)

Adjacent Ecological System Comments: It may occur on steeper, north-facing slopes at higher elevations, often adjacent to Rocky Mountain Gambel Oak-Mixed Montane Shrubland (CES306.818) or Rocky Mountain Aspen Forest and Woodland (CES306.813).

DISTRIBUTION

Range: Occurs in the northern and central Wasatch Range and Tavaputs Plateau extending into southern Idaho, as well as in scattered localities in southwestern Utah, central Arizona and New Mexico and the Trans-Pecos of Texas.
Divisions: 302:C; 304:?; 306:C
Nations: US
Subnations: ID, NM, TX, UT, WY?
Map Zones: 15:C, 16:C, 17:C, 18:C, 23:P, 24:P, 25:C, 26:C
USFS Ecomap Regions: 315A:PP, 321A:PP, 341A:CC, 342C:C?, 342D:CC, 342E:CC, 342J:CC, M313A:CC, M313B:CC, M331D:CC, M331E:CC, M341A:CP, M341B:CC, M341C:CP
TNC Ecoregions: 6:C, 9:C, 18:P, 21:P, 24:C

SOURCES

References: Comer et al. 2003, Gehlbach 1967, Ream 1964
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722859#references
Description Author: NatureServe Western Ecology Team

Version: 20 Feb 2003
Concept Author: NatureServe Western Ecology Team

Stakeholders: Southeast, West
ClassifResp: West

ROCKY MOUNTAIN FOOTHILL LIMBER PINE-JUNIPER WOODLAND (CES306.955)

CLASSIFIERS

Conf.: 3 - Weak **Classification Status:** Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland [Foothill]; Forest and Woodland (Treed); Very Shallow Soil; Mineral: W/ A-Horizon <10 cm; Sand Soil Texture; Aridic; Long Disturbance Interval; F-Patch/High Intensity; Needle-Leaved Tree; Pinus flexilis, Juniperus scopulorum, J. osteosperma
Non-Diagnostic Classifiers: Escarpment; Montane [Lower Montane]; Hillslope bedrock outcrop; Ridgetop bedrock outcrop; Ridge/Summit/Upper Slope; Sideslope; Temperate [Temperate Continental]; Loam Soil Texture
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2049; ESLF 4236; ESP 1049

CONCEPT

Summary: This ecological system occurs in foothill and lower montane zones in the Rocky Mountains from northern Montana south to central Colorado and on escarpments across Wyoming extending out into the western Great Plains. Elevation ranges from 1000-2400 m. It occurs generally below continuous forests of *Pseudotsuga menziesii* or *Pinus ponderosa* and can occur in large stands well within the zone of continuous forests in the northeastern Rocky Mountains. It is restricted to shallow soils and fractured bedrock derived from a variety of parent material, including limestone, sandstone, dolomite, granite and colluvium. Soils have a high rock component (typically over 50% cover) and are coarse- to fine-textured, often gravelly and calcareous. Slopes are typically moderately steep to steep. At higher elevations, it is limited to the most xeric aspects on rock outcrops, and at lower elevations to the relatively mesic north aspects. Fire is infrequent and spotty because rocky substrates prevent a continuous vegetation canopy needed to spread. Vegetation is characterized by an open-tree canopy or patchy woodland that is dominated by either *Pinus flexilis, Juniperus osteosperma,* or *Juniperus scopulorum*. *Pinus edulis* is not present. A sparse to moderately dense short-shrub layer, if present, may include a variety of shrubs, such as *Arctostaphylos uva-ursi, Artemisia nova, Artemisia tridentata, Cercocarpus ledifolius, Cercocarpus montanus, Dasiphora fruticosa ssp. floribunda, Ericameria nauseosa, Juniperus horizontalis, Purshia tridentata, Rhus trilobata, Rosa woodsii, Shepherdia canadensis* (important in Montana stands), *Symphoricarpos albus,* or *Symphoricarpos oreophilus*. Herbaceous layers are generally sparse, but range to moderately dense, and are typically dominated by perennial graminoids such as *Bouteloua gracilis, Festuca idahoensis, Festuca campestris, Danthonia intermedia, Leucopoa kingii, Hesperostipa comata, Koeleria macrantha, Piptatherum micranthum, Poa secunda,* or *Pseudoroegneria spicata*. Within this ecological system, there may be small patches of grassland or shrubland composed of some of the above species. In Wyoming, some limber pine stands are found up to 2440 m (8000 feet) elevation and are still included in this system.
Related Concepts:
- Limber Pine: 219 (Eyre 1980) Intersecting
- Rocky Mountain Juniper: 220 (Eyre 1980) Intersecting

Component Associations:
- *Juniperus osteosperma / Artemisia tridentata* Woodland (CEGL000730, G5?)
- *Juniperus osteosperma / Cercocarpus ledifolius* Woodland (CEGL000734, G3?)
- *Juniperus osteosperma / Cercocarpus montanus* Woodland (CEGL000735, G2G3)
- *Juniperus osteosperma / Pseudoroegneria spicata* Woodland (CEGL000738, G4)
- *Juniperus scopulorum - Cercocarpus ledifolius* Woodland (CEGL000744, G3?)
- *Juniperus scopulorum / Artemisia nova* Woodland (CEGL000742, G2?)
- *Juniperus scopulorum / Artemisia tridentata* Woodland (CEGL000743, G3Q)
- *Juniperus scopulorum / Cercocarpus montanus* Woodland (CEGL000745, G2)
- *Juniperus scopulorum / Piptatherum micranthum* Woodland (CEGL000747, G3G4)
- *Juniperus scopulorum / Pseudoroegneria spicata* Woodland (CEGL000748, G4)
- *Juniperus scopulorum / Purshia tridentata* Woodland (CEGL000749, G2)
- *Juniperus scopulorum / Schizachyrium scoparium* Woodland (CEGL000750, G2)
- *Krascheninnikovia lanata / Phlox* spp. Dwarf-shrubland (CEGL001325, G3Q)
- *Pinus edulis - Juniperus osteosperma / Amelanchier utahensis* Woodland (CEGL002329, GNR)
- *Pinus flexilis / Cercocarpus ledifolius* Woodland (CEGL000804, G4)
- *Pinus flexilis / Cercocarpus montanus - Amelanchier utahensis* Woodland (CEGL005320, GNR)
- *Pinus flexilis / Festuca campestris* Woodland (CEGL000806, G3)
- *Pinus flexilis / Festuca idahoensis* Woodland (CEGL000805, G5)
- *Pinus flexilis / Juniperus communis* Woodland (CEGL000807, G5)
- *Pinus flexilis / Juniperus osteosperma* Woodland (CEGL000808, G3)
- *Pinus flexilis / Juniperus scopulorum* Woodland (CEGL000809, G3)

- *Pinus flexilis / Leucopoa kingii* Woodland (CEGL000810, G3)
- *Pinus flexilis / Pseudoroegneria spicata* Woodland (CEGL000813, G4?)
- *Pinus flexilis / Symphoricarpos oreophilus* Woodland (CEGL005321, GNR)
- *Pinus flexilis* Scree Woodland (CEGL000815, G3Q)

DISTRIBUTION

Range: This system occurs in foothill and lower montane zones in the Rocky Mountains from northern Montana south to central Colorado and on escarpments across Wyoming, extending out into the western Great Plains. Elevation ranges from 1000-2400 m. This system may also occur in southeastern Idaho, though it would not be common there. It is also very likely to occur north into Canada along the Front Range of Alberta, in similar ecological settings.
Divisions: 303:C; 306:C
Nations: CA? , US
Subnations: AB?, CO, MT, ND, SD, WY
Map Zones: 16:C, 19:C, 20:C, 21:P, 22:C, 28:C, 29:C, 30:C, 31:?, 33:C, 40:?
USFS Ecomap Regions: 331D:CC, 331F:CC, 331G:CC, 331H:CC, 331K:CP, 331N:CC, 332C:CC, 342A:CC, 342E:CC, 342F:CC, 342G:CC, M242D:PP, M331A:CC, M331B:CC, M331D:CC, M331E:CC, M331I:CC, M331J:CC, M332D:CC, M334A:??
TNC Ecoregions: 8:C, 9:C, 10:C, 20:C, 25:P, 26:C, 27:C

SOURCES

References: Anderson 1999b, Comer et al. 2003, DeVelice and Lesica 1993, Hansen and Hoffman 1988, Knight 1994, Knight et al. 1987, NCC 2002, Steele et al. 1983, Thilenius et al. 1995
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722726#references
Description Author: G. Jones, K. Schulz, mod. G. Kittel
Version: 20 Apr 2006 **Stakeholders:** Canada, Midwest, West
Concept Author: G. Jones, K. Schulz **ClassifResp:** West

ROCKY MOUNTAIN LODGEPOLE PINE FOREST (CES306.820)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Moderate (100-500 yrs) Persistence; Acidic Soil; Very Shallow Soil; Mineral: W/ A-Horizon <10 cm; Ustic; Long Disturbance Interval; F-Patch/High Intensity [Seasonality/Fall Fire]; F-Landscape/High Intensity; Needle-Leaved Tree; Pinus contorta
Non-Diagnostic Classifiers: Montane [Upper Montane]; Montane [Montane]; Forest and Woodland (Treed); Sideslope; Toeslope/Valley Bottom; Temperate [Temperate Continental]
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2050; ESLF 4237; ESP 1050

CONCEPT

Summary: This ecological system is widespread in upper montane to subalpine elevations of the Rocky Mountains, Intermountain West region, north into the Canadian Rockies and east into mountain "islands" of north-central Montana. These are subalpine forests where the dominance of *Pinus contorta* is related to fire history and topo-edaphic conditions. Following stand-replacing fires, *Pinus contorta* will rapidly colonize and develop into dense, even-aged stands. Most forests in this ecological system occur as early- to mid-successional forests which developed following fires. This system includes *Pinus contorta*-dominated stands that, while typically persistent for >100-year time frames, may succeed to spruce-fir; in the southern and central Rocky Mountains it is seral to Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland (CES306.828). More northern occurrences are seral to Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland (CES306.830). Soils supporting these forests are typically well-drained, gravelly, coarse-textured, acidic, and rarely formed from calcareous parent materials. These forests are dominated by *Pinus contorta* with shrub, grass, or barren understories. Sometimes there are intermingled mixed conifer/*Populus tremuloides* stands, with the latter occurring with inclusions of deeper, typically fine-textured soils. The shrub stratum may be conspicuous to absent; common species include *Arctostaphylos uva-ursi, Ceanothus velutinus, Linnaea borealis, Mahonia repens, Menziesia ferruginea* (in northern occurrences), *Purshia tridentata, Rhododendron albiflorum* (in northern occurrences), *Spiraea betulifolia, Spiraea douglasii, Shepherdia canadensis, Vaccinium caespitosum, Vaccinium scoparium, Vaccinium membranaceum, Symphoricarpos albus*, and *Ribes* spp. In southern interior British Columbia, this system is usually an open lodgepole pine forest found extensively between 500 and 1600 m elevation in the Columbia Range. In the Interior Cedar Hemlock and Interior Douglas-fir zones, *Tsuga heterophylla* or *Pseudotsuga menziesii* may be present. In Alberta, species composition indicates the transition to more boreal floristics, including such species as *Empetrum nigrum, Ledum groenlandicum, Leymus innovatus*, and more abundant lichens or mosses such as *Cladina* spp., *Hylocomium splendens*, and *Pleurozium schreberi*.

Related Concepts:

- BlPa - Juniper - Cladonia (ESSFxv2/02) (Steen and Coupe 1997) Intersecting
- BlPl - Cladina (ESSFmm1/03) (DeLong 1996) Intersecting
- Lodgepole Pine: 218 (Eyre 1980) Broader
- LP Lodgepole pine, Interior Cedar Hemlock and Interior Douglas-fir zones (Ecosystems Working Group 1998) Broader
- Pl - Huckleberry - Cladonia (ESSFwc2/02) (Lloyd et al. 1990) Intersecting
- Pl - Huckleberry - Knight's plume (SBSmw/11) (Steen and Coupe 1997) Intersecting
- Pl - Huckleberry - Velvet-leaved blueberry (SBSmw/03) (Steen and Coupe 1997) Intersecting
- Pl - Juniper - Dwarf blueberry (SBSmc3/02) (DeLong et al. 1993) Intersecting
- Pl - Juniper - Dwarf blueberry (SBSmc3/02) (Steen and Coupe 1997) Intersecting
- Pl - Juniper - Ricegrass (SBSdk/02) (Banner et al. 1993) Intersecting
- Pl - Juniper - Ricegrass (SBSdk/02) (Steen and Coupe 1997) Intersecting
- Pl - Juniper - Ricegrass (SBSdk/02) (DeLong et al. 1993) Intersecting
- Pl - Labrador tea - Velvet-leaved blueberry (SBSdh1/05) (DeLong 1996) Intersecting
- Pl - Velvet-leaved blueberry - Cladonia (SBSdh1/02) (DeLong 1996) Intersecting
- PlBl - Soopolallie - Kinnikinnick (MSdc2/04) (Steen and Coupe 1997) Intersecting
- SwPl - Soopolallie - Twinflower (BWBSdk1/05) (MacKinnon et al. 1990) Intersecting

DESCRIPTION

Dynamics: *Pinus contorta* is an aggressively colonizing, shade-intolerant conifer which usually occurs in lower subalpine forests in the major ranges of the western United States. Establishment is episodic and linked to stand-replacing disturbances, primarily fire. The incidence of serotinous cones varies within and between varieties of *Pinus contorta*, being most prevalent in Rocky Mountain populations. Closed, serotinous cones appear to be strongly favored by fire, and allow rapid colonization of fire-cleared substrates (Burns and Honkala 1990a). Hoffman and Alexander (1980, 1983) report that in stands where *Pinus contorta* exhibits a multi-aged population structure, with regeneration occurring, there is typically a higher proportion of trees bearing nonserotinous cones.

Component Associations:
- *Ceanothus velutinus* Shrubland (CEGL002167, GNR)
- *Chamerion angustifolium* Rocky Mountain Herbaceous Vegetation (CEGL005856, G4G5)
- *Pinus contorta / Arnica cordifolia* Forest (CEGL000135, G4?)
- *Pinus contorta / Carex geyeri* Forest (CEGL000141, G4?)
- *Pinus contorta / Ceanothus velutinus* Forest (CEGL000145, G4)
- *Pinus contorta / Clintonia uniflora - Xerophyllum tenax* Woodland (CEGL005921, G4G5)
- *Pinus contorta / Clintonia uniflora* Forest (CEGL005916, G5)
- *Pinus contorta / Heracleum maximum* Woodland (CEGL005915, G3?)
- *Pinus contorta / Linnaea borealis* Forest (CEGL000153, G5)
- *Pinus contorta / Menziesia ferruginea / Clintonia uniflora* Forest (CEGL005922, G4G5)
- *Pinus contorta / Menziesia ferruginea* Forest (CEGL005928, G3G4)
- *Pinus contorta / Osmorhiza berteroi* Forest (CEGL000155, G3Q)
- *Pinus contorta / Pedicularis racemosa* Forest (CEGL000156, G2Q)
- *Pinus contorta / Shepherdia canadensis* Forest (CEGL000163, G3G4)
- *Pinus contorta / Spiraea betulifolia* Forest (CEGL000164, G3G4)
- *Pinus contorta / Spiraea douglasii* Forest (CEGL002604, G3G4)
- *Pinus contorta / Symphoricarpos albus* Forest (CEGL000166, G3Q)
- *Pinus contorta / Thalictrum occidentale* Forest (CEGL000167, G4Q)
- *Pinus contorta / Vaccinium caespitosum / Clintonia uniflora* Forest (CEGL005923, G4?)
- *Pinus contorta / Vaccinium caespitosum* Forest (CEGL000168, G5)
- *Pinus contorta / Vaccinium membranaceum / Xerophyllum tenax* Forest (CEGL005913, G4G5)
- *Pinus contorta / Vaccinium membranaceum* Forest (CEGL000170, G4?)
- *Pinus contorta / Vaccinium membranaceum* Rocky Mountain Forest (CEGL000169, G3G4)
- *Pinus contorta / Vaccinium scoparium / Calamagrostis rubescens* Forest (CEGL000174, G3Q)
- *Pinus contorta / Vaccinium scoparium / Xerophyllum tenax* Forest (CEGL005924, G3G4)
- *Pinus contorta / Vaccinium scoparium* Forest (CEGL000172, G5)
- *Pinus contorta / Xerophyllum tenax* Forest (CEGL000175, G5)
- *Pinus contorta var. latifolia / Vaccinium scoparium / Carex inops ssp. inops* Forest (CEGL000173, G3)

DISTRIBUTION

Range: This system occurs at upper montane to subalpine elevations of the Rocky Mountains, Intermountain West region, north into the Canadian Rockies, and east onto mountain "islands" of north-central Montana. In Washington, this system occurs mostly on the east side of the Cascade Crest. In Oregon, this system only occurs in the Blue Mountains; all Oregon Cascades lodgepole pine forests are included in other systems.
Divisions: 304:C; 306:C
Nations: CA, US
Subnations: AB, BC, CO, ID, MT, NV, OR, UT, WA, WY
Map Zones: 1:C, 8:?, 9:C, 10:C, 16:C, 18:C, 19:C, 20:C, 21:C, 22:C, 23:?, 28:C, 29:C, 33:?
USFS Ecomap Regions: 331A:CC, 331G:CC, 331J:CC, 331K:C?, 342A:CC, 342B:C?, 342C:CC, 342D:CC, 342E:CC, 342F:CC, 342G:CC, 342H:CC, 342J:CC, M242B:CC, M242C:CC, M242D:CC, M331A:CC, M331B:CC, M331D:CC, M331E:CC, M331F:CP, M331G:CP, M331H:CC, M331I:CC, M331J:CC, M332A:CC, M332B:CC, M332D:CC, M332E:CC, M332F:CC, M332G:CC, M333A:CC, M333B:CC, M333C:CC, M333D:CC, M341B:CC
TNC Ecoregions: 7:C, 8:C, 9:C, 11:C, 18:C, 20:C, 26:C, 68:C

SOURCES

References: Alexander 1986, Alexander et al. 1987, Anderson 1999a, Arno et al. 1985, Barrows et al. 1977, Burns and Honkala 1990a, Comer et al. 2003, Despain 1973a, Despain 1973b, Ecosystems Working Group 1998, Hess and Alexander 1986, Hess and Wasser 1982, Hoffman and Alexander 1976, Hoffman and Alexander 1980, Hoffman and Alexander 1983, Johnson and Clausnitzer 1992, Johnston 1997, Kingery 1998, Mauk and Henderson 1984, Mehl 1992, Meidinger and Pojar 1991, Moir 1969a, Nachlinger et al. 2001, NCC 2002, Neely et al. 2001, Pfister et al. 1977, Steele et al. 1981, Whipple 1975, Williams and Smith 1990
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722853#references
Description Author: R. Crawford, M.S. Reid, G. Kittel
Version: 30 Mar 2010 **Stakeholders:** Canada, Midwest, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

ROCKY MOUNTAIN POOR-SITE LODGEPOLE PINE FOREST (CES306.960)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Moderate (100-500 yrs) Persistence; Acidic Soil; Very Shallow Soil; Mineral: W/ A-Horizon <10 cm; Ustic; Long Disturbance Interval; F-Patch/High Intensity [Seasonality/Fall Fire]; F-Landscape/High Intensity; Needle-Leaved Tree; Pinus contorta
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2167; ESLF 4267; ESP 1167

CONCEPT

Summary: This ecological system is widespread but patchy in distribution in upper montane to subalpine elevations of the Rocky Mountains and Intermountain region. These are subalpine forests, occasionally found in the montane zone, where the dominance of *Pinus contorta* is related to topo-edaphic conditions and nutrient-poor soils. These include excessively well-drained pumice deposits, glacial till and alluvium on valley floors where there is cold-air accumulation, warm and droughty shallow soils over fractured quartzite bedrock, and shallow moisture-deficient soils with a significant component of volcanic ash. Pumice soils at lower elevations of the pumice zone of Oregon support this system. Soils on these sites are typically well-drained, gravelly, coarse-textured, acidic, and rarely formed from calcareous parent materials. Following stand-replacing fires, *Pinus contorta* will rapidly colonize and develop into dense, even-aged stands and then persist on these sites that are too extreme for other conifers to establish. In some cases, stands are open to dense and may be multi-aged, not just even-aged. These forests are dominated by *Pinus contorta* with shrub, grass, or barren understories. Sometimes there are intermingled mixed conifer/*Populus tremuloides* stands, with the latter occurring with inclusions of deeper, typically fine-textured soils. In central Oregon, *Pseudotsuga menziesii, Pinus ponderosa*, and *Abies concolor* may be present, and *Populus tremuloides* may be present as small patches. The shrub stratum may be conspicuous to absent; common species include *Arctostaphylos uva-ursi, Artemisia tridentata, Juniperus communis, Ceanothus velutinus, Linnaea borealis, Mahonia repens, Purshia tridentata, Spiraea betulifolia, Shepherdia canadensis, Vaccinium scoparium, Symphoricarpos albus*, and *Ribes* spp. Some open stands with very sparse understories can experience a form of mixed-severity burning via cigarette burning along downed logs (insufficient fuels between logs to carry fire). Depending on the arrangement and loading of logs to living trees, either mortality or fire-scarring may occur.
Classification Comments: The higher elevation *Pinus contorta* forests of the southern Cascades are included in Sierra Nevada Subalpine Lodgepole Pine Forest and Woodland (CES206.912).
Related Concepts:
- Lodgepole Pine: 218 (Eyre 1980) Broader

DESCRIPTION

Dynamics: *Pinus contorta* is an aggressively colonizing, shade-intolerant conifer which usually occurs in lower subalpine forests in the major ranges of the western United States. Establishment is episodic and linked to stand-replacing disturbances, primarily fire. The incidence of serotinous cones varies within and between varieties of *Pinus contorta*, being most prevalent in Rocky Mountain populations. Closed, serotinous cones appear to be strongly favored by fire and allow rapid colonization of fire-cleared substrates (Burns and Honkala 1990a). Hoffman and Alexander (1980, 1983) report that, in stands where *Pinus contorta* exhibits a multi-aged population structure with regeneration occurring, there is typically a higher proportion of trees bearing nonserotinous cones.

Past clearcutting has expanded this type into ponderosa pine forests south of Bend, Oregon, by creating frost pockets that favor lodgepole pine establishment.

Component Associations:
- *Artemisia tridentata ssp. vaseyana / Achnatherum occidentale* Shrubland (CEGL001033, G2)
- *Pinus contorta / Achnatherum occidentale* Woodland (CEGL000165, G4Q)
- *Pinus contorta / Arctostaphylos uva-ursi* Forest (CEGL000134, G5)
- *Pinus contorta / Artemisia tridentata / Elymus elymoides* Woodland (CEGL000137, G3)
- *Pinus contorta / Artemisia tridentata / Festuca idahoensis* Woodland (CEGL000136, G3)
- *Pinus contorta / Calamagrostis rubescens* Forest (CEGL000139, G5)
- *Pinus contorta / Carex geyeri* Forest (CEGL000141, G4?)
- *Pinus contorta / Carex pensylvanica* Forest (CEGL000143, G3G4)
- *Pinus contorta / Carex rossii* Forest (CEGL000144, G5)
- *Pinus contorta / Danthonia californica* Forest (CEGL000146, G3Q)
- *Pinus contorta / Festuca idahoensis* Woodland (CEGL000149, G3)
- *Pinus contorta / Juniperus communis* Woodland (CEGL000764, G5)
- *Pinus contorta / Mahonia repens* Forest (CEGL000154, G4G5)
- *Pinus contorta / Purshia tridentata - Ribes cereum* Woodland (CEGL000161, G4)

- *Pinus contorta / Purshia tridentata / Carex pensylvanica* Forest (CEGL000159, G4)
- *Pinus contorta / Purshia tridentata* Woodland (CEGL000765, G3)
- *Pinus contorta / Vaccinium scoparium* Forest (CEGL000172, G5)
- *Pinus contorta var. latifolia / Purshia tridentata / Achnatherum occidentale ssp. occidentale* Woodland (CEGL000162, G3)
- *Pinus contorta var. latifolia / Purshia tridentata / Festuca idahoensis* Woodland (CEGL000160, G3)

DISTRIBUTION

Range: This system is found in the upper montane to subalpine elevations of the Rocky Mountains from north-central Colorado north and west into Wyoming, Montana, Idaho, Oregon and Washington, as well as the Intermountain region (northeastern Nevada and north-central Utah). In north-central Montana (mapzone 20), it may occur on appropriate habitats (intrusive volcanics, very nutrient-poor) within "island" mountain ranges (Big Snowy and Highwood mountains). In central Wyoming, it may occur in the Ferris Mountains and possibly north into the Bighorns.
Divisions: 304:C; 306:C
Nations: CA, US
Subnations: AB, BC?, CO?, ID, MT, NV?, OR, UT, WA, WY
Map Zones: 7:?, 8:?, 9:C, 10:C, 16:P, 19:C, 20:?, 21:C, 22:C, 28:C, 29:P
USFS Ecomap Regions: 342B:P?, 342C:PP, 342D:PP, 342H:PP, 342J:PP, M331A:CC, M331B:CC, M331D:CC, M331E:CP, M331H:C?, M331I:C?, M332A:CC, M332B:CC, M332D:CC, M332E:CC, M332F:CC, M332G:CC, M333A:??, M333B:??, M333C:??, M333D:??
TNC Ecoregions: 7:C, 8:C, 9:C, 11:C, 18:C, 20:C, 26:P, 68:C

SOURCES

References: Alexander 1986, Alexander et al. 1987, Anderson 1999a, Arno et al. 1985, Barrows et al. 1977, Burns and Honkala 1990a, Comer et al. 2003, Despain 1973a, Despain 1973b, Ecosystems Working Group 1998, Hess and Alexander 1986, Hess and Wasser 1982, Hoffman and Alexander 1976, Hoffman and Alexander 1980, Hoffman and Alexander 1983, Johnson and Clausnitzer 1992, Johnston 1997, Kingery 1998, Mauk and Henderson 1984, Mehl 1992, Meidinger and Pojar 1991, Moir 1969a, Nachlinger et al. 2001, NCC 2002, Neely et al. 2001, Pfister et al. 1977, Steele et al. 1981, Western Ecology Working Group n.d., Whipple 1975, Williams and Smith 1990
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.786433#references
Description Author: M.S. Reid
Version: 23 Jan 2006 **Stakeholders:** Canada, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

ROCKY MOUNTAIN SUBALPINE DRY-MESIC SPRUCE-FIR FOREST AND WOODLAND (CES306.828)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: RM Subalpine Mesic Spruce-Fir; Long (>500 yrs) Persistence; Montane [Upper Montane]; Forest and Woodland (Treed); Acidic Soil; Ustic; Very Long Disturbance Interval [Seasonality/Summer Disturbance]; F-Patch/High Intensity; F-Landscape/High Intensity; Needle-Leaved Tree; Abies lasiocarpa - Picea engelmannii
Non-Diagnostic Classifiers: Montane [Montane]; Ridge/Summit/Upper Slope; Sideslope; Temperate [Temperate Continental]; Mesotrophic Soil; Shallow Soil; Mineral: W/ A-Horizon >10 cm; W-Patch/Medium Intensity; W-Landscape/Low Intensity
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2055; ESLF 4242; ESP 1055

CONCEPT

Summary: Engelmann spruce and subalpine fir forests comprise a substantial part of the subalpine forests of the Cascades and Rocky Mountains from southern British Columbia east into Alberta, and south into New Mexico and the Intermountain region. They also occur on mountain "islands" of north-central Montana. They are the matrix forests of the subalpine zone, with elevations ranging from 1275 m in its northern distribution to 3355 m in the south (4100-11,000 feet). They often represent the highest elevation forests in an area. Sites within this system are cold year-round, and precipitation is predominantly in the form of snow, which may persist until late summer. Snowpacks are deep and late-lying, and summers are cool. Frost is possible almost all summer and may be common in restricted topographic basins and benches. Despite their wide distribution, the tree canopy characteristics are remarkably similar, with *Picea engelmannii* and *Abies lasiocarpa* dominating either mixed or alone. *Pseudotsuga menziesii* may persist in occurrences of this system for long periods without regeneration. *Pinus contorta* is common in many occurrences, and patches of pure *Pinus contorta* are not uncommon, as well as mixed conifer/*Populus tremuloides* stands. In some areas, such as Wyoming, *Picea engelmannii*-dominated forests are on limestone or dolomite, while nearby codominated spruce-fir forests are on granitic or volcanic rocks. Upper elevation examples may have more woodland physiognomy, and *Pinus albicaulis* can be a seral component. What have been called "ribbon forests" or "tree islands" by some authors are included here; they can be found at upper treeline in many areas of the Rockies, including the central and northern ranges in Colorado and the Medicine Bow and Bighorn ranges of Wyoming. These are more typically islands or ribbons of trees, sometimes with a krummholz form, with open-meadow areas in a mosaic. These patterns are controlled by snow deposition and wind-blown ice. Xeric species may include *Juniperus communis, Linnaea borealis, Mahonia repens,* or *Vaccinium scoparium*. In the Bighorn Mountains, *Artemisia tridentata* is a common shrub. More northern occurrences often have taller, more mesic shrub and herbaceous species, such as *Empetrum nigrum, Rhododendron albiflorum*, and *Vaccinium membranaceum*. Disturbance includes occasional blowdown, insect outbreaks and stand-replacing fire. Mean return interval for stand-replacing fire is 222 years as estimated in southeastern British Columbia.
Classification Comments: It has been proposed to split out the tree island or ribbon forests of high timberline in the drier mountain ranges of north-central Colorado, southern Wyoming and north-central Wyoming (the Bighorns) into a new Southern Rocky Mountain Parkland system. With further discussion, this may be implemented, but for now these areas are still included in this existing system.
Similar Ecological Systems:
- Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest (CES306.805)
- Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland (CES306.830)

Related Concepts:
- DL Douglas-fir Lodgepole Pine (Ecosystems Working Group 1998) Broader. in ESSFdv1 dv2 xc xc2 xc4 xv2
- EF Engelmann Spruce - Sub-alpine Fir Dry Forested (Ecosystems Working Group 1998) Broader. Dry Grouseberry/Crowberry sites, Azalea/Rhododendron sites in ESSFdv dv1 dv2 xc xc 3 xc4 xv1 xv2
- Engelmann Spruce - Subalpine Fir: 206 (Eyre 1980) Broader

DESCRIPTION

Dynamics: *Picea engelmannii* can be very long-lived, reaching 500 years of age. *Abies lasiocarpa* decreases in importance relative to *Picea engelmannii* with increasing distance from the region of Montana and Idaho where maritime air masses influence the climate. Fire is an important disturbance factor, but fire regimes have a long return interval and so are often stand-replacing. *Picea engelmannii* can rapidly recolonize and dominate burned sites, or can succeed other species such as *Pinus contorta* or *Populus tremuloides*. Due to great longevity, *Pseudotsuga menziesii* may persist in occurrences of this system for long periods without regeneration. Old-growth characteristics in *Picea engelmannii* forests will include treefall and windthrow gaps in the canopy, with large downed logs, rotting woody material, tree seedling establishment on logs or on mineral soils unearthed in root balls, and snags. Landfire VDDT models: #RSPFI.

Component Associations:
- *Abies lasiocarpa - Picea engelmannii / Arnica cordifolia* Forest (CEGL000298, G5)
- *Abies lasiocarpa - Picea engelmannii / Arnica latifolia* Forest (CEGL000299, G4)

- *Abies lasiocarpa - Picea engelmannii / Calamagrostis rubescens* Forest (CEGL000301, G4G5)
- *Abies lasiocarpa - Picea engelmannii / Carex geyeri* Forest (CEGL000304, G5)
- *Abies lasiocarpa - Picea engelmannii / Carex siccata* Forest (CEGL000303, G2)
- *Abies lasiocarpa - Picea engelmannii / Galium triflorum* Forest (CEGL000311, G4)
- *Abies lasiocarpa - Picea engelmannii / Juniperus communis* Woodland (CEGL000919, G4G5)
- *Abies lasiocarpa - Picea engelmannii / Linnaea borealis* Forest (CEGL000315, G5)
- *Abies lasiocarpa - Picea engelmannii / Menziesia ferruginea* Forest (CEGL000319, G5)
- *Abies lasiocarpa - Picea engelmannii* / Moss Forest (CEGL000321, G4)
- *Abies lasiocarpa - Picea engelmannii / Polemonium pulcherrimum* Forest (CEGL000373, G5)
- *Abies lasiocarpa - Picea engelmannii / Symphoricarpos albus* Forest (CEGL000337, G3)
- *Abies lasiocarpa - Picea engelmannii / Vaccinium caespitosum* Forest (CEGL000340, G5)
- *Abies lasiocarpa - Picea engelmannii / Vaccinium membranaceum* Rocky Mountain Forest (CEGL000341, G5)
- *Abies lasiocarpa - Picea engelmannii / Vaccinium myrtillus* Forest (CEGL000343, G5)
- *Abies lasiocarpa - Picea engelmannii / Vaccinium scoparium* Forest (CEGL000344, G5)
- *Abies lasiocarpa - Picea engelmannii* Krummholz Shrubland (CEGL000985, G4)
- *Abies lasiocarpa - Picea engelmannii* Tree Island Forest (CEGL000329, GUQ)
- *Abies lasiocarpa / Carex rossii* Forest (CEGL000305, G4G5)
- *Abies lasiocarpa / Jamesia americana* Forest (CEGL000312, G1)
- *Abies lasiocarpa / Lathyrus lanszwertii var. leucanthus* Forest (CEGL000313, G3G4)
- *Abies lasiocarpa / Mahonia repens* Forest (CEGL000318, G5)
- *Abies lasiocarpa / Osmorhiza berteroi* Forest (CEGL000323, G4)
- *Abies lasiocarpa / Packera sanguisorboides* Forest (CEGL000333, G3)
- *Abies lasiocarpa / Paxistima myrsinites* Woodland (CEGL000324, G4)
- *Abies lasiocarpa / Pedicularis racemosa* Forest (CEGL000325, G5)
- *Abies lasiocarpa / Physocarpus malvaceus* Forest (CEGL000326, G3)
- *Abies lasiocarpa / Saxifraga bronchialis* Scree Woodland (CEGL000924, G4)
- *Abies lasiocarpa / Spiraea betulifolia* Forest (CEGL000335, G4)
- *Abies lasiocarpa / Xerophyllum tenax* Forest (CEGL000346, G5)
- *Abies lasiocarpa* Scree Woodland (CEGL000925, G5?)
- *Chamerion angustifolium* Rocky Mountain Herbaceous Vegetation (CEGL005856, G4G5)
- *Picea (engelmannii X glauca, engelmannii) / Clintonia uniflora* Forest (CEGL000406, G4)
- *Picea engelmannii / Arnica cordifolia* Forest (CEGL000355, G3G4)
- *Picea engelmannii / Clintonia uniflora* Forest (CEGL000360, G3)
- *Picea engelmannii / Erigeron eximius* Forest (CEGL000364, G5)
- *Picea engelmannii / Galium triflorum* Forest (CEGL002174, G4)
- *Picea engelmannii / Geum rossii* Forest (CEGL000366, G3?)
- *Picea engelmannii / Hypnum revolutum* Forest (CEGL000368, G3)
- *Picea engelmannii / Juniperus communis* Forest (CEGL005925, G3)
- *Picea engelmannii / Leymus triticoides* Forest (CEGL000362, G3)
- *Picea engelmannii / Linnaea borealis* Forest (CEGL002689, G4)
- *Picea engelmannii / Trifolium dasyphyllum* Forest (CEGL000377, G2?)
- *Picea engelmannii / Vaccinium myrtillus* Forest (CEGL000379, G4Q)
- *Picea engelmannii / Vaccinium scoparium* Forest (CEGL000381, G3G5)

DISTRIBUTION

Range: This system is found in the Cascades and Rocky Mountains from southern interior British Columbia east into Alberta, south into New Mexico and the Intermountain region. This type tends to be very limited in the northern Oregon Cascades.
Divisions: 304:C; 306:C
Nations: CA, US
Subnations: AB, AZ, BC, CO, ID, MT, NM, NV, OR, UT, WA, WY
Map Zones: 1:C, 6:?, 7:C, 9:C, 10:C, 12:C, 15:C, 16:C, 17:C, 18:C, 19:C, 20:C, 21:C, 22:C, 23:P, 24:P, 25:C, 27:C, 28:C, 29:C
USFS Ecomap Regions: 313A:CC, 313B:CC, 315A:PP, 321A:CC, 331J:CC, 341A:CC, 341B:CC, 341D:CC, 341E:CP, 341F:CC, 341G:CC, 342A:CC, 342B:CP, 342C:CC, 342D:CC, 342E:CC, 342F:CC, 342G:CC, 342H:CC, 342I:CP, 342J:CC, M242B:CC, M242C:CC, M242D:CC, M313A:CC, M313B:CC, M331A:CC, M331B:CC, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M331J:CC, M332A:CC, M332B:CC, M332D:CC, M332E:CC, M332F:CC, M332G:CC, M333A:CC, M333B:CC, M333C:CC, M333D:CC, M341A:CC, M341B:CC, M341C:CC, M341D:CC
TNC Ecoregions: 4:C, 7:C, 8:C, 9:C, 11:C, 20:C, 21:C, 26:C, 68:C

SOURCES

References: Alexander and Ronco 1987, Alexander et al. 1984a, Alexander et al. 1987, Anderson 1999a, Brand et al. 1976, Clagg 1975, Comer et al. 2002, Comer et al. 2003, Cooper et al. 1987, Daubenmire and Daubenmire 1968, DeVelice et al. 1986, Ecosystems Working Group 1998, Fitzgerald et al. 1994, Fitzhugh et al. 1987, Graybosch and Buchanan 1983, Hess and Alexander 1986, Hess and Wasser 1982, Hoffman and Alexander 1976, Hoffman and Alexander 1980, Hoffman and Alexander 1983, Hopkins 1979a,

Hopkins 1979b, Johnson and Clausnitzer 1992, Johnson and Simon 1987, Komarkova et al. 1988b, Lillybridge et al. 1995, Major et al. 1981, Mauk and Henderson 1984, Mehl 1992, Meidinger and Pojar 1991, Muldavin et al. 1992, Nachlinger et al. 2001, NCC 2002, Neely et al. 2001, Peet 1978a, Peet 1981, Pfister 1972, Pfister et al. 1977, Romme 1982, Schaupp et al. 1999, Steele and Geier-Hayes 1995, Steele et al. 1981, Tuhy et al. 2002, Veblen 1986, Whipple and Dix 1979, Williams and Lillybridge 1983, Williams et al. 1995, Wong and Iverson 2004, Wong et al. 2003, Youngblood and Mauk 1985

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722845#references

Description Author: R. Crawford and M.S. Reid, mod. C. Chappell and G. Kittel

Version: 25 Jan 2007 **Stakeholders:** Canada, Midwest, West

Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

ROCKY MOUNTAIN SUBALPINE MESIC-WET SPRUCE-FIR FOREST AND WOODLAND (CES306.830)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: RM Subalpine Dry-Mesic Spruce-Fir; Long (>500 yrs) Persistence; Montane [Upper Montane]; Forest and Woodland (Treed); Acidic Soil; Udic; Very Long Disturbance Interval [Seasonality/Summer Disturbance]; F-Patch/High Intensity; F-Landscape/Medium Intensity; Abies lasiocarpa - Picea engelmannii
Non-Diagnostic Classifiers: Montane [Montane]; Sideslope; Toeslope/Valley Bottom; Temperate [Temperate Continental]; Mesotrophic Soil; Shallow Soil; Mineral: W/ A-Horizon >10 cm
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2056; ESLF 4243; ESP 1056

CONCEPT

Summary: This is a high-elevation system of the Rocky Mountains, dry eastern Cascades and eastern Olympic Mountains dominated by *Picea engelmannii* and *Abies lasiocarpa*. It extends westward into the northeastern Olympic Mountains and the northeastern side of Mount Rainier in Washington, and as far east as mountain "islands" of north-central Montana. It also occurs northward into the Upper Foothills subregion of western Alberta. *Picea engelmannii* is generally more important in southern forests than those in the Pacific Northwest. Occurrences are typically found in locations with cold-air drainage or ponding, or where snowpacks linger late into the summer, such as north-facing slopes and high-elevation ravines. They can extend down in elevation below the subalpine zone in places where cold-air ponding occurs (as low as 970 m [3180 feet] in the Canadian Rockies); northerly and easterly aspects predominate. These forests are found on gentle to very steep mountain slopes, high-elevation ridgetops and upper slopes, plateau-like surfaces, basins, alluvial terraces, well-drained benches, and inactive stream terraces. In the northern Rocky Mountains of northern Idaho and Montana, *Tsuga mertensiana* occurs as small to large patches within the matrix of this mesic spruce-fir system and only in the most maritime of environments (the coldest and wettest of the more Continental subalpine fir forests). In the Olympics and northern Cascades, the climate is more maritime than typical for this system, but due to the lower snowfall in these rainshadow areas, summer drought may be more significant than snowpack in limiting tree regeneration in burned areas. *Picea engelmannii* is rare in these areas. Mesic understory shrubs include *Menziesia ferruginea, Vaccinium membranaceum, Rhododendron albiflorum, Amelanchier alnifolia, Rubus parviflorus, Ledum glandulosum, Phyllodoce empetriformis*, and *Salix* spp. Herbaceous species include *Actaea rubra, Maianthemum stellatum, Cornus canadensis, Erigeron eximius, Gymnocarpium dryopteris, Rubus pedatus, Saxifraga bronchialis, Tiarella* spp., *Lupinus arcticus ssp. subalpinus, Valeriana sitchensis*, and graminoids *Luzula glabrata var. hitchcockii* or *Calamagrostis canadensis*. In Alberta, species composition indicates the transition to more boreal floristics, including such species as *Ledum groenlandicum* and *Leymus innovatus*, and more abundant mosses such as *Hylocomium splendens* and *Pleurozium schreberi*. Disturbances include occasional blowdown, insect outbreaks (30-50 years), mixed-severity fire, and stand-replacing fire (every 150-500 years). The more summer-dry climatic areas also have occasional high-severity fires.
Classification Comments: This system is similar to Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland (CES306.828) but is distinguished by its occurrence on mesic to wet microsites within the matrix of the drier (and warmer) subalpine spruce-fir or lodgepole pine forests. The microsites include north-facing slopes, swales or ravines, toeslopes, cold pockets, and other locations where available soil moisture is higher or lasts longer into the growing season. This system is NOT confined to the northern Rocky Mountains or Pacific Northwest (it is not geographically defined, rather by topographic settings in the subalpine).

While the name of this system suggests a Rocky Mountain distribution, floristic affinities of Engelmann spruce-subalpine fir forests in western Washington and the Oregon Cascades are such that the spruce-fir forests of those regions are included in this system. The subalpine fir-dominated forests of the northeastern Olympic Mountains and the northeastern side of Mount Rainier are included here. They are more similar to subalpine fir forests on the eastern slopes of the Cascades than they are to mountain hemlock forests.

Similar Ecological Systems:
- Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest (CES306.805)
- Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland (CES306.828)

Related Concepts:
- Bl - Devil's club - Rhododendron (ESSFmv3/05) (MacKinnon et al. 1990) Intersecting
- Bl - Gooseberry - Oak fern (ESSFdc2/06) (Steen and Coupe 1997) Intersecting
- Bl - Grouseberry - Cladonia (ESSFdc2/04) (Steen and Coupe 1997) Intersecting
- Bl - Horsetail - Feathermoss (ESSFmv3/07) (MacKinnon et al. 1990) Intersecting
- Bl - Huckleberry - Feathermoss (ESSFdc2/05) (Steen and Coupe 1997) Intersecting
- Bl - Oak fern - Knight's plume (ESSFmv3/04) (Banner et al. 1993) Intersecting
- Bl - Oak fern - Knight's plume (ESSFmv3/04) (MacKinnon et al. 1990) Intersecting
- Bl - Rhododendron - Feathermoss (ESSFmv3/01) (MacKinnon et al. 1990) Intersecting
- Bl - Rhododendron - Feathermoss (ESSFmv3/01) (Banner et al. 1993) Intersecting
- Bl - Rhododendron - Grouseberry (ESSFdc2/01) (Steen and Coupe 1997) Intersecting

- Bl - Rhododendron - Valerian (ESSFdc2/07) (Steen and Coupe 1997) Intersecting
- Bl - Trapper's tea (ESSFdc2/08) (Steen and Coupe 1997) Intersecting
- BlPl - Crowberry - Cladina (ESSFmv3/02) (MacKinnon et al. 1990) Intersecting
- BlPl - Crowberry - Cladina (ESSFmv3/02) (Banner et al. 1993) Intersecting
- BlPl - Rhododendron (ESSFmv3/08) (MacKinnon et al. 1990) Intersecting
- BlSb - Labrador tea (ESSFmv3/03) (Banner et al. 1993) Intersecting
- BlSb - Labrador tea (ESSFmv3/03) (MacKinnon et al. 1990) Intersecting
- EF Engelmann Spruce - Sub-alpine Fir Dry Forested (Ecosystems Working Group 1998) Broader. Rhododendron sites, Azalea/ Rhododendron sites, in ESSFdc1 dc2 mw wc1 wc2 wc4 xc ICHmk1 mk2 mw2 mw3 mw5 vk1 wk1
- Engelmann Spruce - Subalpine Fir: 206 (Eyre 1980) Broader
- EW Engelmann Spruce - Mountain Hemlock (Ecosystems Working Group 1998) Broader. in ESSFdc2 dv1 mw; IH in ESSFdc1 dc2 wc1 wc2 wc4
- Mountain Hemlock: 205 (Eyre 1980) Intersecting. Mountain hemlock in the northern Rockies of MT, ID and northeast WA is included in this ecological system.
- no data (Essfdc3/) (BCMF 2006) Intersecting
- Se - Trapper's tea - Glow moss (ESSFxv2/09) (Steen and Coupe 1997) Intersecting
- Se - Willow - Glow moss (ESSFxv2/10) (Steen and Coupe 1997) Intersecting

DESCRIPTION

Dynamics: Landfire VDDT models: #RSPFI and #RABLA.

Component Associations:
- *Abies lasiocarpa - Picea engelmannii / Acer glabrum* Forest (CEGL000294, G5)
- *Abies lasiocarpa - Picea engelmannii / Actaea rubra* Forest (CEGL000295, G4?)
- *Abies lasiocarpa - Picea engelmannii / Calamagrostis canadensis* Forest (CEGL000300, G5)
- *Abies lasiocarpa - Picea engelmannii / Clintonia uniflora - Xerophyllum tenax* Forest (CEGL005892, G4G5)
- *Abies lasiocarpa - Picea engelmannii / Clintonia uniflora* Forest (CEGL005912, G5)
- *Abies lasiocarpa - Picea engelmannii / Luzula glabrata var. hitchcockii* Woodland (CEGL000317, G5)
- *Abies lasiocarpa - Picea engelmannii / Menziesia ferruginea - Vaccinium scoparium* Forest (CEGL005894, G2G4)
- *Abies lasiocarpa - Picea engelmannii / Menziesia ferruginea / Clintonia uniflora* Forest (CEGL005893, G4G5)
- *Abies lasiocarpa - Picea engelmannii / Menziesia ferruginea / Luzula glabrata var. hitchcockii* Woodland (CEGL005896, G4?)
- *Abies lasiocarpa - Picea engelmannii / Menziesia ferruginea / Streptopus amplexifolius* Woodland (CEGL005897, G3G4)
- *Abies lasiocarpa - Picea engelmannii / Menziesia ferruginea / Xerophyllum tenax* Forest (CEGL005895, G4G5)
- *Abies lasiocarpa - Picea engelmannii / Ribes (montigenum, lacustre, inerme)* Forest (CEGL000331, G5)
- *Abies lasiocarpa - Picea engelmannii / Salix (brachycarpa, glauca)* Krummholz Shrubland (CEGL000986, GUQ)
- *Abies lasiocarpa - Picea engelmannii / Streptopus amplexifolius - Luzula glabrata var. hitchcockii* Woodland (CEGL005920, G2G3)
- *Abies lasiocarpa - Picea engelmannii / Vaccinium caespitosum / Clintonia uniflora* Forest (CEGL005918, G3G4)
- *Abies lasiocarpa - Picea engelmannii / Vaccinium membranaceum / Xerophyllum tenax* Forest (CEGL005917, GNR)
- *Abies lasiocarpa - Picea engelmannii / Vaccinium membranaceum* Rocky Mountain Forest (CEGL000341, G5)
- *Abies lasiocarpa - Picea engelmannii / Vaccinium scoparium / Thalictrum occidentale* Forest (CEGL005919, G3G4)
- *Abies lasiocarpa - Picea engelmannii / Vaccinium scoparium / Xerophyllum tenax* Forest (CEGL005914, G4G5)
- *Abies lasiocarpa - Picea engelmannii / Valeriana sitchensis* Woodland (CEGL005823, G2?)
- *Abies lasiocarpa - Picea engelmannii / Xerophyllum tenax - Luzula glabrata var. hitchcockii* Woodland (CEGL005898, G4G5)
- *Abies lasiocarpa - Picea engelmannii* Ribbon Forest (CEGL000328, GUQ)
- *Abies lasiocarpa / Caltha leptosepala ssp. howellii* Forest (CEGL000302, G3)
- *Abies lasiocarpa / Clematis columbiana var. columbiana* Forest (CEGL000306, G3?)
- *Abies lasiocarpa / Coptis occidentalis* Forest (CEGL000308, G4)
- *Abies lasiocarpa / Cornus canadensis* Forest (CEGL000309, G3G4)
- *Abies lasiocarpa / Gymnocarpium dryopteris* Forest (CEGL002611, GNRQ)
- *Abies lasiocarpa / Ledum glandulosum* Forest (CEGL000314, G4)
- *Abies lasiocarpa / Phyllodoce empetriformis* Woodland (CEGL000920, G4Q)
- *Abies lasiocarpa / Rhododendron albiflorum* Woodland (CEGL000330, G4)
- *Abies lasiocarpa / Rubus parviflorus* Forest (CEGL000332, G5)
- *Abies lasiocarpa / Vaccinium membranaceum / Valeriana sitchensis* Forest (CEGL002612, G4)
- *Abies lasiocarpa / Vaccinium membranaceum* Forest (CEGL000342, G4)
- *Betula papyrifera* - Conifer / *Clintonia uniflora* Woodland (CEGL005904, G3G4)
- *Chamerion angustifolium* Rocky Mountain Herbaceous Vegetation (CEGL005856, G4G5)
- *Picea (engelmannii X glauca, engelmannii) / Packera streptanthifolia* Forest (CEGL000414, G4)
- *Picea engelmannii / Acer glabrum* Forest (CEGL000354, G2)
- *Picea engelmannii / Erigeron eximius* Forest (CEGL000364, G5)
- *Picea engelmannii / Maianthemum stellatum* Forest (CEGL000415, G4?)
- *Picea engelmannii* / Moss Forest (CEGL000371, G4)

- *Picea engelmannii / Packera cardamine* Forest (CEGL000375, G2)
- *Picea engelmannii / Physocarpus malvaceus* Forest (CEGL002676, G3)
- *Picea engelmannii / Ribes montigenum* Forest (CEGL000374, G5?)
- *Populus balsamifera ssp. trichocarpa - Populus tremuloides* - Conifer / *Clintonia uniflora* Forest (CEGL005906, G3?)
- *Populus tremuloides - Abies lasiocarpa / Amelanchier alnifolia* Forest (CEGL000524, G3?)
- *Populus tremuloides - Abies lasiocarpa / Carex geyeri - Calamagrostis rubescens* Forest (CEGL000525, G3?)
- *Populus tremuloides - Abies lasiocarpa / Juniperus communis* Forest (CEGL000527, G3G4)
- *Tsuga mertensiana / Clintonia uniflora* Forest (CEGL000504, G3)
- *Tsuga mertensiana / Luzula glabrata var. hitchcockii* Forest (CEGL000505, G5)
- *Tsuga mertensiana / Menziesia ferruginea* Forest (CEGL000506, G4)
- *Tsuga mertensiana / Rhododendron albiflorum* Forest (CEGL000508, GNR)
- *Tsuga mertensiana / Streptopus amplexifolius* Forest (CEGL000511, G2)
- *Tsuga mertensiana / Vaccinium membranaceum* Forest (CEGL000514, G4)
- *Tsuga mertensiana / Xerophyllum tenax* Forest (CEGL000516, G4)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- East Cascades Mesic Montane Mixed-Conifer Forest and Woodland (CES204.086)

DISTRIBUTION

Range: This system is found at high elevations of the Rocky Mountains, extending west into the northeastern Olympic Mountains and the northeastern side of Mount Rainier in Washington, and as far east as mountain "islands" of north-central Montana. It also occurs north into the Canadian Rockies of Alberta and British Columbia.
Divisions: 204:C; 304:C; 306:C
Nations: CA, US
Subnations: AB, AZ, BC, CO, ID, MT, NM, NV, OR, UT, WA, WY
Map Zones: 1:C, 6:?, 7:C, 8:?, 9:C, 10:C, 12:C, 15:C, 16:C, 17:C, 18:C, 19:C, 20:C, 21:C, 22:P, 23:P, 24:P, 25:C, 27:C, 28:C, 29:C
USFS Ecomap Regions: 242A:CC, 313A:CC, 313B:CC, 315A:??, 331J:CC, 341A:CC, 341B:CC, 341D:CC, 341E:CP, 341F:CC, 341G:CC, 342A:CC, 342B:CC, 342C:CP, 342D:CC, 342E:CC, 342H:CC, 342I:C?, 342J:CC, M242A:CC, M242B:CC, M242C:CC, M242D:CC, M313A:CC, M313B:CC, M331A:CC, M331B:CC, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M331J:CC, M332A:CC, M332B:CC, M332D:CC, M332E:CC, M332F:CC, M332G:CC, M333A:CC, M333B:CC, M333C:CC, M333D:CC, M341A:CC, M341B:CC, M341C:CC, M341D:CC
TNC Ecoregions: 1:C, 4:C, 7:C, 8:C, 9:C, 11:C, 20:C, 21:C, 26:C, 68:C

SOURCES

References: Alexander and Ronco 1987, Alexander et al. 1984a, Alexander et al. 1987, Anderson 1999a, Brand et al. 1976, Clagg 1975, Comer et al. 2002, Comer et al. 2003, Cooper et al. 1987, Daubenmire and Daubenmire 1968, DeVelice et al. 1986, Ecosystems Working Group 1998, Fitzgerald et al. 1994, Graybosch and Buchanan 1983, Henderson et al. 1989, Hess and Alexander 1986, Hess and Wasser 1982, Hoffman and Alexander 1976, Hoffman and Alexander 1980, Hoffman and Alexander 1983, Johnson and Clausnitzer 1992, Johnson and Simon 1987, Komarkova et al. 1988b, Lillybridge et al. 1995, Major et al. 1981, Mauk and Henderson 1984, Mehl 1992, Meidinger and Pojar 1991, Muldavin et al. 1996, NCC 2002, Neely et al. 2001, Peet 1978a, Peet 1981, Pfister 1972, Pfister et al. 1977, Romme 1982, Schaupp et al. 1999, Steele and Geier-Hayes 1995, Steele et al. 1981, Tuhy et al. 2002, Veblen 1986, Whipple and Dix 1979, Williams and Lillybridge 1983, Williams et al. 1995, Wong and Iverson 2004, Wong et al. 2003, Youngblood and Mauk 1985
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722843#references
Description Author: R. Crawford, C. Chappell, M.S. Reid, G. Kittel
Version: 30 Mar 2010 **Stakeholders:** Canada, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

ROCKY MOUNTAIN SUBALPINE-MONTANE LIMBER-BRISTLECONE PINE WOODLAND (CES306.819)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Upper Treeline; Ridge/Summit/Upper Slope; Calcareous; Very Shallow Soil; Mineral: W/ A-Horizon <10 cm; Aridic; W-Patch/High Intensity; W-Landscape/High Intensity; Needle-Leaved Tree; Pinus flexilis, P. aristata
Non-Diagnostic Classifiers: Moderate (100-500 yrs) Persistence; Montane [Upper Montane]; Montane [Montane]; Montane [Lower Montane]; Forest and Woodland (Treed); Temperate [Temperate Continental]; Alkaline Soil
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2057; ESLF 4244; ESP 1057

CONCEPT

Summary: This ecological system occurs throughout the Rocky Mountains, south of Montana, on dry, rocky ridges and slopes near upper treeline above the matrix spruce-fir forest. It extends down to the lower montane in the northeastern Great Basin mountains where dominated by *Pinus flexilis*. Sites are harsh, exposed to desiccating winds, with rocky substrates and a short growing season that limit plant growth. Higher-elevation occurrences are found well into the subalpine-alpine transition on wind-blasted, mostly west-facing slopes and exposed ridges. Calcareous substrates are important for *Pinus flexilis*-dominated communities in the northern Rocky Mountains and possibly elsewhere. The open tree canopy is often patchy and is strongly dominated by *Pinus flexilis* or *Pinus aristata* with the latter restricted to southern Colorado, northern New Mexico and the San Francisco Mountains in Arizona. In the Wyoming Rockies and northern Great Basin, *Pinus albicaulis* is found in some occurrences, but is a minor component. Other trees such as *Juniperus* spp., *Pinus contorta, Pinus ponderosa*, or *Pseudotsuga menziesii* are occasionally present. *Arctostaphylos uva-ursi, Cercocarpus ledifolius, Juniperus communis, Mahonia repens, Purshia tridentata, Ribes montigenum*, or *Vaccinium* spp. may form an open shrub layer in some stands. The herbaceous layer, if present, is generally sparse and composed of xeric graminoids, such as *Calamagrostis purpurascens, Festuca arizonica, Festuca idahoensis, Festuca thurberi*, or *Pseudoroegneria spicata*, or more alpine plants.
Classification Comments: This system is distinguished from lower montane and foothill limber pine stands in Wyoming and Montana. The foothill system (Rocky Mountain Foothill Limber Pine-Juniper Woodland (CES306.955)) is found at the lower treeline, below the zone of continuous *Pinus ponderosa* or *Pseudotsuga menziesii* woodlands and forest, and extends out into the eastern portions of these states in the foothill zones of mountain ranges, along rock outcrops, breaks along rivers, and on sheltered sites where soil moisture is slightly higher than surrounding grasslands.

This system needs to be more clearly distinguished from Northern Rocky Mountain Subalpine Woodland and Parkland (CES306.807), which also includes woodlands of *Pinus flexilis* and *Pinus albicaulis* and occurs in similar environmental settings of the northern Rocky Mountains, particularly northwestern Wyoming, Montana, and north into Alberta and British Columbia. There is a proposal to include the dry, subalpine *Pinus albicaulis* woodlands of the Blue Mountains (Oregon) and northern Nevada into this system, Rocky Mountain Subalpine-Montane Limber-Bristlecone Pine Woodland (CES306.819). For Landfire, these *Pinus albicaulis* woodlands were included in the subalpine parkland system, but ecologically and floristically they are more similar to Rocky Mountain dry subalpine woodlands.
Related Concepts:
- Bristlecone Pine: 209 (Eyre 1980) Broader
- Limber Pine: 219 (Eyre 1980) Intersecting

DESCRIPTION

Environment: This system is found throughout the Rocky Mountains, south of Montana, on dry, rocky ridges and slopes near upper treeline above the matrix spruce-fir forest. It extends down to the lower montane in the northeastern Great Basin mountains. Sites are harsh, exposed to desiccating winds with rocky substrates and a short growing season that limit plant growth. Higher elevation occurrences are found well into the subalpine - alpine transition on wind-blasted, mostly south- to west-facing slopes and exposed ridges. *Pinus aristata* forests are typically found on steep, south-facing slopes from 2700 to 3700 m (8850-12,140 feet) elevation. *Pinus flexilis* woodlands occupy similar habitats, but may occur at lower elevations than *Pinus aristata*. When found in the same landscape, stands dominated by *Pinus aristata* occur at higher elevation.
Dynamics: Both *Pinus flexilis* and *Pinus aristata* are short-statured, slow-growing, long-lived species in which individuals may live for 1000 or more years in fire-protected areas. They are adapted to cold, drought and extremely windy conditions with flexible branches that likely reduce wind damage. Fire is an important source of disturbance that facilitates stand regeneration in this system. Older woodlands are often broadly even-aged stands where seedlings are nearly absent, while areas that have recently burned may have abundant seedlings. Bristlecone pine is somewhat more tolerant of fire than is limber pine; however, both species appear to depend on fire for regeneration. Post-fire regeneration of bristlecone pine tends to be near burn edges and/or under surviving trees (Coop and Schoettle 2011). Regeneration of limber pine on burned areas is largely due to the germination of seeds cached primarily by Clark's nutcrackers (*Nucifraga columbiana*) and jays (i.e., corvid family), but also small mammals such as squirrels (Lanner and

Vander Wall 1980, Tomback 2001, Lanner 2007, CNHP 2010b). Dispersal of the smaller winged seeds of bristlecone pine is primarily by wind, but seeds are likely to also be dispersed by birds (Coop and Schoettle 2011).

Fire occurrence in this ecosystem is low frequency and mixed severity. In the absence of wind, fires are likely limited in extent (two acres or less). Understories are often sparse, with little to carry fires across the surface (Landfire 2007a). Stand-replacement fires are usually wind-driven, especially in mid- and late-serial classes. Landfire (2007a) review estimated replacement fires occurring between 35-100+ years and 200+ years (Fire Regime Groups IV and V) with surface fires occurring every 1000 years. However, in northern New Mexico, some open stands transition into subalpine grasslands and have more frequent, less severe fires (Coop and Schoettle 2011).

Component Associations:
- *Pinus aristata / Festuca arizonica* Woodland (CEGL000759, G4)
- *Pinus aristata / Festuca thurberi* Woodland (CEGL000760, G5)
- *Pinus aristata / Juniperus communis* Woodland (CEGL002894, GU)
- *Pinus aristata / Ribes montigenum* Woodland (CEGL000761, G3)
- *Pinus aristata / Trifolium dasyphyllum* Woodland (CEGL000762, G2)
- *Pinus aristata / Vaccinium myrtillus* Woodland (CEGL002895, GU)
- *Pinus flexilis / Arctostaphylos uva-ursi* Woodland (CEGL000802, G4)
- *Pinus flexilis / Calamagrostis purpurascens* Woodland (CEGL000803, G4)
- *Pinus flexilis / Cercocarpus ledifolius* Woodland (CEGL000804, G4)
- *Pinus flexilis / Dasiphora fruticosa ssp. floribunda / Distichlis spicata* Woodland (CEGL000812, G1)
- *Pinus flexilis / Festuca campestris* Woodland (CEGL000806, G3)
- *Pinus flexilis / Festuca idahoensis* Woodland (CEGL000805, G5)
- *Pinus flexilis / Juniperus communis* Woodland (CEGL000807, G5)
- *Pinus flexilis / Juniperus osteosperma* Woodland (CEGL000808, G3)
- *Pinus flexilis / Juniperus scopulorum* Woodland (CEGL000809, G3)
- *Pinus flexilis / Leucopoa kingii* Woodland (CEGL000810, G3)
- *Pinus flexilis / Mahonia repens* Woodland (CEGL000811, G3?)
- *Pinus flexilis / Pseudoroegneria spicata* Woodland (CEGL000813, G4?)
- *Pseudotsuga menziesii - Pinus flexilis / Leucopoa kingii* Woodland (CEGL000906, G4Q)

DISTRIBUTION

Range: This system occurs throughout the Rocky Mountains south of Montana on dry, rocky ridges and slopes near upper treeline, including the Uinta and northern Wasatch mountains, and the Jarbridge Mountains in northeastern Nevada. It also occurs farther east, in the Bighorn Range of north-central Wyoming, although it is not common there.
Divisions: 303:C; 304:C; 306:C
Nations: CA, US
Subnations: CO, ID?, MT?, NM, NV, OR?, UT, WY
Map Zones: 9:C, 12:P, 15:P, 16:C, 18:C, 19:C, 23:P, 24:C, 25:C, 27:C, 28:C, 29:C
USFS Ecomap Regions: 313B:CC, 331J:CC, 341G:PP, 342J:??, M242B:CP, M242C:CC, M313A:CC, M313B:CC, M331A:CC, M331B:CC, M331D:CC, M331E:CP, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M332G:CC, M341A:CC, M341B:CC
TNC Ecoregions: 6:C, 7:C, 8:C, 9:C, 20:C, 21:C, 26:C, 68:P

SOURCES

References: Baker 1992, Baumeister and Callaway 2006, Beasley and Klemmedson 1980, Brunstein and Yamaguchi 1992, CNHP 2010b, Comer et al. 2003, Coop and Schoettle 2011, Eyre 1980, Gibson et al. 2008, Keane et al. 2011, Knight 1994, Krebs 1972, LaMarche and Mooney 1972, Landfire 2007a, Lanner 2007, Lanner and Vander Wall 1980, McKinney et al. 2007, NCC 2002, Neely et al. 2001, Ranne 1995, Ranne et al. 1997, Schoettle and Sniezko 2007a, Schoettle et al. 2008, Steele et al. 1983, TNC 2013, Tomback 2001
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722854#references
Description Author: NatureServe Western Ecology Team, mod. K.A. Schulz
Version: 14 Jan 2014 **Stakeholders:** Canada, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

SIERRA NEVADA SUBALPINE LODGEPOLE PINE FOREST AND WOODLAND (CES206.912)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Upper Montane]; Mediterranean [Mediterranean Xeric-Oceanic]; Shallow Soil; Xeric; Short Disturbance Interval [Periodicity/Irregular Disturbance]; Pinus contorta
Non-Diagnostic Classifiers: Forest and Woodland (Treed); Acidic Soil; Sand Soil Texture; F-Patch/High Intensity; Avalanche; Needle-Leaved Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2058; ESLF 4245; ESP 1058

CONCEPT

Summary: This ecological system is widespread in glacial basins at upper montane to subalpine elevations of the central and northern Sierra Nevada and Transverse and Peninsular ranges where cold-dry conditions exist (1800-2450 m [6000-8000 feet] in the north and 2450-3600 m [8000-12,000 feet] in the south). It also occurs on extensive broad ridges and pumice plateaus of the southern Cascades in Oregon (the broad ridges that form the Cascade crest in southern Oregon tend to be dominated by extensive stands of lodgepole pine). Soils are often shallow and coarse-textured. These forests and woodlands are dominated by *Pinus contorta var. murrayana* with shrub, grass or barren understories. Avalanche as well as tree mortality from insect outbreak and disease, drought and associated wildfire are drivers of community structure and composition. Understories are open, with scattered shrubs and herbaceous species, which do not carry fire should one get started. Trees can be very large and old and can attain diameters of 1.2 m (4 feet). Associated plant species include *Arctostaphylos nevadensis, Ceanothus cordulatus, Cercocarpus ledifolius* (although not that common, just occasional in drier sites), *Chrysolepis sempervirens, Phyllodoce breweri*, and *Ribes montigenum.* Common graminoids include *Poa wheeleri, Carex filifolia, Carex rossii*, and *Carex exserta*. Fire-return intervals are many hundreds of years. This system occurs in less severe settings than Mediterranean California Subalpine Woodland (CES206.910) and Northern California Mesic Subalpine Woodland (CES206.911) and is made up of trees that are not usually krummholz. Avalanches are less of a factor except in association with the volcanic peaks. Low-elevation stands of *Pinus contorta* in the pumice zone of Oregon are included in Rocky Mountain Poor-Site Lodgepole Pine Forest (CES306.960).

Similar Ecological Systems:
- Mediterranean California Subalpine Woodland (CES206.910)
- Northern California Mesic Subalpine Woodland (CES206.911)

Related Concepts:
- Lodgepole Pine: 218 (Eyre 1980) Broader

DESCRIPTION

Dynamics: LANDFIRE model information: Disturbance patterns have been poorly studied in Sierran lodgepole pine. Sierran lodgepole has been described as not being a fire type (Barbour and Minnich 2000) or as having long intervals between fires (Keeley 1980, Parker 1986, Potter 1998). Avalanche as well as tree mortality from insect outbreak and disease, drought and associated wildfire are the main drivers of community structure and composition. Somewhat similar wet lodgepole types in the Klamath Mountains and Oregon had a fire-return interval range of 70-100 years. Season of fire is generally late summer to early fall. Stand-replacement fire occurs at long interval, resulting in low stand complexity. Mixed-severity fire occurs when fuel conditions remain moist and result in mixed-age stands. Very infrequently, surface fires can occur. Forest understory is typically sparse with few shrubs and low to moderate herbaceous cover. Fuel is considered sparse (Parker 1986, van Wagtendonk 1991). Stands in the southern Sierra Nevada have been described as self-perpetuating (regeneration from treefall gaps) with long intervals between fires (Keeley 1980, Parker 1986, Potter 1998). Sparse fuels are believed to limit ignition and fire spread (Parker 1986). In contrast, fire history studies from dry subalpine lodgepole pine forest in the southern Sierra Nevada have found moderate fire-return intervals in some stands (Keifer 1991, Caprio 2008 and unpubl. data). Intervals ranged from 31-74 years (Chagoopa Plateau, Sequoia National Park and Palisades Canyon, Kings Canyon National Park). Fire severity was mixed and ranged from understory burns on areas up to 100s of ha to high-severity crown fires in patches up to 10s of ha (FRG of III). Season of fires was late summer or early fall. Seasonal fire scar positions on Chagoopa and Palisades (SEKI) was 40.7% and 15% latewood and 59.3% and 80% dormant, respectively (Caprio unpubl. data). Other important disturbance agents in this system include the lodgepole needle miner, windthrow and stress from extreme climatic events.

Component Associations:
- *Pinus albicaulis - Pinus contorta var. latifolia / Penstemon laetus* Forest (CEGL000130, G2)
- *Pinus contorta var. murrayana / Artemisia tridentata* Forest (CEGL005812, G3?)
- *Pinus contorta var. murrayana / Carex exserta* Forest (CEGL008667, G4)
- *Pinus contorta var. murrayana / Carex rossii* Forest (CEGL002749, G3?)
- *Pinus contorta var. murrayana / Ledum glandulosum* Forest (CEGL008668, G3)

- *Pinus contorta var. murrayana / Ligusticum grayi* Forest (CEGL002747, G4?)
- *Pinus contorta var. murrayana / Penstemon newberryi* Woodland (CEGL002748, G3?)
- *Pinus contorta var. murrayana* / Sparse Understory Forest (CEGL003069, G4?)
- *Pinus contorta var. murrayana* / Sparse Understory Woodland (CEGL003070, G3G4)

DISTRIBUTION

Range: This system occurs in glacial basins at upper montane to subalpine elevations of the central and northern Sierra Nevada and Transverse and Peninsular ranges where cold-dry conditions exist (1800-2450 m [6000-8000 feet] in the north and 2450-3600 m [8000-12,000 feet] in the south). It also extends south into Baja California, Mexico, in the San Pedro Martir Mountains.

If present in Oregon, the most likely location is the southern Oregon Cascades. The broad ridges that form the Cascade Crest in southern Oregon tend to be dominated by extensive stands of lodgepole pine (south of Crater Lake and north maybe to Mount Bachelor). There are also relatively large areas of lodgepole pine along the broad crest from Mt. Jefferson to a little ways north of Olallie Butte that may also fit this type better than the Rocky Mountain lodgepole pine type, as these stands are more likely dominated by *Pinus contorta var. murrayana* than var. *latifolia*. Understory species are probably different from those listed, however.
Divisions: 206:C
Nations: MX, US
Subnations: CA, MXBC(MX), NV, OR
Map Zones: 4:C, 6:C, 7:C, 12:C
USFS Ecomap Regions: 341D:CC, 342B:??, M242B:CC, M242C:CC, M261A:CP, M261D:CC, M261E:CC, M261G:CC
TNC Ecoregions: 4:C, 5:C, 12:C

SOURCES

References: Agee 1993, Barbour and Billings 2000, Barbour and Major 1988, Barbour and Minnich 2000, Caprio 2008, Comer et al. 2003, Holland and Keil 1995, Keeley 1980, Parker 1986b, Potter 1998, Sawyer and Keeler-Wolf 1995, Sheppard and Lassoie 1998, van Wagtendonk 1991
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722769#references
Description Author: P. Comer, T. Keeler-Wolf, mod. M.S. Reid, L. Evers, G. Kittel
Version: 12 Jan 2012 **Stakeholders:** Latin America, West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

SIERRAN-INTERMONTANE DESERT WESTERN WHITE PINE-WHITE FIR WOODLAND (CES204.101)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Woody-Herbaceous; Very Shallow Soil; Aridic; Short Disturbance Interval; F-Patch/Low Intensity; F-Landscape/Low Intensity; Needle-Leaved Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2172; ESLF 4269; ESP 1172

CONCEPT

Summary: This interior Pacific Northwest ecological system occurs on the Modoc Plateau and Warner Mountains of California, north into the Fremont National Forest along the east slope of the southern Cascades in Oregon, and may also occur in isolated high-elevation ranges of northern Nevada. These forests and woodlands range from just above the zone of ponderosa pine in the montane zone, to the upper montane zone. Elevations range from 1370 m to over 2135 m (4500-7000 feet). Occurrences are found on all slopes and aspects, although more frequently on drier areas, including northwest- and southeast-facing slopes, but also occurs on northerly slopes and ridges. This ecological system generally occurs on basalts, andesite, glacial till, basaltic rubble, colluvium, or volcanic ash-derived soils, and sometimes on granitics (Carson Range). These soils have characteristic features of good aeration and drainage, coarse textures, circumneutral to slightly acidic pH, an abundance of mineral material, rockiness, and periods of drought during the growing season. Climatically, this system occurs somewhat in the rainshadow of the Sierras and Cascades and has a more continental regime, similar to the northern Great Basin. This system tends to be more woodland than forest in character, and the undergrowth is more open and drier, with little shrub or herbaceous cover. Tree regeneration is less prolific than in other mixed-montane conifer systems of the Cascades, Sierras and California Coast Ranges. *Pinus monticola* is the dominant conifer in most places, but *Abies concolor var. lowiana* is usually present, at least in the understory, and occasionally as the dominant in the canopy, replacing *Pinus monticola*, particularly at lower elevations, and *Pinus ponderosa* is also often present. In the Warner Mountains, the *Abies concolor var. lowiana* stands range from 1675 to 2135 m (5500-7000 feet) in elevation, and the mixed *Pinus monticola - Abies concolor* is usually above 2135 m (7000 feet). Mixed stands with *Pinus contorta*, in moister locations, as well as *Pinus jeffreyi* and sometimes *Populus tremuloides* occasionally occur. Southern stands (around Babbitt Peak and in the Carson Range) can sometime have *Abies magnifica* in them, sometimes replacing *Abies concolor*. These forests and woodlands are marked by the absence of *Pseudotsuga menziesii*, *Pinus lambertiana*, and *Calocedrus decurrens*, and the generally drier, continental climatic conditions. In addition, the overall floristic affinities are with the Great Basin rather than Pacific Northwest. Understories are typically open, with moderately low shrub cover and diversity, and include *Arctostaphylos patula*, *Arctostaphylos nevadensis*, *Chrysolepis sempervirens*, *Ceanothus* sp., and *Ribes viscosissimum*. Common herbaceous taxa include *Arnica cordifolia*, *Festuca* sp., *Poa nervosa*, *Carex inops*, *Pyrola picta*, and *Hieracium albiflorum*. In openings, *Wyethia mollis* can be abundant.
Classification Comments: An alternative name could be Modoc Plateau Western White Pine - White Fir Woodland. This system is very similar to Mediterranean California Dry-Mesic Mixed Conifer Forest and Woodland (CES206.916), Mediterranean California Mesic Mixed Conifer Forest and Woodland (CES206.915) and Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest (CES306.805). Justification for splitting this system includes the following: it is *Abies concolor var. lowiana* (as opposed to being grand fir, which is found further east and north; hence it's probably not the northern Rocky Mountain system); it lacks Douglas-fir completely which is an important component of the Californian mixed conifer systems in the Sierras; and the understory composition suggests it is drier (due to: lower elevations? volcanic-derived ash/tuff soils? rainshadow of the Cascades?) than the Californian systems.

Similar Ecological Systems:
- Mediterranean California Dry-Mesic Mixed Conifer Forest and Woodland (CES206.916)
- Mediterranean California Mesic Mixed Conifer Forest and Woodland (CES206.915)
- Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest (CES306.805)

Related Concepts:
- Western White Pine: 215 (Eyre 1980) Intersecting. White pine is a major component.
- White Fir: 211 (Eyre 1980) Intersecting. White fir (*Abies concolor ssp. lowiana*) is a major component of this ecological system.

DESCRIPTION

Dynamics: The open nature of the stands suggests regeneration and establishment is slow and sporadic. Stand-replacing events are not frequent; most fire is probably partial stand disturbance. These stands are relatively high elevation, and there are generally widely spaced large and somewhat fire-resistant individuals. Also the discontinuous understory and only patchy regeneration suggests non-stand-replacing fire as the norm., rather patchy burns with isolated trees surviving regularly. Local windthrow, insects, disease (blister rust), and individual lightning strikes probably make up most of the disturbances.

Component Associations:
- *Abies concolor - Pinus monticola / Ribes viscosissimum* Forest (CEGL000260, G2)

- *Pinus monticola / Achnatherum occidentale* Woodland (CEGL008622, G3)

DISTRIBUTION

Range: This ecological system is found in the transition zone from the northern Sierra Nevada of California and Oregon, east into the Modoc Plateau and Intermountain region of northwestern Nevada. It is found in the Fremont National Forest east of Lake View in Oregon, and in the Modoc Plateau and Warner Mountains of California. It continues farther south in California to the Diamond Mountains south of Honey Lake (a northeast extension of the Sierras), on Babbitt Peak between Lake Tahoe and Sierra Valley, and also in the Carson Range in Nevada east of Lake Tahoe Scattered stands may occur on Hart Mountain and Steens Mountain in Oregon and possibly a few isolated places in the northern Great Basin and the Jarbridge Mountains of Nevada.
Divisions: 204:C; 304:P
Nations: US
Subnations: CA, NV, OR
Map Zones: 6:C, 7:C, 9:?
USFS Ecomap Regions: M242C:CC, M261D:CP, M261E:CC, M261G:CC
TNC Ecoregions: 4:C, 6:C

SOURCES

References: Hopkins 1979a, Volland 1985, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.791107#references
Description Author: M.S. Reid
Version: 23 Jan 2006 **Stakeholders:** West
Concept Author: M.S. Reid **ClassifResp:** West

SOUTH FLORIDA HARDWOOD HAMMOCK (CES411.287)

CLASSIFIERS

Classification Status: Standard

Primary Division: Caribbean (411)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Alkaline Soil; Broad-Leaved Evergreen Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: EVT 2333; ESLF 4139; ESP 1333

CONCEPT

Summary: This rockland tropical hammock system, as currently defined, occurs only in extreme southern Florida. It consists of upland hardwood forest on elevated ridges of limestone in three discrete major regions; the Keys, southeastern Big Cypress, and the Miami Rock Ridge. Tropical hardwood species are diagnostic of the system. Among the species likely to be encountered throughout are *Bursera simaruba, Coccoloba diversifolia*, and *Eugenia axillaris*. *Quercus laurifolia* is one of the few temperate species which attains prominence in this system. These forests tend to have a dense canopy that produces deeper shade, less evaporation, and lower air temperature than surrounding vegetation. This microclimate, in combination with high water tables, tends to keep humidity levels high. A number of orchid and bromeliad species thrive in such conditions. Unlike most coastal plain systems, fire is a major threat to South Florida Hardwood Hammock (CES411.287). For this reason, many examples occur alongside natural firebreaks.

Related Concepts:

- Coastal Rock Barren (FNAI 1990) Intersecting
- Live Oak: 89 (Eyre 1980) Finer
- Rockland Hammock (FNAI 1990) Finer
- Tropical Hammock (Snyder et al. 1990) Equivalent
- Tropical Hardwoods: 105 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs in three discrete regions of south Florida. Underlying geology and soils are somewhat different among these regions, and the juxtaposition of the system may be somewhat unique. Generally, soils are highly organic with uneven and widely ranging thickness (Snyder et al. 1990). These forests tend to have a dense canopy that produces deeper shade, less evaporation, and lower air temperature than surrounding vegetation. This microclimate, in combination with high water tables, tends to keep humidity levels high and the community quite mesic (FNAI 1990). Unlike most coastal plain ecological systems, fire is a major threat to South Florida Hardwood Hammock (CES411.287). For this reason, many examples occur alongside natural firebreaks, such as the leeward side of exposed limestone (Robertson 1955), moats created by limestone solution (Duever et al. 1986), and elevated outcrops above marshes, scrub cypress, or sometimes mangrove swamps (Snyder et al. 1990).

Vegetation: There tends not to be strong dominance in these forests, so the principal species list can be long. Tropical hardwood species are diagnostic of the system, although few are common or dominant in all regions where these hammocks occur (Snyder et al. 1990). Among the species likely to be encountered throughout are *Bursera simaruba, Coccoloba diversifolia*, and *Eugenia axillaris*. The northward ranges of these species are limited by the incidence of frosts (Drew and Schomer 1984). Other typical dominant tree species, in no real order, are *Metopium toxiferum, Swietenia mahagoni, Zanthoxylum fagara, Gymnanthes lucida (= Ateramnus lucidus), Piscidia piscipula*, and *Pithecellobium keyense* (T. Armentano pers. comm.). Other species can include *Lysiloma latisiliquum, Nectandra coriacea, Ficus aurea, Sideroxylon foetidissimum, Eugenia foetida, Guapira discolor, Coccoloba uvifera, Thrinax morrisii, Thrinax radiata, Erithalis fruticosa, Krugiodendron ferreum, Casasia clusiifolia, Erithalis fruticosa, Byrsonima lucida*, and *Capparis flexuosa*.

Dynamics: Groundwater and seasonal pooling and drying of the soil are important dynamics. There is organic soil accumulation, thick in some areas and thin in others. Solution-eroded limestone provides wet pockets and dry patches in the environment. Thick organic soil helps maintain high levels of moisture in the system. Hurricanes are a part of the natural dynamics of this ecological system. Fire is very infrequent, due to the protection of this ecological system, many examples occur alongside natural firebreaks.

Component Associations:

- *Bursera simaruba - Swietenia mahagoni - Lysiloma latisiliquum / Nectandra coriacea - Coccoloba diversifolia* Forest (CEGL007003, G1G2)
- *Casasia clusiifolia - Guapira discolor - Pithecellobium keyense - Metopium toxiferum / Solanum bahamense / Hymenocallis latifolia* Forest (CEGL007005, G1)
- *Conocarpus erectus - Sideroxylon celastrinum - Erithalis fruticosa - Manilkara jaimiqui ssp. emarginata* Forest (CEGL007058, G1)
- *Ficus aurea - Sideroxylon foetidissimum - Bursera simaruba / Eugenia foetida - Guapira discolor - Nectandra coriacea* Forest (CEGL007001, G1)
- *Metopium toxiferum - Eugenia foetida - Coccoloba uvifera - Thrinax morrisii / Erithalis fruticosa* Forest (CEGL007008, G2)
- *Metopium toxiferum - Eugenia foetida - Krugiodendron ferreum - Swietenia mahagoni / Capparis flexuosa* Forest (CEGL007007,

G2)
- *Metopium toxiferum - Thrinax morrisii - Byrsonima lucida / Schizachyrium* spp. Woodland (CEGL003503, G1)
- *Morella cerifera - Ilex cassine - Quercus virginiana - Serenoa repens* Shrubland (CEGL003788, G2)
- *Opuntia stricta - Acanthocereus tetragonus - Evolvulus convolvuloides - Indigofera oxycarpa* Shrubland (CEGL003872, G1)
- *Pteridium caudatum* Herbaceous Vegetation (CEGL004259, GNR)
- *Sideroxylon foetidissimum - Sideroxylon salicifolium - Ficus aurea - Quercus virginiana - Celtis laevigata* Forest (CEGL007004, G1Q)
- *Strumpfia maritima* Florida Keys Shrubland (CEGL003794, G1)
- *Thrinax radiata - Casasia clusiifolia - Erithalis fruticosa* Forest (CEGL004711, G1Q)

Spatial Characteristics

Adjacent Ecological Systems:
- South Florida Depression Pondshore (CES411.054)

Distribution

Range: This system is endemic to south Florida.
Divisions: 411:C
Nations: US
Subnations: FL
Map Zones: 56:C
USFS Ecomap Regions: 411A:CC
TNC Ecoregions: 54:C

Sources

References: Armentano pers. comm., Comer et al. 2003, Davis 1943, Drew and Schomer 1984, Duever et al. 1986, Enge et al. 2002, Eyre 1980, FNAI 1990, FNAI 2010a, Harshberger 1914a, Landfire 2007a, Robertson 1955, Ross et al. 1992, Snyder et al. 1990
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723201#references
Description Author: R. Evans, mod. M. Pyne and C.W. Nordman
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: R. Evans **ClassifResp:** Southeast

SOUTH FLORIDA PINE ROCKLAND (CES411.367)

CLASSIFIERS

Classification Status: Standard

Primary Division: Caribbean (411)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Circumneutral Soil; Needle-Leaved Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2360; ESLF 4263; ESP 1360

CONCEPT

Summary: This system includes pinelands of extreme south Florida growing on limestone. The uniqueness of the flora associated with this type has long been recognized, including the number of endemic and West Indian species. Many plant and animal taxa found in this system are restricted to it, including many of south Florida's endemic plants. Unlike pinelands elsewhere in the southeastern coastal plain, *Pinus elliottii var. densa* is the only native pine species in this system. Understory vegetation consists of many hardwood species, including a number with tropical origins, and the herbaceous flora is species-rich and fire-adapted.

Similar Ecological Systems:
- South Florida Pine Flatwoods (CES411.381)--is also dominated nearly exclusively by *Pinus elliottii var. densa* in the canopy, but is on more acidic substrates (e.g., sand) and lacks much of the diversity and tropical characteristics of the understory.

Related Concepts:
- Coastal Rock Barren (FNAI 1990) Intersecting
- Pine Forest (Duever et al. 1986) Broader
- Pine Rockland (FNAI 1990) Equivalent
- South Florida Slash Pine: 111 (Eyre 1980) Undetermined

DESCRIPTION

Environment: In southeast Florida this system occurs on Miami Oolitic Limestone, while in the Big Cypress region (southwest Florida) it is found on outcrops of Tamiami Limestone. Pinnacle rock is characteristic of some sites; these are solution-formed irregular limestone features which stick up in places.
Vegetation: *Pinus elliottii var. densa* is the only native pine species in this system. It has been estimated that nearly one-third of the taxa found in this system are restricted to it, including half of south Florida's endemic plants (Stout and Marion 1993). The range of this system is largely outside the natural range of *Pinus serotina*, *Pinus elliottii var. elliottii*, and *Pinus palustris*.
Dynamics: Historical accounts show that fire has been frequent over the past several hundred years, perhaps as often as every 1-4 years (Wade et al. 1980, Bergh and Wisby 1996, Slocum et al. 2003). Without fire, after 15-20 years, hardwoods will be numerous and quite large (Wade et al. 1980). In the absence of fire, this system may be replaced by hardwoods species within several decades (Stout and Marion 1993). High winds from hurricanes are an infrequent, natural disturbance. Pine rockland in the Florida Keys can be subjected to storm surge associated with hurricanes (Saha et al. 2011).

Component Associations:
- *Pinus elliottii var. densa / Coccothrinax argentata - Thrinax morrisii* Woodland (CEGL003532, G1)
- *Pinus elliottii var. densa / Sabal palmetto / Schizachyrium rhizomatum - Muhlenbergia filipes - Rhynchospora divergens* Tropical Woodland (CEGL003533, G1G2)
- *Pinus elliottii var. densa / Sabal palmetto / Serenoa repens* Woodland (CEGL003534, G2?)
- *Pinus elliottii var. densa / Serenoa repens - Tetrazygia bicolor - Guettarda scabra* Woodland (CEGL003538, G1)
- *Pinus elliottii var. densa / Sideroxylon salicifolium - Chrysobalanus icaco - Ilex cassine* Woodland (CEGL003535, G2?)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- South Florida Depression Pondshore (CES411.054)

DISTRIBUTION

Range: Davis (1943) mapped this system, which occurred primarily on the Miami ridge bordering the Everglades, with disjunct examples found in the Big Cypress Swamp. Davis estimated there once was 180,000 acres of "Miami region pine" (Davis 1943). McPherson's (1986) map of Big Cypress shows "pine forest," which includes both pine rocklands and pine flatwoods, scattered across the unit. It may be possible to differentiate based on soil type or geology, the pine rockland being in the southeast part of Big Cypress. In the Florida Keys it is found on Big Pine Key, No Name Key, Little Pine Key, Cudjoe Key, and Upper Sugarloaf Key. There has been an estimated 98% decline in the amount of pine rockland habitat on the Miami Rock Ridge in southern Florida, outside of the Everglades National Park where Long Pine Key is protected (Noss et al. 1995, Enge et al. 2002). About 6200 ha (15,000 acres) of pine rockland remain (Enge et al. 2002).
Divisions: 411:C
Nations: US

Subnations: FL
Map Zones: 56:C
USFS Ecomap Regions: 411A:CC
TNC Ecoregions: 54:C

SOURCES

References: Bergh and Wisby 1996, Comer et al. 2003, Davis 1943, Duever et al. 1986, Enge et al. 2002, Eyre 1980, FNAI 1990, FNAI 2010a, Landfire 2007a, McPherson 1986, Noss et al. 1995, Saha et al. 2011, Slocum et al. 2003, Stout and Marion 1993, USFWS 1998b, Wade et al. 1980

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723149#references

Description Author: R. Evans, mod. M. Pyne and C. Nordman
Version: 14 Jan 2014
Concept Author: R. Evans
Stakeholders: Southeast
ClassifResp: Southeast

SOUTH-CENTRAL INTERIOR / UPPER COASTAL PLAIN FLATWOODS (CES203.479)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Pimple mounds; Forest and Woodland (Treed); Broad-Leaved Deciduous Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: EVT 2326; ESLF 4132; ESP 1326

CONCEPT

Summary: This system represents mostly *Quercus stellata* dominated "xerohydric flatwoods" of limited flat areas of the most inland portions of the East Gulf Coastal Plain in western Kentucky, as well as in the nearby Shawnee Hills in the western Interior Low Plateau. The core of the area is referred to as the Jackson Purchase or "Jackson Plain." There is some local variability in the expression of this system along a hydrologic/microtopographic gradient. The elevated areas are composed of somewhat coarser-textured soils and retain less moisture than do the lower areas, although both occur in a tight local mosaic. The soils appear to have well-developed subsurface hardpans. Thus, soil moisture fluctuates widely throughout the growing season, from saturated to very dry.
Classification Comments: The component associations are poorly known and described. More work is needed to clarify which types are present.
Similar Ecological Systems:
- Interior Highlands Unglaciated Flatwoods (CES202.454)
- South-Central Interior / Upper Coastal Plain Wet Flatwoods (CES203.480)

Related Concepts:
- Flatwoods (Evans 1991) Broader
- Post Oak - Blackjack Oak: 40 (Eyre 1980) Finer

DESCRIPTION

Environment: The soils appear to have well-developed subsurface hardpans, the impermeability of which contributes to shallowly perched water tables during portions of the year when precipitation is greatest and evapotranspiration is lowest (not due to overbank flooding). Thus, soil moisture fluctuates widely throughout the growing season, from saturated to very dry, a condition sometimes referred to as xerohydric (Evans 1991). Examples of this system occur along the northeastern flank of the Upper East Gulf Coastal Plain ecoregion where loess deposits thin out and gravelly or sandy soils predominate. Examples occur on relatively high flat areas that are not directly affected by overbank flooding. These environments include ancient Quaternary or Tertiary post-glacial meltwater lakebeds and high terraces of the Upper Gulf Coastal Plain. The most typical soil is Okaw Silt Loam. The same system is found in the Shawnee Hills of Kentucky (M. Evans pers. comm. 2006). The lakes were originally formed by glacial damming of the Ohio River. It could also occur on upland plains and flat ridgetops (KSNPC 2009).
Vegetation: Stands of this system are dominated by *Quercus stellata*, a somewhat fire-tolerant oak. In addition, *Quercus alba, Carya ovata, Carya glabra*, and *Quercus velutina* may be present. The presence of *Quercus falcata* indicates longer fire-return times. The presence of *Quercus imbricaria* indicates that the stands were formerly more open. *Pinus* spp. are not prevalent in this area, but could invade from nearby plantations. Herbaceous cover is sparse to moderate; leaf litter is the dominant ground cover. Some shrubs include *Crataegus viridis, Ilex decidua*, and *Ulmus alata*. Characteristic grasses could include *Schizachyrium scoparium, Sorghastrum nutans*, and *Andropogon* spp. Some other typical herbs include *Manfreda virginica, Croton willdenowii, Danthonia spicata, Porteranthus stipulatus*, and *Pycnanthemum tenuifolium* (Hendricks et al. 1991). Lower areas (drainage ways and depressions) have *Quercus michauxii, Quercus pagoda, Quercus phellos, Liquidambar styraciflua*, or even *Taxodium distichum*. Local herb dominance in depressions is of wetland species such as *Juncus* spp. and *Carex* spp. For this related and possibly juxtaposed wetland vegetation, see South-Central Interior / Upper Coastal Plain Wet Flatwoods (CES203.480).
Dynamics: Fire was an important natural process in this system, and well-burned examples tend to be relatively open-canopied with well-developed herbaceous layers (M. Evans pers. comm.). The natural dynamics of wetness and drought and the patchy variation in soil wetness probably led to patchy fires in this habitat. Due to subsurface hardpans, tree rooting is restricted which makes trees more prone to windthrow. High wind and ice storms contribute to forest openings (Landfire 2007a).

Component Associations:
- *Quercus stellata / (Danthonia spicata, Croton willdenowii)* Woodland (CEGL005057, G1)
- *Quercus stellata / Cinna arundinacea* Flatwoods Forest (CEGL002405, G2G3)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- East Gulf Coastal Plain Northern Dry Upland Hardwood Forest (CES203.483)
- East Gulf Coastal Plain Northern Loess Plain Oak-Hickory Upland (CES203.482)

Adjacent Ecological System Comments: East Gulf Coastal Plain Northern Dry Upland Hardwood Forest (CES203.483).

DISTRIBUTION

Range: This system occurs in limited areas of the most inland portions of the East Gulf Coastal Plain in western Kentucky and adjacent Tennessee (the "Jackson Purchase" or "Jackson Plain" region; 222Cb; 74b in part), as well as in the nearby "Shawnee Hills" of the Interior Low Plateau (222Dh, 222Di; 72c) of Kentucky and adjacent Indiana. The core of the area from which this system was initially described is referred to as the Jackson Purchase or "Jackson Plain," where these areas have long been recognized as a distinctive subdivision within this region (Davis 1923, Bryant and Martin 1988). It is known from the Clarks River National Wildlife Refuge (KSNPC 2009).
Divisions: 203:C
Nations: US
Subnations: IL?, IN, KY, TN
Map Zones: 46:P, 47:C, 49:?
USFS Ecomap Regions: 223D:CC, 223E:CC, 231H:CC
TNC Ecoregions: 43:C, 44:C

SOURCES

References: Bryant and Martin 1988, Comer et al. 2003, Davis 1923, Evans 1991, Evans, M. pers. comm., Eyre 1980, Hendricks et al. 1991, KSNPC 2009, Landfire 2007a, NatureServe Ecology - Southeastern U.S. unpubl. data, Nelson 2005
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723107#references
Description Author: R. Evans and M. Evans, mod. M. Pyne and C. Nordman
Version: 14 Jan 2014 **Stakeholders:** Midwest, Southeast
Concept Author: R. Evans and M. Evans **ClassifResp:** Southeast

SOUTH-CENTRAL INTERIOR MESOPHYTIC FOREST (CES202.887)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Sideslope; Unglaciated; Eutrophic Soil; Broad-Leaved Deciduous Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: EVT 2321; ESLF 4127; ESP 1321

CONCEPT

Summary: These high-diversity, predominately deciduous forests occur on deep and enriched soils (in some cases due to, or enhanced by, the presence of limestone or related base-rich geology), in non-montane settings and usually in somewhat protected landscape positions such as coves or lower slopes. The core distribution of this system lies in the Cumberland and Allegheny plateaus, extending into the adjacent southern Ridge and Valley and portions of the Interior Low Plateau where it is located entirely south of the glacial boundary. Dominant species include *Acer saccharum, Fagus grandifolia, Liriodendron tulipifera, Tilia americana, Quercus rubra, Magnolia acuminata*, and *Juglans nigra*. *Tsuga canadensis* may be a component of some stands, although its abundance is being rapidly reduced by the hemlock woolly adelgid (*Adelges tsugae*). Trees may grow very large in undisturbed areas. The herb layer is very rich, often with abundant spring ephemerals. Many examples may be bisected by small streams.
Classification Comments: Southern and Central Appalachian Cove Forest (CES202.373) (Ecoregions 51 and 59) is being treated as a separate system. The concept of this type (CES202.887) is more-or-less consistent with the "Mixed Mesophytic Communities" of both the Mixed Mesophytic Forest Region and the non-coastal plain portion of the Western Mesophytic Forest Region, extending north into unglaciated portions of the Beech-Maple Forest Region, of Braun (1950) and Greller (1988). There is much variability in different examples of this system across its range, with the composition of some occurrences in the escarpment of the Cumberland Plateau approaching that of examples of Southern and Central Appalachian Cove Forest (CES202.373). The Allegheny Front is adopted as the divide between these two similar systems: material to the west goes to this system, and material to the east goes to Southern and Central Appalachian Cove Forest (CES202.373). In limited areas of the region, some stands may contain hemlock (*Tsuga canadensis*). These are noteworthy on a local basis, as the tree is less well distributed in the range of this system than it is in corresponding environments at higher elevation in the Appalachians or to the north.
Similar Ecological Systems:
- Appalachian (Hemlock)-Northern Hardwood Forest (CES202.593)--found to the north and east.
- North-Central Interior Beech-Maple Forest (CES202.693)--is an equivalent system of glaciated terrain to the north.
- Ozark-Ouachita Mesic Hardwood Forest (CES202.043)
- Southern and Central Appalachian Cove Forest (CES202.373)--is found in adjacent regions to the east.

Related Concepts:
- Acidic Mesophytic Forest (Evans 1991) Finer
- Beech - Sugar Maple: 60 (Eyre 1980) Finer
- Bluegrass Mesophytic Cane Forest (Evans 1991) Finer
- Calcareous Mesophytic Forest (Evans 1991) Finer
- Northern Red Oak: 55 (Eyre 1980) Finer
- Rich mesophytic forest (Edinger et al. 2002) Finer
- Sugar Maple - Basswood: 26 (Eyre 1980) Finer
- Sugar Maple: 27 (Eyre 1980) Finer
- White Oak: 53 (Eyre 1980) Finer
- Yellow-Poplar - Eastern Hemlock: 58 (Eyre 1980) Finer
- Yellow-Poplar: 57 (Eyre 1980) Finer

DESCRIPTION

Environment: These high-diversity deciduous forests occur on deep and enriched soils, usually in somewhat protected landscape positions such as coves or lower slopes.
Vegetation: Dominant tree species include *Acer saccharum, Fagus grandifolia, Liriodendron tulipifera, Tilia americana, Quercus rubra, Magnolia acuminata*, and *Juglans nigra*. *Tsuga canadensis* may be a component of some stands. The herb layer is very rich, often with abundant spring ephemerals.

Component Associations:
- *Acer saccharum - Carya ovata - Juglans nigra / Symphoricarpos orbiculatus / Galium circaezans* Forest (CEGL004741, G3G4)
- *Acer saccharum - Fraxinus americana - Tilia americana - Liriodendron tulipifera / Actaea racemosa* Forest (CEGL006237, G4?)
- *Acer saccharum - Liriodendron tulipifera - Fraxinus americana / Staphylea trifolia* Forest (CEGL006201, G4?)
- *Fagus grandifolia - Acer saccharum - Liriodendron tulipifera* Unglaciated Forest (CEGL002411, G4?)
- *Fagus grandifolia - Liriodendron tulipifera / Euonymus americanus / Athyrium filix-femina ssp. asplenioides* Forest

(CEGL007201, G4)
- *Fagus grandifolia - Quercus alba / Cornus florida* Forest (CEGL007881, G4)
- *Fagus grandifolia* Ridge and Valley Forest (CEGL007200, G3G4Q)
- *Liriodendron tulipifera - Tilia americana var. heterophylla - Aesculus flava - Acer saccharum / (Magnolia tripetala)* Forest (CEGL005222, G4?)
- *Quercus alba - (Liriodendron tulipifera, Liquidambar styraciflua) / Calycanthus floridus / Athyrium filix-femina* Forest (CEGL008428, G3G4)
- *Quercus alba - Fagus grandifolia / Hydrangea quercifolia - Viburnum acerifolium / Carex picta - Polystichum acrostichoides* Forest (CEGL007213, G3G4)
- *Quercus alba - Fagus grandifolia* Western Allegheny Plateau Forest (CEGL006144, GNR)
- *Quercus alba - Quercus rubra - Carya ovalis / Acer saccharum / Polystichum acrostichoides* Forest (CEGL007233, G4)
- *Quercus rubra - Acer saccharum - Tilia americana var. heterophylla - Aesculus flava - (Cladrastis kentukea)* Forest (CEGL007698, G3)
- *Quercus rubra - Tilia americana var. heterophylla - Carya carolinae-septentrionalis / Acer (barbatum, leucoderme) / Hydrangea quercifolia* Forest (CEGL008488, G2G3)
- *Tsuga canadensis - (Liriodendron tulipifera, Fagus grandifolia) / (Magnolia macrophylla, Ilex opaca) / Polystichum acrostichoides* Forest (CEGL004767, G1G2)
- *Tsuga canadensis - Fagus grandifolia - Acer saccharum / (Hamamelis virginiana, Kalmia latifolia)* Forest (CEGL005043, G3?)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Allegheny-Cumberland Dry Oak Forest and Woodland (CES202.359)
- Southern Interior Low Plateau Dry-Mesic Oak Forest (CES202.898)

DISTRIBUTION

Range: This system occurs in southeastern Ohio east to Virginia, West Virginia, Kentucky, Tennessee, Georgia, and Alabama, with disjunct occurrences in unglaciated southwestern Pennsylvania and southwestern New York. This range is more-or-less consistent with the "Mixed Mesophytic" and "Western Mesophytic" (non-coastal plain portion only) forest regions of Braun (1950) and Greller (1988), although it does extend into unglaciated portions of the "Beech-Maple" region to the north. Thus, this system is most extensive in the Cumberland and Allegheny plateaus, as well as the unglaciated Interior Low Plateau, and becomes relatively limited in extent towards its western limit in the Ozark Hills of Illinois, and towards its northern limit in southwestern New York.. It is replaced in the Upper East Gulf Coastal Plain by other systems. Its range also includes the southern Ridge and Valley from Tennessee (and adjacent southwestern Virginia) to Alabama. Parts of the Cumberland Mountains (EPA 69 in Kentucky and Tennessee) are instead occupied by Southern and Central Appalachian Cove Forest (CES202.373). North-Central Interior Beech-Maple Forest (CES202.693) replaces this one in EPA 72b of Indiana.
Divisions: 202:C
Nations: US
Subnations: AL, GA, IL, IN, KY, NY, OH, PA, TN, VA, WV
Map Zones: 47:C, 48:C, 49:C, 53:C, 57:C, 61:C, 62:C, 63:C
USFS Ecomap Regions: 211G:CC, 221E:CC, 221F:C?, 221H:CC, 223D:CC, 223E:CC, 223F:CC, 231C:CC, 231D:CC, M221C:CC
TNC Ecoregions: 44:C, 49:C, 50:C, 60:C

SOURCES

References: Braun 1950, Comer et al. 2003, Greller 1988
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722791#references
Description Author: M. Pyne and R. Evans
Version: 20 Aug 2007 **Stakeholders:** East, Midwest, Southeast
Concept Author: M. Pyne and R. Evans **ClassifResp:** Southeast

SOUTHEAST FLORIDA COASTAL STRAND AND MARITIME HAMMOCK (CES411.369)

CLASSIFIERS

Classification Status: Standard

Primary Division: Caribbean (411)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed)
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: EVT 2337; ESLF 4143; ESP 1337

CONCEPT

Summary: This ecological system occurs as a narrow band of hardwood forest and shrublands along the Atlantic coast of southeastern Florida (approximately Volusia County southward). It is found on stabilized, old, coastal dunes, often with substantial shell components. The vegetation is characterized by hardwood species with tropical affinities, such as *Guapira discolor* and *Exothea paniculata*. As such, the northern extent of this type is limited by periodic freezes. This system is closely related to both inland tropical hammocks and southwest Florida maritime hammocks, and may share some species overlap with each.
Classification Comments: This system may be distinguished from southwest Florida maritime hammocks by geographic location, presence of certain indicator species lacking from southwest type (*Guapira discolor* and *Exothea paniculata*), and relatively harsher coastal exposure. It is distinguished from maritime hammocks further north which contain temperate species including *Persea borbonia, Quercus virginiana, Magnolia grandiflora*, and *Juniperus virginiana var. silicicola* (Johnson and Muller 1993a). Thatch palms (*Thrinax morrisii, Thrinax radiata*) are found in rockland hammocks, but absent from maritime hammocks.
Similar Ecological Systems:
- Southwest Florida Coastal Strand and Maritime Hammock (CES411.368)

Related Concepts:
- Cabbage Palmetto: 74 (Eyre 1980) Finer
- Coastal Strand (FNAI 1990) Intersecting
- Live Oak: 89 (Eyre 1980) Finer
- Maritime Hammock (FNAI 1990) Intersecting
- Southern Scrub Oak: 72 (Eyre 1980) Finer
- Tropical Hardwoods: 105 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs along the coast on stabilized, old coastal dunes, often with substantial shell components. The northern extent of this type is limited by periodic freezes.
Dynamics: The northern extent of this type is limited by periodic freezes and lack of cold tolerance of tropical plants, such as *Guapira discolor* and *Exothea paniculata* (Johnson and Muller 1993a). Maritime hammocks are relatively stable forest communities, as long as the canopy remains intact and the underlying landform is stable (FNAI 1990). Surface fires may help to maintain the open understory (Landfire 2007a). The shrub-dominated, coastal strand communities are considered ecotonal, and historically burned more frequently than maritime hammocks, possibly every 4-5 years (Austin and Coleman-Marois 1977). However, there is some disagreement on this point. There is little information on natural fire frequency in coastal strand (FNAI 2010a). The low stature of strand is due to the influence of storms and the ongoing salt spray pruning (FNAI 2010a). Fire is not needed to explain the shrub-dominated vegetation of coastal strands (Landfire 2007a).

Component Associations:
- *Ficus aurea - Sideroxylon foetidissimum - Bursera simaruba / Eugenia foetida - Guapira discolor - Nectandra coriacea* Forest (CEGL007001, G1)
- *Quercus geminata - Quercus myrtifolia - Serenoa repens - Sideroxylon tenax - Ximenia americana* Scrub (CEGL003822, G1)
- *Quercus virginiana - Sabal palmetto - Persea borbonia / Myrcianthes fragrans - Ardisia escallonoides - Psychotria nervosa* Forest (CEGL007033, G1)
- *Scaevola plumieri - Coccoloba uvifera / Uniola paniculata* Shrubland (CEGL003781, G1?)
- *Serenoa repens - Coccoloba uvifera - Pithecellobium keyense - Dalbergia ecastaphyllum* Scrub (CEGL003782, G1)
- *Serenoa repens - Sabal palmetto - Coccoloba uvifera - Sideroxylon tenax - Myrcianthes fragrans - Myrsine floridana* Scrub (CEGL003811, G2)

DISTRIBUTION

Range: Endemic to south Florida.
Divisions: 411:C
Nations: US
Subnations: FL
Map Zones: 56:C

USFS Ecomap Regions: 232G:CC, 411A:CC
TNC Ecoregions: 54:C

SOURCES

References: Austin and Coleman-Marois 1977, Comer et al. 2003, Eyre 1980, FNAI 1990, FNAI 2010a, Johnson and Muller 1993a, Landfire 2007a

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723147#references

Description Author: R. Evans (after Johnson and Muller 1993a), mod. C.W. Nordman

Version: 14 Jan 2014 **Stakeholders:** Southeast

Concept Author: R. Evans, after Johnson and Muller **ClassifResp:** Southeast

SOUTHEASTERN INTERIOR LONGLEAF PINE WOODLAND (CES202.319)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Short Disturbance Interval; Needle-Leaved Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2351; ESLF 4254; ESP 1351

CONCEPT

Summary: This system encompasses the fire-maintained non-Coastal Plain woodlands and forests where *Pinus palustris* is a dominant or codominant canopy species. Its current range includes the outer Piedmont of Georgia and the Carolinas and various parts of Alabama, including the Talladega upland region (quartzite-slate transition) and the Cumberland Plateau, as well as, at least historically, the intervening Ridge and Valley. Examples occur on rolling to somewhat mountainous upland slopes in North Carolina, South Carolina, Georgia, and Alabama. They are believed to naturally be open woodlands with grassy ground cover, but many are now closed forests with dense shrubs or with little ground cover. *Pinus palustris* is either dominant, codominant, or present in circumstances that indicate former dominance or codominance. *Pinus echinata, Quercus coccinea, Quercus falcata, Quercus marilandica, Quercus prinus, Quercus stellata,* and *Quercus velutina* are frequent associates, often codominating. *Carya pallida* and *Sassafras albidum* are also frequent trees. Some of the most frequently encountered grasses include *Andropogon* spp., *Chasmanthium laxum, Danthonia spicata, Dichanthelium commutatum (= Panicum commutatum), Panicum virgatum, Piptochaetium avenaceum, Schizachyrium scoparium,* and *Sorghastrum nutans*. Important forbs include *Coreopsis major, Euphorbia corollata, Helianthus microcephalus, Pityopsis graminifolia, Solidago odora, Tephrosia virginiana,* and the fern *Pteridium aquilinum*.
Classification Comments: This system is closely related to the upland longleaf pine systems of the Coastal Plain, with which it shares the ecological importance of fire, much of its flora and presumably fauna, and probably canopy dynamics. It is distinguished by the distinctive non-Coastal Plain soils and landscape, with its greater topographic relief, and by some floristic and compositional differences. It probably had less frequent natural fire and a somewhat more mixed canopy, with additional pine species in addition to oaks.

This system is distinguished from all other Piedmont and interior systems in having *Pinus palustris*, an indicator of frequent fire, as a dominant species. However, universal logging and fire suppression have blurred the distinction and have made many former examples indistinguishable from one of these other systems. This system should be recognized where there remains evidence of its past occurrence in the form of remnant flora.

Similar Ecological Systems:
- East Gulf Coastal Plain Interior Upland Longleaf Pine Woodland (CES203.496)
- Southern Piedmont Dry Oak-(Pine) Forest (CES202.339)

Related Concepts:
- Longleaf Pine: 70 (Eyre 1980) Finer
- Longleaf Pine: Clayey and Rocky Uplands, Piedmont and Montane Uplands (Peet 2006) Equivalent

DESCRIPTION

Environment: This system occurs in upland settings, which may range from gently rolling to rugged and mountainous. Geologic substrates vary. Most portions are dry, but occasional moist areas and seepage wetlands occur. The primary influence on the system is frequent fire, associated with a location near a fire-prone portion of the Coastal Plain or with other factors. Apparently once widespread along the Fall-line, remnants are now largely limited to two clusters, in eastern Alabama and adjacent Georgia and in south-central North Carolina. The former occurs on rugged terrain associated with the extension of geologic belts of the Blue Ridge. The latter is on gently to moderately rolling topography of metasedimentary and volcanic rocks. Most common on the poorest soils in the Piedmont of eastern Alabama, *Pinus palustris* was "a prominent constituent of the upland forests of nearly every county" but, by the first half of the twentieth century, "grew too scattered to be logged economically" (Harper 1943). About 35% of the original forest there was estimated to have been evergreen; the most common pines were *Pinus taeda, Pinus palustris,* and *Pinus echinata* (Harper 1943). However, this estimate is likely to have been low, since much *Pinus palustris* logging, turpentining and regeneration failure had already occurred prior to Harper's time (J.M. Varner pers. comm.). Today, montane *Pinus palustris* occurs mainly on ridgelines and south to southwesterly slopes (USFWS 2005), but was previously found on nearly all upland sites surveyed in Coosa County, Alabama (Reed 1905). In northwest Georgia, *Pinus palustris* occurs above 300 m (1000 feet) elevation, and it occurs up to nearly 600 m (2000 feet) in Talladega County, Alabama (Harper 1905).

Vegetation: Vegetation consists of open woodlands or forests. *Pinus palustris* is either dominant, codominant, or present in circumstances that indicate former dominance or codominance. *Pinus echinata, Pinus taeda, Quercus falcata, Quercus stellata, Quercus prinus, Quercus coccinea,* and *Quercus velutina* are frequent associates, often codominating. Alteration of fire regimes and universal logging have made the natural condition of the vegetation somewhat uncertain. Almost certainly *Pinus palustris* was more abundant than it usually is at present, but very likely some component of other pines and oaks was present. Under conditions of

frequent fire, understories and shrub layers were sparse and the grassy herb layer dense. Some of the most frequently encountered grasses include *Schizachyrium scoparium, Sorghastrum nutans, Andropogon* spp., *Chasmanthium laxum*, and *Panicum virgatum*. Some frequent forbs include *Tephrosia virginiana, Solidago odora*, and *Pteridium aquilinum* (Andrews 1917, Peet 2006). Other frequently dominant species, such as *Piptochaetium avenaceum* and *Danthonia spicata*, are not characteristic of Coastal Plain longleaf pine systems. Many other grasses and forbs are shared with the upland longleaf pine systems of the Coastal Plain. There is no evidence that *Aristida stricta* or *Aristida beyrichiana* were present in stands of this system, as these species are confined to the coastal plains. In remnant examples, where fire suppression has affected vegetation structure, the ground cover is often shrubby, with dense ericaceous shrubs leaving little space for herbs. Examples that have been burned recently often have ground cover dominated by shrubs and hardwood sprouts, with somewhat increased herb cover.

Dynamics: The dynamics of this system are strongly dominated by fire. The needles of *Pinus palustris* are an important fuel source for low-intensity fires. Fires probably once occurred at frequencies similar to those in the Coastal Plain but more frequently than in any other Piedmont ecological system. Evidence suggests fire frequencies of once every two to four years, with some annual fires (Bale 2009). Modern fire suppression has allowed *Pinus taeda* and *Quercus* spp. to increase in density, along with shrubs, and has resulted in the decrease in cover and diversity of the herb layer. Reproduction of *Pinus palustris* has been largely eliminated by the lack of fire, and the rooting of feral hogs (*Sus scrofa*). Where the canopy was also logged, *Pinus palustris* has often been completely eliminated, leaving the system indistinguishable from logged examples of Southern Piedmont Dry Oak-(Pine) Forest (CES202.339). Because *Pinus palustris* and some of the canopy species naturally associated with it are fairly resilient to fire, and many have the ability to sprout, reintroduction of fire can return this system to its natural composition and structure, but only gradually. Despite frequent fire, canopy dynamics were probably naturally dominated by gap-phase regeneration, with trees reproducing in small to medium-sized gaps created by wind storms and hot spots in fires. *Pinus palustris* is a long-lived tree, which continues to produce greater numbers of cones after age 100.

Component Associations:
- *(Pinus palustris) / Quercus georgiana* Woodland (CEGL007029, G2Q)
- *Pinus palustris - Pinus echinata - (Pinus virginiana) / Quercus marilandica - (Quercus prinus) / Vaccinium pallidum* Woodland (CEGL008437, G2)
- *Pinus palustris - Pinus echinata / Quercus coccinea - Quercus georgiana* Woodland (CEGL004432, G1Q)
- *Pinus palustris - Pinus echinata / Schizachyrium scoparium - Manfreda virginica* Serpentine Woodland (CEGL003608, G1)
- *Pinus palustris - Pinus taeda - Pinus serotina / Chasmanthium laxum - Panicum virgatum* Piedmont Woodland (CEGL003663, G1)
- *Pinus palustris / Rhus aromatica / Salvia urticifolia - Piptochaetium avenaceum* Basic Woodland (CEGL007018, G1)
- *Quercus prinus - Pinus palustris* Forest (CEGL004060, G2G3)

Spatial Characteristics

Spatial Summary: This system was once a large-patch to matrix system, locally dominating the landscape matrix. Remnants are mostly large patches, some up to hundreds of acres or possibly even more.

Size: This system naturally occurs as a large-patch system, or as matrix system in limited areas. Contiguous examples or complexes of related patches of thousands of acres probably once occurred. Remnants are mostly large to medium patches. Occurrences over 1000 acres are present in Alabama, and patches up to 400 acres are present in North Carolina.

Adjacent Ecological Systems:
- Piedmont Seepage Wetland (CES202.298)
- Southern Piedmont Dry Oak-(Pine) Forest (CES202.339)

Adjacent Ecological System Comments: Examples are interfingered or associated with various mesic and floodplain or bottomland systems. Upland systems such as Southern Piedmont Dry Oak-(Pine) Forest (CES202.339) sometimes occur adjacent to remnants, especially on more rugged terrain. It is not always clear which oak-hickory forests are true examples of that system and which represent longleaf pine systems that have been degraded beyond recognition.

Distribution

Range: This system once occurred in parts of the mostly outer Piedmont, from central North Carolina to Alabama, where it extends into the adjacent Ridge and Valley in northeastern Alabama and northwest Georgia. More extensive areas are now largely, if not exclusively, restricted to south-central North Carolina (outer Piedmont) and to eastern Alabama (Talladega upland), as well as the Cumberland Plateau and at least historically, the Ridge and Valley of Alabama. Smaller remnants are found in very limited areas of South Carolina and Georgia (such as Pine Mountain).

Divisions: 202:C
Nations: US
Subnations: AL, GA, NC, SC
Map Zones: 48:C, 54:C, 59:C
USFS Ecomap Regions: 231A:CC, 231C:CC, 231D:CC, 231I:CC
TNC Ecoregions: 50:C, 52:C

Sources

References: Andrews 1917, Bale 2009, Comer et al. 2003, Eyre 1980, Harper 1905, Harper 1943, Klaus 2006, Landfire 2007a, Maceina et al. 2000, NatureServe 2011, Peet 2006, Reed 1905, Schafale pers. comm., USFWS 2005, Varner et al. 2003a, Varner et al. 2003b

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723180#references
Description Author: M. Schafale and R. Evans, mod. M. Pyne and C. Nordman
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: M. Schafale and R. Evans **ClassifResp:** Southeast

SOUTHERN AND CENTRAL APPALACHIAN COVE FOREST (CES202.373)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Broad-Leaved Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: EVT 2318; ESLF 4124; ESP 1318

CONCEPT

Summary: This system consists of mesophytic hardwood or hemlock-hardwood forests of sheltered topographic positions in the Southern Blue Ridge and central Appalachian Mountains. Examples are generally found on concave slopes that promote moist conditions. The system includes a mosaic of acidic and "rich" coves that may be distinguished by individual plant communities based on perceived differences in soil fertility and species richness (rich examples have higher diversity and density in the herbaceous layer). Both acidic and rich coves may occur in the same site, with the acidic coves potentially creeping out of the draw-up to at least midslope on well-protected north-facing slopes. Characteristic species in the canopy include *Aesculus flava, Acer saccharum, Fraxinus americana, Tilia americana, Liriodendron tulipifera, Halesia tetraptera, Tsuga canadensis, Fagus grandifolia, Magnolia acuminata,* and *Magnolia fraseri.*

Classification Comments: This system is best distinguished from others in its range by the combination of sheltered topography, low elevation, and mesophytic flora with high species richness. Canopies can sometimes become depauperate after repeated logging. It is presently defined as not including rich, mesophytic "cove" forests of the Cumberland Plateau and Interior Low Plateau, even though some of these approach or exceed Appalachian examples in their species composition and or their "coveyness." This will be interpreted as variability within South-Central Interior Mesophytic Forest (CES202.887). The Allegheny Front is adopted as the divide between these two similar systems: material to the west goes to South-Central Interior Mesophytic Forest (CES202.887), and material to the east goes to this system.

Similar Ecological Systems:
- Appalachian (Hemlock)-Northern Hardwood Forest (CES202.593)
- South-Central Interior Mesophytic Forest (CES202.887)--found in adjacent regions to the west, out of the mountains, with a more matrix landscape character.
- Southern Piedmont Mesic Forest (CES202.342)--found in adjacent regions to the east.

Related Concepts:
- Beech - Sugar Maple: 60 (Eyre 1980) Finer
- Eastern White Pine: 21 (Eyre 1980) Finer
- Sugar Maple - Basswood: 26 (Eyre 1980) Finer
- Sugar Maple - Beech - Yellow Birch: 25 (Eyre 1980) Finer
- White Oak: 53 (Eyre 1980) Finer
- White Pine - Hemlock: 22 (Eyre 1980) Finer
- Yellow-Poplar - Eastern Hemlock: 58 (Eyre 1980) Finer
- Yellow-Poplar: 57 (Eyre 1980) Finer

DESCRIPTION

Environment: This mixed mesophytic forest system occurs on moist, topographically protected areas such as coves, V-shaped valley bottoms and ravines, and north- and east-facing toeslopes in a dissected landscape. It generally occurs below 1525 m (5000 feet) elevation. The dissected topography creates strong gradients in microclimate and soil moisture and fertility at the local (watershed) scale (Hutchins et al. 1976, Iverson et al. 1997, Morris and Boerner 1998). This forest type developed primarily on mesic, sheltered landscape positions (e.g., lower slopes, coves, ravines) but also occurred on some dry-mesic slopes, where presumably fire was infrequent (Wade et al. 2000). This system has two primary components, an acidic cove of lower soil fertility that ranges from the lowest slope positions up the slope on north-facing protected slopes, and a rich, high-fertility cove forest that tends to occur only at the lowest slope positions. Both are sheltered from wind and may be shaded by topography, promoting moist conditions. Local slopes are usually concave. Bedrock may be of virtually any type. Acidic rocks, such as felsic igneous and metamorphic rocks, support rich cove forests in a more limited range of sites than do basic rocks, such as mafic metamorphic rocks or marble. Soils may be rocky or fine-textured, and may be residual, alluvial, or colluvial. In the southern Appalachians, the hemlock "phase" of this ("acidic cove forest") often occurs between "richer" examples of Southern and Central Appalachian Cove Forest (CES202.373) in the lowest areas and Southern Appalachian Oak Forest (CES202.886) on the midslopes.

Vegetation: This system is among the most diverse in the United States, containing more than 30 canopy tree species. Vegetation consists of forests dominated by various combinations of mesophytic species, usually with many different species of primarily deciduous trees present. *Acer saccharum, Liriodendron tulipifera, Tilia americana, Tilia americana var. heterophylla, Fraxinus americana, Aesculus flava, Fagus grandifolia, Betula lenta, Magnolia acuminata, Magnolia fraseri, Quercus rubra, Halesia*

tetraptera, Prunus serotina, and *Tsuga canadensis* are the most frequent dominant canopy species (Braun 1950, Muller 1982). Witness tree data (from early land surveys) and studies of old-growth forests suggest that mixed-oak forests were generally more abundant on the landscape than mixed-mesophytic forests prior to European settlement (Beatley 1959, McCarthy et al. 1987, Abrams et al. 1995, Dyer 2001, McCarthy et al. 2001, Rentch et al. 2003). Canopies are generally very diverse, with all species potentially occurring in one 20x50-meter plot in rich cove areas. A well-developed herb layer, often very dense and usually high in species richness, is present in all but the acid coves. Well-developed and fairly diverse subcanopy and shrub layers are often also present in all but the acid coves. Ulrey (1999) listed *Caulophyllum thalictroides, Actaea racemosa (= Cimicifuga racemosa), Laportea canadensis, Osmorhiza claytonii, Sanguinaria canadensis, Viola canadensis, Acer saccharum, Aesculus flava, Carya cordiformis,* and *Tilia americana var. heterophylla* as characteristic species.

Dynamics: This system is naturally dominated by stable, uneven-aged forests, with canopy dynamics dominated by gap-phase regeneration on a fine scale. Occasional extreme wind or ice events may disturb larger patches. In the absence of frequent or catastrophic disturbance, environmental gradients formed by the dissected topography determine forest composition (Hutchins et al. 1976, Muller 1982, Iverson et al. 1997, Dyer 2001). Most of the component species are among the less fire-tolerant in the region. The mixed-mesophytic forest type is fire regime class III, surface fires with return intervals 30-100+ years (Wade et al. 2000). Mixed-severity fires may occur approximately every 500 years opening the canopy with increased mortality. Straight-line winds or microbursts may cause blowdowns on a scale of one to 100 acres. Stand-replacement fires happen very infrequently. Current composition and structure of this system is influenced by the absence of fire, deer herbivory, and non-native invasive species (plants, animals, insects and disease). The absence of fire is causing an expansion of some of the characteristic mesic taxa out of coves, potentially replacing previous oak-dominated vegetation on drier and more exposed sites than those typically associated with "mesic" vegetation.

Component Associations:

- *Acer (nigrum, saccharum) - Tilia americana / Asimina triloba / Jeffersonia diphylla - Caulophyllum thalictroides* Forest (CEGL008412, G4G5)
- *Acer saccharum - Fraxinus americana - Tilia americana - Liriodendron tulipifera / Actaea racemosa* Forest (CEGL006237, G4?)
- *Aesculus flava - Acer saccharum - (Fraxinus americana, Tilia americana var. heterophylla) / Hydrophyllum canadense - Solidago flexicaulis* Forest (CEGL007695, G3G4)
- *Betula alleghaniensis - Tilia americana var. heterophylla / Acer spicatum / Ribes cynosbati / Dryopteris marginalis* Forest (CEGL004982, G2G3)
- *Diphylleia cymosa - Saxifraga micranthidifolia - Laportea canadensis* Herbaceous Vegetation (CEGL004296, G3)
- *Impatiens (capensis, pallida) - Monarda didyma - Rudbeckia laciniata var. humilis* Herbaceous Vegetation (CEGL004293, G3)
- *Liriodendron tulipifera - Betula lenta - Tsuga canadensis / Rhododendron maximum* Forest (CEGL007543, G5)
- *Liriodendron tulipifera - Fraxinus americana - (Tilia americana, Aesculus flava) / Actaea racemosa - Laportea canadensis* Forest (CEGL007710, G4)
- *Liriodendron tulipifera - Pinus strobus - Tsuga canadensis - Quercus (rubra, alba) / Polystichum acrostichoides* Forest (CEGL006304, G4?)
- *Liriodendron tulipifera - Quercus rubra - Fraxinus americana / Asimina triloba / Actaea racemosa - Uvularia perfoliata* Forest (CEGL006186, G4?)
- *Liriodendron tulipifera - Quercus rubra - Magnolia acuminata / Cornus florida* Forest (CEGL008510, G5?)
- *Liriodendron tulipifera - Tilia americana var. heterophylla - (Aesculus flava) / Actaea racemosa* Forest (CEGL007291, G4?)
- *Pinus strobus - Tsuga canadensis / Rhododendron maximum - (Leucothoe fontanesiana)* Forest (CEGL007102, G4)
- *Quercus alba - Quercus rubra - Carya ovalis / Acer saccharum / Polystichum acrostichoides* Forest (CEGL007233, G4)
- *Quercus rubra - Tilia americana var. heterophylla - (Halesia tetraptera var. monticola) / Collinsonia canadensis - Prosartes lanuginosa* Forest (CEGL007878, G3?)
- *Tilia americana var. heterophylla - Aesculus flava - Acer saccharum / Cystopteris bulbifera - Asarum canadense* Forest (CEGL006472, G3G4)
- *Tilia americana var. heterophylla - Fraxinus americana - (Ulmus rubra) / Sanguinaria canadensis - (Aquilegia canadensis, Asplenium rhizophyllum)* Forest (CEGL007711, G2G3)
- *Tsuga canadensis - (Fagus grandifolia, Tilia americana var. heterophylla) / Magnolia tripetala* Forest (CEGL008407, G4)
- *Tsuga canadensis - Halesia tetraptera - (Fagus grandifolia, Magnolia fraseri) / Rhododendron maximum / Dryopteris intermedia* Forest (CEGL007693, G2)
- *Tsuga canadensis - Quercus prinus - Liriodendron tulipifera / Kalmia latifolia - (Rhododendron catawbiense)* Forest (CEGL008512, G4)
- *Tsuga canadensis / Rhododendron maximum - (Clethra acuminata, Leucothoe fontanesiana)* Forest (CEGL007136, G3G4)

SPATIAL CHARACTERISTICS

Spatial Summary: Large-patch system commonly occurring in a landscape mosaic with several other systems. On slopes it forms a mosaic with fire-prone Central Appalachian Dry Oak-Pine Forest (CES202.591), where these forests are restricted to the most protected coves.

Size: Most individual patches are tens to sometimes a few hundred acres. Because it frequently occurs in mosaics with other systems, separation distance for occurrences has a strong effect on the size of occurrences. Complexes of thousands of acres of this system are possible.

Adjacent Ecological Systems:

- Central Appalachian Dry Oak-Pine Forest (CES202.591)
- Northeastern Interior Dry-Mesic Oak Forest (CES202.592)
- Southern and Central Appalachian Bog and Fen (CES202.300)
- Southern Appalachian Low-Elevation Pine Forest (CES202.332)
- Southern Appalachian Montane Cliff and Talus (CES202.330)
- Southern Appalachian Oak Forest (CES202.886)
- Southern Appalachian Seepage Wetland (CES202.317)
- Southern Appalachian Spray Cliff (CES202.288)

Adjacent Ecological System Comments: This system is usually bordered by Southern Appalachian Oak Forest (CES202.886) in the Southern Blue Ridge. The border with adjacent systems is gradational. It may also contain small embedded patches of Southern Appalachian Montane Cliff and Talus (CES202.330) or other small-patch systems. In the southern Appalachians, the "richer" phase of Southern and Central Appalachian Cove Forest (CES202.373) occurs downslope from the hemlock "phase" ("acidic cove forests") and tends to be more mesic and more species-rich than the hemlock-dominated areas. Southern Appalachian Oak Forest (CES202.886) occurs upslope from this system and tends to be drier and even less diverse than the hemlock areas, which may grade into Southern Appalachian Low-Elevation Pine Forest (CES202.332) in especially dry occurrences. On slopes it forms a mosaic with fire-prone Central Appalachian Dry Oak-Pine Forest (CES202.591), where these forests are restricted to the most protected coves.

DISTRIBUTION

Range: This system occurs in the southern and central Appalachian Mountains, ranging into the Cumberland Mountains of Kentucky and Tennessee. This range is more-or-less consistent with the "Oak-Chestnut" forest region of Braun (1950) and Greller (1988), versus the "Mixed Mesophytic" and "Western Mesophytic" forest regions to the west.
Divisions: 202:C
Nations: US
Subnations: GA, KY, MD, NC, SC, TN, VA, WV
Map Zones: 53:C, 57:C, 61:C, 62:C
USFS Ecomap Regions: M221A:CC, M221B:CC, M221C:CC, M221D:CC
TNC Ecoregions: 50:C, 51:C, 52:C, 59:C, 61:P

SOURCES

References: Abrams et al. 1995, Beatley 1959, Braun 1950, Brown and Smith 2000, Comer et al. 2003, Delcourt et al. 1998, Dyer 2001, Eyre 1980, Frost 1998, Guyette et al. 2003, Hutchins et al. 1976, Iverson et al. 1997, Kuchler 1964, Landfire 2007a, McCarthy et al. 1987, McCarthy et al. 2001, McNab and Avers 1994, Morris and Boerner 1998, Muller 1982, Rentch et al. 2003, Schmidt et al. 2002, Ulrey 1999, Wade et al. 2000
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723143#references
Description Author: M. Schafale, M. Pyne, R. White, R. Evans, mod. S. Gawler and L.A. Sneddon
Version: 23 Jan 2012 **Stakeholders:** East, Southeast
Concept Author: M. Schafale, M. Pyne, R. White, R. Evans **ClassifResp:** Southeast

SOUTHERN APPALACHIAN LOW-ELEVATION PINE FOREST (CES202.332)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Acidic Soil; Short Disturbance Interval; Needle-Leaved Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2353; ESLF 4256; ESP 1353

CONCEPT

Summary: This ecological system consists of *Pinus echinata*- and *Pinus virginiana*-dominated forests in the lower elevation Southern Appalachians and adjacent Piedmont and Cumberland Plateau, extending into the Interior Low Plateau of Indiana, Kentucky and Tennessee. Examples can occur on a variety of topographic and landscape positions, including ridgetops, upper and midslopes, as well as lower elevations (generally below 700 m [2300 feet]) in the Southern Appalachians such as mountain valleys. Examples occur on a variety of acidic bedrock types. Frequent, low-intensity fires coupled with severe fires may have been the sole factor favoring the occurrence of this system instead of hardwood forests in the absence of fire. Under current conditions, stands are dominated by *Pinus echinata* or *Pinus virginiana*. *Pinus rigida* may sometimes be present. Hardwoods are sometimes abundant, especially dry-site oaks such as *Quercus falcata*, *Quercus prinus*, and *Quercus coccinea*, but also *Carya glabra, Acer rubrum*, and others. The shrub layer may be well-developed, with *Gaylussacia baccata, Kalmia latifolia, Rhododendron minus, Vaccinium pallidum,* or other acid-tolerant species most characteristic. Herbs are usually sparse but may include *Pityopsis graminifolia* and *Tephrosia virginiana*.
Classification Comments: This system and its component associations are among the least studied in the southern Appalachians (Harrod and White 1999). Settlement, universal logging, pine beetle outbreaks, and fire suppression potentially have altered their character and blurred their boundaries more than most systems in the region. The situation is further complicated by the potential for pine-dominated forests to have been both created and destroyed in different places by these disturbances. Obviously successional pine forests associated with the recovery of heavily logged or plowed slopes and valleys are grouped into the matrix Central and Southern Appalachian Montane Oak Forest (CES202.596).

The relationship between this system and Southern Appalachian Montane Pine Forest and Woodland (CES202.331) may need further clarification. Southern Appalachian Low-Elevation Pine Forest (CES202.332) is distinguished by its occurrence as large patches on lower terrain (generally below 700 m [2300 feet]) and less extreme topography. The vegetation of the two systems may overlap due to the factors outlined above, but pitch pine and Table Mountain pine are more typical of the former, while shortleaf pine and Virginia pine are more typical of the latter.

Presently the shortleaf pine-dominated vegetation of the Interior Low Plateau (ILP), including examples in southern Indiana and the Tennessee portion of Land Between the Lakes, is included in this system. Frost (1998) treats the ILP region in a different fire-return-interval class than the core range of this system, although local variation may overwhelm the broad regional differences. If more detailed information becomes available to document important ecological differences between these areas, a new system may be required.

This system (CES202.332) at its western extent in central Tennessee and Kentucky would be distinguished from equivalent Ozarkian systems (e.g., Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland (CES202.313)) by the presence of *Pinus virginiana* and *Quercus prinus*, which do not cross the Mississippi River.
Similar Ecological Systems:
- Allegheny-Cumberland Dry Oak Forest and Woodland (CES202.359)
- Central and Southern Appalachian Montane Oak Forest (CES202.596)
- Ozark-Ouachita Shortleaf Pine-Bluestem Woodland (CES202.325)
- Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland (CES202.313)
- Southern Appalachian Montane Pine Forest and Woodland (CES202.331)
- Southern Piedmont Dry Oak-(Pine) Forest (CES202.339)

Related Concepts:
- Appalachian Pine-Oak Forest (Evans 1991) Finer
- Eastern White Pine: 21 (Eyre 1980) Finer
- Shortleaf Pine - Oak: 76 (Eyre 1980) Finer
- Shortleaf Pine: 75 (Eyre 1980) Finer
- Virginia Pine: 79 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs on ridgetops, upper and midslopes, in mountain valleys and the lower ranges. It is found on south- and southwest-facing slopes (Whittaker 1956). Bedrock may be a variety of types, but the system may be limited to acidic substrates. Fire is undoubtedly a very important and necessary influence.

Vegetation: Vegetation consists of closed to open forests or woodlands dominated by *Pinus echinata* or *Pinus virginiana*. *Pinus rigida* may sometimes be present. Hardwoods are sometimes abundant, especially dry-site oaks such as *Quercus falcata, Quercus prinus*, and *Quercus coccinea*, but also *Carya glabra, Acer rubrum*, and others. An extensive hardwood component may partly be the result of fire suppression. The shrub layer may be well-developed, with *Vaccinium pallidum, Gaylussacia baccata*, or other acid-tolerant species most characteristic. Herbs are usually sparse but may include *Pityopsis graminifolia* and *Tephrosia virginiana*. Herbs probably were more abundant and shrubs less dense when fires occurred more frequently, and the communities of this system may have been grassy under more natural conditions, with *Schizachyrium scoparium* being a typical component, possibly with *Danthonia* sp.
Dynamics: Fire is clearly an important influence on the dynamics of this ecological system, and frequent, low-intensity fires coupled with occasional severe fires (Harrod and White 1999) are thought to have been the primary factor leading to the occurrence of this system rather than hardwood forests on dry sites in the absence of fire. Fires probably were frequent and of low intensity, or a mix of low and higher intensity. Over many decades, accumulation of dead biomass can predispose these forests to catastrophic fire. However, even in the absence of fire, successional changes are normally restricted (possibly ending with oak domination) because most sites are infertile and dry (Murphy and Nowacki 1997). Fire probably is important for determining the balance of the two pine species, the component of hardwoods, and the overall vegetation structure. *Pinus echinata* is fairly resilient to fire once mature, while *Pinus virginiana* individuals are fairly susceptible to fire but well-adapted to establishing in areas opened by intense fire.

Southern pine beetles (*Dendroctonus frontalis*) are an important disturbance and threat in this system, at least under present conditions and severe outbreaks can kill all the pines without creating the conditions for the pines to regenerate. Effects of logging and past clearing as well as lack of fire make understanding of this system's natural character and dynamics difficult. An extensive hardwood component may partly be the result of lack of fire. Some pine-dominated areas appear to be successional stands established in former hardwood forests after logging or cultivation, and would not be expected to have the same dynamics or ecosystem characteristics as natural pine forests maintained by fire. In natural pine forests, logging may allow pines to regenerate or may change the composition to weedy hardwoods. This might also alter canopy composition as well as structure. In many cases, several prescribed fires or a combination of fire and thinning treatments will be necessary to restore these ecosystems (Elliott and Vose 2005).

Component Associations:
- *Pinus echinata - Quercus (prinus, falcata) / Oxydendrum arboreum / Vaccinium pallidum* Forest (CEGL007493, G3G4)
- *Pinus echinata - Quercus alba / Vaccinium pallidum / Hexastylis arifolia - Chimaphila maculata* Forest (CEGL008427, G3G4)
- *Pinus echinata - Quercus prinus - Quercus stellata / Vaccinium pallidum / Pityopsis graminifolia var. latifolia* Woodland (CEGL004445, G2?)
- *Pinus echinata - Quercus prinus / Rhododendron minus / Vaccinium pallidum* Forest (CEGL007496, G2G3)
- *Pinus echinata - Quercus stellata - Quercus marilandica / Vaccinium pallidum* Woodland (CEGL003765, G4?)
- *Pinus echinata - Quercus stellata - Quercus prinus - Carya glabra / (Danthonia spicata, Piptochaetium avenaceum)* Forest (CEGL007500, G3?)
- *Pinus echinata / Schizachyrium scoparium* Appalachian Woodland (CEGL003560, G2)
- *Pinus echinata / Vaccinium (pallidum, stamineum) - Kalmia latifolia* Forest (CEGL007078, G4?)
- *Pinus strobus / Kalmia latifolia - (Vaccinium stamineum, Gaylussacia ursina)* Forest (CEGL007100, G2G3)
- *Pinus virginiana - (Pinus rigida, Pinus pungens) / Schizachyrium scoparium* Forest (CEGL008500, G3G4)
- *Pinus virginiana - Pinus (rigida, echinata) - (Quercus prinus) / Vaccinium pallidum* Forest (CEGL007119, G3)

SPATIAL CHARACTERISTICS

Spatial Summary: Probably naturally a large-patch system, covering thousands of acres. Most remnants in relatively natural condition are probably small patches
Size: Natural size distribution not well-known, but probably a large-patch system with patches or complexes covering hundreds to thousands of acres. The current distribution of patch size is also not well-known. Size of defined occurrences may be strongly affected by standards for condition and separation distances. In some parts of the Interior Low Plateau, this system consists of smaller patches or linear strips along acidic (sandstone, cherty limestone) clifflines.
Adjacent Ecological Systems:
- Southern and Central Appalachian Cove Forest (CES202.373)
- Southern Appalachian Montane Cliff and Talus (CES202.330)
- Southern Appalachian Montane Pine Forest and Woodland (CES202.331)
- Southern Appalachian Oak Forest (CES202.886)

Adjacent Ecological System Comments: Probably usually bordered and intermixed with Southern Appalachian Oak Forest (CES202.886). Southern and Central Appalachian Cove Forest (CES202.373) may be present in more mesic areas. This system may also intergrade into Southern Appalachian Montane Pine Forest and Woodland (CES202.331) at high elevations.

DISTRIBUTION

Range: This system is found primarily in the Appalachian regions of Kentucky and the Southern Blue Ridge in northern Georgia, western North Carolina, southeastern Tennessee, the Cumberlands of Alabama, parts of the Interior Low Plateau (e.g., the Knobs Region of Kentucky and southern Indiana and the western Highland Rim of Tennessee), and southwestern Virginia.
Divisions: 202:C
Nations: US
Subnations: AL, GA, IN, KY, NC, SC, TN, VA

Map Zones: 47:C, 48:C, 53:C, 54:C, 57:C, 59:C
USFS Ecomap Regions: 221H:CC, 221J:CC, 223D:CC, 223E:CC, 231A:CC, 231C:CC, 231D:CC, 231I:CC, M221A:CC, M221C:CC, M221D:CC
TNC Ecoregions: 44:C, 50:C, 51:C, 52:C

SOURCES

References: Comer et al. 2003, Elliott and Vose 2005, Elliott et al. 2011, Evans 1991, Eyre 1980, Frost 1998, Harper 1943, Harrod and White 1999, Murphy and Nowacki 1997, NatureServe 2002, Whittaker 1956
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723171#references
Description Author: M. Schafale, R. Evans, R. White, mod. M. Pyne and C. Nordman
Version: 14 Jan 2014 **Stakeholders:** East, Midwest, Southeast
Concept Author: M. Schafale, R. Evans, R. White **ClassifResp:** Southeast

SOUTHERN APPALACHIAN MONTANE PINE FOREST AND WOODLAND (CES202.331)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane; Forest and Woodland (Treed); Needle-Leaved Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2352; ESLF 4255; ESP 1352

CONCEPT

Summary: This system consists of predominantly evergreen woodlands (or more rarely forests) occupying very exposed, convex, often rocky south- and west-facing slopes, ridge spurs, crests, and clifftops in the Central Appalachians, Southern Ridge and Valley and Southern Blue Ridge. They occur at moderate to upper elevations (450-1200 m [1500-4000 feet]), with the more southerly examples at the higher elevations. In the Southern Blue Ridge, this system is best developed above 700 m (2300 feet) in elevation. The underlying rock is acidic and sedimentary or metasedimentary (e.g., quartzites, sandstones and shales). The soils are very infertile, shallow and droughty. A thick, poorly decomposed duff layer, along with dead wood and highly volatile ericaceous shrubs, creates a strongly fire-prone habitat. Most examples are dominated by *Pinus pungens*, often with *Pinus rigida* and/or *Pinus virginiana*, and occasionally *Tsuga caroliniana*. The canopy is usually patchy to open, but areas of closed canopy may be present, especially where *Tsuga caroliniana* is prominent. Fire is a very important ecological process in this system. Pines may be able to maintain dominance due to edaphic conditions, such as very shallow soil or extreme exposure in some areas which can produce sustained drought conditions, but most sites appear eventually to succeed to oak dominance in the absence of fire. Fire is also presumably a strong influence on vegetation structure, producing a more open woodland canopy structure and more herbaceous ground cover.
Classification Comments: This system is related to Central Appalachian Pine-Oak Rocky Woodland (CES202.600), which is distinguished by a mixed or deciduous canopy and absence of *Pinus pungens*. Stands with *Pinus echinata* present are generally accommodated by Southern Appalachian Low-Elevation Pine Forest (CES202.332). The relationship between these two systems may need further clarification. This system is distinguished by occurrence as small patches on the most extreme topography, as well as by the species of pines dominating. However, *Pinus echinata* may codominate in Southern Appalachian Low-Elevation Pine Forest (CES202.332) at times. Sites that would support this system under a natural fire regime, but which have lost the pines by logging, southern pine beetle or senescence in the absence of fire, should probably be regarded as degraded examples of this system. However, they become virtually indistinguishable from Southern Appalachian Oak Forest (CES202.886) and Central Appalachian Pine-Oak Rocky Woodland (CES202.600) over time.
Similar Ecological Systems:
- Central Appalachian Pine-Oak Rocky Woodland (CES202.600)
- Southern Appalachian Granitic Dome (CES202.297)
- Southern Appalachian Low-Elevation Pine Forest (CES202.332)
- Southern Appalachian Oak Forest (CES202.886)
- Southern Piedmont Dry Oak-(Pine) Forest (CES202.339)

Related Concepts:
- Pine Savanna/Woodland (Evans 1991) Finer
- Pitch Pine: 45 (Eyre 1980) Finer
- Virginia Pine: 79 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs on ridgetops, usually only on the sharpest and narrowest spur ridges, and adjacent convex upper slopes. These sites are the extreme of convex landforms. Rapid drainage of rainfall and exposure to wind, sun and lightning are probably the important characteristics. Bedrock may be of any acidic type, including felsic igneous and metamorphic rocks, sandstone and quartzite. Soils are shallow and rocky residual soils. Fire appears to be an important factor.
Vegetation: Vegetation consists of open forests or woodlands dominated by *Pinus pungens*, often with *Pinus rigida* or less commonly *Tsuga caroliniana*, and sometimes with *Pinus virginiana* or rarely *Pinus echinata* codominant. In examples that have not had fire in a long time, *Quercus prinus, Quercus coccinea*, or other oaks are usually present and are sometimes abundant, as are *Nyssa sylvatica* and *Acer rubrum*. *Castanea dentata* may also have once been abundant. A dense heath shrub layer is almost always present. *Kalmia latifolia* is the most typical dominant, but species of *Rhododendron, Vaccinium*, or *Gaylussacia* may be dominant. Herbs are usually sparse but probably were more abundant and shrubs less dense when fires occurred more frequently.
Dynamics: Fire is apparently a very important process in this system (Harrod and White 1999). Pines may be able to maintain dominance due to shallow soils and extreme exposure in some areas, but most sites appear eventually to succeed to oak dominance in the absence of fire. Fire is also presumably a strong influence on vegetation structure, producing a more open woodland canopy structure and more herbaceous ground cover. Occurrence in highly exposed sites may make this system more prone to ignition, but most fires probably spread from adjacent oak forests. Fires could be expected to show more extreme behavior in this system than in

oaks forests under similar conditions, due to the flammability of the vegetation and the dry, windy and steep location. Both intense catastrophic fires and lower-intensity fires probably occurred naturally. Natural occurrences probably include both even-aged and uneven-aged canopies.

Southern pine beetles are an important factor in this system, at least under present conditions. Beetle outbreaks can kill all the pines without creating the conditions for the pines to regenerate. If the pines are lost, the distinction between this system and Southern Appalachian Oak Forest (CES202.886) or Central Appalachian Pine-Oak Rocky Woodland (CES202.600) becomes blurred.

Component Associations:
- *Pinus pungens - Pinus rigida - (Quercus prinus) / Kalmia latifolia - Vaccinium pallidum* Woodland (CEGL007097, G3)
- *Pinus rigida - (Pinus pungens) / Rhododendron catawbiense - Kalmia latifolia / Galax urceolata* Woodland (CEGL004985, G2)
- *Pinus rigida / Schizachyrium scoparium - Sorghastrum nutans - Baptisia tinctoria* Woodland (CEGL003617, G2?)
- *Pinus virginiana - Pinus (rigida, echinata) - (Quercus prinus) / Vaccinium pallidum* Forest (CEGL007119, G3)
- *Tsuga caroliniana - Pinus (rigida, pungens, virginiana)* Forest (CEGL006178, G2)
- *Tsuga caroliniana / Kalmia latifolia - Rhododendron catawbiense* Forest (CEGL007139, G2)

SPATIAL CHARACTERISTICS

Spatial Summary: Large- to small-patch system, occurring as a frequent part of the landscape mosaic.
Size: Occurs as a large- to small-patch system. Contiguous bodies probably once covered dozens to 100 or more acres. Patches often occur in complexes with other systems. Size of defined occurrences may be strongly affected by separation distances for occurrences.
Adjacent Ecological Systems:
- Southern Appalachian Grass and Shrub Bald (CES202.294)
- Southern Appalachian Low-Elevation Pine Forest (CES202.332)
- Southern Appalachian Montane Cliff and Talus (CES202.330)
- Southern Appalachian Oak Forest (CES202.886)

Adjacent Ecological System Comments: This system is almost always bordered and intermixed with Southern Appalachian Oak Forest (CES202.886). Distinctions are made more difficult by the suppression of fire and subsequent invasion of less fire-tolerant species such as *Acer rubrum* and *Nyssa sylvatica*. Generally speaking, communities with a heavy component of pine (at least 25 or 50% of canopy, and with some *Pinus pungens*) are categorized as Southern Appalachian Montane Pine Forest and Woodland (CES202.331), whereas communities with a much smaller component of pines are considered Southern Appalachian Oak Forest (CES202.886). At the highest elevations that this system is seen, it may intergrade with Southern Appalachian Grass and Shrub Bald (CES202.294).

DISTRIBUTION

Range: This system is centered on the Southern Blue Ridge, from northern Georgia and South Carolina north through Virginia, with outlying occurrences north through the Central Appalachians to a small incursion in the northern Blue Ridge of south-central Pennsylvania.
Divisions: 202:C
Nations: US
Subnations: GA, KY, MD, NC, OH, PA, SC, TN, VA, WV
Map Zones: 53:C, 54:C, 57:C, 59:C, 60:C, 61:C
USFS Ecomap Regions: M221D:CC
TNC Ecoregions: 49:C, 50:C, 51:C, 52:C, 59:C

SOURCES

References: Comer et al. 2003, Harrod and White 1999
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723172#references
Description Author: M. Schafale, R. Evans, M. Pyne, R. White, mod. S.C. Gawler
Version: 05 May 2008 **Stakeholders:** East, Midwest, Southeast
Concept Author: M. Schafale, R. Evans, M. Pyne, R. White **ClassifResp:** Southeast

SOUTHERN APPALACHIAN NORTHERN HARDWOOD FOREST (CES202.029)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane; Broad-Leaved Tree
Non-Diagnostic Classifiers: Forest and Woodland (Treed)
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: EVT 2309; ESLF 4115; ESP 1309

CONCEPT

Summary: This system consists of hardwood forests of the higher elevation zones of the Southern Appalachians, generally above 1372 m (4500 feet) elevation. Included are classic northern hardwood forests, dominated by various combinations of mesophytic hardwoods, which interfinger with high-elevation oak forests downslope or on more exposed aspects. The combination of elevation and aspect provides habitat for this system. Included in this system are limited areas locally known as "beech gaps" and "boulderfields." Stands are dominated by various combinations of Appalachian mesophytic trees, including *Betula alleghaniensis, Fagus grandifolia, Aesculus flava, Acer saccharum*, and *Tsuga canadensis*. *Prunus serotina* and *Tilia americana var. heterophylla* are occasionally abundant. *Quercus rubra* may be present but is not dominant. In Kentucky, this system is of extremely limited extent, being restricted to areas above about 1100-1160 m (3600-3800 feet) elevation on Black Mountain, the highest elevation in Kentucky, which is apparently higher in elevation than adjacent areas in Tennessee and Virginia.
Classification Comments: This system does not include high-elevation *Quercus rubra* associations, which are placed in related Central and Southern Appalachian Montane Oak Forest (CES202.596). Even though they may occur in the same elevational zone as the mesophytic northern hardwood forests, they occupy a different habitat (drier and more exposed aspects), and comprise a different set of plant associations. They differ from the mesophytic northern hardwood forests in the dominance of oaks and the probable importance of fire as a process. The border of this system with adjacent systems is usually gradational. The transition to Central and Southern Appalachian Spruce-Fir Forest (CES202.028) that often adjoins at higher elevation is marked by a gradual shift in canopy dominance from hardwoods to conifers. The transition to lower elevation hardwood forest systems is similarly marked by a gradual turnover of dominant trees but may be more subtle because more species are shared. The transition to Southern and Central Appalachian Cove Forest (CES202.373) is particularly gradual, being marked mainly by the addition of species without loss of species. The non-forested systems that occur in the same elevational zone may have transition zones of open woody vegetation, though some have sharp borders. In relatively undisturbed stands, the canopy composition and structure are the best way to determine the boundary of this system.

This system is similar to the northern hardwood forests of the northeastern U.S., i.e., Laurentian-Acadian Northern Hardwood Forest (CES201.564), but differs in having a southern mountain climate (shorter winters, less extreme cold temperatures, shorter summer days), lacking a history of glaciation, and in having a flora and fauna with many southern Appalachian endemics. A few characteristic dominants of the northern hardwoods are lacking, including *Betula papyrifera* and *Populus tremuloides*. It differs from Appalachian (Hemlock)-Northern Hardwood Forest (CES202.593) in its more montane setting and its flora and fauna having many southern Appalachian endemics. The northern hardwoods in the Ridge and Valley are primarily included in CES202.593. The northern boundary of this system follows a gradual northward transition through central and northern Virginia.
Similar Ecological Systems:
- Appalachian (Hemlock)-Northern Hardwood Forest (CES202.593)
- Central and Southern Appalachian Montane Oak Forest (CES202.596)--generally occupies more exposed and drier aspects and becomes more prominent at lower elevations.
- Southern Appalachian Oak Forest (CES202.886)

Related Concepts:
- Hemlock - Yellow Birch: 24 (Eyre 1980) Finer
- Northern Hardwood Forest (Schafale and Weakley 1990) Broader
- Sugar Maple - Beech - Yellow Birch: 25 (Eyre 1980) Undetermined

DESCRIPTION

Environment: The habitat for this system in the Southern Blue Ridge includes cooler, moister slopes and more-or-less concave landforms, at elevations from 1220-1680 m (4000-5500 feet), occasionally extending up to nearly 1830 m (6000 feet). It is most prevalent on north- to east-facing slopes, but can occur on a variety of landforms and aspects within this elevational range, tending to be more predominant towards its upper limits, where it transitions to spruce- or spruce-hardwood-dominated types. Elevation and orographic effects make the climate cool and wet, with significant moisture input from fog as well as high rainfall. Strong winds, ice glaze, and extreme cold may occur but are less important than in Central and Southern Appalachian Spruce-Fir Forest (CES202.028). Soils are generally very rocky, with the matrix ranging from well-weathered parent material to coarse colluvial boulder deposits. Soils are probably moist but not saturated most of the time. Any kind of bedrock may be present. Limited areas support boulderfields. In

related areas of Kentucky (in the highest elevations of the Cumberlands), this system is of extremely limited extent. Its elevational range is lower than in the Southern Blue Ridge, being restricted to areas above about 1100-1160 m (3600-3800 feet) elevation on Black Mountain. These are the highest elevations in Kentucky and are apparently higher in elevation than adjacent areas in Tennessee and Virginia, which apparently lack examples of this system.

Vegetation: Vegetation consists of forests dominated by various combinations of *Betula alleghaniensis*, *Fagus grandifolia*, *Aesculus flava*, *Acer saccharum*, and *Tsuga canadensis*. *Prunus serotina* and *Tilia americana var. heterophylla* are occasionally abundant. *Quercus rubra* may be present but is not dominant; it dominates the warmer, more exposed aspects in this elevational range, and these stands are part of Central and Southern Appalachian Montane Oak Forest (CES202.596), not Southern Appalachian Northern Hardwood Forest (CES202.029). Lower strata usually include a dense herb layer and often a well-developed deciduous shrub layer as well. Limited areas may have a dense evergreen shrub layer. Plant species richness ranges from fairly high to very low.

Dynamics: This system is naturally dominated by stable, uneven-aged forests, with canopy dynamics dominated by gap-phase regeneration on a fine to medium scale. Occasional extreme wind or ice events disturb larger patches on exposed slopes. Fire appears to be uncommon under natural conditions, perhaps extremely rare in the more mesic portions. In contrast, fire may be important in regeneration of *Quercus rubra* in stands of Central and Southern Appalachian Montane Oak Forest (CES202.596), and may be crucial in maintaining its dominance in these drier sites. Many *Quercus rubra* forests now appear to be succeeding to mesophytic hardwoods in the absence of fire. Little is known about natural fire behavior. Fires are likely to be low in intensity because of limited flammability of the vegetation and prevailing moist conditions, but most of the component tree species are probably not very tolerant of fire.

Component Associations:

- *Aesculus flava - Betula alleghaniensis - Acer saccharum / Acer spicatum / Caulophyllum thalictroides - Actaea podocarpa* Forest (CEGL004973, G3)
- *Betula alleghaniensis - (Tsuga canadensis) / Rhododendron maximum / (Leucothoe fontanesiana)* Forest (CEGL007861, G3)
- *Betula alleghaniensis - Acer saccharum - Aesculus flava / Acer pensylvanicum / Trillium grandiflorum* Forest (CEGL004417, G2G3Q)
- *Betula alleghaniensis - Fagus grandifolia - Aesculus flava / Viburnum lantanoides / Eurybia chlorolepis - Dryopteris intermedia* Forest (CEGL007285, G3G4)
- *Betula alleghaniensis / Ribes glandulosum / Polypodium appalachianum* Forest (CEGL006124, G2G3)
- *Fagus grandifolia / Carex pensylvanica - Ageratina altissima var. roanensis* Forest (CEGL006130, G1)

Spatial Characteristics

Spatial Summary: Large-patch to local matrix system, dominating the landscape of fairly high mountain ranges and occurring as a broad elevational zone on the highest. Small-patch systems may be embedded. It may be interfingered with Central and Southern Appalachian Montane Oak Forest (CES202.596) particularly between 1220-1372 m (4000-4500 feet) elevation.

Size: The size of patches is variable, being interfingered with montane oak vegetation in some cases, or occurring in larger more continuous patches in others. In the highest ranges, it occupies a broad elevational zone on the flanks. On somewhat lower mountain ranges, it dominates the mountaintops. Natural patches covered thousands to maybe 10,000 to 20,000 acres. A few remnant patches of thousands of acres remain, along with patches of hundreds of acres.

Adjacent Ecological Systems:

- Central and Southern Appalachian Montane Oak Forest (CES202.596)
- Central and Southern Appalachian Spruce-Fir Forest (CES202.028)
- High Allegheny Wetland (CES202.069)
- Southern and Central Appalachian Bog and Fen (CES202.300)
- Southern Appalachian Grass and Shrub Bald (CES202.294)
- Southern Appalachian Rocky Summit (CES202.327)
- Southern Appalachian Seepage Wetland (CES202.317)

Adjacent Ecological System Comments: Central and Southern Appalachian Montane Oak Forest (CES202.596) most typically interfingers at intermediate elevations and adjoins at lower ones. Central and Southern Appalachian Spruce-Fir Forest (CES202.028) may adjoin or interfinger at higher elevation. Small-patch systems such as Southern Appalachian Rocky Summit (CES202.327), Southern Appalachian Seepage Wetland (CES202.317), Southern and Central Appalachian Bog and Fen (CES202.300), and Southern Appalachian Grass and Shrub Bald (CES202.294) may be embedded.

Distribution

Range: This system is primarily found in the Southern Blue Ridge, where it ranges from northwestern Georgia, western North Carolina and eastern Tennessee northward to southern Virginia. In Kentucky, this system is restricted to the Cumberland Mountains in the extreme southeastern corner of that state.

Divisions: 202:C

Nations: US

Subnations: GA, KY, NC, TN, VA

Map Zones: 53:C, 57:C, 61:C

USFS Ecomap Regions: 221A:CC, 221B:CC, 221E:CC, 231A:CC, M221A:CC, M221Bc:CCC, M221C:CC, M221D:CC

TNC Ecoregions: 50:C, 51:C, 59:P

Sources

References: Comer et al. 2003, Lohman and Watson 1943, Schafale and Weakley 1990

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722676#references

Description Author: M. Schafale and R. Evans, mod. M. Pyne and S. Gawler

Version: 06 Jun 2008

Concept Author: M. Schafale and R. Evans

Stakeholders: East, Southeast

ClassifResp: Southeast

SOUTHERN APPALACHIAN OAK FOREST (CES202.886)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Ridge/Summit/Upper Slope; Unglaciated; Broad-Leaved Deciduous Tree; Quercus - Carya
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: EVT 2315; ESLF 4121; ESP 1315

CONCEPT

Summary: This system consists of predominantly dry-mesic (to dry) forests occurring on open and exposed topography at lower to mid elevations in the Southern Blue Ridge and Southern Ridge and Valley ecoregions. This is the upland forest that characterizes much of the lower elevations of these areas. Substrates of stands included in this system can range from acidic to circumneutral or basic, and the vegetation varies accordingly. Bedrock may be of any type. Soils are usually deep residual soils but are often rocky. Some shallow soils and colluvium may be present locally within the group, but shallow soils tend to produce environments that are more extreme and have a larger component of various pine species. Typically, the vegetation consists of forests dominated by oaks, especially *Quercus prinus, Quercus alba, Quercus rubra, Quercus velutina*, and *Quercus coccinea*, with varying amounts of *Carya* spp., *Nyssa sylvatica, Acer rubrum*, and other species such as *Pinus strobus* and *Fraxinus americana*. Historically, *Castanea dentata* was a dominant or codominant in many of these communities until its virtual elimination by the chestnut blight fungus (*Cryphonectria parasitica*] during the early 1900s. Some areas (usually on drier sites) now have dense evergreen ericaceous shrub layers of *Kalmia latifolia*, with *Rhododendron* spp. on more mesic sites. Some other areas have deciduous ericad layers, sometimes consisting of *Vaccinium* spp. or *Gaylussacia* spp. This system concept also includes many successional communities that have been impacted by logging or agriculture, such as types dominated by *Liriodendron tulipifera, Pinus* spp., and *Robinia pseudoacacia*. This system is naturally dominated by stable, uneven-aged forests, with canopy dynamics dominated by gap-phase regeneration. Most oaks are long-lived with typical age of mortality ranging from 200 to 400 years. Scarlet and black oaks are shorter lived with typical ages being approximately 50 to 100 years, while white oaks can live as long as 600 years.
Classification Comments: This system is distinguished from the oak forests of the Piedmont by substantial floristic differences that probably are determined by biogeography as well as climate and topography. Compositional differences were more pronounced in the past, when *Castanea dentata* was a major species in this system and not in Piedmont oak forests. This system is distinguished from most other systems in its primary range by the canopy dominance of oaks (other than strong dominance by red oak) without a large component of yellow pines (*Pinus echinata, Pinus virginiana, Pinus pungens*) in the canopy. It shares those characteristics with Allegheny-Cumberland Dry Oak Forest and Woodland (CES202.359), which might be thought of as a subtype of this system on the more exposed and acidic substrates. The environment is intermediate within the region in topography and moisture. Northward this system grades into Northeastern Interior Dry-Mesic Oak Forest (CES202.592), which occurs in similar environmental conditions. This southern Appalachian system is characterized by the presence, in most occurrences, of plant species of southern Appalachian affinity, such as *Magnolia fraseri, Gaylussacia ursina, Rhododendron calendulaceum*, etc.
Similar Ecological Systems:
- Allegheny-Cumberland Dry Oak Forest and Woodland (CES202.359)--may represent a narrower concept subset of this.
- Central and Southern Appalachian Montane Oak Forest (CES202.596)
- Central Appalachian Dry Oak-Pine Forest (CES202.591)
- Northeastern Interior Dry-Mesic Oak Forest (CES202.592)
- Southern Appalachian Montane Pine Forest and Woodland (CES202.331)
- Southern Appalachian Northern Hardwood Forest (CES202.029)

Related Concepts:
- Chestnut Oak: 44 (Eyre 1980) Finer
- Eastern White Pine: 21 (Eyre 1980) Finer
- White Oak - Black Oak - Northern Red Oak: 52 (Eyre 1980) Finer
- White Oak: 53 (Eyre 1980) Finer
- White Pine - Chestnut Oak: 51 (Eyre 1980) Finer
- White Pine - Northern Red Oak - Red Maple: 20 (Eyre 1980) Finer

DESCRIPTION

Environment: Occurs on open slopes, ridgetops, lower elevation peaks, and higher parts of broad valley bottoms, at low to moderate elevations. Bedrock may be of any type. Soils are usually deep residual soils, but are often rocky. Some shallow soils, colluvium, and other soils may be present locally within the system, but shallow soils tend to produce environments that are more extreme and have a larger component of *Pinus* spp. than this system. Moisture levels are intermediate for the region. Soil chemistry and topography are important determinants of different associations within the system. Topography, elevation, and soil depth are the most important

factors separating this system from others.

Vegetation: Vegetation consists of forests dominated by *Quercus* species, most typically *Quercus prinus, Quercus alba*, and *Quercus coccinea*, with varying amounts of *Carya* spp., *Acer rubrum*, and other species. Less typical are stands dominated by other species, such as *Pinus strobus*, or other hardwood species. *Castanea dentata* was once dominant or codominant in many of these forests. Subcanopies and shrub layers are usually well-developed. Some associations have dense evergreen shrub layers, while others have open shrub layers. Herbs, forbs and ferns are usually sparse to moderate in density.

Dynamics: This system is naturally dominated by stable, uneven-aged forests, with canopy dynamics dominated by gap-phase regeneration. Extreme wind or ice storms occasionally create larger canopy openings. Fire occurred fairly frequently in presettlement times, though there is some dispute whether most of the fires were natural or anthropogenic in origin (Abrams 1992, Delcourt and Delcourt 1997). Fires were usually low-intensity surface fires. The dominant species are fairly fire-tolerant, making most fires non-catastrophic. Fire may be important for favoring oak dominance over more mesophytic tree species within some of the topographic range of this system. Fire also can be expected to have a moderate effect on vegetation structure, producing a somewhat more open canopy and less dense understory and shrub layer than currently seen in most examples. Fire frequency or intensity may be important for determining the boundary between this system and both the more mesic and the drier systems. Virtually all examples have been strongly affected by the introduction of the chestnut blight, which killed all of the *Castanea dentata* trees, eliminating it as a canopy dominant. Past logging affected most occurrences by changing canopies to an even-aged, or more even-aged, structure. Extreme wind or ice storms occasionally create larger canopy openings. Virtually all examples have been strongly affected by introduction of chestnut blight, which killed all the American chestnut trees, eliminating it as a canopy dominant. The introduction, and now widespread establishment, of gypsy moth (*Lymantria dispar*) that favors oaks as food has also affected these forests by causing widespread mortality of overstory trees depending on topographic position and precipitation amounts around defoliation events. Past logging, and now lack of fire, has affected most occurrences by changing canopies to an even-aged, or more even-aged, structure with an understory of shade-tolerant but fire-intolerant species such as *Pinus strobus, Acer rubrum*, and *Acer pensylvanicum*. The removal of American chestnut from the overstory of these forests is thought to have benefited *Carya* spp., and their persistence and continued recruitment in contemporary oak-hickory forests may reflect fire exclusion in recent decades.

Component Associations:

- *Pinus strobus - Quercus (coccinea, prinus) / (Gaylussacia ursina, Vaccinium stamineum)* Forest (CEGL007519, G4)
- *Pinus strobus - Quercus alba - (Carya alba) / Gaylussacia ursina* Forest (CEGL007517, G3G4)
- *Quercus (prinus, coccinea) / Kalmia latifolia / (Galax urceolata, Gaultheria procumbens)* Forest (CEGL006271, G5)
- *Quercus alba - Quercus (rubra, prinus) / Rhododendron calendulaceum - Kalmia latifolia - (Gaylussacia ursina)* Forest (CEGL007230, G4G5)
- *Quercus alba - Quercus coccinea - Quercus falcata / Kalmia latifolia - Vaccinium pallidum* Forest (CEGL007691, G2G3)
- *Quercus alba - Quercus falcata / Vaccinium (arboreum, hirsutum, pallidum)* Forest (CEGL008567, G3G4)
- *Quercus alba - Quercus rubra - Carya ovata / Cercis canadensis - Juniperus virginiana var. virginiana* Forest (CEGL007240, G4)
- *Quercus alba - Quercus rubra - Quercus prinus / Collinsonia canadensis - Podophyllum peltatum - Amphicarpaea bracteata* Forest (CEGL007692, G3)
- *Quercus alba / Kalmia latifolia* Forest (CEGL007295, G2Q)
- *Quercus muehlenbergii - Quercus (alba, rubra) - Carya cordiformis / Viburnum prunifolium* Forest (CEGL004793, G3G4)
- *Quercus prinus - (Quercus coccinea) / Carya pallida / Vaccinium arboreum - Vaccinium pallidum* Forest (CEGL008431, G4G5)
- *Quercus prinus - (Quercus rubra) - Carya* spp. / *Oxydendrum arboreum - Cornus florida* Forest (CEGL007267, G4G5)
- *Quercus prinus - Carya ovata - Quercus rubra / Acer saccharum* Forest (CEGL007268, G4?)
- *Quercus prinus - Quercus rubra - Carya* spp. *- Fraxinus americana / Cercis canadensis / Solidago sphacelata* Forest (CEGL008549, G3?)
- *Quercus prinus - Quercus rubra / Rhododendron maximum / Galax urceolata* Forest (CEGL006286, G4)
- *Quercus rubra - Acer rubrum / Pyrularia pubera / Thelypteris noveboracensis* Forest (CEGL006192, G4?)
- *Quercus rubra - Quercus muehlenbergii / Hamamelis virginiana / Polymnia canadensis* Forest (CEGL007215, G1Q)
- *Sassafras albidum - Quercus* spp. Forest (CEGL004096, G5)
- *Vitis aestivalis* Vine-Shrubland (CEGL003890, G2G3)

SPATIAL CHARACTERISTICS

Spatial Summary: Matrix system, covering a majority of the landscape over large areas.

Size: Occurs as a large-patch to matrix system. Contiguous bodies of tens of thousands of acres once occurred. The oak forests probably make up slightly more than 50% of the landscape in all but the higher elevations of the region. Size of existing occurrences may be strongly affected by separation distances for occurrences. A few remaining occurrences over 10,000 acres are probably present.

Adjacent Ecological Systems:

- Central and Southern Appalachian Montane Oak Forest (CES202.596)
- Southern and Central Appalachian Cove Forest (CES202.373)
- Southern and Central Appalachian Mafic Glade and Barrens (CES202.348)
- Southern Appalachian Granitic Dome (CES202.297)
- Southern Appalachian Low-Elevation Pine Forest (CES202.332)
- Southern Appalachian Montane Cliff and Talus (CES202.330)
- Southern Appalachian Montane Pine Forest and Woodland (CES202.331)

Adjacent Ecological System Comments: This system is almost always bordered by Southern and Central Appalachian Cove Forest (CES202.373) in more mesic sites. It is often bordered by Southern Appalachian Low-Elevation Pine Forest (CES202.332) on more exposed topography. It may grade into Central and Southern Appalachian Montane Oak Forest (CES202.596) at the highest elevations. Various rock outcrop systems may be present as embedded small patches.

DISTRIBUTION

Range: This system ranges throughout the southern Appalachians, from northern Georgia and South Carolina north into the Southern Blue Ridge of Virginia to the Roanoke River in the Blue Ridge, and slightly farther south in the Ridge and Valley. It occurs in very limited montane outliers in the Piedmont, and possibly on Pine/Black mountain in Kentucky.
Divisions: 202:C
Nations: US
Subnations: GA, KY, NC, SC, TN, VA, WV
Map Zones: 53:C, 57:C, 59:C, 61:P
USFS Ecomap Regions: 231Aa:CCC, M221C:CC, M221D:CC
TNC Ecoregions: 50:C, 51:C, 52:C

SOURCES

References: Abrams 1992, Comer et al. 2003, Delcourt and Delcourt 1997, Woods et al. 2002
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722792#references
Description Author: M. Schafale, R. Evans, M. Pyne, R. White, mod. S.C. Gawler
Version: 01 Oct 2007 **Stakeholders:** East, Southeast
Concept Author: M. Schafale, R. Evans, M. Pyne, R. White **ClassifResp:** Southeast

SOUTHERN ATLANTIC COASTAL PLAIN DRY AND DRY-MESIC OAK FOREST (CES203.241)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Long Disturbance Interval; Broad-Leaved Tree
Non-Diagnostic Classifiers: Forest and Woodland (Treed)
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: EVT 2335; ESLF 4141; ESP 1335

CONCEPT

Summary: This system encompasses oak-dominated forests of somewhat fire-sheltered dry to dry-mesic sites in the Mid-Atlantic and South Atlantic coastal plains from southeastern Virginia to Georgia. Sites where this system occurs are somewhat protected from most natural fires by some combination of steeper topography, isolation from the spread of fire, and limited flammability of the vegetation. If fires were more frequent, the vegetation would likely be replaced by more fire-tolerant southern pines, especially *Pinus palustris*.

Classification Comments: There remains some uncertainty how this system and other dry and dry-mesic hardwood systems should be divided. There is a broad gradient in climate and species composition from north to south and west. The boundaries at the north edge of the Mid-Atlantic Coastal Plain ecoregion and at the break between the South Atlantic Coastal Plain and East Gulf Coastal Plain ecoregions are boundaries of convenience to create breaks in this broad gradient. Better boundaries may be possible. Differences from comparable systems in the Piedmont are sometimes fairly subtle, and species that differentiate them in one part of the range many not work in other parts. In particular, some species that are excluded from the Coastal Plain farther south are common components farther north. The boundary with Southern Atlantic Coastal Plain Mesic Hardwood Forest (CES203.242) and with adjacent *Pinus palustris*-dominated systems may be blurred by fire suppression.

Related Concepts:

- Dry Oak-Hickory Forest (Schafale and Weakley 1990) Broader
- Dry-Mesic Oak-Hickory Forest (Schafale and Weakley 1990) Broader. The Schafale and Weakley (1990) types (Dry and Dry-Mesic Oak-Hickory Forest) include both their Coastal Plain and Piedmont manifestations.
- Oak-Hickory Forest (Bennett and Nelson 1991) Finer
- Southern Scrub Oak: 72 (Eyre 1980) Finer
- White Oak - Black Oak - Northern Red Oak: 52 (Eyre 1980) Finer
- White Oak: 53 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs in dry-mesic to dry but not xeric sites, generally on upper to midslopes in bluff systems, but occasionally it occurs on broader uplands or on the highest parts of non-flooded river terraces. Soils are generally acidic, though calcareous soils occur occasionally (as in Carya glabra - Tilia americana var. caroliniana - Acer barbatum / Trillium maculatum Forest (CEGL004747)). Soils are loamy to clayey and well-drained but not excessively drained. Similar sites with coarse sandy soils tend to support other ecological systems, in part due to the influence of more frequent fire. Sites are somewhat protected from most natural fires by steep topography and by limited flammability of the vegetation. Fires that penetrate them are generally low in intensity and have fairly limited ecological effect.

Vegetation: Vegetation consists of forests dominated by combinations of upland oaks, particularly *Quercus alba, Quercus falcata,* and *Quercus stellata*. In the northern part of the range, *Quercus rubra* may be a component, while in the southern part, evergreen species such as *Quercus nigra* or *Quercus hemisphaerica* become more prominent. Hickories (*Carya* spp.) are also prominent, including *Carya alba, Carya glabra,* and *Carya pallida*. Other woody plants may include *Tilia americana var. caroliniana, Acer barbatum, Aesculus pavia, Osmanthus americanus var. americanus, Ilex glabra, Ilex opaca, Vaccinium arboreum, Vaccinium elliottii,* and *Clethra alnifolia*. Some typical herbs are *Trillium maculatum* and *Chasmanthium sessiliflorum.* There is some variation in composition with aspect and degree of exposure to fire. *Pinus echinata* may be present in some stands, particularly on drier south- and west-facing slopes but is typically not dominant. *Pinus taeda* is sometimes present, but it is unclear if it is a natural component or has entered only as a result of past cutting. More mesophytic species such as *Fagus grandifolia* and *Magnolia grandiflora* are absent or are confined to the understory. Analogous systems on the Gulf Coastal Plain have pine as a natural component, and this may be true for some examples of this system as well, where occasional fires may allow them to regenerate. A well-developed shrub layer may be present, with *Vaccinium* spp. and *Gaylussacia* spp. most typical. The herb layer is generally sparse, and species richness tends to be low. In examples where fires have occurred, the understory is open and savannalike and dominated by grasses and forbs rather than shrubs.

Dynamics: Fire is intermediate in frequency in this system, being less frequent than in adjacent *Pinus palustris*-dominated stands, and more frequent than in mesic hardwood stands below. This fire regime is an important factor separating it from adjacent *Pinus palustris*-dominated systems. If fire does penetrate, it is likely to be low in intensity and have somewhat limited ecological effects.

However, there is some evidence that this system has expanded into areas once occupied by *Pinus palustris* as fire has been suppressed (Ware et al. 1993). There may have been a shifting boundary between these systems, driven by variation in fire frequency. These forests probably generally naturally existed as old-growth forests, with canopy dynamics dominated by gap-phase regeneration. However, exposure to occasional fires and hurricanes may create more frequent and larger canopy disturbances than analogous systems inland.

Frequent surface fires occurred on a 5- to 10-year return interval from both lightning and Native American ignitions. These frequent light surface fires would have maintained a grassy understory and kept more fire-tolerant hardwoods and shrubs from capturing the understory and forming a midstory layer. Lightning fires occurred primarily during the spring dry season (April and May) with a secondary peak of Native American and settler burning during the fall (October and November) (Landfire 2007a). Occasionally, during extensive droughts, mixed-severity or stand-replacement fires did occur, especially in drier stand dominated of codominated by *Pinus echinata*.

Local blowdown winds associated with thunderstorms created gaps on a small but continual basis. More extensive regional disturbances included tropical storms during the growing season and ice storms during winter (in the northern part of the range). Dense stands of middle to older aged pines (where present) were susceptible to periodic mortality from bark beetle epidemics (Landfire 2007a).

Component Associations:
- *Carya glabra - Tilia americana var. caroliniana - Acer barbatum / Trillium maculatum* Forest (CEGL004747, G2G3)
- *Quercus alba - Carya alba / Oxydendrum arboreum - Ilex opaca / Gaylussacia frondosa - Symplocos tinctoria - Vaccinium stamineum* Coastal Plain Forest (CEGL004321, G3G4)
- *Quercus alba - Carya glabra - Carya alba / Aesculus pavia* Forest (CEGL007225, G4?)
- *Quercus alba - Carya glabra* / Mixed Herbs Coastal Plain Forest (CEGL007226, G4?)
- *Quercus alba - Quercus (margarettiae, rubra, stellata) / Vaccinium pallidum* Sandhill Forest (CEGL007766, G2?)
- *Quercus alba - Quercus nigra - Quercus falcata / Ilex opaca / Clethra alnifolia - Arundinaria gigantea ssp. tecta* Forest (CEGL007862, G4?)
- *Quercus falcata - Quercus stellata - Carya alba / Vaccinium* spp. Coastal Plain Forest (CEGL007246, G4?)
- *Quercus hemisphaerica - Magnolia grandiflora - Carya (glabra, pallida) / Vaccinium arboreum / Chasmanthium sessiliflorum* Forest (CEGL004788, G3G4)
- *Quercus hemisphaerica - Pinus taeda - (Quercus nigra) / Osmanthus americanus var. americanus / Ilex glabra* Forest (CEGL007022, G2G3)

SPATIAL CHARACTERISTICS

Spatial Summary: Occurs in mosaics with small-patch systems, or as small isolated patches surrounded by wetlands.
Size: Generally occurs as small to medium patches, of a few to dozens of acres. Mosaics may contain up to several hundred acres in close proximity.
Adjacent Ecological Systems:
- Southeastern Coastal Plain Cliff (CES203.398)
- Southern Atlantic Coastal Plain Mesic Hardwood Forest (CES203.242)

Adjacent Ecological System Comments: Most commonly associated with Southern Atlantic Coastal Plain Mesic Hardwood Forest (CES203.242). Naturally grades to adjacent *Pinus palustris*-dominated systems on drier or flatter sites, but virtually no examples remain with this association intact.

DISTRIBUTION

Range: This system ranges from southeastern Virginia (south of the James River) south to southeastern Georgia in the Atlantic Coastal Plain.
Divisions: 203:C
Nations: US
Subnations: GA, NC, SC, VA
Map Zones: 55:C, 58:C, 60:C
USFS Ecomap Regions: 232C:CC, 232H:CC, 232I:CC, 232J:CC
TNC Ecoregions: 56:C, 57:C

SOURCES

References: Bennett and Nelson 1991, Comer et al. 2003, Edwards et al. 2013, Engeman et al. 2007, Eyre 1980, Landfire 2007a, Nordman 2013, Rehn and Hebard 1916, Schafale and Weakley 1990, Ware et al. 1993
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723244#references
Description Author: R. Evans and M. Schafale, mod. M. Pyne
Version: 14 Jan 2014 **Stakeholders:** East, Southeast
Concept Author: R. Evans and M. Schafale **ClassifResp:** Southeast

SOUTHERN ATLANTIC COASTAL PLAIN MARITIME FOREST (CES203.537)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Coast
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Mixed evergreen-deciduous closed tree canopy
National Mapping Codes: EVT 2382; ESLF 4325; ESP 1382

CONCEPT

Summary: This system encompasses a range of woody vegetation present on stabilized upland dunes of barrier islands and near-coastal strands, from central South Carolina (from approximately the Cooper River) southward to Volusia County, Florida. It includes vegetation whose structure and composition are influenced by salt spray, extreme disturbance events, and the distinctive climate of the immediate coast. Examples are known from the barrier islands of Georgia and Florida, such as Big Talbot Island, Florida, and probably Sapelo Island, Georgia. Most typical stands are dominated by oaks, primarily *Quercus virginiana* and/or *Quercus geminata*. Vegetation may also include different woodland communities often dominated by southern pine species. *Pinus palustris, Pinus serotina,* and *Pinus elliottii var. elliottii* are all important in documented examples. These examples tend to have densely shrubby subcanopies and understories with species such as *Quercus virginiana, Quercus geminata, Quercus hemisphaerica, Quercus chapmanii, Quercus myrtifolia,* and *Magnolia grandiflora*. Unlike maritime vegetation to the north, this system may be more heavily influenced by natural fire regimes that may help to explain the predominance of the fire-tolerant pine species. It has been postulated that the natural fire-return interval is from 20 to 30 years.

Similar Ecological Systems:
- Central Atlantic Coastal Plain Maritime Forest (CES203.261)--occurs to north.
- Southern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.273)

Related Concepts:
- Cabbage Palmetto: 74 (Eyre 1980) Finer
- Live Oak: 89 (Eyre 1980) Finer
- Longleaf Pine - Scrub Oak: 71 (Eyre 1980) Finer
- Longleaf Pine - Slash Pine: 83 (Eyre 1980) Finer
- Longleaf Pine: 70 (Eyre 1980) Finer
- Maritime Hammock (FNAI 1990) Broader
- Pond Pine: 98 (Eyre 1980) Finer
- Shell Mound (FNAI 1990) Intersecting
- Southern Scrub Oak: 72 (Eyre 1980) Finer

DESCRIPTION

Environment: The primary range of this system coincides with the Sea Islands, a chain of more than 100 low islands off the Atlantic coast of South Carolina, Georgia, and northern Florida, extending from the Cooper River to the St. Johns River. Many of these islands have a long history of human use and occupation, including Spanish missions and garrisons in the 16th century. In addition, the Sea Islands were the first important cotton-growing area in North America. The degree to which this system has been altered by these events is unknown.

This system is found on these islands and associated near-coastal strands, on stable dune and swale topography in somewhat more protected environments. These areas are generally landward of the foredune and transitional backdune zones. Examples typically include forests and/or shrublands that are found in somewhat more protected environments than adjacent dune and coastal grassland vegetation. The system typically includes a series of stabilized dunes and interdune swales oriented parallel to the coastline. Soils are primarily wind- and wave-deposited, well-drained quartz sands of Appalachian origin (Drehle 1973, Johnson and Barbour 1990), sometimes with a substantial shell component, that have been stabilized long enough to support trees and shrubs. As the forest establishes, soil temperature fluctuations moderate and humus begins to build up over the well-drained sands, contributing to moisture retention and leading to more mesic conditions, especially in swales where soil moisture is typically higher (FNAI 1990).

Vegetation: Most typical stands are dominated by oaks, primarily *Quercus virginiana* and/or *Quercus geminata*. Vegetation may also include different woodland communities often dominated by southern pine species. *Pinus palustris, Pinus serotina,* and *Pinus elliottii var. elliottii* are all important in documented examples. These examples tend to have densely shrubby subcanopies and understories with species such as *Quercus virginiana, Quercus geminata, Quercus hemisphaerica, Quercus chapmanii, Quercus myrtifolia,* and *Magnolia grandiflora*.

Dynamics: Maritime forests occur in the most stable portions of barrier islands, but the maritime environment is still extremely dynamic. Wind events and hurricanes will have significant impacts on this system. The environment for these forests may be severely altered or destroyed by geologic processes, such as the slow movement of dunes or their catastrophic destruction by storms. Sand movement may also create new sites for this system to occupy. Extreme salt spray or saltwater flooding in storms can severely disturb

vegetation, though it recovers if the landforms have not been altered. Mature *Quercus virginiana* trees are fire-resistant when mature, and their litter also does not easily burn (Stalter and Odum 1993). Fire may have occurred naturally yet infrequently in this system, but probably was not an important factor.

The vegetation of this system has a structure and composition that is influenced by salt spray (sea salt aerosol), extreme disturbance events, and the distinctive climate of the immediate coast. Extreme salt spray or saltwater flooding in storms can severely disturb vegetation, although the vegetation recovers if the landforms have not been altered. Unlike maritime vegetation to the north, this system may be more heavily influenced by natural fire regimes that may help to explain the predominance of the fire-tolerant pine species. It has been postulated that the natural fire frequency is from 20 to 30 years.

Component Associations:
- *Acer rubrum - Nyssa biflora - (Liquidambar styraciflua, Fraxinus* sp.) Maritime Swamp Forest (CEGL004082, G2)
- *Ceratiola ericoides - Quercus geminata - Ximenia americana / Cladonia* spp. - *Cladina* spp. Shrubland (CEGL003862, G2)
- *Juniperus virginiana var. silicicola - Zanthoxylum clava-herculis - Quercus virginiana - (Sabal palmetto) / Sageretia minutiflora - (Sideroxylon tenax)* Woodland (CEGL003525, G2?)
- *Morella cerifera - Prunus caroliniana - Zanthoxylum clava-herculis* Shrubland (CEGL004784, G2?)
- *Pinus elliottii var. elliottii - (Pinus palustris) / Ilex vomitoria - Serenoa repens - Morella cerifera* Woodland (CEGL004658, G2G3)
- *Pinus palustris - Pinus serotina / Quercus chapmanii - Quercus myrtifolia - Quercus geminata - Lyonia ferruginea* Woodland (CEGL003662, G2?)
- *Quercus geminata - (Quercus virginiana) / Serenoa repens - Lyonia fruticosa* Forest (CEGL007020, G2?)
- *Quercus geminata - Quercus myrtifolia - Serenoa repens - Persea borbonia* Shrubland (CEGL003821, G2)
- *Quercus virginiana - (Pinus elliottii var. elliottii, Sabal palmetto) / Persea borbonia - Callicarpa americana* Forest (CEGL007032, G2)
- *Quercus virginiana - Quercus hemisphaerica - Pinus taeda / Persea palustris - Ilex vomitoria* Forest (CEGL007027, G2)
- *Sabal palmetto - (Juniperus virginiana var. silicicola)* Woodland (CEGL003526, G2?)

DISTRIBUTION

Range: This system occurs from central South Carolina (Cooper River) southward to approximately Volusia County, Florida (ca. 28 degrees 30 minutes N latitude).
Divisions: 203:C
Nations: US
Subnations: FL, GA, SC
Map Zones: 55:C, 58:C
USFS Ecomap Regions: 232C:CC
TNC Ecoregions: 56:C

SOURCES

References: Comer et al. 2003, Eyre 1980, FNAI 1990, FNAI 2010a
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723065#references
Description Author: R. Evans, mod. M. Pyne
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: R. Evans **ClassifResp:** Southeast

SOUTHERN ATLANTIC COASTAL PLAIN MESIC HARDWOOD FOREST (CES203.242)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Long Disturbance Interval
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: EVT 2343; ESLF 4150; ESP 1343

CONCEPT

Summary: This upland system of the Atlantic Coastal Plain ranges from Delaware south to interior Georgia in a variety of moist but non-wetland sites that are naturally sheltered from frequent fire. Such sites include lower slopes and bluffs along streams and rivers in dissected terrain, mesic flats between drier pine-dominated uplands and floodplains, and local topographic high areas within bottomland terraces or nonriverine wet flats. Soil textures are variable in both texture and pH. The vegetation consists of forests dominated by combinations of trees that include a significant component of mesophytic deciduous hardwood species, such as *Fagus grandifolia* or *Acer barbatum*. Its southern limit is generally exclusive of the natural range of *Pinus glabra* and *Magnolia grandiflora*. Upland and bottomland oaks at the mid range of moisture tolerance are usually also present, particularly *Quercus alba*, but sometimes also *Quercus pagoda*, *Quercus falcata*, *Quercus michauxii*, *Quercus shumardii*, or *Quercus nigra*. *Pinus taeda* is sometimes present, but it is unclear if it is a natural component or has entered only as a result of past cutting. Analogous systems on the Gulf Coastal Plain have pine as a natural component, and this may be true for some examples of this system. Understories are usually well-developed. Shrub and herb layers may be sparse or moderately dense. Within its range, *Sabal minor* may be a prominent shrub. Species richness may be fairly high in basic sites but is fairly low otherwise.

Classification Comments: There remains some uncertainty how this system and other mesic hardwood systems should be divided. There is a broad gradient in climate and species composition from north to south and west. The boundaries at the northern edge of its range (the Chesapeake Bay Lowlands TNC ecoregion) and at the break between the South Atlantic Coastal Plain and East Gulf Coastal Plain ecoregions are boundaries of convenience to create breaks in this broad gradient. At the southern end, the boundary has been better determined (April 2006) to exclude areas within the combined ranges of *Pinus glabra* and *Magnolia grandiflora*, making this system deciduous rather than mixed evergreen-deciduous. Differences from mesic forests of the Piedmont are sometimes fairly subtle, and species that differentiate them in one part of the range many not work in other parts. In particular, some species that are excluded from the Coastal Plain farther south are common components farther north. In MD and DC, this system can extend into the Piedmont, straddling the fall zone where the Coastal Plain and Piedmont meet. Besides the variation across the range of this system, there are two sets of distinctions within it that may be worthy of consideration for defining separate systems. Acidic and basic substrates have substantial floristic differences. Variants on upland slopes, nonriverine swamp islands, and high ridges in bottomlands could be recognized as separate systems, or the latter two could be treated as part of the systems that surround them. However, the difference between ecological processes in uplands and wetlands separates those surrounded by wetland systems from the surrounding systems. This is especially true in the case of floodplains, which have flood-carried nutrient input as well as wetness as a difference. Floristic differences may exist between these variants, but they are subtle and do not appear to be definitive.

Similar Ecological Systems:
- Atlantic Coastal Plain Brownwater Stream Floodplain Forest (CES203.248)
- Northern Atlantic Coastal Plain Hardwood Forest (CES203.475)
- Southern Coastal Plain Mesic Slope Forest (CES203.476)
- Southern Piedmont Mesic Forest (CES202.342)

Related Concepts:
- Sugar Maple: 27 (Eyre 1980) Finer
- White Oak: 53 (Eyre 1980) Finer
- Yellow-Poplar: 57 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs in a variety of moist non-wetland sites that are naturally sheltered from frequent fire. The distribution of these forests is determined by the interaction of local topography and soil texture. Most common are lower slope and bluff examples along streams and rivers in dissected terrain, but some examples occur on mesic flats between drier pine-dominated uplands and floodplains or on local high areas within bottomland terraces or nonriverine wet flats. Soils cover the full range of mineral soil textures, except the coarsest sands. Richer and more mesic stands occur in more strongly concave and finer-textured areas. Soils are not saturated for any significant time during the growing season and seldom, if ever, are extremely dry. Soils developed from calcareous materials or rich alluvium may be basic; others are strongly acidic. Sites are protected from most natural fires by steep topography or by surrounding extensive areas of non-flammable vegetation (Batista and Platt 1997).

Vegetation: Stands of this system include a significant component of mesophytic species such as *Fagus grandifolia* or *Acer barbatum*. Upland and bottomland oaks at the mid range of moisture tolerance are usually also present, particularly *Quercus alba*, but

sometimes also *Quercus falcata, Quercus michauxii, Quercus shumardii,* or *Quercus nigra*. Other hardwood components include *Liriodendron tulipifera, Liquidambar styraciflua, Carya cordiformis, Nyssa sylvatica,* and *Magnolia tripetala*. *Pinus taeda* is sometimes present, but it is unclear if it is a natural component or has entered only as a result of past removal of the hardwood canopy and subsequent invasion. Analogous systems on the Gulf Coastal Plain have pine as a natural component, and this may be true for some examples of this system. Understories are usually well-developed. Shrub and herb layers may be sparse or moderately dense, with the herb layer being forb-dominated. Some typical smaller trees and shrubs include *Cornus florida, Symplocos tinctoria, Oxydendrum arboreum, Hamamelis virginiana, Morus rubra,* and *Stewartia malacodendron*. Within its range, *Sabal minor* may be a prominent shrub. Some stands may contain *Arundinaria gigantea*. Some typical herbs include *Mitchella repens* and *Hexastylis arifolia*. Species richness may be fairly high in basic sites but is fairly low otherwise.

Dynamics: Fire is naturally infrequent to absent in this system. Sites are protected from most natural fires by steep topography or by surrounding extensive areas of non-flammable vegetation (Landfire 2007a). If fire does penetrate, it is likely to be low in intensity but may have significant ecological effects. These forests probably generally exist naturally as old-growth forests, with canopy dynamics dominated by gap-phase regeneration. However, exposure to occasional fires and severe storms may create more frequent and larger canopy disturbances than analogous systems inland. Storm-related disturbance can be followed by waves of tree recruitment, growth, and death resulting in changes in the density and structure of tree populations and in consequent fluctuations in forest species composition. Disturbances in these forests appear to be critical for both regeneration and change in older stands (Batista and Platt 1997). Periodic droughts will cause death of or stress to moisture-requiring canopy trees.

Component Associations:

- *Aquilegia canadensis - Asplenium X heteroresiliens* Herbaceous Vegetation (CEGL004269, G1?)
- *Fagus grandifolia - Acer barbatum - Quercus muehlenbergii / Sanguinaria canadensis* Forest (CEGL007181, G2?)
- *Fagus grandifolia - Liriodendron tulipifera - Carya cordiformis / Lindera benzoin / Podophyllum peltatum* Forest (CEGL006055, G4?)
- *Fagus grandifolia - Quercus (alba, rubra) - Liriodendron tulipifera / (Ilex opaca var. opaca) / Polystichum acrostichoides* Forest (CEGL006075, G5)
- *Fagus grandifolia - Quercus alba - (Acer barbatum)* / Mixed Herbs Forest (CEGL007206, G4)
- *Fagus grandifolia - Quercus alba - Quercus laurifolia / Galax urceolata* Forest (CEGL007863, G4?)
- *Fagus grandifolia - Quercus nigra* Forest (CEGL007211, G3)
- *Fagus grandifolia - Quercus rubra / Cornus florida / Polystichum acrostichoides - Hexastylis virginica* Forest (CEGL008465, G3G4)
- *Quercus alba - Carya glabra - Carya alba / Aesculus pavia* Forest (CEGL007225, G4?)
- *Quercus alba - Quercus (michauxii, nigra) / Ilex opaca / Chasmanthium laxum* Forest (CEGL007845, G3G4)
- *Quercus alba - Quercus velutina - Carya alba / Cornus florida / Chimaphila maculata* Forest (CEGL007278, G3G4)
- *Quercus falcata - Quercus phellos / Ilex opaca* Forest (CEGL006390, GNR)
- *Quercus hemisphaerica - Tilia americana var. caroliniana - Magnolia grandiflora / Aesculus pavia - Ilex vomitoria* Forest (CEGL007470, G2G3)
- *Quercus muehlenbergii / Cercis canadensis / Dichanthelium boscii - Bromus pubescens - Erigeron pulchellus var. pulchellus - Aquilegia canadensis* Forest (CEGL007748, G1)
- *Quercus pagoda - Carya cordiformis / Chasmanthium sessiliflorum - Verbesina virginica* Forest (CEGL004092, G2?)
- *Quercus virginiana - Celtis laevigata - Tilia americana var. caroliniana / Aesculus pavia - Ilex vomitoria* Forest (CEGL007282, G1)
- *Quercus virginiana - Quercus pagoda - Magnolia grandiflora - Carya glabra / Ilex opaca* Forest (CEGL007850, G1Q)

Spatial Characteristics

Spatial Summary: Large-patch system, occurring in mosaics with other small-patch systems, or as small isolated patches surrounded by wetlands.

Size: Generally occurs as small to large patches, of a few to dozens of acres. Mosaics may contain up to several hundred acres in close proximity.

Adjacent Ecological Systems:

- Central Appalachian Dry Oak-Pine Forest (CES202.591)
- Central Atlantic Coastal Plain Wet Longleaf Pine Savanna and Flatwoods (CES203.265)
- Northern Atlantic Coastal Plain Hardwood Forest (CES203.475)
- Southeastern Coastal Plain Cliff (CES203.398)
- Southern Atlantic Coastal Plain Dry and Dry-Mesic Oak Forest (CES203.241)
- Southern Atlantic Coastal Plain Nonriverine Swamp and Wet Hardwood Forest (CES203.304)
- Southern Atlantic White-cedar Peatland Forest (CES203.068)

Adjacent Ecological System Comments: Most commonly associated with Southern Atlantic Coastal Plain Dry and Dry-Mesic Oak Forest (CES203.241) and various floodplain systems. Less commonly associated with Southern Atlantic Coastal Plain Nonriverine Swamp and Wet Hardwood Forest (CES203.304). Floodplain systems often occur below this system. In MD and DC, where this system occurs along the fall zone, it may be found below ridges and hilltops supporting Central Appalachian Dry Oak-Pine Forest (CES202.591) and adjacent to steep slopes supporting Northern Atlantic Coastal Plain Hardwood Forest (CES203.475).

Distribution

Range: This system ranges from Delaware south to central Georgia in the Atlantic Coastal Plain. Its southern limit is generally

exclusive of the natural range of *Pinus glabra* as mapped by Kossuth and Michael (1990) and *Magnolia grandiflora* as mapped by Outcalt (1990).
Divisions: 203:C
Nations: US
Subnations: DC, DE, GA, MD, NC, SC, VA
Map Zones: 55:C, 58:C, 60:C
USFS Ecomap Regions: 221D:CC, 232B:CC, 232C:CC, 232H:CC, 232I:CC, 232J:CC
TNC Ecoregions: 52:C, 56:C, 57:C, 58:C, 61:C

SOURCES

References: Batista and Platt 1997, Comer et al. 2003, Edwards et al. 2013, Engeman et al. 2007, Eyre 1980, Flynn 1994, Kossuth and Michael 1990, Landfire 2007a, Outcalt 1990, Quarterman and Keever 1962, Ware et al. 1993
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723243#references
Description Author: R. Evans, mod. M. Pyne and J. Teague
Version: 14 Jan 2014 **Stakeholders:** East, Southeast
Concept Author: R. Evans **ClassifResp:** Southeast

SOUTHERN COASTAL PLAIN DRY UPLAND HARDWOOD FOREST (CES203.560)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Broad-Leaved Deciduous Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: EVT 2330; ESLF 4136; ESP 1330

CONCEPT

Summary: This is one of three hardwood-dominated systems found in the East Gulf Coastal Plain and adjacent areas of central Florida. This type is found in the Southern Coastal Plain and Southeastern Plains (EPA Level III Ecoregion 75 and parts of 65). Examples attributable to this type are typically deciduous or mixed evergreen oak-dominated forests, often with a pine component present. Although the southern portion of the range of this system overlaps Southern Coastal Plain Oak Dome and Hammock (CES203.494), the latter is dominated by evergreen oak species, and the two should not be confused. The core range of this type extends northward to the approximate historical range of *Pinus palustris*; although most deciduous species do not mimic this range, this boundary does appear to be a reasonable demarcation boundary north of which *Quercus alba* becomes more abundant and south of which *Quercus hemisphaerica* is more diagnostic. Like all hardwood systems of this region, examples occur within a landscape matrix historically occupied by pine-dominated uplands and consequently this system only occurred in fire-sheltered locations in naturally small to large patches. Examples of this system tend to occur on sites intermediate in moisture status (mostly dry to dry-mesic), although occasionally very dry (xeric) stands may also be included. Toward the northern range limits of this system, it may have been less restricted to small patches in fire-protected locations, and may have been formerly more prevalent on the landscape even in areas heavily influenced by fire.

Important tree species vary geographically and according to previous disturbance. *Quercus hemisphaerica* is a typical species in many examples, with *Quercus stellata*, *Quercus falcata*, and *Quercus alba* less frequently encountered, but dominant in some stands. The overstory of some examples may be quite diverse, with hickories and other hardwood species often present. Typically mesic sites, as indicated by species indicative of these conditions (e.g., *Fagus grandifolia*), are covered under other systems. *Pinus taeda* is sometimes present, but it is unclear if it is a natural component or has entered only as a result of past cutting. *Pinus glabra* or *Pinus echinata* may also be present in some examples. Stands may be found on slopes above rivers and adjacent to sinkholes, as well as other fire-infrequent habitats including narrow bands between mesic slopes below and pine-dominated flats above.
Classification Comments: As currently conceived, the Alabama range of this type extends throughout the Southern Hilly Gulf Coastal Plain (Ecoregion 65d), as mapped by the U.S. Environmental Protection Agency (EPA 2004) northward across the Black Belt and into the Fall Line Hills (Ecoregion 65i) to approximately Tuscaloosa (A. Schotz pers. comm.). To the north it is eventually replaced by East Gulf Coastal Plain Northern Dry Upland Hardwood Forest (CES203.483), but along this northern range it occurs in a mosaic with CES203.483 as well as East Gulf Coastal Plain Interior Shortleaf Pine-Oak Forest (CES203.506). In Mississippi the range extends almost to the same latitude, but this range is confined to Ecoregion 65d.
Similar Ecological Systems:
- Southern Coastal Plain Oak Dome and Hammock (CES203.494)

Related Concepts:
- Southern Scrub Oak: 72 (Eyre 1980) Finer
- Upland Hardwood Forest (FNAI 1990) Finer
- Upland Mixed Forest (FNAI 1990) Finer
- White Oak - Black Oak - Northern Red Oak: 52 (Eyre 1980) Finer

DESCRIPTION

Environment: Topographically, these sites tend to occur on upper to mid slopes, but occasionally on broader uplands with reduced fire frequencies. A range of soils may be present from loamy and clayey to coarse sands, but are generally well-drained but not excessively drained. Soils are generally acidic, though calcareous soils occur occasionally. Sites are somewhat protected from most natural fires by steep topography and by limited flammability of the vegetation.
Vegetation: Vegetation consists of forests dominated by combinations of upland oaks, particularly *Quercus alba, Quercus falcata, Quercus stellata, Quercus margarettiae*, and other species. There is some variation between the composition of northern versus southern examples in which evergreen species such as *Quercus nigra* and *Quercus hemisphaerica* become more prominent. Hickories (*Carya alba, Carya glabra*) may be present. There is some variation in composition with aspect and degree of exposure to fire. More mesophytic species such as *Fagus grandifolia* and *Magnolia grandiflora* are absent or are confined to the understory. *Pinus echinata* may be present in some stands, particularly on drier south- and west-facing slopes, but is typically not dominant. *Pinus taeda* is sometimes present, but it is unclear if it is a natural component or has entered only as a result of past cutting. Some examples of this system will have pine (*Pinus echinata, Pinus glabra, Pinus taeda*) as a natural component, where occasional fires may allow them to regenerate. In most examples, the understory is well-developed. A well-developed shrub layer may be present, with *Vaccinium* spp.

and *Gaylussacia* spp. most typical. The herb layer is generally sparse; species richness tends to be low but may be richer if fire has played a role in shaping the structure and composition of the stand. The most likely grass taxa (found in open-understory examples) are *Schizachyrium scoparium, Andropogon* spp., *Chasmanthium* spp., *Dichanthelium* spp., and *Danthonia sericea*.

Dynamics: Sites where this system occurs almost invariably grade upslope into pine-dominated systems, especially stands containing *Pinus palustris* and, to a lesser extent, *Pinus echinata*. If these sites were burned more frequently, the vegetation would likely be replaced by more fire-tolerant southern pines. Fires that penetrate stands of this type are generally low in intensity and have fairly limited ecological effect. In general, more frequent or intense fire would move the vegetation on the site toward more fire-tolerant components. Conversely, with the prolonged complete absence of fire, less fire-tolerant species could invade, causing the vegetation to resemble the more mesic slope forests below.

Frequent surface fires occurred on a 4- to 8-year return interval from both lightning and Native American ignitions. These frequent light surface fires maintained the grassy understory and kept more fire-tolerant hardwoods and shrubs from capturing the understory and forming a midstory layer. Lightning fires occurred primarily during the spring dry season (April and May) with a secondary peak of Native American and settler burning during the fall (October and November) (Landfire 2007a). Occasionally, during extensive droughts, mixed-severity or stand-replacement fires did occur, especially in drier *Pinus echinata*-dominated stands. Local thunderstorms created gaps on a small but continual basis. More extensive regional disturbances included tropical storms during the growing season and ice storms during winter (in the northern part of the range). Dense stands of middle to older aged *Pinus* species (where present) were susceptible to periodic mortality from bark beetle epidemics (Landfire 2007a).

Component Associations:

- *Quercus falcata - Quercus stellata - Carya alba / Vaccinium* spp. Coastal Plain Forest (CEGL007246, G4?)
- *Quercus hemisphaerica - Carya glabra - Magnolia grandiflora / Sabal etonia* Forest (CEGL003792, G2?)
- *Quercus hemisphaerica - Carya glabra / Oxydendrum arboreum / Sebastiania fruticosa / Carex baltzellii* Forest (CEGL007023, G2G3)
- *Quercus hemisphaerica - Magnolia grandiflora - Carya (glabra, pallida) / Vaccinium arboreum / Chasmanthium sessiliflorum* Forest (CEGL004788, G3G4)
- *Quercus hemisphaerica - Quercus (falcata, nigra) / Ilex opaca - Vaccinium arboreum / Cnidoscolus stimulosus* Forest (CEGL007751, G4)
- *Quercus velutina - Carya pallida - (Pinus echinata) / Vaccinium arboreum / Yucca filamentosa* Forest (CEGL008553, G3G4)

Spatial Characteristics

Spatial Summary: Examples occur within a landscape matrix historically occupied by pine-dominated uplands and therefore typically occur in somewhat fire-sheltered locations in naturally small to large patches. Toward the northern range limits of this system, it may have been less restricted to small patches in fire-protected locations, and may have been formerly more prevalent on the landscape even in areas heavily influenced by fire.

Adjacent Ecological Systems:

- East Gulf Coastal Plain Interior Shortleaf Pine-Oak Forest (CES203.506)

Distribution

Range: This system is found in the East Gulf Coastal Plain and adjacent areas of central Florida ranging northward into central Mississippi and Alabama.

Divisions: 203:C

Nations: US

Subnations: AL, FL, GA, MS

Map Zones: 46:C, 55:C, 56:C, 99:C

USFS Ecomap Regions: 231B:CC, 232B:CC, 232C:CC, 232D:CC, 232J:CC, 232K:CC, 232L:CC

TNC Ecoregions: 43:C, 53:C, 55:C

Sources

References: Comer et al. 2003, Edwards et al. 2013, Engeman et al. 2007, EPA 2004, Eyre 1980, FNAI 1990, Landfire 2007a, Schotz pers. comm., Ware et al. 1993

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723044#references

Description Author: M. Pyne and R. Evans

Version: 14 Jan 2014

Concept Author: M. Pyne and R. Evans

Stakeholders: Southeast

ClassifResp: Southeast

SOUTHERN COASTAL PLAIN LIMESTONE FOREST (CES203.502)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Circumneutral Soil; Broad-Leaved Deciduous Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: EVT 2328; ESLF 4134; ESP 1328

CONCEPT

Summary: This system represents dry to dry-mesic deciduous forests of the East Gulf Coastal Plain where limestone, marl, or other calcareous substrates occur near enough to the surface to influence vegetation composition. Examples are most common in the Black Belt region of Alabama and Mississippi, but are also present in more isolated patches in other portions of the region, including western Alabama, eastern Georgia, and southwestern middle Tennessee. Generally, the vegetation consists of forests and woodlands on well-developed, deep soils. Related, but physiognomically distinct, vegetation surrounding rock outcrops and calcareous prairies is accommodated within other ecological systems.
Classification Comments: Examples have been found in the Atlantic Coastal Plain which has led to a range expansion. South Carolina Heritage (B. Pittman/K. Boyle pers. comm.) has an ongoing study related to these communities in that state.
Related Concepts:
- Eastern Redcedar: 46 (Eyre 1980) Finer
- Sugar Maple: 27 (Eyre 1980) Finer

DESCRIPTION

Environment: Stands typically occur on ridges and upper to middle slopes of the southern coastal plains where limestone, marl, or other calcareous substrates occur near enough to the surface to influence vegetation composition.
Vegetation: Typical stands are dominated by oaks and hickories, particularly species which are indicative of finer-textured soils and/or a higher base status in the soil (e.g., *Carya carolinae-septentrionalis, Quercus muehlenbergii, Quercus pagoda, Quercus shumardii, Quercus stellata*). Other hardwood trees include *Fraxinus americana, Liquidambar styraciflua, Acer barbatum*, and *Aesculus glabra*. The rare *Carya myristiciformis* may also be found in some stands. Understory trees may include *Fraxinus americana* and *Juniperus virginiana var. virginiana*. Early-successional or fire-suppressed stands may exhibit greater dominance by *Juniperus virginiana*. More nutrient-rich or fire-sheltered stands may exhibit dominance or codominance by *Fraxinus americana, Tilia americana* (most commonly *var. caroliniana*, but *var. heterophylla* along the Chattahoochee River), and/or *Acer barbatum*. Understory trees may include smaller examples of canopy species in addition to *Aesculus pavia var. pavia*, *Cercis canadensis, Cornus florida*, *Ostrya virginiana*, and *Ulmus alata*. Shrubs and woody vines may include *Arundinaria gigantea, Berchemia scandens, Bignonia capreolata, Cocculus carolinus, Cornus drummondii, Crataegus* spp., *Euonymus americanus, Euonymus atropurpureus, Frangula caroliniana, Hydrangea quercifolia, Ilex decidua, Menispermum canadense, Parthenocissus quinquefolia, Ptelea trifoliata, Sideroxylon lycioides, Staphylea trifolia, Symphoricarpos orbiculatus, Toxicodendron radicans, Viburnum* spp., and *Vitis* spp. Some typical herbs include *Chasmanthium laxum, Chasmanthium sessiliflorum, Dichanthelium boscii, Lithospermum tuberosum, Polystichum acrostichoides, Sanicula* spp., *Solidago auriculata, Spigelia marilandica, Trillium* spp., and *Verbesina virginica*. The ground layers of some stands may exhibit dominance by native warm-season grasses and other graminoids, including *Schizachyrium scoparium, Andropogon* spp., *Danthonia* spp., and *Carex cherokeensis*. In addition, *Tillandsia usneoides* may be present as an epiphyte.
Dynamics: Fire frequency and intensity are factors determining the relative mixture of deciduous hardwood versus evergreen trees in this system. Frequent surface fires occurred on a 5- to 10-year return interval from both lightning and Native American ignitions. These frequent light surface fires maintained the grassy understory and kept hardwoods and shrubs from dominating the understory and forming a midstory layer. Lightning fires occurred primarily during the spring dry season (April and May) with a secondary peak of Native American and settler burning during the fall (October and November) (Landfire 2007a). Occasionally, during extensive droughts, mixed-severity or stand-replacement fires did occur, especially in drier stands, or those containing *Juniperus virginiana* or rarely with *Pinus* species (e.g., *Pinus taeda* and/or *Pinus echinata*). In addition, local thunderstorm-caused blowdowns created gaps on a small but continual basis. More extensive regional disturbances included tropical storms during the growing season and ice storms during winter (in the northern part of the range). Dense stands of middle to older aged pines (where present) were susceptible to periodic mortality from bark beetle epidemics, and younger *Juniperus virginiana* trees were killed by periodic droughts.

Component Associations:
- *Acer barbatum - Aesculus glabra - Carya myristiciformis - Quercus shumardii - Quercus muehlenbergii* Forest (CEGL004671, G1G2)
- *Aquilegia canadensis - Asplenium heterochroum - Polymnia laevigata - Urtica chamaedryoides* Herbaceous Vegetation (CEGL004268, G1?)
- *Fagus grandifolia - Magnolia grandiflora - Fraxinus americana / Acer barbatum - Cercis canadensis - Ostrya virginiana* Forest

(CEGL007458, G1G2)
- *Fraxinus americana - Juglans nigra - Ulmus rubra / Acer barbatum - Ostrya virginiana / Ptelea trifoliata* Forest (CEGL007180, G2)
- *Quercus (pagoda, shumardii) - Liquidambar styraciflua / Verbesina virginica - Solidago auriculata* Forest (CEGL008585, G3G4)
- *Quercus muehlenbergii - (Quercus sinuata) - Carya* spp. / *Sabal minor / Carex cherokeensis - Chasmanthium sessiliflorum* Forest (CEGL004023, G2)
- *Quercus muehlenbergii - Quercus shumardii - Carya (carolinae-septentrionalis, ovata)* Forest (CEGL007808, G3)
- *Quercus shumardii - Fraxinus americana - Carya* spp. / *Juniperus virginiana var. virginiana* Forest (CEGL004685, G2?)
- *Quercus shumardii - Quercus pagoda - Fraxinus americana / Ostrya virginiana - Cornus florida / Trillium ludovicianum* Forest (CEGL007272, G1)
- *Tilia americana (var. caroliniana, var. heterophylla) - Acer barbatum - Fraxinus americana / Arundinaria gigantea / Tillandsia usneoides* Forest (CEGL008557, G2G3)

Spatial Characteristics

Adjacent Ecological Systems:
- East Gulf Coastal Plain Interior Shortleaf Pine-Oak Forest (CES203.506)

Distribution

Range: This system occurs in the East Gulf (and rarely the Atlantic) Coastal Plain, most commonly in the Black Belt region of Alabama and Mississippi. It is also present in more isolated patches in other portions of the region, including western Alabama, eastern Georgia, and marginally in southwestern middle Tennessee.
Divisions: 203:C
Nations: US
Subnations: AL, GA?, MS, TN
Map Zones: 46:C, 55:C, 99:C
USFS Ecomap Regions: 231B:CC, 232B:CC, 232J:CC, 232K:CC
TNC Ecoregions: 43:C, 53:C

Sources

References: Comer et al. 2003, Edwards et al. 2013, Engeman et al. 2007, Eyre 1980, Landfire 2007a, Spetich 2004, TNC 1996c
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723086#references
Description Author: A. Schotz and R. Evans, mod. M. Pyne
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: A. Schotz and R. Evans **ClassifResp:** Southeast

SOUTHERN COASTAL PLAIN MESIC SLOPE FOREST (CES203.476)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Slope; Long Disturbance Interval; Broad-Leaved Evergreen Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2357; ESLF 4260; ESP 1357

CONCEPT

Summary: This forested system of the southern East Gulf and Atlantic coastal plains occurs on steep slopes, bluffs, or sheltered ravines where fire is naturally rare, generally within the natural range of *Pinus glabra* and *Magnolia grandiflora*. Stands are mesic, and vegetation typically includes species such as *Fagus grandifolia, Magnolia grandiflora, Illicium floridanum,* and other species rarely encountered outside this system in the region. Related forests which occur on deep loess soils along the western margin of the region are classified as East Gulf Coastal Plain Southern Loess Bluff Forest (CES203.556). Some component associations are also found in temporarily flooded floodplains adjacent to these slopes, but this is primarily an upland system. The system also includes essentially upland vegetation of Pleistocene terraces, although these are conceptually transitional to creek floodplain systems.
Classification Comments: East Gulf Coastal Plain Northern Mesic Hardwood Slope Forest (CES203.477) is a similar mesic forest system to the north of this one in the Upper East Gulf Coastal Plain that has greater dominance by deciduous trees. The systems of the loess bluffs to the west of this one, bordering the Mississippi River Alluvial Plain, are treated as distinct and are more extensive and continuous in their extent both vertically and latitudinally [see East Gulf Coastal Plain Northern Loess Bluff Forest (CES203.481) and East Gulf Coastal Plain Southern Loess Bluff Forest (CES203.556)]. To the north of the combined ranges of *Pinus glabra* and *Magnolia grandiflora* in the Atlantic Coastal Plain, this system is replaced by Southern Atlantic Coastal Plain Mesic Hardwood Forest (CES203.242).
Similar Ecological Systems:
- East Gulf Coastal Plain Northern Loess Bluff Forest (CES203.481)
- East Gulf Coastal Plain Northern Mesic Hardwood Slope Forest (CES203.477)
- East Gulf Coastal Plain Southern Loess Bluff Forest (CES203.556)
- Southeastern Coastal Plain Cliff (CES203.398)
- Southern Atlantic Coastal Plain Mesic Hardwood Forest (CES203.242)

Related Concepts:
- Loblolly Pine - Hardwood: 82 (Eyre 1980) Finer
- Slope Forest (FNAI 1990) Intersecting
- White Oak: 53 (Eyre 1980) Finer

DESCRIPTION

Environment: This system is restricted to steep slopes, bluffs, or sheltered ravines where fire is naturally rare. This mesic habitat is confined to very limited, fire-sheltered areas within the natural ranges of *Pinus glabra* (Kossuth and Michael 1990) and *Magnolia grandiflora* (Outcalt 1990). This system occurs in a variety of moist, non-wetland sites that are naturally sheltered from frequent fire. These are typically narrow bands of vegetation between floodplain forests and upland communities dominated by *Pinus palustris* (Batista and Platt 1997). Most common are lower slope, bluff, and ravine examples along streams and rivers in dissected terrain, but some examples occur on mesic flats between drier pine-dominated uplands and floodplains or on local high areas within bottomland terraces or nonriverine wet flats. There may be larger patches where side -drains join larger streams. Under closed-canopy conditions, fire may only partially penetrate this system from adjacent uplands. Soils are typically deep, fine-textured, and moderately well-drained. Soils cover the full range of mineral soil textures, except for the coarsest sands. Soils are not saturated for any significant time during the growing season and seldom, if ever, are extremely dry. Soils developed from calcareous materials or rich alluvium may be basic; others are strongly acidic. Richer and more mesic stands occur in more strongly concave and finer-textured areas. Sites are normally protected from most natural fires by steep topography or by surrounding extensive areas of non-flammable vegetation. This system occurs in a region of mild winters, high annual rainfall and high evapotranspiration, as well as a high likelihood of hurricane landfall (Ware et al. 1993). These forests may represent relicts derived from the early Tertiary flora (Batista and Platt 1997).
Vegetation: Stands are mesic, and vegetation typically includes species such as *Fagus grandifolia, Magnolia grandiflora, Pinus glabra,* and other species rarely encountered outside this system in the region. All woody strata contain a mixture of evergreen and deciduous species. Canopies are diverse; in addition to the aforementioned taxa, other canopy taxa may include *Quercus alba, Quercus pagoda, Quercus michauxii, Quercus falcata, Quercus shumardii, Quercus velutina, Quercus laurifolia, Quercus nigra, Quercus hemisphaerica, Pinus echinata, Pinus taeda, Nyssa sylvatica, Fraxinus americana, Carya alba* (in the north), *Carya glabra, Ulmus alata, Ulmus americana, Ulmus rubra, Liriodendron tulipifera,* and *Liquidambar styraciflua* (NatureServe Ecology unpubl. data 2003). The presence of *Pinus taeda* is normal at lower frequencies, but higher ones may indicate past disturbance or removal of the hardwood canopy and subsequent invasion. Additional subcanopy taxa may include *Acer barbatum, Acer rubrum, Oxydendrum*

arboreum, Carpinus caroliniana ssp. caroliniana, Ostrya virginiana, Prunus caroliniana, Prunus serotina, Symplocos tinctoria, Magnolia macrophylla (rare to the west), *Halesia diptera, Styrax grandifolius, Sassafras albidum, Ilex opaca, Hamamelis virginiana, Magnolia pyramidata, Tilia americana var. caroliniana, Zanthoxylum clava-herculis, Crataegus marshallii, Morus rubra,* and *Cornus florida*. The shrub layer can be very diverse. Trees support lianas and epiphytes. Shrubs and woody vines include *Illicium floridanum, Hydrangea quercifolia, Arundinaria gigantea, Halesia diptera, Aesculus pavia, Calycanthus floridus var. floridus, Toxicodendron radicans, Parthenocissus quinquefolia, Viburnum rufidulum, Ilex vomitoria, Berchemia scandens, Vitis rotundifolia, Decumaria barbara, Callicarpa americana, Symplocos tinctoria, Ampelopsis arborea, Frangula caroliniana, Smilax tamnoides (= Smilax hispida), Gelsemium sempervirens, Sabal minor, Schisandra glabra, Lindera benzoin, Asimina parviflora, Cornus drummondii, Bignonia capreolata,* and *Euonymus americanus*. Except in gaps, herbs are scarce (Batista and Platt 1997). Herbs and herbaceous vines include *Thelypteris kunthii, Cystopteris protrusa, Viola walteri, Polystichum acrostichoides, Galium obtusum, Chasmanthium sessiliflorum, Aristolochia serpentaria, Trillium foetidissimum, Desmodium nudiflorum, Lithospermum tuberosum, Boehmeria cylindrica, Ageratina altissima var. altissima, Sanicula canadensis, Sanicula marilandica, Arisaema dracontium, Tillandsia usneoides, Cryptotaenia canadensis, Adiantum pedatum, Passiflora lutea, Cynoglossum virginianum, Botrychium virginianum, Ranunculus recurvatus, Mikania scandens,* and *Clematis crispa* (NatureServe Ecology unpubl. data 2003).
Dynamics: These are stable, fire-sheltered forests. Fire is naturally infrequent to absent in this system. Sites are protected from most natural fires by steep topography or by surrounding extensive areas of non-flammable vegetation (Landfire 2007a). If fire does penetrate, it is likely to be low in intensity but may have significant ecological effects. These forests probably generally exist naturally as old-growth forests, with canopy dynamics dominated by gap-phase regeneration. There is presumably some natural disturbance from the effects of hurricanes, which are relatively frequent in the range of this system, creating more frequent and larger canopy disturbances than analogous systems inland. Hurricanes can be followed by waves of tree recruitment, growth, and death resulting in changes in the density and structure of tree populations and in consequent fluctuations in forest species composition. Disturbances in these forests appear to be critical for both regeneration and change in older stands (Batista and Platt 1997). Periodic droughts will cause death of or stress to moisture-requiring canopy trees.

Component Associations:
- *(Fagus grandifolia) - Quercus pagoda - Magnolia grandiflora / Hydrangea quercifolia / Cystopteris protrusa - Thelypteris kunthii* Forest (CEGL007461, G3?)
- *Fagus grandifolia - Magnolia grandiflora - Fraxinus americana / Acer barbatum - Cercis canadensis - Ostrya virginiana* Forest (CEGL007458, G1G2)
- *Fagus grandifolia - Magnolia grandiflora - Pinus glabra - (Magnolia macrophylla) / (Illicium floridanum) / Hexastylis arifolia* Forest (CEGL007460, G3)
- *Fagus grandifolia - Magnolia grandiflora - Quercus michauxii - Quercus nigra / Rhododendron canescens* Forest (CEGL004965, G2G3)
- *Fagus grandifolia - Magnolia grandiflora - Quercus pagoda - Acer barbatum - Pinus taeda* Forest (CEGL004963, G1G2)
- *Fagus grandifolia - Magnolia grandiflora / Ilex opaca - (Persea borbonia) / Mitchella repens* Forest (CEGL007459, G2G3)
- *Fagus grandifolia - Magnolia grandiflora / Ostrya virginiana / Aesculus parviflora* Forest (CEGL008554, G2?)
- *Fagus grandifolia - Pinus glabra - Magnolia grandiflora / Serenoa repens* Forest (CEGL004977, G2G3)
- *Fagus grandifolia - Quercus alba - Liquidambar styraciflua / Magnolia grandiflora / Smilax pumila - Hexastylis arifolia* Forest (CEGL007210, G4)
- *Fagus grandifolia - Quercus alba / Symplocos tinctoria* East Gulf Coastal Plain Forest (CEGL003859, G3G4)
- *Pinus taeda - Quercus alba / Chasmanthium sessiliflorum* Forest (CEGL004763, G3G4)
- *Quercus (pagoda, shumardii) - Liquidambar styraciflua / Verbesina virginica - Solidago auriculata* Forest (CEGL008585, G3G4)
- *Quercus alba - Carya glabra - Carya alba / Aesculus pavia* Forest (CEGL007225, G4?)
- *Quercus alba - Quercus nigra - Carya pallida - (Quercus pagoda) / Magnolia (grandiflora, macrophylla)* Forest (CEGL004775, G3G4)
- *Quercus pagoda - Quercus (michauxii, shumardii) - Magnolia grandiflora - (Tilia americana var. caroliniana) / Sabal minor* Forest (CEGL007712, G2?)
- *Tilia americana (var. caroliniana, var. heterophylla) - Acer barbatum - Fraxinus americana / Arundinaria gigantea / Tillandsia usneoides* Forest (CEGL008557, G2G3)

DISTRIBUTION

Range: This mesic upland system of the southern (Atlantic and Gulf) coastal plains is found in suitable conditions from southern South Carolina south to northern Florida and west to (and including) the loessal plains of Mississippi and Louisiana. Its range is generally congruent with the natural range of *Pinus glabra* as mapped by Kossuth and Michael (1990) and *Magnolia grandiflora* as mapped by Outcalt (1990).
Divisions: 203:C
Nations: US
Subnations: AL, FL, GA, LA, MS, SC
Map Zones: 46:C, 55:C, 56:?, 58:C, 99:C
USFS Ecomap Regions: 231B:CC, 231H:CC, 232B:CC, 232C:CC, 232D:CC, 232J:CC, 232K:CC, 232L:CC, 234A:CC
TNC Ecoregions: 43:C, 53:C, 55:P, 56:C

SOURCES

References: Batista and Platt 1997, Comer et al. 2003, Edwards et al. 2013, Engeman et al. 2007, Eyre 1980, Flynn 1994, FNAI

1990, Kossuth and Michael 1990, Landfire 2007a, NatureServe Ecology - Southeastern U.S. unpubl. data, Nordman 2013, Outcalt 1990, Quarterman and Keever 1962, Ware et al. 1993

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723110#references

Description Author: A. Schotz and R. Evans, mod. M. Pyne

Version: 14 Jan 2014 **Stakeholders:** Southeast

Concept Author: A. Schotz and R. Evans **ClassifResp:** Southeast

SOUTHERN COASTAL PLAIN OAK DOME AND HAMMOCK (CES203.494)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Long Disturbance Interval; Broad-Leaved Evergreen Tree
National Mapping Codes: ESLF 4275

CONCEPT

Summary: This small-patch system occurs in the Southern Coastal Plain (EPA ecoregion 75). Examples are known from some more inland portions of this region as well as the Southeastern Plain (EPA ecoregion 65) in Georgia and Alabama. Relatively dense stands of *Quercus virginiana* and/or *Quercus geminata* are diagnostic of this system. Examples often occupy locally distinct microhabitats that differ from the surrounding landscape, such as shallow depressions or slight topographic highs in a predominantly *Pinus palustris* -dominated landscape. Although embedded in a matrix of vegetation with extremely frequent fire regimes, patches of this system are subject to only infrequent or rare fire events. Under more frequent fire regimes, these sites would likely be occupied by *Pinus palustris*. It has been postulated that winter burning regimes have allowed this type to expand. A range of soil and moisture conditions may be present. More mesic examples have relatively thin soils (to 50 cm) above clay, while xeric examples occupy deep (>130 cm) well-drained sands. Dominant plants of mesic examples include *Quercus virginiana* and *Quercus hemisphaerica*, along with *Diospyros virginiana*. Vines including *Campsis radicans* and *Smilax* spp. dominate the sparse ground cover. In xeric examples, dominants include *Quercus geminata, Pinus palustris, Quercus virginiana, Aristida beyrichiana*, and *Stylisma humistrata*. This system is low in plant species diversity compared to most other habitats in the region.
Classification Comments: More diverse stands of upland hardwoods occurring in the same ecoregions should generally be treated under Southern Coastal Plain Dry Upland Hardwood Forest (CES203.560). The core range of this system lies farther south than CES203.560. Closely related stands of vegetation may also occur in near-coastal environments where they are more obviously influenced by maritime disturbances; these are treated under different ecological systems. In Alabama examples of this system are of very limited extent, but occur inland as far as 60 miles or so from the coast; it is also known from bluffs along the Mobile-Tensas (A. Schotz pers. comm.).
Similar Ecological Systems:
- Southern Coastal Plain Dry Upland Hardwood Forest (CES203.560)

Related Concepts:
- Cabbage Palmetto: 74 (Eyre 1980) Finer
- Live Oak: 89 (Eyre 1980) Finer
- Mesic Hammock (FNAI 1990) Finer
- Southern Scrub Oak: 72 (Eyre 1980) Finer
- Xeric Hammock (FNAI 1990) Finer

DESCRIPTION

Environment: Examples are thickets or groves of *Quercus* species in a *Pinus* spp.-dominated landscape (Myers 1990). These typically occupy locally distinct microhabitats that differ from the surrounding landscape, such as shallow depressions or slight topographic highs in a predominantly *Pinus palustris*-dominated landscape. A range of soil and moisture conditions may be present. As currently defined, this system includes examples across a moisture gradient from mesic to xeric, ranging across parts of the southeastern coastal plains from Georgia to Mississippi. In Georgia, more mesic examples of this system have relatively thin soils (to 50 cm) above clay, while xeric examples occupy deep (>130 cm) well-drained sands (Drew et al. 1998). In Florida, the xeric hammock typically develops on excessively drained sands where fire exclusion has allowed for the establishment of an oak canopy (FNAI 2010a). This may occur naturally, when the area has isolation from, or significant barriers to, fire. This can also occur as the result of human intervention, as at old homesites where fire was excluded for many years. In these areas, xeric hammock is found as small patches within or near sandhill or scrub. Xeric hammock can also occur on high islands within flatwoods or even on a high, well-drained ridge within a floodplain. Xeric hammock can occur on barrier islands and in other coastal situations, as an advanced successional stage of coastal scrub.

Along and near the east coast of Florida, from Cape Canaveral and northward, there is more shell or humus in the sand, and a tendency to have hammocks containing *Quercus virginiana* with coastal strand rather than scrub; on the other hand, where there is more dry acidic sand, scrub occurs nearer the coast and *Quercus geminata* hammocks are found further back from the coast (A. Johnson pers. comm.).
Vegetation: This concept covers both xeric and more mesic types of oak domes and hammocks. In the more xeric examples (Xeric Hammock of FNAI 2010a), the canopy is more-or-less closed and dominated by *Quercus geminata*, although *Quercus chapmanii, Quercus hemisphaerica, Quercus incana, Quercus laevis*, and *Quercus margarettiae* may also be common. An emergent canopy of pine, either *Pinus clausa, Pinus elliottii*, or *Pinus palustris* may be present (FNAI 2010a). *Quercus myrtifolia* may form a clonal shrub layer. *Aristida beyrichiana* and *Stylisma humistrata* may also be present. Hammocks that are intermediate in moisture status may have

some live oak (*Quercus virginiana*) in the canopy. According to Drew et al. (1998), the dominant taxa of mesic examples are *Quercus hemisphaerica*, *Quercus nigra*, and *Quercus virginiana*, along with *Diospyros virginiana*. *Campsis radicans* and *Smilax* spp. dominate the sparse ground cover. Examples of this system are low in plant species diversity compared to other habitats in the region. Cabbage palms are a diagnostic component of examples of this system in central Florida (A. Johnson pers. comm.).

Dynamics: Although embedded in a matrix of vegetation with extremely frequent fire regimes, patches of this system are subject to only infrequent or rare fire events. Under more frequent fire regimes, these sites would likely be occupied by *Pinus palustris*. Myers (1990) postulated that winter -burning regimes have allowed for the expansion of this type. *Quercus geminata* and *Quercus myrtifolia* are both clonal species which establish large rhizome systems capable of quickly resprouting following injury. Xeric hammocks, whether natural or anthropogenic, result from years of fire exclusion, maintained and further enhanced by incombustible oak litter and a sparsity of herbs. The thick bark of *Quercus geminata* makes these trees somewhat resistant to fire. Once they form a canopy that shades the understory, the trees generate a layer of leaf litter that covers open patches of sand and leads to more shaded, mesic ground conditions. The resulting shaded habitat can allow more fire-intolerant species such as *Magnolia grandiflora* to establish (Daubenmire 1990). Once the canopy is greater than 2 m high, even hot summer burns may not be sufficient to kill the dome, which can become established after only 7 to 16 years of fire exclusion (Guerin 1993). At that stage, oaks would only be killed through a catastrophic burn during dry conditions. Otherwise, the spread of oaks could be halted through mechanical removal or the use of herbicides if the management intent is the re-establishment of the fire-maintained community that was replaced by the xeric hammock. Xeric hammocks also form from long unburned oak scrub (Laessle 1958). There is a dynamic tension between the *Quercus*-dominated patches and the *Pinus*-dominated matrix. Oak domes are a natural part of the landscape, but can also result from human-caused fire exclusion. Near the coast, these communities are affected by salt spray (sea salt aerosol). At and near the coast, salt spray maintains the *Quercus geminata* at shrub height as much as does fire; one may observe a gradient of increasingly taller *Quercus geminata* as you move inland and the effect of salt spray becomes diminished (A. Johnson pers. comm.).

Component Associations:

- *Quercus geminata / Sabal etonia* Forest (CEGL008599, G2G3)
- *Quercus geminata / Vaccinium arboreum* Forest (CEGL003564, G3)
- *Quercus hemisphaerica - Carya glabra - (Quercus virginiana)* Forest (CEGL004506, G2G3)
- *Quercus hemisphaerica - Quercus geminata / Persea borbonia - Osmanthus americanus* Forest (CEGL004787, G2G3)
- *Quercus nigra - Quercus geminata / Lyonia ferruginea - Serenoa repens* Forest (CEGL003665, G2?)
- *Quercus virginiana - Quercus (hemisphaerica, nigra) / Serenoa repens* Forest (CEGL004408, G3?)
- *Quercus virginiana / Vaccinium arboreum - Ilex vomitoria* Forest (CEGL007028, G2G3)

DISTRIBUTION

Range: This system occurs in Florida, adjacent Georgia and in very limited areas of Alabama (A. Schotz pers. comm.).
Divisions: 203:C
Nations: US
Subnations: AL, FL, GA, MS
Map Zones: 55:C, 56:C, 99:C
TNC Ecoregions: 53:C, 55:C, 56:C

SOURCES

References: Brewer 2008, Comer et al. 2003, Daubenmire 1990, Drew et al. 1998, Edwards et al. 2013, Engeman et al. 2007, Eyre 1980, FNAI 1990, FNAI 2010a, Guerin 1993, Johnson, A. pers. comm., Laessle 1958, Myers 1990, Schotz pers. comm.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723092#references
Description Author: R. Evans, mod. M. Pyne
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: R. Evans **ClassifResp:** Southeast

SOUTHERN INTERIOR LOW PLATEAU DRY-MESIC OAK FOREST (CES202.898)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Non-Diagnostic Classifiers: Forest and Woodland (Treed)
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: EVT 2305; ESLF 4111; ESP 1305

CONCEPT

Summary: This system of upland hardwood-dominated forests occurs in the Interior Low Plateau region of the southeastern United States along ridgetops and slopes of various aspects. The system includes essentially all upland hardwood stands of the region except for mesic hardwood forests (which are accommodated by South-Central Interior Mesophytic Forest (CES202.887)). The floristic expression of different stands included in this system varies considerably with aspect and soil type. Included here are a variety of associations ranging along a moisture gradient from submesic to drier ones. The submesic to dry-mesic expressions tend to be found on midslopes with northerly to easterly aspects, and the drier ones on southerly to westerly aspects and on broad ridges. Parent material can range from calcareous to acidic with very shallow, well- to excessively well-drained soils in the drier expressions and moderately well-drained soils in the submesic to dry-mesic ones. The canopy closure of this system ranges from closed to somewhat open in the drier examples. Historically, these examples may have been more open under conditions of more frequent fire.

A number of different *Quercus* species may dominate stands of this system, with *Carya* species also prominent. In some drier examples on more acidic substrates, *Quercus prinus* is typical over most of the range, reflecting relations with other Appalachian systems to the east. In addition, *Quercus stellata, Quercus marilandica,* and *Quercus coccinea* will also share dominance or be prominent in many of the drier examples. *Quercus muehlenbergii* and/or *Quercus shumardii* may appear in drier examples with high base status. *Quercus alba* may also be present but not typically dominant. In the submesic to dry-mesic examples, *Quercus alba* will typically exhibit dominance, possibly with *Quercus velutina* or *Quercus falcata*. The understories are typically shrub- and small tree-dominated, with the typical species varying with aspect, soil, and moisture relations.

Classification Comments: The range of this system is consistent with the non-coastal plain portion of the "Western Mesophytic" Forest region of Braun (1950), Keever (1971), and Greller (1988). To the glaciated north, it is replaced by North-Central Interior Dry-Mesic Oak Forest and Woodland (CES202.046) or North-Central Interior Dry Oak Forest and Woodland (CES202.047).

Similar Ecological Systems:
- Allegheny-Cumberland Dry Oak Forest and Woodland (CES202.359)--is found to the east and southeast in the Cumberlands.
- East Gulf Coastal Plain Northern Dry Upland Hardwood Forest (CES203.483)--is found to the southwest in the Coastal Plain.
- North-Central Interior Dry-Mesic Oak Forest and Woodland (CES202.046)--is found to the (glaciated) north.

Related Concepts:
- Black Oak: 110 (Eyre 1980) Finer
- Calcareous Xeric Forest (Evans 1991) Finer
- Chestnut Oak: 44 (Eyre 1980) Finer
- Eastern Redcedar: 46 (Eyre 1980) Finer
- Northern Red Oak: 55 (Eyre 1980) Finer
- Post Oak - Blackjack Oak: 40 (Eyre 1980) Finer
- Shortleaf Pine - Oak: 76 (Eyre 1980) Finer
- Sugar Maple: 27 (Eyre 1980) Finer
- White Oak - Black Oak - Northern Red Oak: 52 (Eyre 1980) Finer
- White Oak: 53 (Eyre 1980) Finer
- Xeric Acidic Forest (Evans 1991) Finer
- Yellow-Poplar: 57 (Eyre 1980) Finer

DESCRIPTION

Environment: This system encompasses a variety of associations ranging along a moisture gradient from submesic to drier ones. The submesic to dry-mesic expressions tend to be found on midslopes with northerly to easterly aspects, the drier ones on southerly to westerly aspects and on broad ridges. Parent material can range from calcareous to acidic with very shallow, well- to excessively well-drained soils in the drier expressions and moderately well-drained soils in the submesic to dry-mesic ones.

Vegetation: A number of different *Quercus* species may dominate stands of this system, with *Carya* species also prominent. In the drier examples, *Quercus prinus* is typical over most of the range, reflecting relations with other Appalachian systems to the east. In addition, *Quercus stellata, Quercus marilandica,* and *Quercus coccinea* will also share dominance or be prominent in many of the drier examples. *Quercus muehlenbergii* and/or *Quercus shumardii* may appear in drier examples with high base status. *Quercus alba* may also be present but not typically dominant. In the submesic to dry-mesic examples, *Quercus alba* will typically exhibit dominance, possibly with *Quercus velutina* or *Quercus falcata*. The understories are typically shrub- and small tree-dominated, with

the typical species varying with aspect, soil, and moisture relations. Some typical species include *Cornus florida, Cercis canadensis, Oxydendrum arboreum, Vaccinium pallidum, Vaccinium stamineum, Vaccinium arboreum,* other highbush *Vaccinium* species, *Kalmia latifolia, Viburnum acerifolium, Styrax americanus,* and others. Some more open and drier stands may exhibit an understory of grassland species such as *Schizachyrium scoparium, Danthonia spicata,* and others. Forbs of the Fabaceae (e.g., *Desmodium*) and Asteraceae (e.g., *Helianthus*) will be prominent in many examples.

Component Associations:
- *Pinus echinata - Quercus prinus* Interior Low Plateau Forest (CEGL004054, G2G3)
- *Quercus alba - Carya alba - (Quercus velutina) / Desmodium nudiflorum - (Carex picta)* Forest (CEGL007795, G4)
- *Quercus alba - Quercus (falcata, stellata) / Chasmanthium laxum* Forest (CEGL007746, G3G4Q)
- *Quercus alba - Quercus rubra - Carya (alba, ovata) / Cornus florida* Acidic Forest (CEGL002067, G3)
- *Quercus alba - Quercus rubra - Quercus muehlenbergii / Cercis canadensis* Forest (CEGL002070, G4G5)
- *Quercus alba / Cornus florida* Unglaciated Forest (CEGL002066, G4?)
- *Quercus falcata - Quercus (coccinea, stellata) / Vaccinium (pallidum, stamineum)* Forest (CEGL007247, G4)
- *Quercus falcata - Quercus alba - Carya alba / Oxydendrum arboreum / Vaccinium stamineum* Forest (CEGL007244, G4G5)
- *Quercus falcata - Quercus alba - Quercus stellata - Quercus velutina* Forest (CEGL005018, G3G5)
- *Quercus imbricaria - Quercus shumardii - Quercus muehlenbergii / Celtis occidentalis / Urtica chamaedryoides* Forest (CEGL003876, G2G3)
- *Quercus muehlenbergii - Quercus (falcata, shumardii, stellata) / Cercis canadensis / Viburnum rufidulum* Forest (CEGL007699, G3)
- *Quercus muehlenbergii - Quercus shumardii - Carya (carolinae-septentrionalis, ovata)* Forest (CEGL007808, G3)
- *Quercus pagoda - (Quercus falcata) / Ostrya virginiana* Forest (CEGL003871, G3?)
- *Quercus prinus - Carya ovata - Quercus rubra / Acer saccharum* Forest (CEGL007268, G4?)
- *Quercus prinus - Quercus* spp. / *Vaccinium arboreum - (Kalmia latifolia, Styrax grandifolius)* Forest (CEGL007700, G4)
- *Quercus prinus / Smilax* spp. Forest (CEGL005022, G4)
- *Quercus rubra - (Acer saccharum, Quercus alba)* Forest (CEGL005017, G4?)
- *Quercus shumardii - Quercus muehlenbergii - Acer (barbatum, leucoderme, saccharum) / Ostrya virginiana* Forest (CEGL008442, G2G3)
- *Quercus stellata - Quercus marilandica - Carya (glabra, texana) / Vaccinium arboreum* Forest (CEGL002075, G4)
- *Quercus stellata / Viburnum rufidulum / Schizachyrium scoparium - (Sorghastrum nutans, Helianthus eggertii)* Woodland (CEGL004686, G2G3)
- *Quercus velutina - Carya (alba, glabra) / Vaccinium arboreum* Forest (CEGL004987, G2G3Q)
- *Quercus velutina - Quercus alba - Carya (glabra, ovata)* Forest (CEGL002076, G4?)

SPATIAL CHARACTERISTICS

Spatial Summary: This is the matrix forest in large parts of the Interior Low Plateau region.
Adjacent Ecological Systems:
- Nashville Basin Limestone Glade and Woodland (CES202.334)
- South-Central Interior Mesophytic Forest (CES202.887)

DISTRIBUTION

Range: This system occurs in the southeastern Interior Highlands of the Interior Low Plateau region, including southern Indiana and a small part of southeastern Ohio.
Divisions: 202:C
Nations: US
Subnations: AL, IL, IN, KY, OH, TN
Map Zones: 47:C, 48:C, 49:C, 53:C
USFS Ecomap Regions: 223B:CC, 223D:CC, 223E:CC, 223F:CC, 231C:CC
TNC Ecoregions: 44:C

SOURCES

References: Braun 1950, Comer et al. 2003, Greller 1988, Keever 1971
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722783#references
Description Author: M. Pyne
Version: 22 Jan 2008 **Stakeholders:** Midwest, Southeast
Concept Author: M. Pyne **ClassifResp:** Southeast

SOUTHERN PIEDMONT DRY OAK-(PINE) FOREST (CES202.339)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Needle-Leaved Tree; Broad-Leaved Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Mixed evergreen-deciduous closed tree canopy
National Mapping Codes: EVT 2368; ESLF 4311; ESP 1368

CONCEPT

Summary: This system encompasses the prevailing upland forests of the southern Piedmont. High-quality and historic examples are typically dominated by combinations of upland oaks, sometimes with pines as a significant component, especially in the southern portions of the region. These forests occur in a variety of habitats and, under natural conditions, were the matrix vegetation type covering most of the landscape. Much of this system is currently composed of successional forests that have arisen after repeated cutting, clearing, and cultivation of original oak-hickory forests. Stands of these forests are dominated by combinations of upland oaks, particularly *Quercus alba*, *Quercus rubra*, *Quercus velutina*, *Quercus stellata*, *Quercus coccinea*, and *Quercus falcata*, along with *Carya glabra*, *Carya alba*, and other *Carya* spp. Other common tree species include *Pinus taeda*, *Pinus echinata*, *Pinus virginiana*, *Acer rubrum*, *Liquidambar styraciflua*, and *Liriodendron tulipifera*.
Classification Comments: Although these forests have often been called "oak-hickory" (Braun 1950) or "oak-pine-hickory" (Kuchler 1964, Greller 1989, Skeen et al. 1993), Monk et al. (1990) concluded there was insufficient abundance of hickory to justify including this genus in the name of such forests. There are fairly dramatic differences in the amount of pine present across the modern day Piedmont landscape, with it being especially prevalent in South Carolina, Georgia, and Alabama (USGS 1992). To some extent, the prevalence of pine in these southern portions of the region may represent natural conditions (Nelson 1957). It is possible that the more heavily mixed or pine-dominated forests of the southern Piedmont should be recognized as a different system, but distinguishing natural examples is difficult given a long history of land-use impacts and resulting vegetational changes in the region (Brender 1974). In addition, Skeen et al. (1993) assert that "the oak-hickory-pine designation may be reflective of past land use and disturbance history and that the steady-state typal forest of the southeastern Piedmont is in reality oak-hickory-yellow poplar."

There are fairly clear variations within this system between dry and dry-mesic forests and also between those on acidic or basic soils. These might warrant separate systems, but the similar canopy composition and similar dynamics tie them together, and those distinctions may best be made at the association level. Large areas once dominated by oak-hickory forests now have successional pine forest. This may be regarded as a distinct phase of this system for mapping purposes.

Similar Ecological Systems:
- Central Appalachian Dry Oak-Pine Forest (CES202.591)--occurs to the north and is more Appalachian in character.
- Southeastern Interior Longleaf Pine Woodland (CES202.319)
- Southern Appalachian Low-Elevation Pine Forest (CES202.332)
- Southern Appalachian Montane Pine Forest and Woodland (CES202.331)
- Southern Piedmont Mesic Forest (CES202.342)

Related Concepts:
- Chestnut Oak: 44 (Eyre 1980) Finer
- Dry Oak-Hickory Forest (Schafale and Weakley 1990) Broader
- Dry-Mesic Oak-Hickory Forest (Schafale and Weakley 1990) Broader
- Loblolly Pine Savanna (VDNH unpubl. data) Undetermined
- Shortleaf Pine - Oak: 76 (Eyre 1980) Finer
- Shortleaf Pine: 75 (Eyre 1980) Finer
- White Oak - Black Oak - Northern Red Oak: 52 (Eyre 1980) Finer
- White Oak: 53 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs on upland ridges and upper to midslopes, occupying most of the uplands where soils are not rocky or otherwise extreme. Moisture conditions, determined by topography, are dry to dry-mesic. This system may occur on any kind of rock type, with rock chemistry being an important determinant of variation. Soils include almost the full range of upland soils, with only the shallowest rocky soils and those with extreme clay hardpans excluded.

The Piedmont has mostly gently rolling topography ranging from 90 to 365 m (300-1200 feet) elevation. Several erosion-resistant metamorphic and igneous rock types have left monadnocks that stand 60 to 305 m (200-1000 feet) above the remaining landscape. Average annual precipitation is 110-122 cm (44-48 inches). The original vegetation as described by early explorers and the first settlers was a mosaic of forest and open woodland, with interspersed savannas or prairies (Lederer 1672, Logan 1859). The prairie component was located on the flat to convex and gently rolling uplands of the larger fire compartments. The largest of these in the southern part of the range was up to five miles wide without a tree or only a few blackjack oaks (Logan 1859).

This system encompasses the prevailing upland forests of the southern Piedmont. High-quality and historic examples are typically dominated by combinations of upland oaks, sometimes with pines as a significant component, especially in the southern portions of the region. These forests occur in a variety of habitats and, under natural conditions, were the matrix vegetation type covering most of the landscape.

There are fairly dramatic differences in the amount of pine present across the modern day Piedmont landscape, with it being especially prevalent in South Carolina, Georgia and Alabama (USGS 1992). To some extent, the prevalence of pine in these southern portions of the region may represent natural conditions (Nelson 1957). It is possible that the more heavily mixed or pine-dominated forests of the southern Piedmont should be recognized as a different system, but distinguishing natural examples is difficult given a long history of land-use impacts and resulting vegetational changes in the region (Brender 1974). In addition, Skeen et al. (1993) assert that "the oak-hickory-pine designation may be reflective of past land use and disturbance history and that the steady-state typal forest of the southeastern Piedmont is in reality oak-hickory-yellow poplar." Although these forests have often been called "oak-hickory" (Braun 1950) or "oak-pine-hickory" (Kuchler 1964, Greller 1989, Skeen et al. 1993), Monk et al. (1990) concluded there was insufficient abundance of hickory to justify including this genus in the name of such forests.

Vegetation: Vegetation consists of forests dominated by combinations of upland oaks, particularly *Quercus alba, Quercus rubra, Quercus velutina, Quercus stellata, Quercus coccinea*, and *Quercus falcata*, along with *Carya glabra, Carya alba*, and other *Carya* spp. Other common tree species include *Pinus taeda, Pinus echinata, Pinus virginiana, Acer rubrum, Liquidambar styraciflua*, and *Liriodendron tulipifera*. In successional forests recovering from clearcutting or cultivation, the pines dominate for a number of decades, with oaks and hickories gradually invading the understory. A well-developed understory and shrub layer is generally present, with species varying with soil chemistry. The herb layer is sparse to at most moderate in density. Before natural fires were suppressed, the forests presumably had less understory and shrub component and probably a grassy herb layer. There is some uncertainly about the composition and physiognomy of this system under presettlement conditions, in particular with some debate about the relative importance of *Quercus* spp., *Carya* spp., and *Liriodendron tulipifera*, as well as the role of *Pinus echinata* and its increasing abundance to the south.

Dynamics: Fire was probably an important natural factor in this system, affecting vegetation structure and composition of the lower strata. It may have been important in favoring oaks and pines over other trees in the canopy. Fires were likely almost always low-intensity surface fires. Native American burning was also important in the Piedmont (Cowell 1998). These forests appear to occur naturally as predominantly old-growth, with canopy dynamics dominated by gap-phase regeneration. Small to medium-sized canopy gaps created by wind are the primary natural disturbance at present, and probably were in the past as well. Fire likely created some small to medium-sized gaps in the past also, and likely caused all canopy gaps to persist longer. The dominant tree species are capable of living for several centuries.

Fire and grazing are possibly the most important natural processes affecting the floristic composition and vegetation structure of this system (Landfire 2007a). The presence of frequent (2-5 years) surface fire is important in order to support the reproduction of *Pinus echinata* and the development of diverse herbaceous understories. *Pinus echinata* is a shade-intolerant species and does not survive or grow well when fire is absent or where fire-return times are very long. Where fire occurs at an appropriate frequency, the stand may develop a relatively pure canopy of *Pinus echinata*, typified by a very open woodland structure with scattered overstory trees and an herbaceous-dominated understory (Landfire 2007a).

The frequency of fire is variable across the landscape to create a mosaic of vegetation. However, most agree that the fire-return interval was relatively short. Fire may have been as frequent as every two to three years. Brewer (2001) compared the current tree species composition to bearing tree records and found that *Pinus echinata* and more fire-tolerant species such as *Quercus velutina* and *Quercus stellata* were prevalent on the landscape, indicating a greater fire frequency. Without a short fire-return interval, community succession tends to favor upland mixed pine-xeric hardwood forests or hardwood-dominated forests. Landers (1989) inferred a fire-return interval of 10 times per century for pure stands of *Pinus echinata*.

Lightning fires occurred primarily during the spring dry season (April and May) with a second peak of Native American burning during the fall (October and November). Occasionally, during extensive droughts, mixed-severity or stand-replacement fires did occur, especially on drier pine-dominated sites. Local thunderstorms and outbreaks of southern pine beetle (*Dendroctonus frontalis*) created gaps on a small but continual basis. More extensive regional disturbances included tropical storms during the growing season, ice storms during winter, and tornadoes throughout the year (Landfire 2007a).

Component Associations:

- *Carya glabra - Fraxinus americana / Acer leucoderme / Piptochaetium avenaceum* Woodland (CEGL008489, G2G3Q)
- *Pinus echinata - (Quercus stellata, Quercus marilandica) / Schizachyrium scoparium - Salvia urticifolia* Woodland (CEGL008492, G2?)
- *Pinus echinata - Quercus marilandica / Kalmia latifolia - Symplocos tinctoria* Woodland (CEGL004446, G2?)
- *Quercus alba - Carya glabra - Fraxinus americana / Acer leucoderme / Vitis rotundifolia* Forest (CEGL004541, G2?)
- *Quercus alba - Carya glabra / Schizachyrium scoparium - Helianthus divaricatus - Salvia urticifolia - Parthenium auriculatum* Woodland (CEGL003721, G1?)
- *Quercus alba - Quercus (coccinea, velutina, prinus) / Gaylussacia baccata* Forest (CEGL008521, G5)
- *Quercus alba - Quercus rubra - Carya (ovata, carolinae-septentrionalis) / Cercis canadensis* Forest (CEGL007232, G3G4)
- *Quercus alba - Quercus rubra - Carya alba / Cornus florida / Vaccinium stamineum / Desmodium nudiflorum* Piedmont Forest (CEGL008475, G4G5)
- *Quercus alba - Quercus stellata - Carya carolinae-septentrionalis / Acer leucoderme - Cercis canadensis* Forest (CEGL007773,

G2G3)
- *Quercus alba - Quercus velutina - Quercus stellata / Schizachyrium scoparium - Desmodium* spp. Woodland (CEGL003722, G1?)
- *Quercus falcata - Quercus alba - Carya alba / Oxydendrum arboreum / Vaccinium stamineum* Forest (CEGL007244, G4G5)
- *Quercus prinus - (Quercus coccinea) / Carya pallida / Vaccinium arboreum - Vaccinium pallidum* Forest (CEGL008431, G4G5)
- *Quercus prinus - Carya* spp. *- Quercus velutina / Vaccinium arboreum / Iris verna var. smalliana* Forest (CEGL007261, G3G4)
- *Quercus prinus - Quercus alba / Oxydendrum arboreum / Kalmia latifolia* Forest (CEGL004415, G3)
- *Quercus prinus - Quercus alba / Oxydendrum arboreum / Vitis rotundifolia* Forest (CEGL006281, G3G4)
- *Quercus prinus - Quercus marilandica* Piedmont Woodland (CEGL003708, G2G3)
- *Quercus prinus - Quercus stellata - Carya glabra / Vaccinium arboreum - Viburnum rufidulum* Forest (CEGL004416, G2G3)

SPATIAL CHARACTERISTICS

Spatial Summary: Naturally a matrix system, dominating most of the upland landscape in the Piedmont. Remnants are mostly large patch, but some large expanses remain.

Size: Once occurred as the matrix system, with contiguous patches covering many thousands of acres. Mature patches are now mostly reduced to large-patch remnants, some of hundreds of acres. A few areas have substantially forested landscapes in which oak-hickory forests in some condition cover thousands of acres in nearly contiguous patches.

Adjacent Ecological Systems:
- Piedmont Hardpan Woodland and Forest (CES202.268)
- Piedmont Seepage Wetland (CES202.298)
- Piedmont Upland Depression Swamp (CES202.336)
- Southeastern Interior Longleaf Pine Woodland (CES202.319)
- Southern Piedmont Cliff (CES202.386)
- Southern Piedmont Glade and Barrens (CES202.328)
- Southern Piedmont Granite Flatrock and Outcrop (CES202.329)
- Southern Piedmont Mesic Forest (CES202.342)

Adjacent Ecological System Comments: Most commonly associated with Southern Piedmont Mesic Forest (CES202.342). Various rock outcrops, Piedmont Hardpan Woodland and Forest (CES202.268), Piedmont Upland Depression Swamp (CES202.336), and other small-patch systems may be embedded.

DISTRIBUTION

Range: This system ranges throughout the Piedmont from Alabama to Virginia. In Virginia, it is primarily central and southern, but extends into a narrow portion of northern Virginia in the Piedmont ecoregion.

Divisions: 202:C
Nations: US
Subnations: AL, GA, NC, SC, VA
Map Zones: 54:C, 59:C, 60:C, 61:C
USFS Ecomap Regions: 231A:CC, 231I:CC
TNC Ecoregions: 52:C

SOURCES

References: Braun 1950, Brender 1974, Brewer 2001, Comer et al. 2003, Cowell 1998, Eyre 1980, Godfrey 1982b, Greller 1989, Kuchler 1964, Landers 1989, Landfire 2007a, Lederer 1672, Logan 1859, McDonald et al. 2002, Monk et al. 1990, Nelson 1957, Nowak 2002, Oosting 1942, Schafale and Weakley 1990, Skeen et al. 1993, Taecker 2007, Taverna et al. 2005, USGS 1992, VDNH unpubl. data

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723166#references

Description Author: M. Schafale, R. Evans, M. Pyne, mod. S. Gawler
Version: 14 Jan 2014 **Stakeholders:** East, Southeast
Concept Author: M. Schafale, R. Evans, M. Pyne **ClassifResp:** Southeast

SOUTHERN PIEDMONT MESIC FOREST (CES202.342)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Very Long Disturbance Interval; Broad-Leaved Deciduous Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: EVT 2316; ESLF 4122; ESP 1316

CONCEPT

Summary: This system encompasses mixed deciduous hardwood or occasionally hardwood-pine forests of mesic sites in the Piedmont of the southeastern United States. Most examples occur on lower or north-facing slopes where topography creates mesic moisture conditions. A mix of a small number of mesophytic trees is usually dominant, with *Fagus grandifolia* most prominent. Both acidic and basic substrates are currently included in this concept, as are certain heath bluffs, where dense shrub layers of mesophytic ericaceous shrubs may occur beneath an open tree canopy. Fire is naturally infrequent in this system, due to the slopes and moist conditions. If fire does penetrate, it is likely to be low in intensity and may not have significant ecological effects. Vegetation consists of forests dominated by combinations of trees that include a significant component of mesophytic species. *Fagus grandifolia* is almost always abundant and is often strongly dominant. *Quercus rubra, Liriodendron tulipifera,* and *Acer rubrum* may be abundant. In basic soil examples, *Fraxinus americana* and *Acer barbatum* are also abundant. A well-developed understory is usually present. Herbs range from fairly dense in basic examples to sparse in acidic examples, and may be nearly absent in a few. The composition of all lower strata varies substantially with soil acidity.
Classification Comments: This system is distinguished from Southern Piedmont Dry Oak-(Pine) Forest (CES202.339) by the significant component of mesophytic tree species, particularly *Fagus grandifolia,* as well as by occurrence on mesic topographic sites. Some oaks may also be present. It is distinguished from Southern Piedmont Small Floodplain and Riparian Forest (CES202.323) and Southern Piedmont Large Floodplain Forest (CES202.324) by the absence of characteristic alluvial or bottomland species, along with upland position. This boundary can be somewhat difficult to place, as some alluvial species will occur upslope in basic soils, and some mesic forests will extend onto higher terraces in bottomlands. This system is closely related to Southern Atlantic Coastal Plain Mesic Hardwood Forest (CES203.242) and in the northern part of the range may be very similar except for the geologic substrate. Farther south, there is a greater floristic difference between the two. This system is related to the cove forest systems of the southern Appalachians but lacks a number of species characteristic of those regions. These species are present in increasing numbers as one goes west in the Piedmont. The westernmost Piedmont has some examples of well-developed Southern and Central Appalachian Cove Forest (CES202.373) in the more mountainous portions. Distinct subsets of this system, which could be recognized as different systems, are the basic/circumneutral and acidic examples, and also the shrubby heath bluffs.
Similar Ecological Systems:
- Southern and Central Appalachian Cove Forest (CES202.373)
- Southern Atlantic Coastal Plain Mesic Hardwood Forest (CES203.242)
- Southern Piedmont Dry Oak-(Pine) Forest (CES202.339)
- Southern Piedmont Large Floodplain Forest (CES202.324)
- Southern Piedmont Small Floodplain and Riparian Forest (CES202.323)

Related Concepts:
- Basic Mesic Forest (Fleming et al. 2005) Undetermined
- Beech - Sugar Maple: 60 (Eyre 1980) Finer
- Northern Red Oak: 55 (Eyre 1980) Finer
- White Oak: 53 (Eyre 1980) Finer
- Yellow-Poplar: 57 (Eyre 1980) Finer

DESCRIPTION

Environment: Examples occur on lower slopes or on north-facing slopes, where topography creates mesic moisture conditions. This system may occur on any kind of rock type, with rock chemistry being an important determinant of variation. Most soils are acidic, but those formed on mafic rocks often are circumneutral to basic. The moist conditions and slope limit natural fire intensity and frequency.
Vegetation: Vegetation consists of forests dominated by combinations of trees that include a significant component of mesophytic species. *Fagus grandifolia* is almost always abundant and is often strongly dominant. *Quercus rubra, Liriodendron tulipifera,* and *Acer rubrum* may be abundant. In basic soil examples, *Fraxinus americana* and *Acer barbatum* are also abundant. A well-developed understory is usually present. Shrubs are generally sparse to moderate in density, except in heath bluffs. Herbs range from fairly dense in basic examples to sparse in acidic examples, and may be nearly absent in a few. The composition of all lower strata varies substantially with soil acidity. Basic examples have a fairly diverse suite, especially of herbs, which may include a number of species shared with Southern and Central Appalachian Cove Forest (CES202.373). The more common acidic examples have fewer species,

though generally they have a higher species richness than the drier systems.
Dynamics: Fire is naturally infrequent in this system, due to the slopes and moist conditions. If fire does penetrate, it is likely to be low in intensity and may not have significant ecological effects. These forests generally exist naturally as old-growth forests, with canopy dynamics dominated by gap-phase regeneration. Small to occasional medium-sized canopy gaps created by wind are likely the primary form of natural disturbance, though occasional fires might create gaps. Most of the prevailing species are shade-tolerant. Most are not very fire-tolerant. The mesophytic forest type is fire regime class III, surface fires with return intervals of 20 to 70 years (Landfire 2007a). Mixed-severity fires may occur approximately every 100 years depending on climatic conditions. This effect may also be achieved by recurrent, severe insect defoliations or droughts. Ice, straight-line winds or microbursts may cause blow-downs on a scale of 1 to 10 acres. Stand-replacement fires happen very infrequently. Low-intensity surface fires, whether natural or set by Native Americans, would have maintained the more fire-resistant American chestnut and oak species.

Component Associations:
- *Fagus grandifolia - Liriodendron tulipifera - Carya cordiformis / Lindera benzoin / Podophyllum peltatum* Forest (CEGL006055, G4?)
- *Fagus grandifolia - Liriodendron tulipifera / Euonymus americanus / Athyrium filix-femina ssp. asplenioides* Forest (CEGL007201, G4)
- *Fagus grandifolia - Quercus (alba, rubra) - Liriodendron tulipifera / (Ilex opaca var. opaca) / Polystichum acrostichoides* Forest (CEGL006075, G5)
- *Fagus grandifolia - Quercus (alba, velutina, prinus) / Kalmia latifolia* Forest (CEGL006919, G4)
- *Fagus grandifolia - Quercus alba / Kalmia latifolia - (Symplocos tinctoria, Rhododendron catawbiense) / Galax urceolata* Forest (CEGL004539, G2G3)
- *Fagus grandifolia - Quercus rubra / Acer barbatum - Aesculus sylvatica / Actaea racemosa - Adiantum pedatum* Forest (CEGL008466, G3G4)
- *Fagus grandifolia - Quercus rubra / Cornus florida / Polystichum acrostichoides - Hexastylis virginica* Forest (CEGL008465, G3G4)
- *Quercus alba - Carya alba / Euonymus americanus / Hexastylis arifolia* Forest (CEGL006227, G4G5)
- *Quercus alba - Quercus rubra - Quercus prinus - Tilia americana var. caroliniana / Ostrya virginiana* Forest (CEGL004542, G2G3)
- *Quercus alba - Quercus rubra - Quercus prinus / Collinsonia canadensis - Podophyllum peltatum - Amphicarpaea bracteata* Forest (CEGL007692, G3)
- *Quercus rubra - Quercus alba - Carya glabra / Geranium maculatum* Forest (CEGL007237, G4Q)
- *Quercus rubra / Magnolia tripetala - Cercis canadensis / Actaea racemosa - Tiarella cordifolia* Forest (CEGL003949, G3?)
- *Tilia americana var. heterophylla - Fraxinus americana - (Ulmus rubra) / Sanguinaria canadensis - (Aquilegia canadensis, Asplenium rhizophyllum)* Forest (CEGL007711, G2G3)

Spatial Characteristics

Spatial Summary: Large- to small-patch system occurring as a regular part of the landscape mosaic in most of the Piedmont.
Size: Generally occurs as large to small patches, often in convoluted bodies following slopes in the dissected lands along streams and rivers. Contiguous convoluted patches or closely associated sets of patches may once have covered thousands of acres and perhaps could have been connected along miles of river bluffs. However, the effect of past fire on the extent of this system is uncertain, and it may have been confined to a more limited range of topography and to smaller, discontinuous patches than it now appears. Most remnants at present are several tens to hundreds of acres.
Adjacent Ecological Systems:
- Southern Piedmont Cliff (CES202.386)
- Southern Piedmont Dry Oak-(Pine) Forest (CES202.339)
- Southern Piedmont Glade and Barrens (CES202.328)
- Southern Piedmont Large Floodplain Forest (CES202.324)
- Southern Piedmont Small Floodplain and Riparian Forest (CES202.323)

Adjacent Ecological System Comments: Most commonly associated with Southern Piedmont Dry Oak-(Pine) Forest (CES202.339), Southern Piedmont Small Floodplain and Riparian Forest (CES202.323), and Southern Piedmont Large Floodplain Forest (CES202.324). May contain embedded Southern Piedmont Cliff (CES202.386) or Southern Piedmont Glade and Barrens (CES202.328).

Distribution

Range: This ecological system ranges throughout the southern Piedmont, from Virginia to Alabama.
Divisions: 202:C
Nations: US
Subnations: AL, GA, NC, SC, VA
Map Zones: 54:C, 59:C, 60:C, 61:C
USFS Ecomap Regions: 231A:CC, 231I:CC
TNC Ecoregions: 52:C

Sources

References: Anderson 1999a, Batista and Platt 1997, Comer et al. 2003, Edwards et al. 2013, Engeman et al. 2007, Eyre 1980,

Fleming et al. 2005, Landfire 2007a

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723165#references

Description Author: M. Schafale and R. Evans

Version: 06 Feb 2014 **Stakeholders:** East, Southeast

Concept Author: M. Schafale and R. Evans **ClassifResp:** Southeast

SOUTHERN RIDGE AND VALLEY / CUMBERLAND DRY CALCAREOUS FOREST (CES202.457)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch, Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Circumneutral Soil; Broad-Leaved Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Mixed evergreen-deciduous closed tree canopy
National Mapping Codes: EVT 2376; ESLF 4319; ESP 1376

CONCEPT

Summary: This system includes dry to dry-mesic calcareous forests of the Southern Ridge and Valley region of Alabama and Georgia, extending north into Tennessee, Kentucky, Virginia and adjacent West Virginia. It includes calcareous forests on lower escarpments of the Cumberland Plateau and other related areas. Examples occur on a variety of different landscape positions and occur on generally deeper soils than glade systems of the same regions. This system is distinguished from those farther north in the Ridge and Valley by its relatively southern location in the region, in an area which is transitional to the "Oak-Pine-Hickory" region. High-quality and historic examples are typically dominated by combinations of *Quercus* species and *Carya* species, sometimes with *Pinus* species and/or *Juniperus virginiana* as a significant component in certain landscape positions and with particular successional histories. These forests occur in a variety of habitats and are the matrix vegetation type that covers portions of the landscape under natural conditions. Examples can occur on a variety of topographic and landscape positions including valley floors, sideslopes, and lower to midslopes. Fire frequency and intensity are factors determining the relative mixture of deciduous hardwood versus evergreen trees in this system. Much of this system is currently composed of successional forests that have arisen after repeated cutting, clearing, and cultivation of the original forests. The range of this system is primarily composed of circumneutral substrates, which exert an expected influence on the composition of the vegetation.

Classification Comments: This system is defined as distinct because of its location in the portion of the Ridge and Valley region which is transitional to the "Oak-Pine-Hickory" region (Greller 1988). Most of the zone of occurrence is attributed to the "Southern Limestone/Dolomite Valleys and Low Rolling Hills" (67f) and the "Southern Shale Valleys" (67g) of Griffith et al. (2001), as well as calcareous parts of 68b and 68c (where it is more limited in extent). In addition, the system could be found in drier, more exposed portions of 66f, "Limestone Valleys and Coves" (Griffith et al. 2001), but most of this terrain is probably more mesic and concave. This ecoregion and "Southern Sedimentary Ridges" (66e) are part of the "Blue Ridge" but are clearly transitional to the Ridge and Valley region. Ecoregion 66e is more likely too acidic to support this system. It is also likely in the "Carter Hills" (EPA Ecoregion 70h of Woods et al. (2002)) of Kentucky and in limited portions of related parts of Ecoregion 70 (Western Allegheny Plateau) in Kentucky.

Similar Ecological Systems:
- Allegheny-Cumberland Dry Oak Forest and Woodland (CES202.359)--is found in some similar landscapes but on more acidic and nutrient-poor substrates, which usually correspond to different landform positions.
- Central Appalachian Alkaline Glade and Woodland (CES202.602)--of central Appalachians, mainly Virginia and north; need to clarify ranges; generally more open stands, not closed canopy.
- Central Interior Highlands Calcareous Glade and Barrens (CES202.691)--is related and overlapping in range, with more open physiognomy.
- Southern Ridge and Valley Calcareous Glade and Woodland (CES202.024)--is more open, with an overlapping range.

Related Concepts:
- Eastern Redcedar: 46 (Eyre 1980) Finer
- Post Oak - Blackjack Oak: 40 (Eyre 1980) Finer
- Sugar Maple: 27 (Eyre 1980) Finer
- White Oak - Black Oak - Northern Red Oak: 52 (Eyre 1980) Finer
- White Oak: 53 (Eyre 1980) Finer
- Xeric Calcareous Forest (Evans 1991) Intersecting

DESCRIPTION

Environment: Examples of this forest and woodland system occur usually on dry sites, on a variety of topographic and landscape positions, including sideslopes (particularly south- and west-facing ones), ridges, and knobs, as well as valley floors, depending on where the base-rich rock is present or crops out, and where the soils are influenced by calcareous/circumneutral geology. Elevation is generally between 200 and 500 m. In some landscapes, the ridges and ridgetops will more likely be composed of sandstones and other more weather-resistant and acidic materials.

Vegetation: Natural vegetation consists of forests (or woodlands) dominated most typically by *Quercus alba, Quercus muehlenbergii, Quercus stellata,* and *Quercus shumardii,* with varying amounts of *Carya* spp., *Acer saccharum, Acer barbatum, Acer leucoderme, Acer rubrum,* and other species. This system concept also includes successional communities that have been impacted by logging or agriculture, including upland forest types dominated by *Liriodendron tulipifera, Pinus* spp., *Juniperus virginiana,* and

Robinia pseudoacacia.
Dynamics: Fire frequency and intensity are factors determining the relative mixture of deciduous hardwood versus evergreen trees in this system. Presettlement fire-return intervals are believed to have ranged from 3 to 14 years from both lightning and Native American ignitions. These frequent surface fires maintained the grassy understory and kept hardwoods and shrubs from dominating the understory and forming a midstory layer. These fires occurred in the dormant season with occasional growing-season mosaic fires (most likely occurring infrequently once or twice every 20 to 25 years) (Landfire 2007a). Occasionally, during extensive droughts, mixed-severity or stand-replacement fires could occur, especially in drier stands or those containing *Juniperus virginiana*. In addition, local thunderstorm-caused blowdowns and windthrow created gaps on a small but continual basis. More extensive regional disturbances included winter ice storms. Dense stands of middle to older aged pines (where present) were susceptible to periodic mortality from bark beetle epidemics, and younger *Juniperus virginiana* trees were killed by periodic droughts.

Component Associations:
- *Acer saccharum - Quercus muehlenbergii / Cercis canadensis* Forest (CEGL006017, G4?)
- *Quercus alba - Quercus rubra - Carya ovata / Cercis canadensis - Juniperus virginiana var. virginiana* Forest (CEGL007240, G4)
- *Quercus alba - Quercus rubra - Quercus muehlenbergii / Cercis canadensis* Forest (CEGL002070, G4G5)
- *Quercus alba - Quercus stellata / Ostrya virginiana - Acer barbatum / Chasmanthium sessiliflorum* Forest (CEGL008443, G3G4)
- *Quercus muehlenbergii - Quercus shumardii - Carya (carolinae-septentrionalis, ovata)* Forest (CEGL007808, G3)
- *Quercus shumardii - Quercus muehlenbergii - Acer (barbatum, leucoderme, saccharum) / Ostrya virginiana* Forest (CEGL008442, G2G3)
- *Quercus stellata - Juniperus virginiana var. virginiana / Ulmus alata - (Cotinus obovatus)* Woodland (CEGL004583, G3)

SPATIAL CHARACTERISTICS

Spatial Summary: This system can be large patch in some areas and matrix in others, depending on the arrangement of geological strata and relative degree of erosion of the landscape. If erosion has exposed extensive areas of calcareous materials, the extent is likely to be matrix rather than large patch.

DISTRIBUTION

Range: This system is endemic to the Southern Ridge and Valley and the Cumberland Plateau escarpment in Alabama, Georgia, Tennessee, Kentucky, Virginia and adjacent West Virginia.
Divisions: 202:C
Nations: US
Subnations: AL, GA, KY, TN, VA, WV
Map Zones: 48:C, 53:C, 57:C, 61:C
USFS Ecomap Regions: 221Jb:CCC, 222J:CC, 231Cc:CCC, 231D:CC
TNC Ecoregions: 50:C, 59:C

SOURCES

References: Comer et al. 2003, Evans 1991, Eyre 1980, Greller 1988, Griffith et al. 2001, Landfire 2007a, TNC 1996c, Woods et al. 2002
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723128#references
Description Author: R. Evans and M. Pyne
Version: 14 Jan 2014 **Stakeholders:** East, Southeast
Concept Author: R. Evans and M. Pyne **ClassifResp:** Southeast

SOUTHERN ROCKY MOUNTAIN DRY-MESIC MONTANE MIXED CONIFER FOREST AND WOODLAND (CES306.823)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: RM Montane Mesic Mixed Conifer; Moderate (100-500 yrs) Persistence; Montane [Montane]; Montane [Lower Montane]; Forest and Woodland (Treed); Aridic; Intermediate Disturbance Interval; F-Patch/Medium Intensity; F-Landscape/Medium Intensity; Needle-Leaved Tree
Non-Diagnostic Classifiers: Ridge/Summit/Upper Slope; Sideslope; Temperate [Temperate Continental]; Mesotrophic Soil; Shallow Soil; Mineral: W/ A-Horizon <10 cm
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2051; ESLF 4238; ESP 1051

CONCEPT

Summary: This is a highly variable ecological system of the montane zone of the Rocky Mountains. It occurs throughout the southern Rockies, north and west into Utah, Nevada, Wyoming and Idaho. These are mixed-conifer forests occurring on all aspects at elevations ranging from 1200 to 3300 m. Rainfall averages less than 75 cm per year (40-60 cm), with summer "monsoons" during the growing season contributing substantial moisture. The composition and structure of the overstory are dependent upon the temperature and moisture relationships of the site and the successional status of the occurrence. *Pseudotsuga menziesii* and *Abies concolor* are most frequent, but *Pinus ponderosa* may be present to codominant. *Pinus flexilis* is common in Nevada. *Pseudotsuga menziesii* forests occupy drier sites, and *Pinus ponderosa* is a common codominant. *Abies concolor*-dominated forests occupy cooler sites, such as upper slopes at higher elevations, canyon sideslopes, ridgetops, and north- and east-facing slopes which burn somewhat infrequently. *Picea pungens* is most often found in cool, moist locations, often occurring as smaller patches within a matrix of other associations. As many as seven conifers can be found growing in the same occurrence, and there are a number of cold-deciduous shrub and graminoid species common, including *Arctostaphylos uva-ursi, Mahonia repens, Paxistima myrsinites, Symphoricarpos oreophilus, Jamesia americana, Quercus gambelii*, and *Festuca arizonica*. This system was undoubtedly characterized by a mixed-severity fire regime in its "natural condition," characterized by a high degree of variability in lethality and return interval.
Classification Comments: The transition between this system and Middle Rocky Mountain Montane Douglas-fir Forest and Woodland (CES306.959) in Wyoming needs to be further clarified, both in terms of floristics and distribution details. For now, it is assumed that this system does not occur in the Bighorn Range or in the Yellowstone region, but its occurrence in isolated ranges of central and western Wyoming is possible.
Similar Ecological Systems:
- Madrean Upper Montane Conifer-Oak Forest and Woodland (CES305.798)
- Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland (CES306.825)

Related Concepts:
- Blue Spruce: 216 (Eyre 1980) Finer
- Interior Douglas-fir: 210 (Eyre 1980) Intersecting
- White Fir: 211 (Eyre 1980) Intersecting

DESCRIPTION

Vegetation: This highly variable ecological system is comprised of mixed-conifer forests at montane elevations throughout the Intermountain West region. The four main alliances in this system are found on slightly different, but intermingled, biophysical environments: *Abies concolor* dominates at higher, colder locations; *Picea pungens* represents mesic conditions; and *Pseudotsuga menziesii* dominates intermediate zones. As many as seven conifers can be found growing in the same occurrence, with the successful reproduction of the diagnostic species determining the association type. Common conifers include *Pinus ponderosa, Pinus flexilis, Abies lasiocarpa var. lasiocarpa, Abies lasiocarpa var. arizonica, Juniperus scopulorum,* and *Picea engelmannii*. *Populus tremuloides* is often present as intermingled individuals in remnant aspen clones or in adjacent patches. The composition and structure of the overstory are dependent upon the temperature and moisture relationships of the site and the successional status of the occurrence (DeVelice et al. 1986, Muldavin et al. 1996).

A number of cold-deciduous shrub and graminoid species are found in many occurrences (e.g., *Arctostaphylos uva-ursi, Mahonia repens, Paxistima myrsinites, Symphoricarpos oreophilus, Jamesia americana, Quercus gambelii*, and *Festuca arizonica*). Other important species include *Acer glabrum, Acer grandidentatum, Amelanchier alnifolia, Arctostaphylos patula, Holodiscus dumosus, Jamesia americana, Juniperus communis, Physocarpus monogynus, Quercus arizonica, Quercus rugosa, Quercus X pauciloba, Quercus hypoleucoides, Robinia neomexicana, Rubus parviflorus,* and *Vaccinium myrtillus*. Where soil moisture is favorable, the herbaceous layer may be quite diverse, including graminoids *Bromus ciliatus (= Bromus canadensis), Calamagrostis rubescens, Carex geyeri, Carex rossii, Carex siccata (= Carex foenea), Festuca occidentalis, Koeleria macrantha, Muhlenbergia montana, Muhlenbergia virescens, Poa fendleriana, Pseudoroegneria spicata*, and forbs *Achillea millefolium, Arnica cordifolia, Erigeron eximius, Fragaria virginiana, Linnaea borealis, Luzula parviflora, Osmorhiza berteroi, Packera cardamine (= Senecio cardamine),*

Thalictrum occidentale, Thalictrum fendleri, Thermopsis rhombifolia, Viola adunca, and species of many other genera, including *Lathyrus, Penstemon, Lupinus, Vicia, Arenaria, Galium*, and others.

Dynamics: Forests in this ecological system represent the gamut of fire tolerance. Formerly, *Abies concolor* in the Utah High Plateaus were restricted to rather moist or less fire-prone areas by frequent ground fires. These areas experienced mixed fire severities, with patches of crowning in which all trees are killed, intermingled with patches of underburn in which larger *Abies concolor* survived (www.fs.fed.us/database/feis/). With fire suppression, *Abies concolor* has vigorously colonized many sites formerly occupied by open *Pinus ponderosa* woodlands. These invasions have dramatically changed the fuel load and potential behavior of fire in these forests. In particular, the potential for high-intensity crown fires on drier sites now codominated by *Pinus ponderosa* and *Abies concolor* has increased. Increased landscape connectivity, in terms of fuel loadings and crown closure, has also increased the potential size of crown fires.

Pseudotsuga menziesii forests are the only true 'fire-tolerant' occurrences in this ecological system. *Pseudotsuga menziesii* forests were probably subject to a moderate-severity fire regime in presettlement times, with fire-return intervals of 30-100 years. Many of the important tree species in these forests are fire-adapted (*Populus tremuloides, Pinus ponderosa, Pinus contorta*) (Pfister et al. 1977), and fire-induced reproduction of *Pinus ponderosa* can result in its continued codominance in *Pseudotsuga menziesii* forests (Steele et al. 1981). Seeds of the shrub *Ceanothus velutinus* can remain dormant in forest occurrences for 200 years (Steele et al. 1981) and germinate abundantly after fire, competitively suppressing conifer seedlings. Successional relationships in this system are complex. *Pseudotsuga menziesii* is less shade-tolerant than many northern or montane trees such as *Tsuga heterophylla, Abies concolor, Picea engelmannii*, and seedlings compete poorly in deep shade. At drier locales, seedlings may be favored by moderate shading, such as by a canopy of *Pinus ponderosa*, which helps to minimize drought stress. In some locations, much of these forests have been logged or burned during European settlement, and present-day occurrences are second-growth forests dating from fire, logging, or other occurrence-replacing disturbances (Mauk and Henderson 1984, Chappell et al. 1997).

Picea pungens is a slow-growing, long-lived tree which regenerates from seed (Burns and Honkala 1990a). Seedlings are shallow-rooted and require perennially moist soils for establishment and optimal growth. *Picea pungens* is intermediate in shade tolerance, being somewhat more tolerant than *Pinus ponderosa* or *Pseudotsuga menziesii*, and less tolerant than *Abies lasiocarpa* or *Picea engelmannii*. It forms late-seral occurrences in the subhumid regions of the Utah High Plateaus. It is common for these forests to be heavily disturbed by grazing or fire.

In general, fire suppression has lead to the encroachment of more shade-tolerant, less fire-tolerant species (e.g., climax) into occurrences and an attendant increase in landscape homogeneity and connectivity (from a fuels perspective). This has increased the lethality and potential size of fires.

Component Associations:

- *Abies concolor - (Pseudotsuga menziesii) / Jamesia americana - Holodiscus dumosus* Scree Woodland (CEGL000890, GNR)
- *Abies concolor - (Pseudotsuga menziesii) / Quercus gambelii / Carex rossii* Forest (CEGL005351, GNR)
- *Abies concolor - (Pseudotsuga menziesii) / Thalictrum fendleri* Forest (CEGL005353, GNR)
- *Abies concolor - Pinus ponderosa / Carex inops ssp. inops* Forest (CEGL000257, G3)
- *Abies concolor - Pinus ponderosa / Cercocarpus ledifolius* Forest (CEGL002732, G4?)
- *Abies concolor - Pinus ponderosa / Symphoricarpos* spp. Forest (CEGL000018, G3)
- *Abies concolor - Pseudotsuga menziesii / Acer glabrum* Forest (CEGL000240, G4)
- *Abies concolor - Pseudotsuga menziesii / Carex rossii* Forest (CEGL000431, G2?)
- *Abies concolor - Pseudotsuga menziesii / Carex siccata* Forest (CEGL000244, G2)
- *Abies concolor - Pseudotsuga menziesii / Erigeron eximius* Forest (CEGL000247, G5)
- *Abies concolor - Pseudotsuga menziesii / Festuca thurberi - Danthonia parryi* Woodland (CEGL005350, GNR)
- *Abies concolor - Pseudotsuga menziesii / Lathyrus lanszwertii var. leucanthus* Forest (CEGL000250, G3)
- *Abies concolor - Pseudotsuga menziesii / Robinia neomexicana* Woodland (CEGL000891, G4Q)
- *Abies concolor - Pseudotsuga menziesii / Vaccinium myrtillus* Forest (CEGL000265, G5)
- *Abies concolor / Arctostaphylos patula* Forest (CEGL000242, G5)
- *Abies concolor / Arctostaphylos uva-ursi* Forest (CEGL000243, G5)
- *Abies concolor / Cercocarpus ledifolius* Woodland (CEGL000885, G4)
- *Abies concolor / Festuca arizonica* Woodland (CEGL000887, G4)
- *Abies concolor / Juniperus communis* Forest (CEGL000249, G4?)
- *Abies concolor / Leymus triticoides* Woodland (CEGL000886, G3)
- *Abies concolor / Mahonia repens* Forest (CEGL000251, G5)
- *Abies concolor* / Mixed Grasses Forest (CEGL005357, GNR)
- *Abies concolor / Muhlenbergia virescens* Forest (CEGL000252, G5)
- *Abies concolor / Osmorhiza berteroi* Forest (CEGL000253, G4G5)
- *Abies concolor / Physocarpus malvaceus* Forest (CEGL000254, G4G5)
- *Abies concolor / Quercus gambelii* Forest (CEGL000261, G5)
- *Abies concolor / Symphoricarpos oreophilus* Forest (CEGL000263, G5)
- *Ceanothus velutinus* Shrubland (CEGL002167, GNR)
- *Picea pungens / Arctostaphylos uva-ursi* Forest (CEGL000385, G4)
- *Picea pungens / Festuca arizonica* Woodland (CEGL000895, G5)
- *Pinus ponderosa - Pseudotsuga menziesii / Arctostaphylos patula* Woodland (CEGL000209, G3)

- *Pinus ponderosa - Pseudotsuga menziesii / Purshia tridentata* Woodland (CEGL000214, G3)
- *Pseudotsuga menziesii / Amelanchier alnifolia* Forest (CEGL000420, G2Q)
- *Pseudotsuga menziesii / Arctostaphylos patula* Woodland (CEGL000423, G4)
- *Pseudotsuga menziesii / Arctostaphylos uva-ursi* Forest (CEGL000424, G4)
- *Pseudotsuga menziesii / Arnica cordifolia* Forest (CEGL000427, G4)
- *Pseudotsuga menziesii / Artemisia tridentata* (ssp. *vaseyana*, ssp. *wyomingensis*) Woodland (CEGL002808, GNR)
- *Pseudotsuga menziesii / Bromus ciliatus* Forest (CEGL000428, G4)
- *Pseudotsuga menziesii / Carex geyeri* Forest (CEGL000430, G4?)
- *Pseudotsuga menziesii / Cercocarpus ledifolius* Woodland (CEGL000897, G3G4)
- *Pseudotsuga menziesii / Cercocarpus montanus* Woodland (CEGL000898, G4?)
- *Pseudotsuga menziesii / Festuca arizonica* Forest (CEGL000433, G5)
- *Pseudotsuga menziesii / Festuca idahoensis* Woodland (CEGL000900, G4)
- *Pseudotsuga menziesii / Holodiscus dumosus* Scree Woodland (CEGL000902, G3G4)
- *Pseudotsuga menziesii / Jamesia americana* Forest (CEGL000438, G3G4)
- *Pseudotsuga menziesii / Juniperus communis* Forest (CEGL000439, G4)
- *Pseudotsuga menziesii / Leucopoa kingii* Woodland (CEGL000904, G3G4)
- *Pseudotsuga menziesii / Mahonia repens* Forest (CEGL000442, G5)
- *Pseudotsuga menziesii / Muhlenbergia montana* Forest (CEGL000443, G4)
- *Pseudotsuga menziesii / Muhlenbergia virescens* Forest (CEGL000444, G4)
- *Pseudotsuga menziesii / Paxistima myrsinites* Forest (CEGL000446, G2G3)
- *Pseudotsuga menziesii / Physocarpus monogynus* Forest (CEGL000449, G4)
- *Pseudotsuga menziesii / Poa fendleriana* Woodland (CEGL002809, GNR)
- *Pseudotsuga menziesii / Pseudoroegneria spicata* Woodland (CEGL000908, G4)
- *Pseudotsuga menziesii / Quercus arizonica* Forest (CEGL000451, G3?)
- *Pseudotsuga menziesii / Quercus gambelii* Forest (CEGL000452, G5)
- *Pseudotsuga menziesii / Quercus hypoleucoides* Forest (CEGL000453, G3)
- *Pseudotsuga menziesii / Quercus rugosa* Forest (CEGL000454, G2)
- *Pseudotsuga menziesii / Quercus X pauciloba* Forest (CEGL000455, GU)
- *Pseudotsuga menziesii / Symphoricarpos occidentalis* Forest (CEGL000461, G3?)
- *Pseudotsuga menziesii / Symphoricarpos oreophilus* Forest (CEGL000462, G5)
- *Pseudotsuga menziesii* Scree Woodland (CEGL000911, G5)

DISTRIBUTION

Range: This system occurs throughout the southern Rockies, north and west into Utah, Nevada, eastern Wyoming (very southern in the Laramie Range and possibly on Sheep Mountain) and Idaho. Although not common, it does occur in southeastern Oregon but does not extend farther west into the Cascades.
Divisions: 304:C; 306:C
Nations: US
Subnations: AZ, CO, ID, NM, NV, OR, UT, WY
Map Zones: 6:P, 9:?, 12:C, 13:C, 15:C, 16:C, 17:C, 18:C, 21:?, 22:C, 23:C, 24:P, 25:C, 27:C, 28:C, 29:C, 33:?
USFS Ecomap Regions: 313A:CC, 313B:CC, 313C:CC, 313D:CP, 315A:C?, 315H:CC, 321A:??, 322A:CC, 331B:CC, 331G:CC, 331H:CC, 331I:CC, 331J:CC, 331N:CP, 341A:CC, 341B:CC, 341C:CP, 341D:CC, 341E:CC, 341F:CC, 341G:CP, 342A:CC, 342B:CC, 342C:CC, 342D:CC, 342E:CC, 342F:CC, 342G:CC, 342H:CC, 342I:CC, 342J:CC, M313A:CC, M313B:CC, M331A:CP, M331B:CC, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M331J:CC, M332A:C?, M332E:CP, M332G:CC, M341A:CC, M341B:CC, M341C:CC, M341D:CC
TNC Ecoregions: 6:?, 7:?, 8:?, 9:C, 11:C, 18:C, 19:C, 20:C, 21:C, 26:C

SOURCES

References: Alexander et al. 1984b, Alexander et al. 1987, Boyce 1977, Bunin 1975c, Burns and Honkala 1990a, Chappell et al. 1997, Comer et al. 2002, Comer et al. 2003, DeVelice et al. 1986, Fitzhugh et al. 1987, Giese 1975, Heinze et al. 1962, Hess 1981, Hess and Alexander 1986, Hess and Wasser 1982, Hoffman and Alexander 1980, Hoffman and Alexander 1983, Komarkova et al. 1988b, Mauk and Henderson 1984, Muldavin et al. 1996, Nachlinger et al. 2001, Neely et al. 2001, Steele et al. 1983, Tuhy et al. 2002, Youngblood and Mauk 1985
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722850#references
Description Author: M.S. Reid
Version: 25 Jan 2007 **Stakeholders:** West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

SOUTHERN ROCKY MOUNTAIN MESIC MONTANE MIXED CONIFER FOREST AND WOODLAND (CES306.825)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: RM Montane Dry-Mesic Mixed Conifer; Forest and Woodland (Treed); Ravine; Stream terrace (undifferentiated); Toeslope; Mesotrophic Soil; Ustic; Long Disturbance Interval; F-Patch/Low Intensity; F-Landscape/Low Intensity; Needle-Leaved Tree
Non-Diagnostic Classifiers: Moderate (100-500 yrs) Persistence; Montane [Montane]; Montane [Lower Montane]; Temperate [Temperate Continental]; Shallow Soil; Mineral: W/ A-Horizon <10 cm
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2052; ESLF 4239; ESP 1052

CONCEPT

Summary: These are mixed conifer forests of the Rocky Mountains west into the ranges of the Great Basin, occurring predominantly in cool ravines and on north-facing slopes. Elevations range from 1200 to 3300 m. Occurrences of this system are found on cooler and more mesic sites than Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823). Such sites include lower and middle slopes of ravines, along stream terraces, moist, concave topographic positions and north- and east-facing slopes which burn somewhat infrequently. *Pseudotsuga menziesii* and *Abies concolor* are most common canopy dominants, but *Picea engelmannii, Picea pungens*, or *Pinus ponderosa* may be present. This system includes mixed conifer - *Populus tremuloides* stands. A number of cold-deciduous shrub species can occur, including *Acer glabrum, Acer grandidentatum, Alnus incana, Betula occidentalis, Cornus sericea, Jamesia americana, Physocarpus malvaceus, Robinia neomexicana, Vaccinium membranaceum,* and *Vaccinium myrtillus*. Herbaceous species include *Bromus ciliatus, Carex geyeri, Carex rossii, Carex siccata, Muhlenbergia virescens, Pseudoroegneria spicata, Erigeron eximius, Fragaria virginiana, Luzula parviflora, Osmorhiza berteroi, Packera cardamine, Thalictrum occidentale,* and *Thalictrum fendleri*. Naturally occurring fires are of variable return intervals and mostly light, erratic, and infrequent due to the cool, moist conditions.
Classification Comments: This system will need to be modeled to separate from similar dry-mesic system.
Similar Ecological Systems:
- Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (CES306.823)

Related Concepts:
- Blue Spruce: 216 (Eyre 1980) Finer
- Interior Douglas-fir: 210 (Eyre 1980) Intersecting
- White Fir: 211 (Eyre 1980) Intersecting

Component Associations:
- *Abies concolor - (Pseudotsuga menziesii) / Jamesia americana - Holodiscus dumosus* Scree Woodland (CEGL000890, GNR)
- *Abies concolor - (Pseudotsuga menziesii) / Quercus gambelii / Thalictrum fendleri* Forest (CEGL005352, GNR)
- *Abies concolor - (Pseudotsuga menziesii) / Thalictrum fendleri* Forest (CEGL005353, GNR)
- *Abies concolor - Acer negundo / Alnus incana ssp. tenuifolia* Forest (CEGL005367, GNR)
- *Abies concolor - Picea pungens - Populus angustifolia / Acer glabrum* Forest (CEGL000255, G2)
- *Abies concolor - Pinus ponderosa / Cercocarpus ledifolius* Forest (CEGL002732, G4?)
- *Abies concolor - Pseudotsuga menziesii / Acer glabrum* Forest (CEGL000240, G4)
- *Abies concolor - Pseudotsuga menziesii / Carex rossii* Forest (CEGL000431, G2?)
- *Abies concolor - Pseudotsuga menziesii / Carex siccata* Forest (CEGL000244, G2)
- *Abies concolor - Pseudotsuga menziesii / Erigeron eximius* Forest (CEGL000247, G5)
- *Abies concolor - Pseudotsuga menziesii / Lathyrus lanszwertii var. leucanthus* Forest (CEGL000250, G3)
- *Abies concolor - Pseudotsuga menziesii / Robinia neomexicana* Woodland (CEGL000891, G4Q)
- *Abies concolor - Pseudotsuga menziesii / Vaccinium myrtillus* Forest (CEGL000265, G5)
- *Abies concolor / Acer grandidentatum* Forest (CEGL000241, G4)
- *Abies concolor / Arctostaphylos patula* Forest (CEGL000242, G5)
- *Abies concolor / Arctostaphylos uva-ursi* Forest (CEGL000243, G5)
- *Abies concolor / Festuca arizonica* Woodland (CEGL000887, G4)
- *Abies concolor / Juglans major* Forest (CEGL000248, G2G3)
- *Abies concolor / Leymus triticoides* Woodland (CEGL000886, G3)
- *Abies concolor / Mahonia repens* Forest (CEGL000251, G5)
- *Abies concolor / Muhlenbergia virescens* Forest (CEGL000252, G5)
- *Abies concolor / Osmorhiza berteroi* Forest (CEGL000253, G4G5)
- *Abies concolor / Physocarpus malvaceus* Forest (CEGL000254, G4G5)

- *Abies concolor / Quercus gambelii* Forest (CEGL000261, G5)
- *Abies concolor / Symphoricarpos oreophilus* Forest (CEGL000263, G5)
- *Picea pungens / Alnus incana* Woodland (CEGL000894, G3)
- *Picea pungens / Arctostaphylos uva-ursi* Forest (CEGL000385, G4)
- *Picea pungens / Arnica cordifolia* Forest (CEGL000386, G3?)
- *Picea pungens / Betula occidentalis* Woodland (CEGL002637, G2)
- *Picea pungens / Carex siccata* Forest (CEGL000387, G4)
- *Picea pungens / Cornus sericea* Woodland (CEGL000388, G4)
- *Picea pungens / Dasiphora fruticosa ssp. floribunda* Woodland (CEGL000396, G2G3)
- *Picea pungens / Equisetum arvense* Woodland (CEGL000389, G3?)
- *Picea pungens / Erigeron eximius* Forest (CEGL000390, G5)
- *Picea pungens / Festuca arizonica* Woodland (CEGL000895, G5)
- *Picea pungens / Fragaria virginiana ssp. virginiana* Forest (CEGL000391, G3G4)
- *Picea pungens / Juniperus communis* Forest (CEGL000392, G4G5)
- *Picea pungens / Linnaea borealis* Forest (CEGL000393, G4)
- *Picea pungens / Lonicera involucrata* Forest (CEGL000394, G2)
- *Picea pungens / Mahonia repens* Forest (CEGL000395, G5)
- *Picea pungens / Packera cardamine* Forest (CEGL000399, GU)
- *Picea pungens / Pseudoroegneria spicata* Forest (CEGL000397, G4?)
- *Pseudotsuga menziesii / Acer glabrum* Forest (CEGL000418, G4?)
- *Pseudotsuga menziesii / Acer grandidentatum* Forest (CEGL000419, GNR)
- *Pseudotsuga menziesii / Acer negundo* Woodland (CEGL002754, GNR)
- *Pseudotsuga menziesii / Betula occidentalis* Woodland (CEGL002639, G3?)
- *Pseudotsuga menziesii / Bromus ciliatus* Forest (CEGL000428, G4)
- *Pseudotsuga menziesii / Cornus sericea* Woodland (CEGL000899, G4)
- *Pseudotsuga menziesii / Quercus gambelii* Forest (CEGL000452, G5)
- *Pseudotsuga menziesii / Viola adunca var. adunca* Forest (CEGL000467, G3)

DISTRIBUTION

Range: This system is found in the southern Rocky Mountains of Arizona and New Mexico north and west into the ranges of the Great Basin, Wyoming and southeastern Idaho, occurring predominantly in cool ravines and on north-facing slopes.
Divisions: 304:C; 306:C
Nations: US
Subnations: AZ, CO, ID, NM, NV, OR?, UT, WY
Map Zones: 6:?, 9:?, 12:P, 13:C, 15:C, 16:C, 17:P, 18:C, 21:?, 22:P, 23:C, 24:P, 25:C, 27:C, 28:C, 29:P
USFS Ecomap Regions: 313A:CC, 313B:CC, 313C:CC, 313D:CP, 315A:C?, 315H:CC, 321A:??, 322A:CC, 331B:CC, 331G:C?, 331H:CP, 331I:CC, 331J:CC, 341A:CC, 341B:CC, 341C:CP, 341D:CC, 341F:CC, 342A:CP, 342B:CP, 342D:CP, 342E:CC, 342F:CP, 342G:CP, 342H:CC, 342I:C?, 342J:CP, M313A:CC, M313B:CC, M331A:CP, M331B:CC, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M331J:CC, M332G:CC, M341A:CC, M341B:CC, M341C:CC, M341D:CC
TNC Ecoregions: 8:C, 9:C, 11:C, 18:C, 19:C, 20:C, 21:C

SOURCES

References: Agree 1982, Alexander et al. 1984a, Alexander et al. 1984b, Alexander et al. 1987, Anderson 1999a, Boyce 1977, Bunin 1975c, Comer et al. 2002, Comer et al. 2003, Cooper et al. 1987, DeVelice and Ludwig 1983c, DeVelice et al. 1986, Dieterich 1979, Fitzhugh et al. 1987, Fowells 1965, Giese 1975, Heinze et al. 1962, Hess 1981, Hess and Alexander 1986, Hess and Wasser 1982, Hoffman and Alexander 1980, Hoffman and Alexander 1983, Hopkins 1982, Komarkova et al. 1988b, Mauk and Henderson 1984, Moir and Ludwig 1979, Nachlinger et al. 2001, Neely et al. 2001, Parson and DeBenedetti 1979, Pfister 1972, Tuhy et al. 2002, Youngblood and Mauk 1985
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722848#references
Description Author: NatureServe Western Ecology Team
Version: 01 Sep 2005 **Stakeholders:** Midwest, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

SOUTHERN ROCKY MOUNTAIN PINYON-JUNIPER WOODLAND (CES306.835)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Very Shallow Soil; Shallow Soil; Mineral: W/ A-Horizon <10 cm; Aridic; Long Disturbance Interval; Needle-Leaved Tree; Pinus edulis, Juniperus monosperma
Non-Diagnostic Classifiers: Escarpment; Foothill(s); Lowland [Foothill]; Midslope; Ridge; Temperate [Temperate Continental]; Unglaciated; F-Patch/Medium Intensity; F-Landscape/Medium Intensity; Butte
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2059; ESLF 4246; ESP 1059

CONCEPT

Summary: This southern Rocky Mountain ecological system occurs on dry mountains and foothills in southern Colorado east of the Continental Divide, in mountains and plateaus of north-central New Mexico, and extends out onto limestone breaks in the southeastern Great Plains. These woodlands occur on warm, dry sites on mountain slopes, mesas, plateaus, and ridges. Severe climatic events occurring during the growing season, such as frosts and drought, are thought to limit the distribution of pinyon-juniper woodlands to relatively narrow altitudinal belts on mountainsides. Soils supporting this system vary in texture ranging from stony, cobbly, gravelly sandy loams to clay loam or clay. *Pinus edulis* and/or *Juniperus monosperma* dominate the tree canopy. *Juniperus scopulorum* may codominate or replace *Juniperus monosperma* at higher elevations. Stands with *Juniperus osteosperma* are representative the Colorado Plateau and are not included in this system. In southern transitional areas between Madrean Pinyon-Juniper Woodland (CES305.797) and Southern Rocky Mountain Pinyon-Juniper Woodland (CES306.835) in central New Mexico, *Juniperus deppeana* becomes common. Understory layers are variable and may be dominated by shrubs, graminoids, or be absent. Associated species are more typical of southern Rocky Mountains than the Colorado Plateau and include *Artemisia bigelovii, Cercocarpus montanus, Quercus gambelii, Achnatherum scribneri, Bouteloua gracilis, Festuca arizonica,* or *Pleuraphis jamesii*.
Related Concepts:
- Juniper - Pinyon Pine Woodland (504) (Shiflet 1994) Broader
- Pinyon - Juniper: 239 (Eyre 1980) Broader

Component Associations:
- *Juniperus monosperma - Rhus trilobata / Schizachyrium scoparium* Woodland (CEGL002121, GNR)
- *Juniperus monosperma / Agave lechuguilla* Woodland (CEGL000703, G4)
- *Juniperus monosperma / Andropogon hallii* Woodland (CEGL000704, G3?)
- *Juniperus monosperma / Artemisia bigelovii* Woodland (CEGL000705, G3?)
- *Juniperus monosperma / Artemisia tridentata* Woodland (CEGL000706, G5)
- *Juniperus monosperma / Atriplex confertifolia / Achnatherum hymenoides* Woodland (CEGL000707, G3G4)
- *Juniperus monosperma / Bouteloua curtipendula* Woodland (CEGL000708, G5)
- *Juniperus monosperma / Bouteloua eriopoda* Woodland (CEGL000709, GNR)
- *Juniperus monosperma / Bouteloua gracilis* Woodland (CEGL000710, G5)
- *Juniperus monosperma / Bouteloua hirsuta* Woodland (CEGL000711, GNR)
- *Juniperus monosperma / Cercocarpus montanus - Ribes cereum* Woodland (CEGL000714, GU)
- *Juniperus monosperma / Cercocarpus montanus* Woodland (CEGL000713, GNR)
- *Juniperus monosperma / Ericameria nauseosa - Fallugia paradoxa* Woodland (CEGL000715, G4)
- *Juniperus monosperma / Fallugia paradoxa* Woodland (CEGL000716, G4)
- *Juniperus monosperma / Forestiera pubescens* Woodland (CEGL005371, GNR)
- *Juniperus monosperma / Hesperostipa neomexicana* Woodland (CEGL000722, G4)
- *Juniperus monosperma / Krascheninnikovia lanata* Woodland (CEGL000712, G3G4)
- *Juniperus monosperma / Muhlenbergia pauciflora* Woodland (CEGL005387, GNR)
- *Juniperus monosperma / Nolina microcarpa - Agave lechuguilla* Woodland (CEGL000718, G4)
- *Juniperus monosperma / Quercus turbinella* Woodland (CEGL000720, GNR)
- *Juniperus monosperma / Quercus X pauciloba* Woodland (CEGL000721, G5)
- *Juniperus monosperma* / Rockland Woodland (CEGL005369, GNR)
- *Juniperus monosperma* / Sparse Understory Woodland (CEGL005368, GNR)
- *Pinus edulis - (Juniperus monosperma, Juniperus deppeana) / Bouteloua gracilis* Woodland (CEGL002151, G5?)
- *Pinus edulis - (Juniperus monosperma, Juniperus osteosperma) / Hesperostipa comata* Woodland (CEGL000797, G2?)
- *Pinus edulis - Juniperus monosperma / Quercus X pauciloba* Woodland (CEGL000793, G5)
- *Pinus edulis - Juniperus osteosperma / Arctostaphylos pungens* Woodland (CEGL000775, G3)
- *Pinus edulis - Juniperus osteosperma / Cercocarpus ledifolius* Woodland (CEGL002940, GNR)

- *Pinus edulis - Juniperus osteosperma / Ephedra viridis* Woodland (CEGL002370, G3)
- *Pinus edulis - Juniperus osteosperma / Hesperostipa neomexicana* Woodland (CEGL002371, GNR)
- *Pinus edulis - Juniperus osteosperma / Pseudoroegneria spicata* - Cushion Plant Woodland (CEGL002819, GNR)
- *Pinus edulis - Juniperus osteosperma / Purshia tridentata* Woodland (CEGL000789, G5)
- *Pinus edulis - Juniperus* spp. / *Artemisia tridentata (ssp. wyomingensis, ssp. vaseyana)* Woodland (CEGL000776, G5)
- *Pinus edulis - Juniperus* spp. / *Cercocarpus montanus* - Mixed Shrubs Woodland (CEGL000780, G5)
- *Pinus edulis - Juniperus* spp. / *Fallugia paradoxa* Woodland (CEGL002188, GNR)
- *Pinus edulis - Juniperus* spp. / *Poa fendleriana* Woodland (CEGL000787, G5)
- *Pinus edulis - Juniperus* spp. / *Pseudoroegneria spicata* Woodland (CEGL000788, G4)
- *Pinus edulis - Juniperus* spp. / *Quercus gambelii* Woodland (CEGL000791, G5)
- *Pinus edulis - Quercus arizonica / Rhus trilobata* Woodland (CEGL000790, G5?)
- *Pinus edulis / Achnatherum nelsonii ssp. dorei* Woodland (CEGL000796, G4)
- *Pinus edulis / Achnatherum scribneri* Woodland (CEGL000798, G3)
- *Pinus edulis / Andropogon hallii* Woodland (CEGL000774, G2)
- *Pinus edulis / Bouteloua curtipendula* Woodland (CEGL000777, GNR)
- *Pinus edulis / Festuca arizonica* Woodland (CEGL000783, G3)
- *Pinus edulis / Leymus ambiguus* Woodland (CEGL002908, GU)
- *Pinus edulis / Muhlenbergia dubia* Woodland (CEGL000784, G2)
- *Pinus edulis / Muhlenbergia pauciflora* Woodland (CEGL000785, G4)
- *Pinus edulis / Nolina microcarpa* Woodland (CEGL000786, GNR)
- *Pinus edulis* / Rockland Woodland (CEGL000794, G5)
- *Pinus edulis* / Sparse Understory Forest (CEGL000795, G5)
- *Pinus ponderosa / Fallugia paradoxa - Ribes cereum* Woodland (CEGL005032, GNR)
- *Pinus ponderosa / Poa fendleriana* Woodland (CEGL005507, GNR)

DISTRIBUTION

Range: This system occurs on dry mountains and foothills in southern Colorado, in mountains and plateaus of northern New Mexico and Arizona, and extends out onto breaks in the Great Plains. It extends south to the Sacramento Mountains, especially the eastern side. The western side has Madrean elements (*Quercus grisea*) and may be classified as Madrean woodland.
Divisions: 303:C; 304:C; 306:C
Nations: US
Subnations: CO, NM
Map Zones: 14:?, 15:P, 24:?, 25:C, 27:C, 28:C, 34:P
USFS Ecomap Regions: 313B:CC, 315A:CC, 315B:CC, 315H:CC, 321A:CC, 322B:CC, 331B:CC, 331H:CP, 331I:CC, 331J:CC, M313B:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC
TNC Ecoregions: 20:C, 21:C, 22:P, 27:C, 28:C

SOURCES

References: Alexander 1981, Bradley et al. 1992, Comer et al. 2003, Commons et al. 1999, Dwyer and Pieper 1967, Eager 1999, Hess and Wasser 1982, Ladyman and Muldavin 1996, Lindauer et al. 1982, Mehl 1992, Muldavin et al. 1992, Muldavin et al. 1996, Neely et al. 2001, Powell 1988b, West 1999a, West 1999b
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723255#references
Description Author: NatureServe Western Ecology Team
Version: 22 Dec 2006 **Stakeholders:** West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

SOUTHERN ROCKY MOUNTAIN PONDEROSA PINE WOODLAND (CES306.648)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Ridge/Summit/Upper Slope; Very Shallow Soil; Mineral: W/ A-Horizon <10 cm; Sand Soil Texture; Aridic; Intermediate Disturbance Interval [Periodicity/Polycyclic Disturbance]; F-Patch/Medium Intensity; Needle-Leaved Tree; Pinus ponderosa with shrubby understory
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2054; ESLF 4241; ESP 1054

CONCEPT

Summary: This very widespread ecological system is most common throughout the cordillera of the Rocky Mountains, from the Greater Yellowstone region south. It is also found in the Colorado Plateau region, west into scattered locations of the Great Basin. Its easternmost extent in Wyoming is in the Bighorn Mountains. These woodlands occur at the lower treeline/ecotone between grassland or shrubland and more mesic coniferous forests typically in warm, dry, exposed sites. Elevations range from less than 1900 m in northern Wyoming to 2800 m in the New Mexico mountains. Occurrences are found on all slopes and aspects; however, moderately steep to very steep slopes or ridgetops are most common. This ecological system generally occurs on soils derived from igneous, metamorphic, and sedimentary material, with characteristic features of good aeration and drainage, coarse textures, circumneutral to slightly acidic pH, an abundance of mineral material, rockiness, and periods of drought during the growing season. Northern Rocky Mountain Ponderosa Pine Woodland and Savanna (CES306.030) in the eastern Cascades, Okanogan, and northern Rockies regions receives winter and spring rains, and thus has a greater spring "green-up" than the drier woodlands in the central Rockies. *Pinus ponderosa* (primarily var. *scopulorum* and var. *ponderosa* (= var. *brachyptera*)) is the predominant conifer; *Pseudotsuga menziesii, Pinus edulis, Pinus contorta, Populus tremuloides*, and *Juniperus* spp. may be present in the tree canopy. The understory is usually shrubby, with *Artemisia nova, Artemisia tridentata, Arctostaphylos patula, Arctostaphylos uva-ursi, Cercocarpus montanus, Purshia stansburiana, Purshia tridentata, Quercus gambelii, Symphoricarpos* spp., *Prunus virginiana, Amelanchier alnifolia* (less so in Montana), and *Rosa* spp. common species. *Pseudoroegneria spicata, Pascopyrum smithii*, and species of *Hesperostipa, Achnatherum, Festuca, Muhlenbergia*, and *Bouteloua* are some of the common grasses. Mixed fire regimes and ground fires of variable return intervals maintain these woodlands, depending on climate, degree of soil development, and understory density.
Classification Comments: This system intergrades with Southern Rocky Mountain Ponderosa Pine Savanna (CES306.649). They are distinguished by the high-frequency, surface-fire regime, less steep or rocky environmental setting, and more open grassy understory structure of the savanna system. Ponderosa pine woodlands, savannas, and "escarpments"' of central and eastern Montana, eastern Wyoming, the Black Hills region, western Dakotas, and Nebraska are now included in Northwestern Great Plains-Black Hills Ponderosa Pine Woodland and Savanna (CES303.650).

Because this ecological system has undergone some important changes in its concept, the original system (CES306.032) was archived, and this new system was created to account for the new concept of ponderosa pine woodlands in the Southern Rocky Mountains.
Similar Ecological Systems:
- North Pacific Interior Dry-Mesic Mixed Conifer Forest (CES207.152)
- Northern Rocky Mountain Ponderosa Pine Woodland and Savanna (CES306.030)
- Northwestern Great Plains-Black Hills Ponderosa Pine Woodland and Savanna (CES303.650)
- Southern Rocky Mountain Ponderosa Pine Savanna (CES306.649)

Related Concepts:
- Interior Ponderosa Pine: 237 (Eyre 1980) Broader

DESCRIPTION

Environment: This ecological system within the region occurs at the lower treeline/ecotone between grassland or shrubland and more mesic coniferous forests typically in warm, dry, exposed sites at elevations ranging from 1980-2800 m (6500-9200 feet). It can occur on all slopes and aspects, however, it commonly occurs on moderately steep to very steep slopes or ridgetops. This ecological system generally occurs on soils derived from igneous, metamorphic, and sedimentary material, including basalt, basaltic, andesitic flows, intrusive granitoids and porphyrites, and tuffs (Youngblood and Mauk 1985). Characteristic soil features include good aeration and drainage, coarse textures, circumneutral to slightly acidic pH, an abundance of mineral material, and periods of drought during the growing season. Some occurrences may occur as edaphic climax communities on very skeletal, infertile, and/or excessively drained soils, such as pumice, cinder or lava fields, and scree slopes. Surface textures are highly variable in this ecological system ranging from sand to loam and silt loam. Exposed rock and bare soil consistently occur to some degree in all the associations. *Pinus ponderosa / Arctostaphylos patula* represents the extreme with typically a high percentage of rock and bare soil present.

Precipitation generally contributes 25-60 cm annually to this system, mostly through winter storms and some monsoonal summer rains. Typically a seasonal drought period occurs throughout this system as well. Fire plays an important role in maintaining the characteristics of these open-canopy woodlands. However, soil infertility and drought may contribute significantly in some areas as

well.

Dynamics: *Pinus ponderosa* is a drought-resistant, shade-intolerant conifer which usually occurs at lower treeline in the major ranges of the western United States. Historically, ground fires and drought were influential in maintaining open-canopy conditions in these woodlands. With settlement and subsequent fire suppression, occurrences have become denser. Presently, many occurrences contain understories of more shade-tolerant species, such as *Pseudotsuga menziesii* and/or *Abies* spp., as well as younger cohorts of *Pinus ponderosa*. These altered structures have affected fuel loads and alter fire regimes. Presettlement fire regimes were primarily frequent (5- to 15-year return intervals), low-intensity ground fires triggered by lightning strikes or deliberately set fires by Native Americans. With fire suppression and increased fuel loads, fire regimes are now less frequent and often become intense crown fires, which can kill mature *Pinus ponderosa* (Reid et al. 1999).

Establishment is erratic and believed to be linked to periods of adequate soil moisture and good seed crops, as well as fire frequencies, which allow seedlings to reach sapling size. Longer fire-return intervals have resulted in many occurrences having dense subcanopies of overstocked and unhealthy young *Pinus ponderosa* (Reid et al. 1999). Mehl (1992) states the following: "Where fire has been present, occurrences will be climax and contain groups of large, old trees with little understory vegetation or down woody material and few occurring dead trees. The age difference of the groups of trees would be large. Where fire is less frequent, there will also be smaller size trees in the understory giving the occurrence some structure with various canopy layers. Dead, down material will be present in varying amounts along with some occurring dead trees. In both cases the large old trees will have irregular open, large branched crowns. The bark will be lighter in color, almost yellow, thick and some will like have basal fire scars."

Grace's warbler, pygmy nuthatch, and flammulated owl are indicators of a healthy ponderosa pine woodland. All of these birds prefer mature trees in an open woodland setting (Winn 1998, Jones 1998, Levad 1998 as cited in Rondeau 2001).

Component Associations:

- *Pinus ponderosa - Pinus strobiformis* Forest (CEGL007091, G3)
- *Pinus ponderosa / Arctostaphylos patula* Woodland (CEGL000842, G5)
- *Pinus ponderosa / Arctostaphylos pungens* Woodland (CEGL000843, G3)
- *Pinus ponderosa / Arctostaphylos uva-ursi* Woodland (CEGL000844, G4)
- *Pinus ponderosa / Artemisia arbuscula* Woodland (CEGL000845, G2G3Q)
- *Pinus ponderosa / Artemisia nova* Woodland (CEGL000846, G5)
- *Pinus ponderosa / Artemisia tridentata - Purshia tridentata* Woodland (CEGL000178, G3)
- *Pinus ponderosa / Artemisia tridentata ssp. vaseyana* Woodland (CEGL002794, GNR)
- *Pinus ponderosa / Bouteloua gracilis* Woodland (CEGL000848, G4)
- *Pinus ponderosa / Carex geyeri* Woodland (CEGL000182, G3G4)
- *Pinus ponderosa / Carex inops ssp. heliophila* Woodland (CEGL000849, G3G4)
- *Pinus ponderosa / Carex rossii* Forest (CEGL000183, G4G5)
- *Pinus ponderosa / Carex siccata* Woodland (CEGL005506, GNR)
- *Pinus ponderosa / Cercocarpus ledifolius* Woodland (CEGL000850, G4)
- *Pinus ponderosa / Cercocarpus montanus* Woodland (CEGL000851, G4)
- *Pinus ponderosa / Fallugia paradoxa* Woodland (CEGL002999, GNR)
- *Pinus ponderosa / Festuca arizonica* Woodland (CEGL000856, G4)
- *Pinus ponderosa / Festuca thurberi* Woodland (CEGL005373, GNR)
- *Pinus ponderosa / Hesperostipa comata* Woodland (CEGL000879, G1)
- *Pinus ponderosa / Juniperus communis* Woodland (CEGL000859, G4?)
- *Pinus ponderosa / Juniperus scopulorum* Woodland (CEGL000861, G4)
- *Pinus ponderosa / Leucopoa kingii* Woodland (CEGL000186, G3)
- *Pinus ponderosa / Muhlenbergia montana* Woodland (CEGL000862, G4G5)
- *Pinus ponderosa / Muhlenbergia virescens - Festuca arizonica* Woodland (CEGL000864, G5?)
- *Pinus ponderosa / Muhlenbergia virescens* Woodland (CEGL000863, G5)
- *Pinus ponderosa / Physocarpus monogynus* Forest (CEGL000190, G3)
- *Pinus ponderosa / Pteridium aquilinum* Woodland (CEGL002944, GNR)
- *Pinus ponderosa / Purshia stansburiana* Woodland (CEGL000854, G3)
- *Pinus ponderosa / Purshia tridentata* Woodland (CEGL000867, G3G5)
- *Pinus ponderosa / Quercus gambelii / Carex inops ssp. heliophila* Woodland (CEGL005372, GNR)
- *Pinus ponderosa / Quercus gambelii* Woodland (CEGL000870, G5)
- *Pinus ponderosa / Quercus X pauciloba* Woodland (CEGL000874, G5)
- *Pinus ponderosa / Ribes cereum* Forest (CEGL000199, GNR)
- *Pinus ponderosa / Ribes inerme* Scree Woodland (CEGL000876, G4)
- *Pinus ponderosa / Robinia neomexicana* Woodland (CEGL005374, GNR)
- *Pinus ponderosa* / Rockland Woodland (CEGL000877, G5?)
- *Pinus ponderosa / Schizachyrium scoparium* Woodland (CEGL000201, G3G4)
- *Pinus ponderosa / Symphoricarpos oreophilus* Forest (CEGL000205, G3)
- *Pinus ponderosa* Scree Woodland (CEGL000878, G4)

DISTRIBUTION

Range: This system is found throughout much of the Rocky Mountains cordillera, from northwestern Wyoming, south through the Rocky Mountains of Colorado and into New Mexico. In Arizona, it occurs on the Mogollon Rim north into the Colorado Plateau region and west into scattered locations of the Great Basin.
Divisions: 304:C; 306:C
Nations: US
Subnations: AZ, CO, ID?, NM, NV, UT, WY
Map Zones: 12:?, 14:?, 15:C, 16:C, 17:?, 22:C, 23:C, 24:C, 25:C, 26:?, 27:C, 28:C, 29:C, 33:P
USFS Ecomap Regions: 313A:CC, 313B:CC, 313C:CC, 313D:CC, 315A:CC, 315B:CC, 315H:CC, 321A:CC, 331B:CC, 331F:CP, 331G:CP, 331H:CC, 331I:CC, 331J:CC, 341A:CP, 341B:CC, 341F:CC, 342F:CC, 342G:CC, M313A:CC, M313B:CC, M331B:CC, M331D:CP, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M341A:CP, M341B:CC, M341C:CC, M341D:C?
TNC Ecoregions: 8:C, 9:C, 10:C, 11:C, 18:C, 19:C, 20:C, 21:C, 25:C, 26:C, 33:?

SOURCES

References: Comer et al. 2002, Comer et al. 2003, DeVelice et al. 1986, Hess and Alexander 1986, Hoffman and Alexander 1976, Johansen and Latta 2003, Komarkova et al. 1988b, Marriott and Faber-Langendoen 2000, Mauk and Henderson 1984, Mehl 1992, Muldavin et al. 1987, Muldavin et al. 1996, Nachlinger et al. 2001, Neely et al. 2001, Reid et al. 1999, Rondeau 2001, Tuhy et al. 2002, Western Ecology Working Group n.d., Youngblood and Mauk 1985
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.797980#references
Description Author: M.S. Reid
Version: 01 Oct 2007 **Stakeholders:** Canada, Midwest, West
Concept Author: M.S. Reid **ClassifResp:** West

SOUTHWEST FLORIDA COASTAL STRAND AND MARITIME HAMMOCK (CES411.368)

CLASSIFIERS

Classification Status: Standard

Primary Division: Caribbean (411)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Coast
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: EVT 2336; ESLF 4142; ESP 1336

CONCEPT

Summary: This ecological system occurs as a narrow band of hardwood forest and strand lying just inland of the coastal dune system in southwestern Florida. It is found on stabilized, old, coastal dunes, often with substantial shell components. The vegetation is characterized by hardwood species with tropical affinities. As such, the northern extent of this type is limited by periodic freezes and cold tolerance of tropical constituent species, such as *Piscidia piscipula* and *Eugenia axillaris*. This system is closely related to both inland tropical hammocks and southeast Florida maritime hammocks, and may share some species overlap with each.
Classification Comments: This system may be distinguished from southeast Florida maritime hammocks by geographic location, presence/absence of certain indicator species, and relatively less harsh coastal exposure. It is distinguished from maritime hammocks further north which contain temperate species including *Persea borbonia, Quercus virginiana, Magnolia grandiflora*, and *Juniperus virginiana var. silicicola* (Johnson and Muller 1993a).
Similar Ecological Systems:
- Southeast Florida Coastal Strand and Maritime Hammock (CES411.369)

Related Concepts:
- Cabbage Palmetto: 74 (Eyre 1980) Finer
- Coastal Berm (FNAI 1990) Undetermined
- Coastal Strand (FNAI 1990) Intersecting
- Live Oak: 89 (Eyre 1980) Finer
- Maritime Hammock (FNAI 1990) Intersecting
- Shell Mound (FNAI 1990) Intersecting
- Tropical Hardwoods: 105 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs along the coast on stabilized, old coastal dunes, often with substantial shell components. The northern extent of this type is limited by periodic freezes.
Dynamics: The northern extent of this type is limited by periodic freezes and lack of cold tolerance of tropical plants, such as *Piscidia piscipula* and *Eugenia axillaris* (Johnson and Muller 1993a). Maritime hammocks are relatively stable forest communities, as long as the canopy remains intact and the underlying landform is stable (FNAI 1990). Surface fires may help to maintain the open understory (Landfire 2007a). The shrub-dominated, coastal strand communities are considered ecotonal, and historically burned more frequently than maritime hammocks, possibly every 4-5 years (Austin and Coleman-Marois 1977). However, there is some disagreement on this point. There is little information on natural fire frequency in coastal strand (FNAI 2010a). The low stature of strand is due to the influence of storms and the ongoing salt spray pruning (FNAI 2010a). Fire is not needed to explain the shrub-dominated vegetation of coastal strands (Landfire 2007a).

Component Associations:
- *Ernodea littoralis - Forestiera segregata var. segregata - Coccoloba uvifera - Jacquinia keyensis* Scrub (CEGL003785, G1)
- *Ficus aurea - Sideroxylon foetidissimum - Bursera simaruba / Eugenia foetida - Piscidia piscipula / Hymenocallis latifolia* Forest (CEGL007002, G1)
- *Quercus virginiana - Sabal palmetto / Eugenia axillaris - Myrsine floridana - Coccoloba uvifera* Forest (CEGL007035, G1)
- *Scaevola plumieri - Coccoloba uvifera / Uniola paniculata* Shrubland (CEGL003781, G1?)
- *Sophora tomentosa var. truncata - Forestiera segregata var. segregata - Ernodea littoralis - Agave decipiens* Scrub (CEGL003793, G1)
- *Swietenia mahagoni - Piscidia piscipula - Colubrina arborescens* Forest (CEGL004710, G1Q)

DISTRIBUTION

Range: Endemic to south Florida.
Divisions: 411:C
Nations: US
Subnations: FL
Map Zones: 56:C
USFS Ecomap Regions: 232D:CC, 411A:CC

TNC Ecoregions: 54:C

SOURCES

References: Comer et al. 2003, Eyre 1980, FNAI 1990, FNAI 2010a, Johnson 1994b, Johnson and Muller 1993a, Landfire 2007a

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723148#references

Description Author: R. Evans, after Johnson and Muller (1993a), mod. C. Nordman

Version: 14 Jan 2014 **Stakeholders:** Southeast

Concept Author: R. Evans, after Johnson and Muller (1993a) **ClassifResp:** Southeast

WEST GULF COASTAL PLAIN CHENIER AND UPPER TEXAS COASTAL FRINGE FOREST AND WOODLAND (CES203.466)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed)
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: EVT 2339; ESLF 4145; ESP 1339

CONCEPT

Summary: This system includes a range of woody vegetation typically dominated by *Quercus virginiana* present along the northern Gulf of Mexico, from Vermillion Bay in Louisiana to the upper Texas coast. Landscape position includes shell ridges along the coast and bay margins, coastal salt domes, stranded ancient barrier ridges (Ingleside barrier strandplain), and chenier ridges of the Chenier Plain. In addition to *Quercus virginiana*, other species such as *Celtis laevigata* and *Quercus nigra* may be present to codominant in the canopy which may also include *Carya illinoinensis, Diospyros virginiana, Fraxinus pennsylvanica, Liquidambar styraciflua,* and *Magnolia grandiflora*.

Related Concepts:

- Chenier Plain: Hardwood Fringe Forest (5504) [CES203.466.4] (Elliott 2011) Finer
- Chenier Plain: Live Oak Fringe Forest (5502) [CES203.466.2] (Elliott 2011) Finer
- Chenier Plain: Mixed Live Oak / Deciduous Hardwood Fringe Forest (5503) [CES203.466.3] (Elliott 2011) Finer
- Live Oak: 89 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occupies sand and shell ridges (Quaternary deposits) which resulted from ancient abandoned beach ridges associated with migrating shorelines, shell ridges, as well as salt domes near the coast. The Ingleside barrier strandplain, an ancient barrier ridge composed of deep sands and occurring well inland of the current Gulf shoreline, may support occurrences of this system. Most occurrences occupy ridges formed from sediments deposited along ancient shorelines. These ridges (cheniers), which often parallel the coast and are composed of coarse material such as sand or shell, may be up to 3 m above mean sea level. Some occurrences occupy coastal salt domes, which may rise 30 m above the surrounding landscape. The soils are typically Entisols of coarse-textured material, either sand or shell. The Ecological Site Description, which may be related to this system, is the Coastal Sand ecoclass (Elliott 2011).

Vegetation: Typically these forests and woodlands are dominated by *Quercus virginiana*; however, other species such as *Celtis laevigata* and *Quercus nigra* may be present to codominant in the canopy. Other species such as *Liquidambar styraciflua, Carya illinoinensis, Diospyros virginiana, Fraxinus pennsylvanica*, and *Magnolia grandiflora* may also be present in the canopy. The understory is often patchy but may include species such as *Ilex vomitoria, Callicarpa americana, Zanthoxylum clava-herculis, Crataegus viridis, Sabal minor, Morella cerifera*, and/or *Sideroxylon lanuginosum*. Woody vines present in this system include *Vitis mustangensis, Parthenocissus quinquefolia, Campsis radicans,* and *Toxicodendron radicans*. The two epiphytes *Tillandsia usneoides* and *Pleopeltis polypodioides* may be commonly encountered. The herbaceous layer is usually sparse, but may include species such as *Schizachyrium scoparium, Sanicula canadensis, Malvaviscus arboreus var. drummondii, Elephantopus carolinianus,* and *Oplismenus hirtellus*. *Triadica sebifera* and *Ligustrum sinense* may be important non-native invaders (Elliott 2011).

Dynamics: This ecological system is heterogeneous in physiognomy, including forests, woodlands and shrublands. The Chenier Plain was historically characterized by a prograding coastline replenished by sediments carried to the Gulf of Mexico initially by the Mississippi and subsequently the Atchafalaya and other rivers. It is void of barrier islands and sediments are reworked by waves into beach ridges, sometimes with a substantial shell component. This process has been continuing since the last glacial retreat, and as the coastline prograded, older beach ridges were left as interior ridges surrounded by marsh. These interior beach ridges are referred to as cheniers (from the French word for oak) because they were historically dominated by *Quercus virginiana*. Ridges parallel the coast and are usually 3-5 m above mean sea level. Though not confined to coastal areas, salt domes are a distinctive feature along the Gulf Coast of upper Texas and Louisiana where they often form a drastic contrast to the low-lying Coastal Plain sediments surrounding them. Formed by the rise of salt masses which push up overlying strata, salt domes may rise 30 m above the surrounding landscape. The natural vegetation of cheniers and coastal salt domes are quite similar. The Ingleside barrier strandplain is a Pleistocene barrier ridge that is exposed discontinuously along the Texas coast. One of these areas is located northeast of Galveston Bay and supports *Quercus virginiana*-dominated woodlands included within this ecological system. Shell ridges located along coast and bay margins are typically dominated by halophytic shrubs. Similar vegetation may also be found on coastal dredge spoil. Vegetation structure and composition of occurrences of this system may be influenced by salt spray (on those shell ridges, salt domes and cheniers closest to the gulf), tropical storms and hurricanes, and the distinctive climate of the immediate coast. Studies have shown that chenier forests and woodlands are very important stop-over sites for neotropical migrants during both spring and fall migration.

Component Associations:

- *Acacia farnesiana - Opuntia stricta var. dillenii - Lycium carolinianum var. quadrifidum / Spartina patens* Shrubland (CEGL003932, G3?)
- *Celtis laevigata - (Zanthoxylum clava-herculis, Acacia farnesiana) / Vitis mustangensis* Forest (CEGL007198, G3?)
- *Quercus virginiana - (Celtis laevigata) / Prunus caroliniana* Forest (CEGL002156, G2G3)
- *Quercus virginiana - Celtis laevigata / Sabal minor* Forest (CEGL007466, G2)
- *Quercus virginiana - Magnolia grandiflora - Quercus pagoda - Celtis laevigata / Sabal minor* Forest (CEGL007467, G1)

DISTRIBUTION

Range: This ecological system is found in small patches along the northern Gulf of Mexico, from Vermillion Bay in Louisiana to the upper Texas coast.
Divisions: 203:C
Nations: US
Subnations: LA, TX
Map Zones: 37:C, 98:C
USFS Ecomap Regions: 232E:CC, 255D:CC
TNC Ecoregions: 31:C

SOURCES

References: Comer et al. 2003, Elliott 2011, Eyre 1980, LDWF 2005, Neyland and Meyer 1997
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723120#references
Description Author: J. Teague and R. Evans, mod. M. Pyne and L. Elliott
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: J. Teague and R. Evans **ClassifResp:** Southeast

WEST GULF COASTAL PLAIN MESIC HARDWOOD FOREST (CES203.280)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Very Long Disturbance Interval; Broad-Leaved Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: EVT 2323; ESLF 4129; ESP 1323

CONCEPT

Summary: This ecological system is found in limited upland areas, including ravines and sideslopes, of the Gulf Coastal Plain west of the Mississippi River. These areas are topographically isolated from historically fire-prone, pine-dominated uplands in eastern Texas, western Louisiana, and southern Arkansas. Sites are often found along slopes above perennial streams in the region. These sites have moderate to high fertility and moisture retention. Soils can be quite variable, ranging from coarse to loamy in surface texture. Most are acidic in surface reactions and less commonly circumneutral. Vegetation indicators are mesic hardwoods such as *Fagus grandifolia, Quercus alba,* and *Ilex opaca,* although scattered, large-diameter pines (most often *Pinus taeda*) are also often present. Spring-blooming herbaceous species are typical in the understory of most examples.
Classification Comments: Some stands from Macon Ridge in Louisiana (a terrace ecoregion in the Mississippi River Alluvial Plain) are also included here. Some hardwood stands could occur on narrow ridgetops which are isolated from fire, but which would not be "mesic" in their composition or environment. These may be treated as a hardwood-dominated example of the widespread and variable West Gulf Coastal Plain Pine-Hardwood Forest (CES203.378). More information is needed.
Related Concepts:
- Beech-Magnolia-Loblolly Slopes (Ajilvsgi 1979) Equivalent
- Floodplain Hardwood Pine Forest (Marks and Harcombe 1981) Broader
- Lower Slope Hardwood Pine Forest (Marks and Harcombe 1981) Finer
- Pineywoods: Northern Mesic Hardwood Forest (3304) [CES203.280.4] (Elliott 2011) Finer
- Pineywoods: Northern Mesic Pine / Hardwood Forest (3303) [CES203.280.3] (Elliott 2011) Finer
- Pineywoods: Southern Mesic Hardwood Forest (3404) [CES203.280.14] (Elliott 2011) Finer
- Pineywoods: Southern Mesic Pine / Hardwood Forest (3403) [CES203.280.13] (Elliott 2011) Finer
- Swamp Chestnut Oak - Cherrybark Oak: 91 (Eyre 1980) Finer
- White Oak: 53 (Eyre 1980) Finer

DESCRIPTION

Environment: Sites are often found along slopes above perennial streams in the region. These sites have moderate to high fertility and moisture retention. Soils can be quite variable, ranging from coarse to loamy in surface texture. Most are acidic in surface reactions and less commonly circumneutral. It is found on Tertiary formations, from the Willis Formation in the south, northward through Eocene formations; it is primarily restricted to fairly rugged landscapes on ravines, steep slopes and low landscape positions, often near streams. It often occupies lower slope positions and adjacent steep slopes, where topographic position results in moisture accumulation and lower solar insolation. These sites may occur adjacent to bottomlands, but on more well-drained soils and/or slightly higher topographic positions (Elliott 2011).
Vegetation: Examples of this forested system can be diverse. Canopy trees can include *Fagus grandifolia, Magnolia grandiflora, Liquidambar styraciflua, Quercus alba, Quercus shumardii, Quercus pagoda, Quercus falcata, Quercus michauxii* (in wetter examples), *Quercus hemisphaerica* (in drier examples), *Quercus stellata* (in drier examples), *Quercus nigra, Fraxinus americana, Carya alba, Celtis laevigata, Nyssa sylvatica, Ulmus americana,* and *Pinus taeda*. *Pinus taeda,* and to a lesser extent, *Pinus echinata* may be present to codominant in the overstory. *Quercus rubra* is rare and of limited extent in the range of this ecological system but is attributed to an association which occurs in Hempstead, Howard, Little River, and Sevier counties, Arkansas. Understory trees can include *Carpinus caroliniana, Prunus caroliniana, Ostrya virginiana, Ilex opaca var. opaca, Cornus florida, Acer barbatum,* and *Acer leucoderme*. *Arundinaria gigantea* may be present in some examples. Other shrubs may include *Persea borbonia, Viburnum acerifolium,* and *Sabal minor*. *Vitis rotundifolia, Smilax* spp., and *Parthenocissus quinquefolia* are commonly encountered woody vines. Herbs can include *Solidago auriculata, Athyrium filix-femina ssp. Asplenioides, Chasmanthium sessiliflorum, Cynoglossum virginianum,* and *Trillium ludovicianum*. Some occurrences on more calcareous substrates lack *Magnolia grandiflora* and may contain species such as *Tilia americana* and *Styrax* spp., and may have a rich, more calciphilic, vernal forb flora. Such species as *Podophyllum peltatum, Arisaema dracontium, Arisaema triphyllum, Sanguinaria canadensis, Erythronium* spp., *Trillium* spp., and *Polygonatum biflorum* may dominate the ground layer of the forest in the early spring. Later in the year, these species become inconspicuous and are replaced by species such as *Chasmanthium sessiliflorum, Mitchella repens, Sanicula canadensis, Carex* spp., and *Dichanthelium* spp. Ferns, such as *Woodwardia* spp., *Osmunda cinnamomea, Athyrium filix-femina ssp. asplenioides,* and *Polystichum acrostichoides,* may be conspicuous.
Dynamics: The mesic nature of sites occupied by this system, along with the topography of the sites and the limited fine fuel

production in the system, results in reduced fire frequency.

Component Associations:
- *Fagus grandifolia - Magnolia grandiflora - Quercus alba / Carpinus caroliniana - Ostrya virginiana - Ilex opaca var. opaca* Forest (CEGL007872, G2)
- *Fagus grandifolia - Magnolia grandiflora / Ostrya virginiana / Aesculus parviflora* Forest (CEGL008554, G2?)
- *Fagus grandifolia - Quercus alba / Acer (barbatum, leucoderme) / Solidago auriculata* Forest (CEGL007207, G2G3)
- *Fagus grandifolia - Quercus alba / Ilex opaca var. opaca / Athyrium filix-femina ssp. asplenioides* Forest (CEGL007208, G3)
- *Fraxinus americana - Celtis laevigata - Nyssa sylvatica - Quercus shumardii - Ulmus americana* Forest (CEGL007897, G2G3)
- *Magnolia grandiflora / Prunus caroliniana - Carpinus caroliniana / Arundinaria gigantea* Forest (CEGL008577, G1?)
- *Quercus alba - Carya alba / Chasmanthium sessiliflorum* West Gulf Coastal Plain Forest (CEGL008413, G3G4)
- *Quercus alba - Quercus hemisphaerica / Prunus caroliniana - Persea borbonia - Viburnum acerifolium* Forest (CEGL007959, G2)
- *Quercus alba - Quercus nigra / Ostrya virginiana / Sabal minor* Forest (CEGL008581, G2G3)
- *Quercus alba - Quercus rubra / Ostrya virginiana / Arundinaria gigantea / Cynoglossum virginianum* Forest (CEGL007971, G2)
- *Quercus alba / Acer leucoderme - Ostrya virginiana / Solidago auriculata* Forest (CEGL008575, G2?)
- *Quercus falcata - Quercus stellata - (Pinus taeda)* West Gulf Coastal Plain Forest (CEGL008415, G3?)
- *Quercus shumardii - Quercus pagoda - Fraxinus americana / Ostrya virginiana - Cornus florida / Trillium ludovicianum* Forest (CEGL007272, G1)

DISTRIBUTION

Range: This system is limited to particular upland areas (especially ravines and sideslopes) of the Gulf Coastal Plain west of the Mississippi River, with some occurrences on Macon Ridge (a terrace ecoregion in the Mississippi River Alluvial Plain) in Louisiana.
Divisions: 203:C
Nations: US
Subnations: AR, LA, TX
Map Zones: 37:C, 44:P, 99:C
USFS Ecomap Regions: 231E:CC, 232F:CC
TNC Ecoregions: 40:C, 41:C, 42:C

SOURCES

References: Comer et al. 2003, Elliott 2011, Eyre 1980, Marks and Harcombe 1981
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723207#references
Description Author: R. Evans, mod. M. Pyne, E. Lunsford and L. Elliott
Version: 14 Feb 2011 **Stakeholders:** Southeast
Concept Author: R. Evans **ClassifResp:** Southeast

WEST GULF COASTAL PLAIN PINE-HARDWOOD FOREST (CES203.378)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Short Disturbance Interval; Needle-Leaved Tree; Broad-Leaved Deciduous Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Mixed evergreen-deciduous closed tree canopy
National Mapping Codes: EVT 2371; ESLF 4314; ESP 1371

CONCEPT

Summary: This West Gulf Coastal Plain ecological system consists of forests and woodlands dominated by *Pinus taeda* and/or *Pinus echinata* in combination with a variety of dry to dry-mesic site hardwood species. This type was the historical matrix vegetation (dominant vegetation type) for large portions of the West Gulf Coastal Plain landward of the range of *Pinus palustris*, where it replaced *Pinus palustris*-dominated vegetation. In this region of southern Arkansas, northwestern Louisiana, and parts of eastern Texas, this type was historically present on nearly all uplands in the region except on the most edaphically limited sites (droughty sands, calcareous clays, and shallow soil barrens/rock outcrops). Such sites are underlain by loamy to fine-textured soils of variable depths. These are upland sites on ridgetops and adjacent sideslopes, with moderate fertility and moisture retention. This type was also present in more limited areas within the range of *Pinus palustris* (in the West Gulf Coastal Plain), where it was confined more typically to sideslopes and other locations not dominated by *Pinus palustris*. There are no known "Fidel" herbaceous species or any local endemic or globally rare plant species, and overall this system may have supported relatively low levels of vascular plant species diversity. This system has undergone major transformations since European settlement of the region.

Similar Ecological Systems:
- West Gulf Coastal Plain Stream Terrace Sandyland Longleaf Pine Woodland (CES203.891)

Related Concepts:
- Calcareous Forest (Smith 1996a) Undetermined
- Loblolly Pine - Hardwood: 82 (Eyre 1980) Finer
- Loblolly Pine - Shortleaf Pine: 80 (Eyre 1980) Finer
- Mid Slope Oak Pine Forest (Marks and Harcombe 1981) Undetermined
- Pineywoods: Dry Pine / Hardwood Forest and Plantation (3013) [CES203.378.13] (Elliott 2011) Finer
- Pineywoods: Dry Pine Forest (3011) [CES203.378.11] (Elliott 2011) Finer
- Pineywoods: Dry Upland Hardwood Forest (3014) [CES203.378.14] (Elliott 2011) Finer
- Pineywoods: Pine / Hardwood Forest and Plantation (3003) [CES203.378.3] (Elliott 2011) Finer
- Pineywoods: Pine Forest or Plantation (3001) [CES203.378.1] (Elliott 2011) Finer
- Pineywoods: Upland Hardwood Forest (3004) [CES203.378.4] (Elliott 2011) Finer
- Shortleaf Pine - Oak: 76 (Eyre 1980) Finer
- Shortleaf Pine/Oak-Hickory Forest (Smith 1996a) Intersecting

DESCRIPTION

Environment: In southern Arkansas, northwestern Louisiana, and parts of eastern Texas, this type was historically present on nearly all uplands in the region except on the most edaphically limited sites (droughty sands, calcareous clays, and shallow soil barrens/rock outcrops). Such sites are underlain by loamy to fine-textured soils of variable depths and generally are Alfisols or Ultisols. These are upland sites on ridgetops and adjacent sideslopes, with moderate fertility and moisture retention. In Texas, this system occurs over a wide variety of landforms, with drier expressions occurring on hilltops and ridges. It occupies slopes and lower landscape positions, where conditions are more mesic, and composition of the system varies across these gradients. It is found on numerous Cenozoic sedimentary formations and some Cretaceous formations of the Mesozoic era. These formations range from sandstone, shale, alluvium, and conglomerate, to marl, with glauconitic formations (Weches) and tuffaceous formations (Catahoula) present (Elliott 2011).

Vegetation: Examples of this system are forests and woodlands dominated by *Pinus taeda* and/or *Pinus echinata* in combination with a host of dry to dry-mesic site hardwood species, such as *Quercus alba, Quercus falcata*, and *Quercus stellata*. Stands on narrow ridgetops, which can be isolated from the effects of fire, may exhibit greater dominance by hardwoods. Other species that may occur include *Quercus margarettiae, Quercus velutina, Carya alba, Carya texana, Cornus florida, Crataegus* spp., *Ostrya virginiana, Symplocos tinctoria, Morella cerifera, Vaccinium arboreum, Vaccinium elliottii, Viburnum acerifolium*, and *Viburnum dentatum*. Woody vines in this system may be conspicuous and often include *Smilax bona-nox, Vitis* spp. (often *Vitis rotundifolia* or *Vitis mustangensis* to the south), *Parthenocissus quinquefolia*, and *Toxicodendron radicans*. The herbaceous layer is generally sparse (often less than 20% cover), with *Schizachyrium scoparium, Chasmanthium laxum, Chasmanthium sessiliflorum, Dichanthelium sphaerocarpon*, and *Pteridium aquilinum* often present to dominant. The importance of *Acer barbatum, Acer leucoderme*, and *Liquidambar styraciflua* may increase with the absence of fire. In parts of southeastern Texas, the hardwood component of stands may

contain *Quercus nigra, Quercus virginiana, Quercus falcata, Liquidambar styraciflua,* and *Ulmus* spp. Shrubs include *Ilex vomitoria, Cornus florida, Morella cerifera, Callicarpa americana,* and *Vaccinium arboreum* (Elliott 2011).
Dynamics: Forests with dense tree cover (especially evergreen cover) have reduced shrub and herbaceous cover. Herbaceous cover may be additionally limited by dense litter accumulation. Few occurrences of this system can be considered old-growth.

Component Associations:
- *Pinus (echinata, taeda) / Symplocos tinctoria - Morella cerifera - Vaccinium elliottii* Forest (CEGL008410, G3?)
- *Pinus echinata - (Pinus taeda) - Quercus falcata / Dichanthelium sphaerocarpon* Forest (CEGL007947, G2G3)
- *Pinus echinata - Pinus taeda - Quercus (alba, falcata, stellata)* Forest (CEGL004713, G2G3)
- *Pinus echinata - Pinus taeda - Quercus stellata - Carya texana / Vaccinium arboreum* Woodland (CEGL007499, G3?)
- *Pinus echinata - Quercus alba / Viburnum (dentatum, acerifolium)* Forest (CEGL003855, G2G3)
- *Pinus echinata - Quercus stellata - Quercus falcata - Carya texana* Woodland (CEGL007800, G1)
- *Pinus taeda - (Pinus echinata) - Quercus alba - Carya alba / Acer barbatum - (Acer leucoderme)* Forest (CEGL007524, G2G3)
- *Pinus taeda - (Pinus echinata) - Quercus falcata - Carya texana / Vaccinium arboreum* Forest (CEGL007528, G4)
- *Pinus taeda - (Pinus echinata) / Quercus michauxii / Thaspium barbinode* Forest (CEGL008582, G1)
- *Pinus taeda* - (*Quercus* spp.) / *Ostrya virginiana - Sabal minor* Forest (CEGL007955, G2G3)
- *Pinus taeda - Quercus alba - (Fagus grandifolia) / Ilex opaca / Smilax pumila - Mitchella repens* Forest (CEGL007525, G3G4)
- *Pinus taeda - Quercus stellata / Crataegus* spp. Woodland (CEGL002112, G2G3)
- *Quercus alba - Quercus falcata - Quercus stellata - Nyssa sylvatica / Carex cherokeensis* Forest (CEGL008414, G3G4)
- *Quercus stellata - Quercus marilandica - Pinus taeda* Jackson Acidic Clay Woodland (CEGL007900, G2?Q)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- West Gulf Coastal Plain Upland Longleaf Pine Forest and Woodland (CES203.293)

DISTRIBUTION

Range: This system is restricted to the West Gulf Coastal Plain of Arkansas, Louisiana and Texas.
Divisions: 203:C
Nations: US
Subnations: AR, LA, TX
Map Zones: 37:C, 44:C
USFS Ecomap Regions: 231E:CC, 232F:CC, 234E:PP
TNC Ecoregions: 40:C, 41:C

SOURCES

References: Comer et al. 2003, Elliott 2011, Eyre 1980, Griffith et al. 2004, Marks and Harcombe 1981
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723138#references
Description Author: R. Evans and T. Foti, mod. M. Pyne and L. Elliott
Version: 23 May 2013 **Stakeholders:** Southeast
Concept Author: R. Evans and T. Foti **ClassifResp:** Southeast

WEST GULF COASTAL PLAIN SANDHILL OAK AND SHORTLEAF PINE FOREST AND WOODLAND (CES203.056)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Needle-Leaved Tree; Broad-Leaved Deciduous Tree
Non-Diagnostic Classifiers: Short Disturbance Interval
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Mixed evergreen-deciduous closed tree canopy
National Mapping Codes: EVT 2378; ESLF 4321; ESP 1378

CONCEPT

Summary: This ecological system occurs west of the Mississippi River primarily outside the natural range of longleaf pine (*Pinus palustris*) and less commonly within this range. Like other sandhill systems of the Gulf and Atlantic coastal plains, this type is found on uplands underlain with deep, coarse sandy soils. These sites are typified by low fertility and moisture retention, which contribute to open tree canopies with usually less than 60% canopy closure. Sparse understory vegetation and abundant patches of bare soil are indicative of this system. Vegetation indicators are species tolerant of droughty sites, especially *Quercus incana* and *Quercus arkansana*, but also *Quercus marilandica* and *Quercus stellata*. *Pinus echinata* is usually present, and *Pinus palustris* is absent (or perhaps at low frequency within its range). This system supports a large concentration of vascular plant endemics, near endemics, and a number of plant species with high fidelity to sandhills in the region. Elsewhere in the Atlantic and Gulf coastal plains, including most of the adjacent outer West Gulf Coastal Plain ecoregion, these site conditions are closely associated with longleaf pine.
Classification Comments: In Arkansas (at least), this system is most closely affiliated with the "Briley-Alaga-Bibb" Soil Association (MUID=AR039 in STATSGO).
Related Concepts:
- Arenic Dry Mixed Pine-Hardwood Uplands (Turner et al. 1999) Broader. in part; the non-longleaf pine part.
- Eastern Redcedar: 46 (Eyre 1980) Finer
- Grossarenic Dry Uplands (Turner et al. 1999) Broader. in part; the non-longleaf pine part.
- Loblolly Pine - Hardwood: 82 (Eyre 1980) Finer
- Longleaf Pine - Scrub Oak: 71 (Eyre 1980) Finer
- Longleaf Pine: 70 (Eyre 1980) Finer
- Oak-Farkleberry Sandylands (Ajilvsgi 1979) Undetermined
- Pineywoods: Sandhill Grassland or Shrubland (3207) [CES203.056.7] (Elliott 2011) Finer
- Pineywoods: Sandhill Oak / Pine Woodland (3203) [CES203.056.3] (Elliott 2011) Finer
- Pineywoods: Sandhill Oak Woodland (3204) [CES203.056.4] (Elliott 2011) Finer
- Pineywoods: Sandhill Pine Woodland (3201) [CES203.056.1] (Elliott 2011) Finer
- Post Oak - Blackjack Oak: 40 (Eyre 1980) Finer
- Sandhill Pine Forest (Marks and Harcombe 1981) Finer
- Shortleaf Pine - Oak: 76 (Eyre 1980) Intersecting

DESCRIPTION

Environment: This system type is found on droughty uplands underlain with deep, coarse sandy soils. It is generally associated with Eocene sand formations such as Carrizo, Sparta, and Queen City sands, including the Betis, Darco, Letney, Tehran, Tonkawa, and other Grossarenic or Psammentic soil series. It is also found on sands derived from the Pliocene Willis formation (Elliott 2011). These sites are typified by low fertility and moisture retention. In particular, these are found on deep sands on generally high, convex landforms, and often display a relatively open overstory canopy.
Vegetation: Examples of this system may occur as pine dominated woodlands, with *Pinus palustris* dominating some sites within its range, and *Pinus echinata* dominating areas where *Pinus palustris* is absent. *Pinus taeda* is naturally less common, but in the current landscape, it is common and sometimes dominant. Pines may co-dominate along with deciduous species, or the canopy may be dominated by oaks and other deciduous species including *Quercus stellata, Quercus marilandica, Quercus incana, Quercus falcata, Quercus margarettiae*, and *Carya texana* (Elliott 2011). Other deciduous trees present may include *Sassafras albidum, Liquidambar styraciflua*, and *Quercus nigra*. The shrub stratum can be fairly well-developed, and includes shorter individuals of canopy species in addition to such species as *Callicarpa americana, Ilex vomitoria, Vaccinium arboreum, Rhus aromatica, Asimina parviflora, Cornus florida*, and *Smilax bona-nox*. The herbaceous layer may be quite well-developed or relatively patchy (with areas of bare sandy soil exposed). Commonly encountered species include *Schizachyrium scoparium, Pteridium aquilinum, Aristida desmantha, Ambrosia psilostachya, Cnidoscolus texanus, Rudbeckia hirta, Dichanthelium dichotomum, Pityopsis graminifolia, Croton argyranthemus, Tragia urticifolia, Froelichia floridana, Matelea cynanchoides, Opuntia humifusa, Sporobolus junceus, Triplasis purpurea, Bulbostylis ciliatifolia, Chamaecrista fasciculata, Berlandiera pumila, Commelina erecta var. angustifolia, Stylisma pickeringii, Tetragonotheca ludoviciana, Tradescantia reverchonii, Rhynchosia* spp., *Tephrosia* spp., *Yucca louisianensis*, as well as the fern ally *Selaginella arenicola ssp. riddellii* (Elliott 2011). All described community types in this system tend to support relatively open

wooded canopies (<60% closure), and one type is described as essentially treeless. A degraded expression of this type has been described [see CEGL007507], but this is treated under the semi-natural ecological system. Other types are floristically differentiated, with special importance placed on the occurrence of *Quercus arkansana*.

Dynamics: The primary natural processes controlling this system are droughty, deep sandy soils, and a natural fire regime. Fire is believed to have been a critical natural disturbance process which affected the vegetation structure and likely the species composition of communities in this system. There are several indirect pieces of evidence which suggest this: (1) *Pinus echinata* is intolerant of competition, and young stems are generally slower growing and slower to dominate sites than either *Pinus taeda* or many hardwood species (Lawson 1990); (2) *Pinus echinata* regeneration decreases dramatically with time since fire (Ferguson 1958); and (3) *Pinus echinata* has the ability to resprout. Watson (1986) postulates that most seedlings of *Pinus echinata* are killed during the periodic fires, and the mature trees are spared. This prevents the formation of thickets. This paper implies that low fuel levels accompany the sparse vegetation of these sandy areas, leading to a somewhat longer fire-return interval, which suits *Pinus echinata*. A variety of fire-return intervals have been estimated for *Pinus echinata* vegetation. Garren (1943) proposed an 8- to 10 -year return interval, Landers (1989) inferred a regime of 10 per century, and Martin and Smith (1993) estimated a 5- to 15 -year interval, however, none of these estimates were specific to *Pinus echinata* on sandhills. Many such sites in the region lack well -developed and continuous fine fuels necessary to ignite and spread fires, possibly due to site infertility and droughtiness (R. Evans pers. obs., L. Smith pers. comm.).

Component Associations:

- *(Pinus palustris) - Quercus stellata - Quercus incana / Tetragonotheca ludoviciana* Woodland (CEGL008566, G2)
- *(Quercus incana) / Schizachyrium scoparium - Bouteloua hirsuta - Dalea villosa var. grisea - Selaginella arenicola ssp. riddellii* Xeric Sand Barrens Woodland (CEGL007973, GNR)
- *Pinus echinata - (Pinus taeda) - Quercus (margarettiae, stellata, falcata) - Carya texana* Woodland (CEGL007946, G2)
- *Pinus echinata - Pinus taeda - Quercus stellata / Juniperus virginiana var. virginiana / Cornus drummondii* Woodland (CEGL007798, G1G2Q)
- *Pinus echinata - Quercus (incana, stellata, margarettiae) / Cnidoscolus texanus* Woodland (CEGL007507, G2)
- *Pinus echinata / Quercus incana / Selaginella arenicola ssp. riddellii* Woodland (CEGL003559, G2Q)
- *Pinus palustris - Pinus (echinata, taeda) - Quercus falcata - Carya texana* Woodland (CEGL008571, G2G3)
- *Quercus (incana, margarettiae, arkansana) - (Pinus echinata) / Schizachyrium scoparium* Woodland (CEGL007972, G2)
- *Quercus arkansana - Quercus incana / Selaginella arenicola ssp. riddellii* Woodland (CEGL003693, G2)

DISTRIBUTION

Range: This system occurs west of the Mississippi River primarily outside the natural range of longleaf pine (*Pinus palustris*).
Divisions: 203:C
Nations: US
Subnations: AR, LA, TX
Map Zones: 37:C
USFS Ecomap Regions: 231E:CC, 232F:CC
TNC Ecoregions: 40:C, 41:C

SOURCES

References: Ajilvsgi 1979, Comer et al. 2003, Elliott 2011, Evans, R. pers. comm., Eyre 1980, Ferguson 1958, Garren 1943, Landers 1989, Lawson 1990, Marks and Harcombe 1981, Martin and Smith 1993, Smith, L. pers. comm., Turner et al. 1999, Watson 1986
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723254#references
Description Author: R. Evans, mod. M. Pyne, L. Elliott, J. Teague
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: R. Evans **ClassifResp:** Southeast

WEST GULF COASTAL PLAIN STREAM TERRACE SANDYLAND LONGLEAF PINE WOODLAND (CES203.891)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); West Gulf Coastal Plain; Very Short Disturbance Interval; Needle-Leaved Tree
National Mapping Codes: EVT 2521; ESLF 4283; ESP 1521

CONCEPT

Summary: These sandhills are dry longleaf pine-dominated woodlands or savannas found on excessively drained, xeric soils of alluvial origin in the West Gulf Coastal Plain (South Central Plains of EPA) of Texas and formerly Louisiana. They occur on areas of deep sand (ranging in texture from coarse to fine) which are present in quaternary alluvial deposits. The general habitat is on low terraces adjacent to stream floodplains, and adjacent communities may include baygalls and ponds. Precipitation rapidly dissipates via percolation due to the character of the soil. Soils include fine sands, such as fluvial terraces of Bienville-Alaga soils developed in the Deweyville Formation, and the Tonkawa fine sand, as well as other coarse sands. *Pinus palustris* historically dominated the vegetation of this region across nearly all uplands regardless of soil type or moisture. The importance of frequent fire has been well-documented for the perpetuation of this and related systems throughout the coastal plains. Stands are dominated by *Pinus palustris*, which often occurs in mixed stands with *Quercus incana, Pinus echinata*, and *Carya texana*. Some small isolated terraces (inclusions) may be dominated by oaks and hickories, with little or no *Pinus palustris*. The oaks generally become denser with fire exclusion, particularly on the small isolated areas. Mesophytic oak species are absent or extremely rare. This type, and other longleaf communities and systems of the West Gulf Coastal Plain, lie outside the range of *Aristida beyrichiana* (wiregrass). Other grasses (*Andropogon* spp., other *Aristida* spp., and *Schizachyrium* spp.) dominate understories which are rich in species diversity.
Classification Comments: This system is relatively xeric vegetation, even though it occurs on terraces adjacent to, or within, floodplains. This is the case because the soils are deep and well-drained sands (often alluvial deposits), with low moisture retention and high permeability. This system is floristically similar to other sandhill longleaf pine systems, but the landform position of the occurrences makes this system unique. This system was formerly part of West Gulf Coastal Plain Upland Longleaf Pine Forest and Woodland (CES203.293) but has been separated out due to its distinctive environment. The herbaceous cover of subtypes 2 and 3 of Bridges and Orzell (1989a) is usually sparse, with considerable exposed sand and foliose lichen cover, and is characterized by numerous West Gulf Coastal Plain endemics (Bridges and Orzell 1989a). Two taxa (*Phlox nivalis ssp. texensis* and *Gaillardia aestivalis var. winkleri*) are nearly endemic to subtype 3 and occur primarily along Village Creek in Hardin County, Texas. *Carex tenax* and *Galium hispidulum* are nearly restricted to subtype 3 and are long-distance disjuncts from the East Gulf Coastal Plain (Bridges and Orzell 1989a).
Similar Ecological Systems:
- West Gulf Coastal Plain Pine-Hardwood Forest (CES203.378)--is found on the inner (landward) side, generally north and west of the range of this type.
- West Gulf Coastal Plain Upland Longleaf Pine Forest and Woodland (CES203.293)--represents the longleaf pine system of regular uplands of varying soil textures.
- West Gulf Coastal Plain Wet Longleaf Pine Savanna and Flatwoods (CES203.191)--is found on the outer (seaward) side, generally south and east of the range of this type, and is an upland/wetland mosaic.

Related Concepts:
- Arenic Dry Mixed Pine-Hardwood Uplands (Turner et al. 1999) Broader
- Grossarenic Dry Uplands (Turner et al. 1999) Broader
- Longleaf Pine - Scrub Oak: 71 (Eyre 1980) Finer
- Longleaf Pine: 70 (Eyre 1980) Finer
- Longleaf-Bluestem Uplands (Ajilvsgi 1979) Undetermined
- Sandhill Pine Forest (Marks and Harcombe 1981) Equivalent
- Upland Pine Forest (Marks and Harcombe 1981) Undetermined
- Xeric stream terrace sand ridge subtype (of Upland Longleaf Pine Savanna) (Bridges and Orzell 1989a) Equivalent

DESCRIPTION

Environment: This system is relatively xeric vegetation, even though it occurs on terraces adjacent to, or within, floodplains. This is because the soils are deep and well-drained sands (often alluvial deposits), with low moisture retention and high permeability. This system usually occurs in deep, well-drained sandy soils on stream terraces, occurring above medium-sized perennial creeks that are typically clear and have sandy bottoms. These sites have very fine sands on ridgetops or slightly higher rises in the sandhill terraces. The flat areas with broad sandhills are slightly coarser and hold a little more water. A site for this system can have both fine and coarse sands. The landscape profile starts out with some bottomland hardwoods type with braided bald-cypress - tupelo, then a slight slope with a wide baygall edge against the sandhill. Sometimes there is a small ribbon of American beech slope forest just above the

baygall, then going into the upland sandhill; sometimes it is just a baygall to sandhill transition (J. Singhurst pers. comm.). It represents a distinctive subset of longleaf pine-dominated vegetation in the inner (landward) portions of the West Gulf Coastal Plain in eastern Texas (and Louisiana).

Vegetation: Stands are dominated by *Pinus palustris*, which may form a discontinuous and sparse overstory, and often occurs in mixed stands with *Quercus incana, Quercus margarettiae, Quercus marilandica, Pinus echinata,* and *Carya texana*. Some small isolated terraces (inclusions) may be dominated by oaks and hickories, with little or no *Pinus palustris*. The oaks generally become denser with fire exclusion, particularly on the small isolated areas. *Pinus elliottii* and *Pinus taeda* may be present to common in the current landscape. Other mesophytic oak species are absent or extremely rare. This type, and other longleaf communities and systems of the West Gulf Coastal Plain, lies outside the range of *Aristida beyrichiana*. Other grasses (*Andropogon* spp., other non-wiregrass *Aristida* spp., and *Schizachyrium* spp.) dominate understories rich in species diversity. Some additional small trees may include *Quercus marilandica, Quercus hemisphaerica,* and *Liquidambar styraciflua*. A sparse understory shrub component includes *Vaccinium arboreum* and *Ilex vomitoria*; however, fire suppression allows the shrubs to become more dominant in the midstory. Some other common shrubs may include *Asimina parviflora, Callicarpa americana, Crataegus* spp., *Prunus angustifolia, Prunus gracilis, Rhus aromatica, Ptelea trifoliata var. mollis, Sassafras albidum,* and *Sideroxylon lanuginosum*. Ground cover plant species are tolerant of periodic drought during the growing season, and they also exhibit adaptations to a frequent fire regime. Some characteristic herbs (which vary across environments) include *Schizachyrium scoparium, Aristida desmantha, Berlandiera pumila, Bulbostylis ciliatifolia, Cnidoscolus texanus, Croton argyranthemus, Dichanthelium acuminatum, Eriogonum longifolium, Lespedeza hirta, Liatris elegans var. elegans, Liatris pycnostachya, Opuntia humifusa var. humifusa, Paronychia drummondii, Rudbeckia grandiflora var. alismifolia, Ruellia humilis, Silphium laciniatum, Stillingia sylvatica, Stylisma pickeringii var. pattersonii, Tradescantia reverchonii, Tragia urens,* and *Yucca louisianensis*. Some other taxa that may be present include *Ambrosia trifida, Baptisia* sp., *Bulbostylis capillaris, Bulbostylis ciliatifolia, Carex tenax, Cenchrus* sp., *Chamaecrista* sp., *Commelina erecta, Croptilon divaricatum, Cyperus grayoides, Dalea* sp., *Delphinium carolinianum, Echinacea* sp., *Eragrostis secundiflora, Eriogonum multiflorum, Euphorbia corollata, Gaillardia aestivalis var. winkleri, Heterotheca subaxillaris, Hypericum drummondii, Hypericum hypericoides, Hymenopappus artemisiifolius , Lechea tenuifolia, Lechea mucronata, Nuttallanthus canadensis (= Linaria canadensis), Loeflingia squarrosa, Matelea cynanchoides, Mirabilis albida, Monarda punctata, Oenothera heterophylla, Paronychia drummondii, Polanisia erosa ssp. erosa, Polypremum procumbens, Pteridium aquilinum, Rhynchosia* sp., *Scutellaria* sp., *Solidago* spp., *Streptanthus hyacinthoides, Tephrosia* sp., *Tetragonotheca ludoviciana, Thelesperma filifolium, Toxicodendron radicans, Trichostema dichotomum,* and *Vernonia* sp. (J. Singhurst pers. comm.).

In Bridges and Orzell (1989a; table 3 - herbs), the following herbs are "differentials" (present in subtype 3 [or at much greater abundance] than in subtype 2): *Aristida desmantha, Carex tenax, Eriogonum longifolium* [which is in subtypes 1 and 3, but not 2], *Eriogonum multiflorum,* and *Polanisia erosa*. Many "indicators" are present at roughly the same frequency in subtypes 2 and 3.

Dynamics: The importance of frequent fire has been widely-accepted for the perpetuation of *Pinus palustris* systems (Stambaugh et al. 2011a), but fires may actually be less frequent, more patchy and discontinuous than in other related longleaf pine-dominated systems. The oaks generally become denser with fire exclusion, particularly in small, isolated examples. Lichens (e.g., *Cladonia* spp.) and *Selaginella arenicola ssp. riddellii* also occur along with patches of bare sand. Canopy trees are patchy in distribution, with regeneration in canopy gaps of a quarter acre or less in size, mid-successional clumps in similar sized patches, and the oldest trees occurring as isolated individuals. The reference condition classes are aggregates of numerous patches well-dispersed over the landscape. Canopy gaps are created by fire mortality, pest outbreaks, lightning, and windthrow at the scale of individual trees or several trees. Because of the irregular seed production of longleaf pine, canopy gaps may lack regeneration for several years. Uncharacteristic vegetation types include even-aged canopy stands in which age structure has been homogenized by logging or clearing. Examples include where *Pinus taeda* or *Pinus elliottii* have replaced some or all of the longleaf pine, where midstory oaks and/or low shrubs have become dense due to fire suppression, and where the grass-dominated ground cover has been lost due to soil disturbance or canopy closure.

Component Associations:

- *Pinus palustris - Pinus (echinata, taeda) - Quercus (incana, margarettiae) / Schizachyrium scoparium* Woodland (CEGL007513, G1G2)
- *Pinus palustris / Quercus incana - Quercus margarettiae / Vaccinium arboreum / Cnidoscolus texanus - Stylisma pickeringii var. pattersonii* Woodland (CEGL003602, G2G3)
- *Pinus palustris / Quercus incana / Schizachyrium scoparium - Croton argyranthemus* Woodland (CEGL008572, G2G3)
- *Pinus palustris / Quercus incana / Schizachyrium scoparium - Liatris elegans - Opuntia humifusa var. humifusa* Woodland (CEGL003580, G1?Q)
- *Pinus palustris / Quercus marilandica / Ilex vomitoria / Schizachyrium scoparium* Woodland (CEGL003579, G2)
- *Pinus palustris / Quercus marilandica / Panicum virgatum* Woodland (CEGL008580, G2)
- *Pinus palustris / Quercus marilandica / Schizachyrium scoparium - Silphium laciniatum - Ruellia humilis* Woodland (CEGL003596, G1)
- *Pinus palustris / Schizachyrium scoparium - Liatris pycnostachya* Woodland (CEGL003571, G2G3)
- *Pinus palustris / Schizachyrium scoparium - Rudbeckia grandiflora var. alismifolia* Woodland (CEGL003572, G2G3)

SPATIAL CHARACTERISTICS

Adjacent Ecological System Comments: Adjacent communities may include baygalls and ponds.

DISTRIBUTION

Range: This upland ecological system occurs mainly in the Southern Loam Hills Subsection (232Fa) of Texas and formerly Louisiana, apparently ranging south into the Southwest Flatwoods Subsection (232Fb) (Hardin County, Texas). West Gulf Coastal Plain longleaf sandhills are distinctive from those in the East Gulf Coastal Plain because they occur beyond the limits of where wiregrass and sand post oak are dominant.
Divisions: 203:C
Nations: US
Subnations: LA?, TX
Map Zones: 37:C
USFS Ecomap Regions: 232F:CC
TNC Ecoregions: 41:C

SOURCES

References: Ajilvsgi 1979, Bray 1906, Bridges and Orzell 1989a, Christensen 1981, Collier 1964, Cruikshank and Eldredge 1939, Eyre 1980, Foster et al. 1917, Frost 1993, Glitzenstein et al. 1986, Harcombe et al. 1993, Marks and Harcombe 1981, McWilliams and Lord 1988, Outcalt 1997, Singhurst 1996, Singhurst pers. comm., Snead and McCulloh 1984, Southeastern Ecology Working Group n.d., Stambaugh et al. 2011a, TNC 2001, TNC 2003b, Turner 1979, Turner et al. 1999, Van Lear et al. 2005, Williams 1989
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.802841#references
Description Author: M. Pyne, mod. J. Teague
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: M. Pyne (after I. McWhorter, W. Ledbetter et al.) **ClassifResp:** Southeast

WEST GULF COASTAL PLAIN UPLAND LONGLEAF PINE FOREST AND WOODLAND (CES203.293)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); West Gulf Coastal Plain; Very Short Disturbance Interval; Needle-Leaved Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2348; ESLF 4251; ESP 1348

CONCEPT

Summary: The common and unifying feature of this system is vegetation naturally dominated by *Pinus palustris*. This was formerly the most extensive system within its natural range in western Louisiana and eastern Texas. In most of the region, longleaf pine is (presently) a distinctive, but rarely dominant, element of existing vegetation. However, this tree historically dominated the vegetation across nearly all uplands regardless of soil type or moisture (excluding wetlands), and longleaf pine forests were among the most valuable economic resources in the region at the turn of the century. Typical sites include sandhills on well-drained to excessively drained soils, but the type is also found on loamy and clayey upland soils. The importance of frequent fire has been well documented for the perpetuation of this system. This type lies outside the ranges of *Aristida stricta* and *Aristida beyrichiana*, unlike comparable systems east of the Mississippi River, but most stands at least formerly supported open grass-dominated understories rich in species diversity.

Classification Comments: This system was part of what was once considered "the lumber region par excellence of Texas" (Bray 1906). Intensive logging began around 1880 as forests in the northern states were cut out and railroads and logging technologies were moved into the region (Collier 1964, Williams 1989). By 1917, the majority of Texas longleaf had been cut (Foster et al. 1917), and by 1934-35, loblolly had become the single most prevalent species in 17 southeastern Texas counties (Cruikshank and Eldredge 1939). Overall losses of longleaf pine in Texas have exceeded those of all other southern states (Outcalt 1997); less than 16,200 hectares of mostly second-growth stands remain (McWilliams and Lord 1988). Land-use practices continue to degrade remaining examples of longleaf pine communities (Bridges and Orzell 1989a).

Similar Ecological Systems:
- West Gulf Coastal Plain Stream Terrace Sandyland Longleaf Pine Woodland (CES203.891)
- West Gulf Coastal Plain Wet Longleaf Pine Savanna and Flatwoods (CES203.191)

Related Concepts:
- Arenic Dry Mixed Pine-Hardwood Uplands (Turner et al. 1999) Broader. in part; the longleaf pine part.
- Eastern Redcedar: 46 (Eyre 1980) Finer
- Grossarenic Dry Uplands (Turner et al. 1999) Broader. in part; the longleaf pine part.
- Longleaf Pine - Scrub Oak: 71 (Eyre 1980) Finer
- Longleaf Pine: 70 (Eyre 1980) Finer
- Longleaf-Bluestem Uplands (Ajilvsgi 1979) Undetermined
- Post Oak - Blackjack Oak: 40 (Eyre 1980) Finer
- Upland Pine Forest (Marks and Harcombe 1981) Undetermined

DESCRIPTION

Environment: This system represents the presumed matrix vegetation type of the inner (landward) portions of the West Gulf Coastal Plain in Louisiana and eastern Texas within the range of *Pinus palustris*. In Louisiana, these are mapped as the Upper Terrace and some smaller landward units (Snead and McCulloh 1984). The system is bounded on the outer (seaward) side by West Gulf Coastal Plain Wet Longleaf Pine Savanna and Flatwoods (CES203.191) and on the inner (landward) side primarily by West Gulf Coastal Plain Pine-Hardwood Forest (CES203.378) and other hardwood or hardwood-pine systems. Stands are found on sedimentary Pleistocene formations (particularly the Bentley Formation), to formations of the Tertiary period (particularly the Catahoula and Wilcox formations). Historically, this system was more widely distributed on older, more inland formations of the Eocene and Paleocene epochs. They occupy topography ranging from rolling uplands, to hills and ridges such as those associated with the Kisatchie Wold (or Kisatchie Cuesta) and the Sabine Uplift, and are usually associated with coarse-textured, well-drained Ultisols and Alfisols, including loams, sandy loams, loamy sands, and sands, though occurrences may also be found to a lesser extent on tighter soils such as clay loams (Elliott 2011). It is characteristically dissected by small to large streams.

Vegetation: Examples are characterized by relatively open-canopied woodlands dominated by *Pinus palustris* with an herbaceous layer often dominated by graminoids. It often occupied gently rolling uplands with coarse-textured, well-drained soils. *Pinus echinata* may be a significant component of some of the stands. *Quercus stellata, Quercus marilandica, Quercus incana, Pinus taeda, Liquidambar styraciflua,* and *Nyssa sylvatica* may also be common components of the canopy or subcanopy. Occurrences that are less frequently burned may develop a significant shrub layer with species including *Callicarpa americana, Vaccinium arboreum, Vaccinium stamineum, Morella cerifera, Ilex vomitoria, Rhus copallinum,* and *Toxicodendron radicans*. Instances with a more optimal

fire-return interval will retain a more open understory with a grassy aspect. Unlike comparable systems east of the Mississippi River, this type lies outside the ranges of *Aristida stricta* and *Aristida beyrichiana*, but most stands historically supported open grass-dominated understories rich in species diversity. The herbaceous layer is often dominated by grass species such as *Schizachyrium scoparium, Schizachyrium tenerum, Sporobolus junceus, Panicum virgatum, Nassella leucotricha, Andropogon ternarius, Dichanthelium* spp., and *Andropogon virginicus*. *Pteridium aquilinum* may be locally abundant, forming a continuous ground cover. Forbs may be diverse in the herbaceous layer, including species such as *Pityopsis graminifolia, Solidago odora, Tephrosia* spp., *Tragia urens, Euphorbia corollata, Croton argyranthemus, Vernonia texana, Alophia drummondii, Lespedeza virginica, Aristolochia reticulata, Rhynchosia reniformis, Stylosanthes biflora, Opuntia humifusa var. humifusa, Cnidoscolus texanus, Stylisma pickeringii var. pattersonii, Rudbeckia grandiflora var. alismifolia, Silphium laciniatum, Ruellia humilis, Liatris pycnostachya,* and *Liatris elegans*. With prolonged absence of fire, hardwoods and *Pinus taeda* may come to dominate the system (Elliott 2011).

In most of the region, *Pinus palustris* is (presently) a distinctive, but rarely dominant, element of existing vegetation (Harcombe et al. 1993). However, this tree historically dominated the vegetation across nearly all uplands regardless of soil type or moisture (excluding wetlands), and longleaf pine forests were among the most valuable economic resources in the region at the turn of the century (Bray 1906).

Dynamics: Frequent fire was the predominant natural disturbance in this system, which is now dependent on management with prescribed fire. The importance of frequent surface fire (every 1-5 years) has been widely accepted for the perpetuation of this system (Stambaugh et al. 2011a and others). Fires are usually low in intensity overall, consuming only shrubs and herbs, but will occasionally kill patches of young pine regeneration and rarely kill individual older trees. Historically, individual fires covered extensive areas. This high fire frequency is dependent on the presence of fine fuels in the form of grasses and pine leaf litter. This ecological system is also affected by hurricane and tornado occurrences every 200 +/- years. In mature stands, competition between pine and hardwood trees is also a factor in maintaining species composition.

Component Associations:
- *(Pinus palustris) - Quercus stellata - Quercus marilandica - Carya texana / Tragia urens* Woodland (CEGL007907, G2)
- *Pinus palustris - Pinus (echinata, taeda) - Quercus (incana, margarettiae) / Schizachyrium scoparium* Woodland (CEGL007513, G1G2)
- *Pinus palustris - Pinus (echinata, taeda)* Upper West Gulf Coastal Plain Woodland (CEGL008482, G1?)
- *Pinus palustris - Quercus marilandica* West Gulf Woodland (CEGL008579, G2G3)
- *Pinus palustris / Quercus incana - Quercus margarettiae / Vaccinium arboreum / Cnidoscolus texanus - Stylisma pickeringii var. pattersonii* Woodland (CEGL003602, G2G3)
- *Pinus palustris / Quercus incana / Schizachyrium scoparium - Croton argyranthemus* Woodland (CEGL008572, G2G3)
- *Pinus palustris / Quercus incana / Schizachyrium scoparium - Liatris elegans - Opuntia humifusa var. humifusa* Woodland (CEGL003580, G1?Q)
- *Pinus palustris / Quercus marilandica / Ilex vomitoria / Schizachyrium scoparium* Woodland (CEGL003579, G2)
- *Pinus palustris / Quercus marilandica / Panicum virgatum* Woodland (CEGL008580, G2)
- *Pinus palustris / Quercus marilandica / Schizachyrium scoparium - Silphium laciniatum - Ruellia humilis* Woodland (CEGL003596, G1)
- *Pinus palustris / Schizachyrium scoparium - Liatris pycnostachya* Woodland (CEGL003571, G2G3)
- *Pinus palustris / Schizachyrium scoparium - Rudbeckia grandiflora var. alismifolia* Woodland (CEGL003572, G2G3)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- West Gulf Coastal Plain Pine-Hardwood Forest (CES203.378)
- West Gulf Coastal Plain Wet Longleaf Pine Savanna and Flatwoods (CES203.191)

DISTRIBUTION

Range: The natural range of this system is in the coastal plains of western Louisiana and eastern Texas. Its boundary follows TNC Ecoregion 41 (West Gulf Coastal Plain) closely in western Louisiana, but extends slightly into Ecoregion 40 (Upper West Gulf Coastal Plain) in eastern Texas.
Divisions: 203:C
Nations: US
Subnations: LA, TX
Map Zones: 37:C
USFS Ecomap Regions: 231Ef:CCC, 231Eg:CCC, 232Fa:CCC, 232Fb:CCC, 232Fe:CCC, 232Ff:CCC
TNC Ecoregions: 40:C, 41:C

SOURCES

References: Ajilvsgi 1979, Bray 1906, Bridges and Orzell 1989a, Collier 1964, Comer et al. 2003, Cruikshank and Eldredge 1939, Elliott 2011, Eyre 1980, Foster et al. 1917, Harcombe et al. 1993, LDWF 2005, Marks and Harcombe 1981, McWilliams and Lord 1988, Outcalt 1997, Smith 1993, Snead and McCulloh 1984, Stambaugh et al. 2011a, Turner et al. 1999, Van Lear et al. 2005, Williams 1989

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723196#references

Description Author: R. Evans, mod. M. Pyne, L. Elliott, J. Teague
Version: 14 Jan 2014
Concept Author: R. Evans

Stakeholders: Southeast
ClassifResp: Southeast

WESTERN CANADIAN BOREAL [DRY] LODGEPOLE PINE FOREST (CES105.514)

CLASSIFIERS

Classification Status: Standard

Primary Division: Montane Boreal (105)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch, Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane; Forest and Woodland (Treed)
National Mapping Codes: ESLF 4408

CONCEPT

Summary: This ecological system encompasses forests in the upper and lower foothills subregions of Alberta, extending north and west into the adjacent foothills and lower montane zone of British Columbia, and the Boreal Highlands region of Alberta. Soils are dry to very dry, and poor. These are dry forests and woodlands dominated by *Pinus contorta*. Stands are mostly even-aged with varying densities as stand sizes depending on fire history. Small *Populus tremuloides* stands are locally present. Hybrid spruce (*Picea engelmannii X glauca*) is often scattered in the understory of most stands, however, the dominance of pine is maintained by frequent fire and a slow rate of succession. The undergrowth is dominated by *Calamagrostis rubescens, Leymus innovatus, Pleurozium schreberi*, and dwarf-shrubs *Arctostaphylos uva-ursi, Juniperus communis, Linnaea borealis, Shepherdia canadensis, Rosa acicularis, Vaccinium membranaceum*, and *Vaccinium vitis-idaea*. Drier sites have less undergrowth and more lichen cover.
Classification Comments: This system includes the former North Pacific Sub-boreal Dry Lodgepole Pine Forest (CES207.344). Apparently in recent decades, *Pinus contorta* has been expanding it's range north and west, due to a warming climate in the western boreal regions.

DISTRIBUTION

Range: Western foothill and highland regions of Alberta, extending north and west into north-central British Columbia. This system is likely to occur as far north and west as the occurrence of lodgepole pine in western Canada.
Divisions: 103:C; 105:C; 207:C
Nations: CA
Subnations: AB, BC, YT?
TNC Ecoregions: 140:C, 144:C

SOURCES

References: Banner et al. 1993, DeLong 2003, DeLong 2004, DeLong et al. 1993, Lloyd et al. 1990, MacKinnon et al. 1990, Steen and Coupe 1997, Western Ecology Working Group n.d., Willoughby 2007
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.837912#references
Description Author: M.S. Reid
Version: 30 Mar 2010
Concept Author: CNVC Technical Committee
Stakeholders: Canada, West
ClassifResp: West

WESTERN CANADIAN BOREAL MESIC BLACK SPRUCE-LODGEPOLE PINE FOREST (CES105.515)

CLASSIFIERS

Classification Status: Standard

Primary Division: Montane Boreal (105)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch, Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
National Mapping Codes: ESLF 4409

CONCEPT

Summary: This ecological system encompasses forests in the upper and lower foothills subregions of Alberta, extending north and west into adjacent foothills and northern regions of British Columbia and the Boreal Highlands region of Alberta. Elevations ranges from just over 550 m to over 1700 m (1800-5570 feet). Soils are nutrient-poor, but can range from thin and rapidly drained to clayey and poorly drained. These forests are dominated by *Picea mariana* and *Pinus contorta*. In some areas, hybrids of *Pinus banksiana* and *Pinus contorta* occur in this system. Occasionally, *Picea glauca* occurs, but is not a major component of these forests. On rapidly drained sites, shrubs include *Arctostaphylos uva-ursi, Alnus viridis ssp. crispa* (which can be dominant in some areas), *Vaccinium myrtilloides*, and *Vaccinium vitis-idaea*, with lichens. *Salix bebbiana* and *Salix scouleriana* are also commonly present, especially on plateaus. More poorly drained sites have shrubs such as *Ledum groenlandicum, Vaccinium membranaceum,* and *Vaccinium vitis-idaea*. On wetter sites, species of *Equisetum* are common. Bryophytes cover much of the ground surface, including *Hylocomium splendens, Pleurozium schreberi, Ptilium crista-castrensis*, and lichens such as *Cladina mitis*.
Classification Comments: It's unclear how far north and west this system is found, but it could occur as far northwest as Yukon Territory, the furthest extension of lodgepole pine to the north.

DISTRIBUTION

Range: This system is found in the western foothill regions of Alberta, extending north and west into north-central British Columbia. It also occurs in the Boreal Highlands region of Alberta.
Divisions: 103:C; 105:C
Nations: CA
Subnations: AB, BC?
TNC Ecoregions: 135:?, 139:P, 140:C

SOURCES

References: Banner et al. 1993, Beckingham et al. 1996, DeLong 2003, DeLong 2004, DeLong et al. 1993, Lawrence et al. 2005, Lee 1984, Lloyd et al. 1990, MacKinnon et al. 1990, Natural Regions Committee 2006, Steen and Coupe 1997, Western Ecology Working Group n.d., Willoughby 2007
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.837922#references
Description Author: M.S. Reid
Version: 30 Mar 2010
Concept Author: M.S. Reid
Stakeholders: Canada, West
ClassifResp: West

WESTERN CANADIAN BOREAL MESIC MIXED CONIFER-HARDWOOD FOREST (CES105.510)

CLASSIFIERS

Classification Status: Standard

Primary Division: Montane Boreal (105)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch, Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane; Forest and Woodland (Treed)
National Mapping Codes: ESLF 4340

CONCEPT

Summary: This ecological system encompasses forests in the upper and lower foothills, and Boreal Highlands subregions of Alberta, extending north and west into adjacent foothills, interior plateaus, and mountains of British Columbia, and into Yukon Territory. These are mesic to moist forests and woodlands, with soil nutrient status ranging from mesotrophic to rich. *Picea glauca* is the predominant conifer tree, with varying amounts of other trees in the upper canopy, including *Picea mariana, Picea engelmannii X glauca, Pinus contorta, Pseudotsuga menziesii, Abies lasiocarpa*, and *Larix occidentalis*. Deciduous trees form an important component of these mixed forests, although in places they are absent; species include *Populus tremuloides, Populus balsamifera*, and *Betula papyrifera*. The canopy ranges from closed to open forests, usually with a shrub understory, although some stands have only a herbaceous carpet. The hybrid *Picea engelmannii X glauca* is the dominant in interior British Columbia, but *Picea mariana* is typically a minor component. *Picea glauca* associations found in Banff, Jasper, Kootenay and Yoho national parks occur on gentle to moderate slopes and are generally very mature stands. Drier to mesic sites have shrub and herbaceous taxa such as *Arctostaphylos uva-ursi, Shepherdia canadensis, Vaccinium membranaceum, Rosa acicularis*, and *Leymus innovatus*. Moist, rich sites will have higher shrub and herb cover, with such species as *Oplopanax horridus, Alnus viridis, Ledum groenlandicum, Menziesia ferruginea, Gymnocarpium dryopteris, Aralia nudicaulis*, and *Equisetum* spp. Other common shrubs and herbs include *Dasiphora fruticosa ssp. floribunda, Lonicera involucrata, Vaccinium myrtilloides, Vaccinium vitis-idaea, Cornus canadensis, Triglochin maritima*, and *Mertensia paniculata*. Feathermosses are an important component of these mesic forests, including *Abietinella abietina (= Thuidium abietinum), Hylocomium splendens* and *Pleurozium schreberi*.
Classification Comments: In the northwest of its distribution, this system transitions to Western North American Boreal White Spruce-Hardwood Forest (CES105.106), where trees such as *Pinus contorta*, and *Abies lasiocarpa* no longer occur. This is the matrix mixed forest type of the Foothills and Highlands ecoregions of Alberta, as well as the Dry Mixedwood, and is likely to be common further west into British Columbia. To the east, this system intermingles with, and transitions to, Boreal White Spruce-Fir-Hardwood Forest (CES103.021), where *Abies balsamea* and *Pinus banksiana* replace *Abies lasiocarpa* and *Pinus contorta*. This system now includes two provisionally defined types from interior British Columbia: North Pacific Sub-boreal Mesic Subalpine Fir-Hybrid White Spruce Forest (CES207.351) and North Pacific Sub-boreal Mesic Hybrid White Spruce Forest (CES207.345).
Similar Ecological Systems:
- Western North American Boreal Mesic Birch-Aspen Forest (CES105.108)

DISTRIBUTION

Range: This system is found in the western region of Alberta, extending north and west into north-central British Columbia. It is likely to occur in Yukon Territory, where it transitions to Western North American Boreal White Spruce-Hardwood (CES105.106).
Divisions: 103:C; 105:C; 207:C
Nations: CA, US
Subnations: AB, AK, BC, YT?
TNC Ecoregions: 140:C, 144:C

SOURCES

References: Achuff and LaRoi 1977, Banner et al. 2005, Beckingham et al. 1996, DeLong 2003, DeLong 2004, DeLong et al. 1990, Lloyd et al. 1990, MacKinnon et al. 1990, Natural Regions Committee 2006, Steen and Coupe 1997, Western Ecology Working Group n.d., Willoughby et al. 2006
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.837917#references
Description Author: M.S. Reid
Version: 30 Mar 2010
Concept Author: M.S. Reid
Stakeholders: Canada, West
ClassifResp: West

WESTERN GREAT PLAINS DRY BUR OAK FOREST AND WOODLAND (CES303.667)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Western Great Plains (303)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Non-Diagnostic Classifiers: Lowland [Lowland]; Forest and Woodland (Treed); F-Landscape/Medium Intensity; G-Landscape/Medium Intensity
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Deciduous open tree canopy
National Mapping Codes: EVT 2013; ESLF 4106; ESP 1013

CONCEPT

Summary: This system is dominated by *Quercus macrocarpa* and is found in upland areas in the northern part of the Western Great Plains. It often occurs as small to large patches on buttes, escarpments, and in foothill zones, usually on northerly-facing slopes. Other species, such as *Tilia americana* (not in the Dakotas), *Populus tremuloides, Juniperus virginiana*, and *Fraxinus* spp., may be present. The herbaceous layer can vary from sparsely to moderately vegetated and is composed of prairie grasses or woodland *Carex* spp. Shrub associates can include *Prunus virginiana*, *Corylus cornuta*, *Amelanchier alnifolia*, or *Symphoricarpos* spp. Historically, higher cover of grass species occurred as these stands were more open due to more frequent fires. Few good examples of this system likely remain because of past timber harvesting and heavy grazing. Where it occurs at elevations above 915 m (3000 feet), *Pinus ponderosa* woodlands are probably adjacent.
Classification Comments: Stands of bur oak can also be included within Central Mixedgrass Prairie (CES303.659); however, that system would only include small patches or single trees protected by fire. Any stands of bur oak or more substantial woodlands should be included within this system.
Similar Ecological Systems:
- Central Mixedgrass Prairie (CES303.659)

Related Concepts:
- Aspen: 16 (Eyre 1980) Finer. Rare but possible where it might be adjacent to Aspen Parklands.
- Aspen: 217 (Eyre 1980) Finer
- Bur Oak: 236 (Eyre 1980) Broader
- Bur Oak: 42 (Eyre 1980) Finer
- Great Plains Dry Upland Bur Oak Woodland (Rolfsmeier and Steinauer 2010) Equivalent

DESCRIPTION

Environment: This system is found in upland areas throughout the northern part of the Western Great Plains. Soils are predominately dry to mesic. It usually occurs on protected eastern or northern slopes of buttes or river valleys (Rolfsmeier and Steinauer 2010).
Vegetation: This system is typified by the predominance of *Quercus macrocarpa* constituting at least 10% of the vegetation cover in any given example of this system. Other species, such as *Tilia americana, Juniperus virginiana*, and *Fraxinus* spp., may be also present. Understory vegetation can range from sparsely vegetated to more dense and usually exemplifies the surrounding prairie grassland vegetation.
Dynamics: This system is primarily driven by fire. This system occurs in a landscape where fire is common but the sites it occupies are somewhat sheltered so fire frequency is less than the surrounding prairie uplands. Fire-return intervals have been estimated at 15-25 years (Landfire 2007a). Fire reduces woody species regeneration and shrub cover and allows prairie grasses to grow under the open tree canopy.

Component Associations:
- *Quercus macrocarpa - Populus tremuloides / Aralia nudicaulis* Forest (CEGL002065, GNRQ)
- *Quercus macrocarpa - Populus tremuloides / Corylus* spp. Woodland (CEGL002139, G4?)
- *Quercus macrocarpa / Cornus drummondii / Aralia nudicaulis* Forest (CEGL002072, G4)
- *Quercus macrocarpa / Corylus americana - Amelanchier alnifolia* Woodland (CEGL000556, G3)
- *Quercus macrocarpa / Corylus cornuta* Woodland (CEGL002137, G2G3)
- *Tilia americana - (Quercus macrocarpa) / Ostrya virginiana* Forest (CEGL002012, G3)

DISTRIBUTION

Range: This system is found throughout the northern part of the Western Great Plains Division. In Wyoming, it occurs in the Bear Lodge Mountains and around Devils Tower National Monument. In North Dakota, it is found in the Killdeer Mountains, and it may occur in the Pine Ridge region of Nebraska.
Divisions: 303:C
Nations: US
Subnations: MT, ND, NE?, SD, WY
Map Zones: 29:C, 30:C, 31:C, 33:C, 38:?, 39:C, 40:C

USFS Ecomap Regions: 251B:CC, 251G:CC, 251H:C?, 331C:CC, 331E:CC, 331F:CC, 331M:CP, 332B:CC, 332C:CC, 332D:CC, 332E:CC, M334A:CC
TNC Ecoregions: 25:P, 26:C, 27:C, 33:C, 34:C

SOURCES

References: Barbour and Billings 1988, Comer et al. 2003, Eyre 1980, Girard et al. 1989, Landfire 2007a, Rolfsmeier and Steinauer 2010, Tolstead 1947
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722991#references
Description Author: S. Menard and K. Kindscher, mod. K.A. Schulz and J. Drake
Version: 14 Jan 2014 **Stakeholders:** Midwest, West
Concept Author: S. Menard and K. Kindscher **ClassifResp:** Midwest

WESTERN NORTH AMERICAN BOREAL MESIC BIRCH-ASPEN FOREST (CES105.108)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Ridge/Summit/Upper Slope; Sideslope; Boreal [Boreal Subcontinental]; Intermediate Disturbance Interval; Broad-Leaved Deciduous Tree; Aspen; Betula spp.
Non-Diagnostic Classifiers: Moderate (100-500 yrs) Persistence; Montane [Montane]; Montane [Lower Montane]; Lowland [Foothill]; Lowland [Lowland]; Long Disturbance Interval; Populus tremuloides
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: EVT 2605; ESLF 4162; ESP 1605

CONCEPT

Summary: This hardwood system is common on well-drained upland terrain on south, west, and east aspects in the boreal region of interior Alaska, and extends south and east into the territories and provinces of western Canada. It is also widespread in the boreal transition region in south-central Alaska on well-drained upland terrain. *Betula papyrifera* is typically dominant in the canopy in Alaska, but other dominants or subdominants include *Populus balsamifera* and *Populus tremuloides*. In western Alberta, *Populus tremuloides* is much more abundant, often forming extensive forests across large areas. Stands are often closed-canopied with an open shrub or herbaceous understory. Canopy cover typically ranges from 25 to 90%. Common understory species include *Alnus viridis ssp. sinuata, Arctostaphylos uva-ursi, Ledum* spp., *Vaccinium vitis-idaea, Vaccinium myrtilloides, Betula nana, Betula glandulosa, Rosa acicularis, Ribes triste, Linnaea borealis, Shepherdia canadensis,* and *Viburnum edule*. This represents a persistent, often self-replacing, hardwood system and may represent a long-term seral stage of any one of several boreal systems where white spruce is important. Spruce may be present in the canopy and, in the absence of fire, could potentially occupy the site.
Classification Comments: This system now includes what was formerly Montane Boreal Aspen-Birch Forest and Woodland (CES105.851). Exactly where this system transitions to Boreal Aspen-Birch Forest (CES103.020) is unclear, but is presumed to be somewhere east of western Alberta. It may well be that these two systems should be merged into one, with the hardwood forests of Alaska considered to be a variant of the very extensive hardwood forests of western Canada. Also, North Pacific Interior Aspen Forest (CES207.360) should probably also be merged into this system, but information about its composition is inadequate to evaluate that at this time. In Alaska, this system combines those known as Boreal Transition Hardwood and Boreal Hardwood by the Alaska Natural Heritage Program. Because this system persists on the landscape for at least 50 to 100 years, it is described as a unique system, although it also occurs as a seral stage of several ecological systems in south-central Alaska, including Western North American Boreal Treeline White Spruce Woodland (CES105.137) and Western North American Boreal White Spruce Forest (CES105.104).
Similar Ecological Systems:
- Alaska Sub-boreal Mountain Hemlock-White Spruce Forest (CES105.103)
- Alaska Sub-boreal White Spruce-Hardwood Forest (CES105.136)
- Alaska Sub-boreal White-Lutz Spruce Forest and Woodland (CES105.102)
- Western Canadian Boreal Mesic Mixed Conifer-Hardwood Forest (CES105.510)
- Western North American Boreal White Spruce-Hardwood Forest (CES105.106)

Related Concepts:
- I.B.1.d - Paper birch (closed) (Viereck et al. 1992) Intersecting
- I.B.1.e - Quaking aspen (closed) (Viereck et al. 1992) Finer
- I.B.1.f - Paper birch-quaking aspen (Viereck et al. 1992) Intersecting
- I.B.2.a - Paper birch (open) (Viereck et al. 1992) Intersecting
- I.B.2.c - Balsam poplar (black cottonwood) (Viereck et al. 1992) Intersecting
- Paper Birch: 252 (Eyre 1980) Intersecting

DESCRIPTION

Environment: This system occurs on rolling hills and mountain sideslopes on west, east, and south aspects. In Alaska it occurs up to 750 m (2460 feet) elevation, but in western Alberta elevations where it is found range from <300 m to over 1500 m (950-5000 feet). Soils are well-drained and develop on residual material or retransported deposits including glacial till, loess, and colluvium. Permafrost is rare on most sites.
Vegetation: *Betula papyrifera* is typically dominant in the canopy, but other dominants or subdominants include *Populus balsamifera* and *Populus tremuloides*. *Salix scouleriana* is locally common. Stands are often closed-canopied with an open shrub or herbaceous understory. Canopy cover typically ranges from 25% to 90%. Common understory species include *Alnus viridis ssp. sinuata, Ledum* spp., *Vaccinium vitis-idaea, Betula nana, Rosa acicularis, Ribes triste, Linnaea borealis, Shepherdia canadensis,* and *Viburnum edule*. Common herbaceous species include *Calamagrostis canadensis, Chamerion angustifolium, Gymnocarpium dryopteris,* and *Cornus canadensis*. Feathermosses such as *Hylocomium splendens* and *Pleurozium schreberi* are common in the ground layer (Boggs and Sturdy 2005).

Dynamics: These deciduous forests originate naturally after fires and blowdowns, or after logging of conifer or mixed conifer-hardwood systems. This system is maintained by repeated disturbance within 50- to100-year return intervals and would otherwise succeed to conifer systems. This system often acts as a firebreak and has a longer fire-return interval than white and black spruce sites. On drier sites, *Populus tremuloides* or *Betula papyrifera* can persist and be self-replacing. Fire regimes prevent spruce the opportunity of reoccupying a site. Since this system represents a long-term seral stage of Alaska Sub-boreal White Spruce-Hardwood Forest (CES105.136) and Alaska Sub-boreal White-Lutz Spruce Forest and Woodland (CES105.102) (and less frequently Alaska Sub-boreal Mountain Hemlock-White Spruce Forest (CES105.103)), the disturbance regime is the same as those defined for these systems.

DISTRIBUTION

Range: This system occurs in the boreal and boreal transition regions of Alaska. It extends east and south into the western boreal regions of Canada in British Columbia and Alberta.
Divisions: 103:C; 105:C; 204:C
Nations: CA, US
Subnations: AB, AK, BC, NT, YT
Map Zones: 68:C, 69:C, 70:C, 71:C, 72:C, 73:C, 74:C, 75:C, 76:C
TNC Ecoregions: 7:C, 66:C, 67:C, 70:C, 71:C, 74:C, 76:C, 77:C, 78:C, 139:C, 140:C

SOURCES

References: Boggs and Sturdy 2005, Eyre 1980, Viereck et al. 1992, Western Ecology Working Group n.d., Willoughby et al. 2006
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817381#references
Description Author: T. Boucher, mod. M.S. Reid
Version: 30 Mar 2010 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

WESTERN NORTH AMERICAN BOREAL MESIC BLACK SPRUCE FOREST (CES105.107)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Boreal [Boreal Subcontinental]; Acidic Soil; Long Disturbance Interval; Picea mariana
Non-Diagnostic Classifiers: Montane [Montane]; Montane [Lower Montane]; Lowland [Foothill]; Lowland [Lowland]; Alluvial fan; Alluvial terrace; Mineral: W/ A-Horizon >10 cm
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2604; ESLF 4287; ESP 1604

CONCEPT

Summary: This ecological system is common throughout upland slopes and inactive alluvial deposits in the boreal region of Alaska east into Yukon Territory, and east into the western provinces and territories of Canada. It is widespread in south-central Alaska on well-drained sites, including old alluvial plains, abandoned floodplains, and inactive terraces. Soils are well-drained, and permafrost may be absent. The *Picea mariana* forests in the Northern Rockies represent the southernmost extent of these expansive boreal forests. The southern limit appears to be related to July mean temperatures exceeding 65 degrees F and maximum of 75 degrees F, and where annual precipitation drops below 38-50 cm (15-20 inches). *Picea mariana* is typically the dominant species in mature stands, though *Picea glauca* may be codominant on some sites. Common understory species include *Vaccinium vitis-idaea*, *Empetrum nigrum*, and *Linnaea borealis*. Feathermosses (*Hylocomium splendens* and *Pleurozium schreberi*) are common in mature stands. Lichens may be an important component in late-seral stages. In the eastern part of its range, it intermingles with and transitions to Western Canadian Boreal Mesic Black Spruce-Lodgepole Forest (CES105.515) and Western Canadian Boreal Mesic Mixed Conifer-Hardwood Forest (CES105.510).
Classification Comments: This system combines those known as Boreal Transition Mesic Black Spruce and Boreal Mesic Black Spruce by the Alaska Natural Heritage Program. Lowland black spruce sites with peat soils are classified with wetland systems, and those with a tussock-dominated understory are classified with black spruce tussock. The full extent of upland black spruce forests into eastern Canada is uncertain. In western Alberta, pure upland black spruce forest is uncommon. In that region, black spruce is more commonly mixed with *Pinus contorta*, forming Western Canadian Boreal Mesic Black Spruce-Lodgepole Pine Forest (CES105.515).
Similar Ecological Systems:
- Montane Boreal White and Black Spruce Forest (CES105.800)

Related Concepts:
- Black Spruce (western type): 204 (Eyre 1980) Broader
- Black Spruce - Lichen (904) (Shiflet 1994) Intersecting
- Black Spruce - White Spruce: 253 (Eyre 1980) Broader
- I.A.1.k - Black spruce (closed) (Viereck et al. 1992) Intersecting
- I.A.1.l - Black spruce-white spruce (closed) (Viereck et al. 1992) Finer
- I.A.2.f - Black spruce (open) (Viereck et al. 1992) Intersecting
- I.A.2.g - Black spruce-white spruce (open) (Viereck et al. 1992) Finer

DESCRIPTION

Environment: This system occurs on well-drained to moderately well-drained sites in the boreal transition region, including old alluvial fans, abandoned floodplains, and inactive terraces and is widespread on uplands (all aspects) and inactive alluvial surfaces in boreal Alaska. Soils are well-drained, gravelly and feature shallow to moderately deep organic horizons. Black spruce occurs up to treeline where it may be stunted due to cold temperatures (Chapin et al. 2006). On most sites there is little to no peat development, but there may be an organic layer derived from non-sphagnum mosses. Permafrost is usually absent except on shallow soils over bedrock and coarse alluvium (Viereck et al. 1992); however, once a well-developed feathermoss layer is established, permafrost begins forming.
Vegetation: In mature stands, *Picea mariana* is the dominant overstory species, though *Picea glauca* may be codominant. Total tree cover in mature stands typically ranges from 40-70%. Early-successional stands may be dominated by *Betula papyrifera* or *Populus tremuloides*. *Populus tremuloides* replaces *Betula papyrifera* on drier sites (Foote 1983, Chapin et al. 2006). Common understory shrubs include *Betula nana*, *Ledum* spp., *Rosa acicularis*, *Vaccinium uliginosum*, *Vaccinium vitis-idaea*, and *Empetrum nigrum*. Herbaceous species include *Calamagrostis canadensis* and *Equisetum* spp. Feathermosses (*Hylocomium splendens* and *Pleurozium schreberi*) are common in mature stands (Jorgenson et al. 2003). Lichens, such as *Cladina* spp., may be an important component in late-seral stages (Klein 1982).
Dynamics: In the boreal transition region, the disturbance regime is characterized by crown fires or ground fires of enough intensity to kill overstory trees. Mean fire-return interval estimates for this system have not been defined, but estimates for similar sites from boreal Alaska range from 25 to 100 years (Rowe et al. 1974, Heinselman 1978, 1981, Viereck 1983, 1986, Yarie 1983, De Volder

1999 [Kenai Lowland including human-caused]). It is likely that the natural fire-return interval is longer than those estimated for boreal sites due to less frequent lightning strikes. A "best guess" for this system without human disturbance has been estimated at 170 years (FRCC experts pers. comm. 2004).

Post-fire succession can be self-replacement to black spruce or to hardwood before returning to black spruce. Seasonality affects burn severity. An early-season burn can kill the overstory without affecting the ground layer, but a late-season burn can reduce the duff layer and kill the understory plants. *Calamagrostis* is not a major factor in boreal transition black spruce succession.

The disturbance regime in the boreal region is characterized by large crown fires or ground fires of enough intensity to kill overstory trees. Mean fire-return interval estimates in boreal Alaska range from 25 to 130 years (Rowe et al. 1974, Heinselman 1978, 1981, Viereck 1983, 1986, Yarie 1983). The post-fire successional trajectory may be self-replacement, with black spruce following the early-seral herb-shrub stage. Alternatively, hardwood or black spruce-hardwood may follow the early-seral stage before returning to black spruce (Chapin et al. 2006).

DISTRIBUTION

Range: This system is found in the subarctic regions of Alaska and northern Yukon Territory, and the North Pacific Coast of south-central Alaska. It also occurs in northern British Columbia, and further east into Alberta and the Northwest Territories.
Divisions: 103:P; 104:C; 105:C; 204:C; 205:P; 306:?
Nations: CA, US
Subnations: AB, AK, BC, NT, SK, YT
Map Zones: 69:C, 70:C, 71:C, 72:C, 73:C, 74:C, 75:C, 76:C
TNC Ecoregions: 7:?, 66:?, 67:?, 70:C, 71:C, 76:C, 77:C, 78:C, 79:C, 135:C, 139:C, 140:C

SOURCES

References: Achuff and LaRoi 1977, Banner et al. 1993, Boggs 2002, Chapin et al. 2006, De Volder 1999, Eyre 1980, Foote 1983, FRCC pers. comm. 2004, Heinselman 1978, Heinselman 1981, Jorgenson et al. 2003, Klein 1982, Rowe et al. 1974, Viereck 1983, Viereck and Little 1972, Viereck et al. 1992, Western Ecology Working Group n.d., Willoughby et al. 2006, Yarie 1981, Yarie 1983
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817375#references
Description Author: T. Boucher, mod. M.S. Reid
Version: 30 Mar 2010 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

WESTERN NORTH AMERICAN BOREAL SPRUCE-LICHEN WOODLAND (CES105.105)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Boreal [Boreal Subcontinental]; Very Shallow Soil; Lichen
Non-Diagnostic Classifiers: Picea glauca; Picea mariana
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2602; ESLF 4288; ESP 1602

CONCEPT

Summary: This system occurs primarily in the northern and western portion of boreal Alaska (west, northeast and northwest boreal) and less commonly in the western and southwestern boreal transition (Nulato Hills and Ahklun Mountains). These are cool dry sites on well-drained to excessively well-drained substrates. Soils are thin and develop on gravels, sandy loess deposits, or bedrock and are likely free of permafrost. Forest canopy is dominated by *Picea glauca* or *Picea mariana*, and cover is generally between 10% and 25%. The shrub layer is open and typically features low and dwarf-shrubs including *Betula nana, Shepherdia canadensis, Arctostaphylos rubra, Arctostaphylos uva-ursi, Vaccinium uliginosum*, or *Empetrum nigrum*. Lichens (primarily *Cladina* spp.) are an important component of the understory in mature stands. Feathermosses are not as important as in other white spruce systems.
Classification Comments: The successional relationships of this system are poorly understood. It could be a late-successional stage of boreal white spruce (self-replacement model), or a possible late-successional stage of boreal and boreal transition white spruce woodland. The range overlaps with the area identified for self-replacement spruce (Noatak, Nulato Hills, northeast taiga: Porcupine, Chandalar, Sheenjek drainages). This system is known as Boreal Spruce Lichen Woodland by the Alaska Natural Heritage Program.
Similar Ecological Systems:
- Western North American Boreal Treeline White Spruce Woodland (CES105.137)
- Western North American Boreal White Spruce Forest (CES105.104)

Related Concepts:
- Black Spruce (western type): 204 (Eyre 1980) Broader
- Black Spruce - Lichen (904) (Shiflet 1994) Intersecting
- I.A.3.c - White spruce (woodland) (Viereck et al. 1992) Intersecting. low shrub or lichen understory
- I.A.3.d - Black spruce (woodland) (Viereck et al. 1992) Intersecting. low shrub or lichen understory
- I.A.3.e - Black spruce-white spruce (woodland) (Viereck et al. 1992) Finer. low shrub or lichen understory

DESCRIPTION

Environment: This system occurs on cool dry sites on well-drained to excessively well-drained substrates. Soils are thin and develop on gravels, sandy loess deposits, or bedrock and are likely free of permafrost.
Vegetation: Forest canopy is dominated by *Picea glauca* or *Picea mariana*, and cover is generally between 10% and 25%. The shrub layer is open and typically features low and dwarf-shrubs including *Betula nana, Shepherdia canadensis, Arctostaphylos rubra, Arctostaphylos uva-ursi, Vaccinium uliginosum*, or *Empetrum nigrum*. Lichens (primarily *Cladina* spp.) are an important component of the understory in mature stands. Feathermosses are not as important as in other white spruce systems.

DISTRIBUTION

Range: This system occurs in the boreal and, less commonly, boreal transition regions of Alaska. It is most common in the northern and western portion of the boreal region and also occurs in the western and southwestern portion of the boreal transition region (Nulato Hills and Ahklun Mountains).
Divisions: 105:C
Nations: US
Subnations: AK
Map Zones: 68:C, 69:C, 70:C, 71:C, 72:C, 73:C, 74:C, 75:C
TNC Ecoregions: 74:C, 75:C, 76:C, 77:C, 78:C, 79:C

SOURCES

References: Klein 1982, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817369#references
Description Author: T. Boucher
Version: 07 Aug 2008
Stakeholders: West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program
ClassifResp: West

WESTERN NORTH AMERICAN BOREAL SUBALPINE BALSAM POPLAR-ASPEN WOODLAND (CES105.110)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane; Slope; Boreal [Boreal Subcontinental]; Populus tremuloides; Populus balsamifera
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Deciduous open tree canopy
National Mapping Codes: EVT 2607; ESLF 4163; ESP 1607

CONCEPT

Summary: Stands of *Populus balsamifera ssp. balsamifera* and *Populus tremuloides* occur along south-facing upper slopes with trees generally persisting in smaller size classes (seedling, sapling and pole). Clones often grow above the elevation limit of *Picea glauca* and into the subalpine zone. This system occurs commonly throughout the mountain ranges of south-central Alaska and also near the northern and western limit of the boreal region, and may be advancing in some areas. Small stands of *Populus balsamifera* occur on the north slope of the Brooks Range on valley bottoms and on sideslopes.
Classification Comments: *Populus balsamifera* stands in the Brooks Range are considered part of this system. This system is known as Boreal Subalpine Balsam Poplar (Aspen) by the Alaska Natural Heritage Program.
Related Concepts:
- I.B.1.c - Balsam poplar (forest) (Viereck et al. 1992) Intersecting
- I.B.2.b - Quaking aspen (open) (Viereck et al. 1992) Intersecting
- I.B.2.c - Balsam poplar (black cottonwood) (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: This system occurs on well-drained upland terrain on southerly aspects on upper slopes to treeline. In the upper elevational range of this system, it can occur in the subalpine zone above the coniferous treeline. Soils are generally well-drained, shallow, and develop on colluvial deposits, glacial till, or bedrock.
Vegetation: *Populus balsamifera ssp. balsamifera* and/or *Populus tremuloides* are dominant in the canopy. Common understory shrubs include *Viburnum edule, Rosa acicularis, Arctostaphylos* spp., and *Salix* spp. A wide variety of herbaceous species may occur, including *Calamagrostis canadensis, Pyrola* spp., and *Aconitum delphiniifolium* (Viereck 1979, Jorgenson et al. 2003).
Dynamics: The disturbance dynamics of these high-elevation forests are unclear. Stands are often small patch and can occur beyond the coniferous treeline. Wind/exposure could be a driving disturbance process.

DISTRIBUTION

Range: This system occurs beyond the coniferous treeline in western and northern Alaska (boreal and boreal transition regions).
Divisions: 104:C; 105:C; 204:C
Nations: US
Subnations: AK
Map Zones: 68:C, 69:C, 70:C, 71:C, 72:P, 73:C, 74:C, 75:C, 76:P
TNC Ecoregions: 70:C, 71:C, 76:C, 77:C, 78:C, 79:C

SOURCES

References: Jorgenson et al. 2003, Viereck 1979, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817387#references
Description Author: T. Boucher
Version: 08 Aug 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

WESTERN NORTH AMERICAN BOREAL TREELINE WHITE SPRUCE WOODLAND (CES105.137)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Upper Montane]; Boreal [Boreal Subcontinental]; Picea glauca
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2601; ESLF 4289; ESP 1601

CONCEPT

Summary: This ecological system occurs primarily near the elevational and latitudinal limits of white spruce tree growth. Soils are cold, but peat-forming mosses are not common in the ground layer. Forest canopy is dominated by *Picea glauca* and cover is generally between 10% and 25% (40%). In some locations *Alnus viridis* is the dominant understory shrub. The shrub layer typically features *Betula nana*, but other low shrubs such as *Vaccinium uliginosum, Ledum groenlandicum*, and *Salix* spp. may be common or dominant. In the western and southwestern portions of the boreal transition region, lichens are commonly abundant in the understory.
Classification Comments: This system combines those known as Boreal White Spruce Woodland and Boreal Transition White Spruce Woodland by the Alaska Natural Heritage Program. It has some similarity and overlap with Western North American Boreal Spruce-Lichen Woodland (CES105.105); need to define differences or merge. This system occupies the elevational zone above white spruce and below subalpine shrub and tundra systems and can be seen as the transition zone between boreal white spruce forest and non-forested alpine vegetation. Depending on the topography, this system can occupy a narrow band just below non-forested subalpine or a broad expanse across gentle slopes and benches. This system also occurs at lower elevations near the western limit of white spruce.
Similar Ecological Systems:
- Western North American Boreal Spruce-Lichen Woodland (CES105.105)
- Western North American Boreal White Spruce Forest (CES105.104)

Related Concepts:
- I.A.3.c - White spruce (woodland) (Viereck et al. 1992) Intersecting. AKVC includes lichen

DESCRIPTION

Environment: This system occupies the forested transition zone between boreal white spruce forest and alpine or tundra systems. Soils are cold and permafrost may be present. The topography includes sideslopes, rolling hills, and relatively level terrain.
Vegetation: This system occurs primarily near the elevational and latitudinal limits of tree growth. Forest canopy cover is dominated by *Picea glauca* and is generally between 10% and 25%. *Picea mariana* may be codominant in the overstory on some sites. The shrub layer typically features *Betula nana*, but other shrubs such as *Vaccinium uliginosum*, *Ledum groenlandicum*, and *Salix pulchra* may be common or dominant. In some locations, *Alnus viridis* is the dominant understory shrub. Feathermosses may be common in the ground layer, but peat-forming mosses are not common. On drier or more exposed sites, *Cladina* spp. replace feathermosses as the dominant ground cover (Viereck 1979).
Dynamics: A possible scenario for post-fire succession in this system is the resprouting of low shrubs from underground propagules and *Picea glauca* then invading by seed from adjacent stands or surviving trees. *Betula papyrifera* may invade the site if a seed source is available and site conditions are favorable, but the hardwood phase only occurs in a small fraction of the landscape (may be more common in southwestern Alaska). The typical seral sequence does not generally include a hardwood sere. The rate of succession depends on severity of fire and seed source, and some sites may be shrub-dominated for long periods without spruce invasion. Spruce beetles can be a major disturbance in this system in boreal transition region.

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Western North American Boreal Mesic Scrub Birch-Willow Shrubland (CES105.113)

DISTRIBUTION

Range: This system occurs in the boreal and boreal transition regions of Alaska, although it is not common in the Kenai Mountains where *Tsuga mertensiana* dominates treeline forest systems.
Divisions: 105:C
Nations: US
Subnations: AK
Map Zones: 68:C, 69:C, 70:C, 71:C, 72:C, 73:C, 74:C, 75:C, 76:C
TNC Ecoregions: 70:C, 71:C, 74:C, 75:C, 76:C, 77:C, 78:C, 79:C

SOURCES

References: Boggs et al. 2001, Foote 1983, Viereck 1979, Western Ecology Working Group n.d.
Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817472#references
Description Author: T. Boucher
Version: 11 Aug 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

WESTERN NORTH AMERICAN BOREAL WHITE SPRUCE FOREST (CES105.104)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Boreal [Boreal Subcontinental]; F-Landscape/High Intensity; Picea glauca; Feathermosses
Non-Diagnostic Classifiers: Esker; Montane; Lowland [Foothill]; Lowland [Lowland]; Kame; Kame moraine; Kettle; Loess deposit (undifferentiated); Moraine; Very Long Disturbance Interval; Sphagnum spp.; Drumlin
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2600; ESLF 4290; ESP 1600

CONCEPT

Summary: This ecological system is common throughout interior Alaska and extends south and eastward into adjacent provinces and territories of Canada into western Alberta. The montane *Picea glauca* forests in the Northern Rockies represent the southernmost extent of these expansive boreal forests. The southern limit appears to be related to July mean temperatures exceeding 65 degrees F and maximum of 75 degrees F, and where annual precipitation drops below 38-50 cm (15-20 inches). The landscape is typically rolling hills formed by drumlins, kettle-kame, stabilized dunes, moraines, lacustrine deposits, loess deposits, eskers, and bedrock outcrops and sometimes mountain slopes. This system is composed of multi-aged stands of *Picea glauca* and the subdominants *Betula papyrifera*, *Populus tremuloides*, and *Picea mariana*. *Picea glauca* associations found in Banff, Jasper, Kootenay and Yoho national parks occur on gentle to moderate slopes and are generally very mature stands. Mature stands are often open-canopied with a well-developed shrub layer. Common understory shrubs include *Rosa acicularis, Viburnum edule, Ledum palustre ssp. decumbens, Ledum groenlandicum, Arctostaphylos uva-ursi, Vaccinium vitis-idaea, Vaccinium uliginosum, Empetrum nigrum, Betula nana*, and *Linnaea borealis*. Common herbaceous species include *Geocaulon lividum, Pyrola* spp., *Equisetum sylvaticum, Equisetum arvense*, and *Mertensia paniculata*. Feathermosses such as *Abietinella abietina, Hylocomium splendens*, and *Pleurozium schreberi* are common in the ground layer (Boggs and Sturdy 2005). The disturbance regime is characterized by large crown fires, though other disturbances, such as insect infestations and blowdown are common.
Classification Comments: It's unclear how white spruce forests in Alaska and western Canada transition to white spruce in the central Canadian boreal regions. It may be that this system is really North American boreal-wide, extending from Alaska east into eastern Canada. White spruce forests and woodlands in Alaska have been placed into Western North American Boreal White Spruce Forest (CES105.104), Western North American Boreal Treeline White Spruce Woodland (CES105.137), or Western North American Boreal Spruce-Lichen Woodland (CES105.105). In Alberta and British Columbia, where *Picea glauca* is mixed with more Rocky Mountain conifers, such as *Abies lasiocarpa, Pinus contorta, Picea engelmannii*, and *Picea engelmannii X glauca*, they are considered to belong to Western Canadian Boreal Mesic Mixed Conifer-Hardwood Forest (CES105.510).
Similar Ecological Systems:
- Alaska Sub-boreal White Spruce-Hardwood Forest (CES105.136)
- Alaska Sub-boreal White-Lutz Spruce Forest and Woodland (CES105.102)
- Montane Boreal White and Black Spruce Forest (CES105.800)
- Western North American Boreal Spruce-Lichen Woodland (CES105.105)
- Western North American Boreal Treeline White Spruce Woodland (CES105.137)
- Western North American Boreal White Spruce-Hardwood Forest (CES105.106)

Related Concepts:
- I.A.1.j - White spruce (closed) (Viereck et al. 1992) Intersecting
- I.A.2.e - White spruce (open) (Viereck et al. 1992) Intersecting
- White Spruce: 201 (Eyre 1980) Intersecting

DESCRIPTION

Environment: This system occurs on well-drained rolling hills, inactive terraces, and mountain sideslopes up to the alpine. Soils are typically derived from glacial or other depositional processes and include moraines, drumlins, eskers, kettle-kame, colluvium, and loess deposits. This system is common on all aspects except north. Permafrost is rare.
Vegetation: Canopy cover in mature stands is dominated by *Picea glauca* and typically ranges from 25% to 70% (Boggs and Sturdy 2005). Other trees such as *Picea mariana, Betula papyrifera*, and *Populus tremuloides* may be subdominant in the overstory, but *Picea glauca* contributes at least 75% of the total forest canopy. Mature stands are often open-canopied with a well-developed shrub layer. Common understory shrubs include *Rosa acicularis, Viburnum edule, Ledum palustre ssp. decumbens, Ledum groenlandicum, Arctostaphylos uva-ursi, Vaccinium vitis-idaea, Vaccinium uliginosum, Empetrum nigrum, Betula nana*, and *Linnaea borealis*. Common herbaceous species include *Geocaulon lividum, Pyrola* spp., *Equisetum sylvaticum, Equisetum arvense*, and *Mertensia paniculata*. Feathermosses such as *Hylocomium splendens* and *Pleurozium schreberi* are common in the ground layer (Boggs and Sturdy 2005).

Dynamics: The disturbance regime is characterized by large crown fires with estimates of mean fire-return intervals ranging from 50 to 238 years (Rowe 1972, Heinselman 1981, Yarie 1981, 1983, Foote 1983, Duchesne and Hawkes 2000). On light to moderate burns, pre-burn species colonize the site via rhizomes, root sprouts and trunk sprouts. A variety of herbaceous communities dominate, primarily *Chamerion angustifolium ssp. angustifolium* and *Calamagrostis canadensis*. *Betula papyrifera, Populus tremuloides*, or *Picea glauca* may individually invade and dominate sites. *Picea glauca* eventually gains dominance over broad-leaved tree species. In severe fires, the organic layer is consumed, killing the underground propagules, and revegetation of the site is by seed. At higher latitudes, *Betula papyrifera* and *Populus tremuloides* are often absent from the early-seral forests, and succession progresses from herbaceous to shrub to spruce. Successional trajectories vary regionally across the boreal region. For example, around Fairbanks, spruce stands typically go through a hardwood sere before going to spruce; in the Yukon Charley region, stands often do not go through a hardwood sere.

DISTRIBUTION

Range: This sytems is found throughout interior Alaska and extends south and eastward into adjacent provinces and territories of Canada into western Alberta.
Divisions: 105:C
Nations: CA, US
Subnations: AB, AK, BC, MB?, ON?, QC?, SK, YT
Map Zones: 68:?, 69:C, 70:C, 71:C, 72:C, 73:C, 74:C, 75:C, 76:C
TNC Ecoregions: 7:C, 66:C, 67:?, 74:C, 76:C, 77:C, 78:C, 79:?, 139:C, 140:C

SOURCES

References: Banner et al. 1993, Boggs and Sturdy 2005, DeLong et al. 1990, Duchesne and Hawkes 2000, Foote 1983, Heinselman 1981, MacKinnon et al. 1990, Rowe 1972, Steen and Coupe 1997, Van Cleve et al. 1991, Western Ecology Working Group n.d., Willoughby et al. 2006, Yarie 1981, Yarie 1983
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817366#references
Description Author: T. Boucher, mod. M.S. Reid
Version: 30 Mar 2010 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

WESTERN NORTH AMERICAN BOREAL WHITE SPRUCE-HARDWOOD FOREST (CES105.106)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Aridic; Unconsolidated
Non-Diagnostic Classifiers: Lowland [Foothill]; Boreal [Boreal Subcontinental]; Deep Soil
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Mixed evergreen-deciduous closed tree canopy
National Mapping Codes: EVT 2603; ESLF 4335; ESP 1603

CONCEPT

Summary: This system is common on well-drained upland terrain on south, west, and east aspects. *Picea glauca* codominates with *Betula papyrifera* and/or *Populus tremuloides*, and the mixed stands are persistent for over 75 years.
Classification Comments: This system is known as Boreal White Spruce-Hardwood by the Alaska Natural Heritage Program. This system is similar to a mid-seral stage of Western North American Boreal White Spruce Forest (CES105.104).
Similar Ecological Systems:
- Alaska Sub-boreal White-Lutz Spruce Forest and Woodland (CES105.102)
- Montane Boreal White and Black Spruce Forest (CES105.800)
- Western North American Boreal Mesic Birch-Aspen Forest (CES105.108)
- Western North American Boreal White Spruce Forest (CES105.104)

Related Concepts:
- I.C.1.a - Spruce paper birch (Viereck et al. 1992) Intersecting
- I.C.1.c - Spruce-paper birch-quaking aspen (Viereck et al. 1992) Finer
- I.C.2.a - Spruce-paper birch (open) (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: This system occurs on rolling hills, inactive terraces, and mountain sideslopes up to 750 m elevation. Soils are typically well-drained and derived from glacial or other depositional processes and include moraines, drumlins, eskers, kettle-kame, colluvium, alluvial fan, floodplains, and loess deposits. This system is common on all aspects except north. Permafrost is rare on most sites; inclusions of wet mixed forest on loamy soils underlain by permafrost also occur (Jorgenson et al. 1999).
Vegetation: Canopy cover is dominated by *Picea glauca* and *Betula papyrifera* and typically ranges from 25% to 80%. *Populus tremuloides* or *Populus balsamifera* may be codominant in the hardwood component. The understory is open shrub or herbaceous. Common understory species include *Alnus* spp., *Ledum* spp., *Vaccinium vitis-idaea, Betula nana, Rosa acicularis, Shepherdia canadensis*, and *Viburnum edule*. Feathermosses such as *Hylocomium splendens* and *Pleurozium schreberi* are common in the ground layer (Boggs and Sturdy 2005). Common understory species on wet sites include *Calamagrostis canadensis* and *Equisetum* spp. (Jorgenson et al. 1999).
Dynamics: After fire, this system returns more quickly to mixed hardwood-spruce than the white spruce system.

DISTRIBUTION

Range: This system is found in the Boreal region of Alaska.
Divisions: 105:C
Nations: US
Subnations: AK
Map Zones: 69:C, 70:C, 71:C, 72:C, 73:C, 74:C, 75:C, 76:C
TNC Ecoregions: 76:C, 77:C, 78:C

SOURCES

References: Boggs and Sturdy 2005, Duchesne and Hawkes 2000, Foote 1983, Heinselman 1981, Jorgenson et al. 1999, Rowe 1972, Western Ecology Working Group n.d., Yarie 1981, Yarie 1983
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817372#references
Description Author: T. Boucher
Version: 07 Aug 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

UPLAND SHRUBLAND

ACADIAN-APPALACHIAN ALPINE TUNDRA (CES201.567)

CLASSIFIERS

Classification Status: Standard

Primary Division: Laurentian-Acadian (201)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Alpine/AltiAndino; Shrubland (Shrub-dominated); Moss/Lichen (Nonvascular); Ridge/Summit/Upper Slope
Non-Diagnostic Classifiers: Long (>500 yrs) Persistence; Glaciated; Oligotrophic Soil; Acidic Soil; Very Shallow Soil; Aquic; Udic; Consolidated; Landslide; W-Landscape/High Intensity; Dwarf-Shrub; Graminoid; Lichen
FGDC Crosswalk: Vegetated, Shrub-dominated, Dwarf-shrubland, Mixed evergreen-deciduous dwarf-shrubland
National Mapping Codes: EVT 2386; ESLF 5210; ESP 1386

CONCEPT

Summary: Restricted to the Northern Appalachians and the Gaspe Peninsula, this system encompasses vegetation above treeline on northeastern mountains. In New Hampshire, climatic treeline occurs at 1495 m (4900 feet) or greater in elevation, following the 10- to 12-degree Celsius July isotherm, but can also occur at lower elevations with high wind exposure, fire history, or shallow soils. Wind, snow, and cloud-cover fog are prominent environmental factors. Most of the cover is dwarf-shrubland, lichen, or sparse vegetation; islands of taller shrubs may occur in protected spots. The dominant plants are ericads (*Vaccinium uliginosum* is diagnostic and often dominant, with several other alpine-restricted ericads such as *Phyllodoce caerulea* and *Loiseleuria procumbens*) and cushion-plants such as *Diapensia lapponica*. *Carex bigelowii* is a characteristic and, in some places, locally dominant sedge. This system includes wetland depressions, small alpine bogs, within the surrounding upland matrix.

Related Concepts:
- Alpine Cliff (Gawler and Cutko 2010) Finer
- Bilberry - Mountain-Heath Alpine Snowbank (Gawler and Cutko 2010) Finer
- Cotton-grass - Heath Alpine Bog (Gawler and Cutko 2010) Finer
- Diapensia Alpine Ridge (Gawler and Cutko 2010) Finer
- Dwarf Heath - Graminoid Alpine Ridge (Gawler and Cutko 2010) Finer

DESCRIPTION

Environment: This system is restricted to high elevations above climatic treeline, ranging from 1460 m (4900 feet) in New Hampshire to 730 m (2400 feet) at Gros Morne National Park in Labrador.
Dynamics: Low temperature, snow accumulation, atmospheric moisture, topography, aspect, and degree of exposure to wind are the primary agents of disturbance to these systems. The degree of wind exposure and snow accumulation is directly related to topographic position. Summits and steep slopes are exposed to high winds, and receive less snow accumulation than more gentle slopes. Ravines collect abundant snowpack, which serves to protect the underlying plants from extreme weather conditions well into the spring (Sperduto and Kimball 2011). The alpine - treeline ecotone is controlled by a variety of climate variables; exposure as a result of topography and mechanical damage caused by ice and wind appear to be largely responsible for the ecotone (Kimball and Weihrauch 2000).

Component Associations:
- *Arctoparmelia centrifuga - Rhizocarpon geographicum* Nonvascular Vegetation (CEGL006420, G3G4)
- *Carex bigelowii* Herbaceous Vegetation (CEGL006081, G2)
- *Diapensia lapponica* Dwarf-shrubland (CEGL006322, G2G3)
- *Empetrum nigrum - Vaccinium uliginosum - Vaccinium oxycoccos / Rubus chamaemorus* Dwarf-shrubland (CEGL006140, GNR)
- *Kalmia angustifolia - Chamaedaphne calyculata / Rubus chamaemorus / Cladina* spp. Dwarf-shrubland (CEGL006425, GNR)
- *Trichophorum caespitosum - Calamagrostis pickeringii* Herbaceous Vegetation (CEGL006423, GNR)
- *Trichophorum caespitosum - Carex scirpoidea - Carex bigelowii* Herbaceous Vegetation (CEGL006424, GNR)
- *Trichophorum caespitosum - Saxifraga (foliolosa, paniculata, rivularis)* Herbaceous Vegetation (CEGL006428, GNR)
- *Vaccinium uliginosum - Harrimanella hypnoides - Loiseleuria procumbens* Dwarf-shrubland (CEGL006155, G2G3)
- *Vaccinium uliginosum - Rhododendron lapponicum / Juncus trifidus* Dwarf-shrubland (CEGL006298, G2G3)
- *Vaccinium uliginosum / Sibbaldiopsis tridentata* Sparse Vegetation (CEGL006533, GNR)

DISTRIBUTION

Range: This system is found at higher summits of the northern Appalachian Mountains, from northern New England and the Adirondacks into the Canadian maritimes, including Labrador, Nova Scotia and the GaspÃ© Peninsula.
Divisions: 201:C
Nations: CA, US
Subnations: ME, NH, NY, QC, VT

Map Zones: 64:C, 66:C
USFS Ecomap Regions: M211A:CC, M211B:CC, M211C:CC, M211D:CC
TNC Ecoregions: 63:C

SOURCES

References: Bliss 1963, Brouillet et al. 1998, Comer et al. 2003, Faber-Langendoen et al. 2011, Forbes 1953, Kimball and Weihrauch 2000, Lambert and McFarland 2004, Macoun 1883, NYNHP 2013i, Sperduto and Cogbill 1999, Sperduto and Kimball 2011, Wipf et al. 2009

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722036#references

Description Author: S.C. Gawler, mod. L.A. Sneddon
Version: 14 Jan 2014 **Stakeholders:** Canada, East
Concept Author: S.C. Gawler **ClassifResp:** East

ACADIAN-APPALACHIAN SUBALPINE WOODLAND AND HEATH-KRUMMHOLZ (CES201.568)

CLASSIFIERS

Classification Status: Standard

Primary Division: Laurentian-Acadian (201)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Alpine/AltiAndino; Shrubland (Shrub-dominated); Ridge/Summit/Upper Slope; Picea (glauca, mariana, rubens) - Abies
Non-Diagnostic Classifiers: Long (>500 yrs) Persistence; Montane; Forest and Woodland (Treed); Moss/Lichen (Nonvascular); Glaciated; Mesotrophic Soil; Oligotrophic Soil; Acidic Soil; Very Shallow Soil; Shallow Soil; Mineral: W/ A-Horizon >10 cm; Mineral: W/ A-Horizon <10 cm; Udic; Consolidated; Intermediate Disturbance Interval; Long Disturbance Interval; F-Patch/Medium Intensity; W-Landscape/High Intensity; Needle-Leaved Tree; Broad-Leaved Shrub
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Mixed evergreen-deciduous shrubland
National Mapping Codes: EVT 2389; ESLF 5320; ESP 1389

CONCEPT

Summary: This ecological system encompasses vegetation of varying physiognomy at upper elevations, near and slightly above treeline, in the northeastern U.S. and adjacent Canada. It may be a zone between montane spruce-fir forest and alpine systems or may cover the ridgelines and summits of lower mountains. In the Appalachians it occurs mostly above 915 m (3000 feet) elevation but can be at much lower elevations near the Atlantic Coast. Trees become progressively stunted as exposure increases, with *Picea rubens* being replaced by *Picea mariana* in a stunted form. Vegetation structure ranges from woodland to shrubland to sparsely vegetated dwarf-shrubs and herbs. Woodlands may be locally extensive, and patches of open rock support areas of shrub, dwarf-shrub or sparse vegetation. In the subalpine zone, shrublands may be extensive on the upper slopes, forming krummholz or, in somewhat more protected spots, deciduous shrub thickets. Ericads, including *Kalmia angustifolia, Ledum groenlandicum,* and *Vaccinium uliginosum*, are the most characteristic shrubs; *Empetrum nigrum* and *Empetrum eamesii ssp. atropurpureum (= Empetrum atropurpureum)* are indicative of the subalpine zone. *Vaccinium boreale* occurs rarely but is diagnostic where it is present. Subalpine fens are included here: these are heath-dominated and graminoid-dominated fens, often occurring in a mosaic surrounded by other subalpine vegetation. They are on gentle slopes (usually about 10%), usually at 732 to 915 m (2400-3000 feet) elevation. *Calamagrostis pickeringii* is dominant and characteristic in the graminoid fens, with northern sedges such as *Carex michauxiana, Carex wiegandii, Carex exilis*, etc. The montane heath fens contain *Alnus viridis ssp. crispa (= Alnus crispa), Nemopanthus mucronatus*, and ericads. Peat accumulation is in the range of 10-50 cm. Occurrences are usually about 5 acres in size but range up to about 20 acres.
Classification Comments: This system is distinguished from Acadian-Appalachian Montane Spruce-Fir Forest (CES201.566) by the shift to woodland and patchy barrens from the forested character of the montane forest, including the decreased importance of *Picea rubens*. They are often contiguous on the ground. It is related to Northern Appalachian-Acadian Rocky Heath Outcrop (CES201.571) but occurs at higher elevations, lacks *Pinus* spp. (except for occasional stunted individuals) and *Quercus rubra*, and features *Vaccinium uliginosum, Empetrum* and other subalpine plant species that are lacking from the lower-elevation analog. Patches of *Picea rubens / Vaccinium angustifolium / Sibbaldiopsis tridentata* Woodland (CEGL006053) might occur in this system, but only incidentally; that association is more central to the concept of Northern Appalachian-Acadian Rocky Heath Outcrop (CES201.571). At Acadia National Park, this system could be attributed to the highest balds if *Empetrum* and/or *Vaccinium uliginosum* are present, representing a low-elevation disjunction; Northern Appalachian-Acadian Rocky Heath Outcrop (CES201.571) is the common system on Acadia's bald hills. Subalpine fens are considered a distinct system by New Hampshire Natural Heritage Program (the only state where they are currently known to occur), but because (1) there is little information currently available on them and (2) they tend to occur below treeline, they are included within this system. This could be reconsidered as more information on their landscape distribution, extent and pattern becomes available.
Similar Ecological Systems:
- Acadian-Appalachian Montane Spruce-Fir Forest (CES201.566)
- Northern Appalachian-Acadian Rocky Heath Outcrop (CES201.571)

Related Concepts:
- Black Spruce (eastern type): 12 (Eyre 1980) Finer
- Crowberry - Bilberry Summit Bald (Gawler and Cutko 2010) Finer
- Heath - Lichen Subalpine Slope Bog (Gawler and Cutko 2010) Finer
- Mountain Alder - Bush-honeysuckle Subalpine Meadow (Gawler and Cutko 2010) Finer
- Red Spruce: 32 (Eyre 1980) Finer
- Rocky Summit Heath (Gawler and Cutko 2010) Finer
- Spruce - Fir - Birch Krummholz (Gawler and Cutko 2010) Finer

Component Associations:
- (*Picea mariana, Abies balsamea*) / *Kalmia angustifolia - Ledum groenlandicum* Dwarf-shrubland (CEGL006031, GNR)
- *Alnus viridis ssp. crispa - Spiraea alba / Solidago macrophylla* Shrubland (CEGL006064, GNR)

- *Empetrum nigrum - Vaccinium uliginosum - Vaccinium oxycoccos / Rubus chamaemorus* Dwarf-shrubland (CEGL006140, GNR)
- *Kalmia angustifolia - Chamaedaphne calyculata / Rubus chamaemorus / Cladina* spp. Dwarf-shrubland (CEGL006425, GNR)
- *Picea mariana - Abies balsamea / Sibbaldiopsis tridentata* Shrubland (CEGL006038, GNR)
- *Picea mariana / Ledum groenlandicum - Empetrum nigrum / Cladina* spp. Dwarf-shrubland (CEGL006268, G3G5)
- *Picea rubens / Vaccinium angustifolium / Sibbaldiopsis tridentata* Woodland (CEGL006053, G4)
- *Vaccinium uliginosum / Sibbaldiopsis tridentata* Sparse Vegetation (CEGL006533, GNR)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Acadian-Appalachian Montane Spruce-Fir Forest (CES201.566)

DISTRIBUTION

Range: This system is found on the higher summits of the northern Appalachian mountains, from northern New England and the Adirondacks into the Canadian GaspÃ©, extending south in scattered locations into southern New England.
Divisions: 201:C; 202:C
Nations: CA, US
Subnations: ME, NB, NH, NY, QC, VT
Map Zones: 64:C, 65:C, 66:C
USFS Ecomap Regions: 211B:CC, 211C:CC, 211I:CP, M211A:CC, M211B:CC, M211C:CC, M211D:CC
TNC Ecoregions: 61:C, 63:C

SOURCES

References: Comer et al. 2003, Sperduto and Cogbill 1999
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723037#references
Description Author: S.C. Gawler
Version: 20 Aug 2007 **Stakeholders:** Canada, East
Concept Author: S.C. Gawler **ClassifResp:** East

ALASKA ARCTIC ACIDIC DRYAS DWARF-SHRUBLAND (CES104.173)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Arctic (104)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Shrubland (Shrub-dominated); Polar [Polar Continental]; Acidic Soil; Dryas integrifolia and/or Dryas octopetala
Non-Diagnostic Classifiers: Ridge/Summit/Upper Slope; Sideslope
FGDC Crosswalk: Vegetated, Shrub-dominated, Dwarf-shrubland, Deciduous dwarf-shrubland
National Mapping Codes: EVT 2688; ESLF 5101; ESP 1688

CONCEPT

Summary: This is a common system on acidic substrates (pH typically <6) in the hills and mountains of arctic Alaska. This system does not occur in the arctic lowlands. Common slope positions include valleys, sideslopes, and summits and ridges. Sites are typically dry to mesic and are uncommon on late-lying snowbeds. Patch size is small to large. Dwarf-shrub cover is >25% and dominated by *Dryas* spp. (primarily *Dryas octopetala*). Other common shrubs include *Empetrum nigrum, Vaccinium uliginosum, Dryas integrifolia, Loiseleuria procumbens*, and *Salix phlebophylla*. Common herbaceous species include *Antennaria alpina, Hierochloe alpina, Minuartia obtusiloba, Carex scirpoidea, Carex podocarpa, Carex microchaeta*, and *Festuca altaica*. Mosses such as *Tortula ruralis* and *Polytrichum* spp. may be common. Lichens include *Cladina* spp., *Sphaerophorus globosus, Nephroma arcticum, Flavocetraria* spp., and *Alectoria ochroleuca*. In the Bering Land Bridge National Preserve and Cape Krusenstern National Monument (Jorgenson et al. 2004), this system differs from non-acidic *Dryas* by lacking the calciphilic species *Saxifraga oppositifolia, Potentilla uniflora, Hedysarum boreale ssp. mackenziei (= Hedysarum mackenziei)*, and *Oxytropis nigrescens*.
Classification Comments: This system is known as Acidic *Dryas* by the Alaska Natural Heritage Program.
Related Concepts:
- II.D.1.a - Dryas tundra (Viereck et al. 1992) Broader

DISTRIBUTION

Range: This system occurs throughout arctic Alaska, from the Bristol Bay lowlands in southwestern Alaska to the North Slope on the Arctic Ocean.
Divisions: 102:C; 104:C
Nations: CA, US
Subnations: AK
Map Zones: 67:C, 68:C, 69:C, 72:C, 76:C
TNC Ecoregions: 73:C, 74:C, 75:C, 79:C

SOURCES

References: Jorgenson et al. 2004, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818185#references
Description Author: K. Boggs
Version: 08 Oct 2008 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKA ARCTIC ACIDIC DWARF-SHRUB LICHEN TUNDRA (CES104.177)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Arctic (104)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Extreme Wind Exposure; Polar [Polar Continental]; Acidic Soil; Dwarf-Shrub; Lichen
Non-Diagnostic Classifiers: Shrubland (Shrub-dominated); Ridge/Summit/Upper Slope; Sideslope; Very Long Disturbance Interval
FGDC Crosswalk: Vegetated, Shrub-dominated, Dwarf-shrubland, Deciduous dwarf-shrubland
National Mapping Codes: EVT 2691; ESLF 5102; ESP 1691

CONCEPT

Summary: This is a common system on acidic substrates in the hills and mountains of arctic Alaska. This system does not occur in arctic lowlands. Common slope positions include valleys, sideslopes, and summits and ridges. Sites are typically dry to mesic, exposed to the wind, and accumulate little winter snow. Patch size is small to large. Dwarf-shrub cover is >25%, and lichen cover is >25%. The dominant lichens are *Cladina rangiferina* and/or *Cladina stellaris*. Common dwarf-shrubs include *Dryas octopetala, Empetrum nigrum, Vaccinium uliginosum, Dryas integrifolia, Salix phlebophylla, Antennaria alpina, Hierochloe alpina, Festuca altaica*, and *Carex microchaeta*. Mosses may be present but contribute little cover.
Classification Comments: This system is known as Acidic Dwarf Shrub Lichen by the Alaska Natural Heritage Program.
Related Concepts:
- II.D.2.a - Bearberry tundra (Viereck et al. 1992) Intersecting
- II.D.2.b - Vaccinium tundra (Viereck et al. 1992) Intersecting
- II.D.2.c - Crowberry tundra (Viereck et al. 1992) Intersecting
- II.D.2.d - Mountain-heath tundra (Viereck et al. 1992) Intersecting
- II.D.2.e - Cassiope tundra (Viereck et al. 1992) Intersecting
- II.D.3.a - Willow tundra (Viereck et al. 1992) Broader

DESCRIPTION

Environment: This is a common system on acidic substrates in the hills and mountains of arctic Alaska. This system does not occur in arctic lowlands. Common slope positions include valleys, sideslopes, and summits and ridges. Sites are typically dry to mesic, exposed to the wind, and accumulate little winter snow (Viereck et al. 1992). Patch size is small to large.
Vegetation: Dwarf-shrub cover is >25%, and lichen cover is >25%. The dominant lichens are *Cladina rangiferina* and/or *Cladina stellaris*. Common dwarf-shrubs include *Dryas octopetala, Empetrum nigrum, Vaccinium uliginosum, Dryas integrifolia, Salix phlebophylla, Antennaria alpina, Hierochloe alpina, Festuca altaica*, and *Carex microchaeta*. Mosses may be present but contribute little cover (Viereck et al. 1992).

DISTRIBUTION

Range: This system occurs throughout arctic Alaska, from the Bristol Bay lowlands in southwestern Alaska to the North Slope on the Arctic Ocean.
Divisions: 102:C; 104:C
Nations: CA, US
Subnations: AK
Map Zones: 67:C, 68:C, 69:C, 72:C, 76:C
TNC Ecoregions: 73:C, 74:C, 75:C, 79:C

SOURCES

References: Viereck et al. 1992, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818197#references
Description Author: K. Boggs
Version: 08 Oct 2008 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKA ARCTIC ACIDIC SPARSE TUNDRA (CES104.171)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Arctic (104)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch, Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Extreme Wind Exposure; Polar [Polar Continental]; Acidic Soil; Very Shallow Soil
Non-Diagnostic Classifiers: Ridge/Summit/Upper Slope; Sideslope; Dwarf-Shrub; Lichen
FGDC Crosswalk: Vegetated, Shrub-dominated, Dwarf-shrubland, Deciduous dwarf-shrubland
National Mapping Codes: EVT 2685; ESLF 5103; ESP 1685

CONCEPT

Summary: This is a common system on acidic substrates (pH typically <6) in the hills and mountains of arctic Alaska. This system does not occur in the arctic lowlands. Common slope positions include valleys, sideslopes, and summits and ridges. The canopy is sparse due to extreme exposure, exposed bedrock or unstable substrates. Sites are typically dry to mesic and occur on acidic substrates. Soils are typically thin, stony, and well-drained. Patch size is small to matrix-forming. Total vascular plant cover is 10-25%, and lichen cover is <25%. Common dwarf-shrub species include *Dryas octopetala, Empetrum nigrum, Vaccinium uliginosum, Dryas integrifolia, Loiseleuria procumbens*, and *Salix phlebophylla*. Herbaceous species may include *Antennaria alpina, Hierochloe alpina (= Anthoxanthum monticola), Minuartia obtusiloba, Carex scirpoidea, Carex podocarpa, Carex microchaeta*, and *Festuca altaica*. Lichens include *Cladina* spp., *Sphaerophorus globosus, Nephroma arcticum, Flavocetraria* spp., and *Alectoria ochroleuca*.
Classification Comments: This system is known as Acidic Sparse Vegetation by the Alaska Natural Heritage Program.

DISTRIBUTION

Range: This system occurs throughout arctic Alaska, from the Bristol Bay lowlands in southwestern Alaska to the North Slope on the Arctic Ocean.
Divisions: 102:C; 104:C
Nations: CA, US
Subnations: AK
Map Zones: 67:C, 68:C, 69:C, 72:C, 76:C
TNC Ecoregions: 73:C, 74:C, 75:C, 79:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818179#references
Description Author: K. Boggs
Version: 08 Oct 2008 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKA ARCTIC DWARF-SHRUBLAND (CES104.175)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Arctic (104)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane; Shrubland (Shrub-dominated); Polar [Polar Oceanic]; Dwarf-Shrub
FGDC Crosswalk: Vegetated, Shrub-dominated, Dwarf-shrubland, Deciduous dwarf-shrubland
National Mapping Codes: EVT 2690; ESLF 5104; ESP 1690

CONCEPT

Summary: This is a common system on acidic and non-acidic substrates in the hills and mountains of arctic Alaska. This system does not occur in arctic lowlands. Common slope positions include valleys, sideslopes (especially north-facing), late-lying snowbeds, and summits and ridges. Sites are typically dry to mesic. Patch size is small to large. Dwarf-shrub cover is >25%, dominated by dwarf-shrubs other than *Dryas* spp., and lichen cover is <25%. Dwarf-shrubs that dominate or codominate the system are *Cassiope tetragona, Empetrum nigrum, Vaccinium uliginosum, Salix reticulata, Salix arctica, Salix rotundifolia,* and *Arctostaphylos alpina*. *Cassiope tetragona* is more common on non-acidic sites. Other shrubs include *Betula nana, Dryas octopetala, Dryas integrifolia, Ledum palustre ssp. decumbens, Loiseleuria procumbens, Vaccinium vitis-idaea*, and *Salix phlebophylla*. Common herbaceous species include *Hierochloe alpina, Boykinia richardsonii, Carex microchaeta, Carex scirpoidea, Geum glaciale, Pedicularis lanata, Eriophorum angustifolium ssp. triste*, and *Equisetum* spp. Mosses such as *Rhytidium rugosum, Aulacomnium turgidum, Distichium capillaceum, Racomitrium lanuginosum, Dicranum elongatum*, and *Polytrichum* sp. may be common.
Classification Comments: This system is known as Dwarf Shrub by the Alaska Natural Heritage Program.
Related Concepts:
- II.D.2.a - Bearberry tundra (Viereck et al. 1992) Intersecting
- II.D.2.b - Vaccinium tundra (Viereck et al. 1992) Intersecting
- II.D.2.c - Crowberry tundra (Viereck et al. 1992) Intersecting
- II.D.2.d - Mountain-heath tundra (Viereck et al. 1992) Intersecting
- II.D.2.e - Cassiope tundra (Viereck et al. 1992) Intersecting
- II.D.3.a - Willow tundra (Viereck et al. 1992) Intersecting

DISTRIBUTION

Range: This system occurs throughout arctic Alaska, from the Bristol Bay lowlands in southwestern Alaska to the North Slope on the Arctic Ocean.
Divisions: 102:C; 104:C
Nations: CA, US
Subnations: AK
Map Zones: 67:C, 68:C, 69:C, 72:C, 76:C
TNC Ecoregions: 73:C, 74:C, 75:C, 79:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818191#references
Description Author: K. Boggs
Version: 08 Oct 2008 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKA ARCTIC MESIC ALDER SHRUBLAND (CES104.168)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Arctic (104)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Mountainside; Shrubland (Shrub-dominated); Sideslope; Polar [Polar Oceanic]; Broad-Leaved Deciduous Shrub
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Deciduous shrubland
National Mapping Codes: EVT 2638; ESLF 5328; ESP 1638

CONCEPT

Summary: The alder system is widespread but uncommon on mountain slopes, hillslopes and small steep streams throughout arctic Alaska. Patch size is typically small. Soils are mesic but sometimes wet if found adjacent to a small stream. Total shrub cover is >25% and dominated by alders. *Alnus viridis ssp. crispa* is the dominant shrub species but may codominate with *Salix glauca* and *Salix pulchra*. Additional species include *Vaccinium uliginosum, Vaccinium vitis-idaea, Betula nana, Ledum palustre ssp. decumbens, Empetrum nigrum, Equisetum* spp., *Spiraea stevenii (= Spiraea beauverdiana), Dryas* spp., and *Cassiope tetragona*. Mosses include *Hylocomium splendens* and *Dicranum* spp. Low-shrub tundra and dwarf-shrubs are common in the gaps between alder patches.
Classification Comments: This system is known as Alder by the Alaska Natural Heritage Program.
Related Concepts:
- II.B.1.b - Alder (closed) (Viereck et al. 1992) Intersecting
- II.B.1.d - Alder-willow (closed) (Viereck et al. 1992) Intersecting
- II.B.2.b - Alder (open) (Viereck et al. 1992) Intersecting
- II.B.2.d - Alder-willow (open) (Viereck et al. 1992) Intersecting
- II.C.1.e - Low alder-willow (closed) (Viereck et al. 1992) Intersecting
- II.C.2.k - Low alder-willow (open) (Viereck et al. 1992) Intersecting
- II.C.2.l - Low alder (Viereck et al. 1992) Intersecting

DESCRIPTION

Dynamics: This system may or may not be controlled by avalanche activity and unstable slopes. Alder will resprout following fire, but no studies exist on fire effects in this type. The fire-return interval is likely long. Burns are more common on the Seward Peninsula and other parts of western Alaska near the spruce forest boundary. Early-season fire prior to green-up would be more likely to carry than late-season fire. Insect defoliators and canker also affect alder. Alder invades disturbed sites but also spreads into undisturbed sites adjacent to existing patches. After establishing in the uplands, it may be stable for long periods. Alder appears to be increasing in cover in the Arctic.

DISTRIBUTION

Range: This system occurs throughout arctic Alaska, from the Bristol Bay lowlands in southwestern Alaska to the North Slope on the Arctic Ocean.
Divisions: 102:C; 104:C
Nations: CA, US
Subnations: AK
Map Zones: 67:C, 68:C, 69:C, 72:C, 76:C
TNC Ecoregions: 73:C, 74:C, 75:C, 79:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818170#references
Description Author: K. Boggs
Version: 08 Oct 2008 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKA ARCTIC MESIC-WET WILLOW SHRUBLAND (CES104.169)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Arctic (104)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch, Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Saturated Soil; Shrubland (Shrub-dominated); Polar [Polar Oceanic]; Salix alaxensis, Salix pulchra, and Salix glauca
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Deciduous shrubland
National Mapping Codes: EVT 2639; ESLF 5276; ESP 1639

CONCEPT

Summary: The low-tall willow system is widespread and common on mesic to wet mountain slopes, hillslopes, flats, and adjacent to streams throughout arctic Alaska. Patch size is small to large and often linear along small streams. Soils are mesic to wet, including wet sites with subsurface waterflow, water tracks, adjacent to narrow constrained streams, and on snow accumulation areas with late snowmelt. Total low- and tall-shrub (>0.2 m tall) cover is >25% and dominated by willows. This system does not include floodplain or tussock-dominated (>35% tussocks) sites. *Salix alaxensis*, *Salix pulchra*, and *Salix glauca* are the dominant species. Other shrubs may codominate, such as *Salix niphoclada*, *Salix chamissonis*, *Salix bebbiana*, *Salix planifolia*, *Salix richardsonii*, *Alnus viridis ssp. crispa*, *Betula nana*, *Vaccinium uliginosum*, and *Ledum palustre ssp. decumbens*. Dwarf-shrubs such as *Empetrum nigrum* and *Vaccinium vitis-idaea* may be common under the low-shrub layer. Herbaceous species are sparse but sedges are sometimes common. Feathermosses (*Hylocomium splendens* and *Pleurozium schreberi*) and lichens may be common.
Classification Comments: This system is known as Low-Tall Willow by the Alaska Natural Heritage Program.
Related Concepts:
- II.B.1.a - Willow (closed) (Viereck et al. 1992) Intersecting
- II.B.2.a - Willow (open) (Viereck et al. 1992) Intersecting
- II.C.1.b - Low willow (Viereck et al. 1992) Intersecting
- II.C.2.g - Willow low (open) (Viereck et al. 1992) Intersecting
- II.D.3.a - Willow tundra (Viereck et al. 1992) Intersecting

DESCRIPTION

Dynamics: Expert review indicates that this system is not controlled by avalanche activity, although avalanches may occur. The fire-return interval is likely long. The willow canopy shades the understory vegetation, possibly making the fine-fuel layer moist and less able to carry fire. Insects and diseases also affect willows. Shrub stringers that occur next to small streams or water tracks appear to be stable. Seasonal overbank flooding may occur, but generally it does not result in shifting channels or gravel bar formation. Subsurface flow may be common, and the soils are often stony.

DISTRIBUTION

Range: This system occurs throughout arctic Alaska, from the Bristol Bay lowlands in southwestern Alaska to the North Slope on the Arctic Ocean.
Divisions: 102:C; 104:C
Nations: CA, US
Subnations: AK
Map Zones: 67:C, 68:C, 69:C, 72:C, 76:C
TNC Ecoregions: 73:C, 74:C, 75:C, 79:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818173#references
Description Author: K. Boggs
Version: 10 Dec 2008 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKA ARCTIC NON-ACIDIC DRYAS DWARF-SHRUBLAND (CES104.174)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Arctic (104)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Montane]; Shrubland (Shrub-dominated); Polar [Polar Oceanic]; Circumneutral Soil; Dwarf-Shrub; Dryas integrifolia and/or Dryas octopetala
FGDC Crosswalk: Vegetated, Shrub-dominated, Dwarf-shrubland, Deciduous dwarf-shrubland
National Mapping Codes: EVT 2689; ESLF 5105; ESP 1689

CONCEPT

Summary: This is a common system on non-acidic substrates (pH typically >6) in the hills and mountains of arctic Alaska. This system also occurs as small patches on river bluffs on the Beaufort Coastal Plain, but otherwise does not occur in the arctic lowlands. Common slope positions include valleys, sideslopes, and summits and ridges. Sites are typically dry to mesic and are rare on late-lying snowbeds. Non-acidic sites are more common near floodplains, on carbonate substrates, and loess deposition areas. Patch size is small to large. Dwarf-shrub cover is >25% and dominated by *Dryas* spp. *Dryas octopetala* and/or *Dryas integrifolia* codominate with *Saxifraga oppositifolia* and *Rhododendron lapponicum*. Other common dwarf-shrubs include *Salix arctica, Salix reticulata, Cassiope tetragona,* and *Arctostaphylos rubra*. Herbaceous species include *Lupinus arcticus, Carex scirpoidea, Carex rupestris, Oxytropis nigrescens, Potentilla uniflora, Artemisia senjavinensis, Artemisia globularia, Artemisia furcata, Hedysarum boreale ssp. mackenziei (= Hedysarum mackenziei), Saxifraga oppositifolia,* and *Equisetum* spp. Lichens such as *Thamnolia* spp. and *Cetraria islandica* also occur.
Classification Comments: This system is known as Non-Acidic *Dryas* by the Alaska Natural Heritage Program.
Related Concepts:
- II.D.1.a - Dryas tundra (Viereck et al. 1992) Broader

DISTRIBUTION

Range: This system occurs throughout arctic Alaska, from the Bristol Bay lowlands in southwestern Alaska to the North Slope on the Arctic Ocean.
Divisions: 102:C; 104:C
Nations: CA, US
Subnations: AK
Map Zones: 67:C, 68:C, 69:C, 72:C, 76:C
TNC Ecoregions: 73:C, 74:C, 75:C, 79:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818188#references
Description Author: K. Boggs
Version: 08 Oct 2008 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKA ARCTIC NON-ACIDIC DWARF-SHRUB LICHEN TUNDRA (CES104.176)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Arctic (104)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Montane]; Shrubland (Shrub-dominated); Moss/Lichen (Nonvascular); Circumneutral Soil; Dwarf-Shrub
FGDC Crosswalk: Vegetated, Shrub-dominated, Dwarf-shrubland, Deciduous dwarf-shrubland
National Mapping Codes: EVT 2692; ESLF 5106; ESP 1692

CONCEPT

Summary: This is a common system on non-acidic substrates (pH typically >6) in the hills and mountains of arctic Alaska. This system does not occur in arctic lowlands. Common slope positions include valleys, sideslopes, and summits and ridges. Sites are typically dry to mesic, exposed to the wind, and do not accumulate much winter snow. Non-acidic sites are more common near floodplains, on carbonate substrates, and loess deposition areas. Patch size is small to large. Dwarf-shrub cover is >25%, and lichen cover is >25%. Common lichens include *Flavocetraria cucullata (= Cetraria cucullata), Flavocetraria* spp., *Stereocaulon* spp., *Alectoria nigricans*, and *Thamnolia vermicularis*. *Cladonia* and *Cladina* species are uncommon. Dwarf-shrubs include *Dryas octopetala, Dryas integrifolia, Saxifraga oppositifolia, Rhododendron lapponicum, Salix arctica, Salix reticulata*, *Cassiope tetragona*, and *Arctostaphylos rubra*. Mosses contribute little cover.
Classification Comments: This system is known as Non-Acidic Dwarf Shrub Lichen by the Alaska Natural Heritage Program.
Related Concepts:
- II.D.2.a - Bearberry tundra (Viereck et al. 1992) Intersecting
- II.D.2.b - Vaccinium tundra (Viereck et al. 1992) Intersecting
- II.D.2.c - Crowberry tundra (Viereck et al. 1992) Intersecting
- II.D.2.d - Mountain-heath tundra (Viereck et al. 1992) Intersecting
- II.D.2.e - Cassiope tundra (Viereck et al. 1992) Intersecting
- II.D.3.a - Willow tundra (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: This is a common system on non-acidic substrates (pH typically >6) in the hills and mountains of arctic Alaska. This system does not occur in arctic lowlands. Common slope positions include valleys, sideslopes, and summits and ridges. Sites are typically dry to mesic, exposed to the wind, and do not accumulate much winter snow (Viereck et al. 1992). Non-acidic sites are more common near floodplains, on carbonate substrates, and loess deposition areas. Patch size is small to large.
Vegetation: Dwarf-shrub cover is >25%, and lichen cover is >25%. Common lichens include *Flavocetraria cucullata (= Cetraria cucullata), Flavocetraria* spp., *Stereocaulon* spp., *Alectoria nigricans*, and *Thamnolia vermicularis*. *Cladonia* and *Cladina* species are uncommon. Dwarf-shrubs include *Dryas octopetala, Dryas integrifolia, Saxifraga oppositifolia, Rhododendron lapponicum, Salix arctica, Salix reticulata*, *Cassiope tetragona*, and *Arctostaphylos rubra*. Mosses contribute little cover (Viereck et al. 1992).

DISTRIBUTION

Range: This system occurs throughout arctic Alaska, from the Bristol Bay lowlands in southwestern Alaska to the North Slope on the Arctic Ocean.
Divisions: 102:C; 104:C
Nations: CA, US
Subnations: AK
Map Zones: 67:C, 68:C, 69:C, 72:C, 76:C
TNC Ecoregions: 73:C, 74:C, 75:C, 79:C

SOURCES

References: Viereck et al. 1992, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818194#references
Description Author: K. Boggs
Version: 08 Oct 2008 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKA ARCTIC NON-ACIDIC SPARSE TUNDRA (CES104.172)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Arctic (104)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Extreme Wind Exposure; Polar [Polar Oceanic]; Circumneutral Soil; Very Shallow Soil; Dwarf-Shrub
Non-Diagnostic Classifiers: Ridge/Summit/Upper Slope; Calcareous
FGDC Crosswalk: Vegetated, Shrub-dominated, Dwarf-shrubland, Deciduous dwarf-shrubland
National Mapping Codes: EVT 2686; ESLF 5107; ESP 1686

CONCEPT

Summary: This is a common system on non-acidic substrates (pH typically >6) in the hills and mountains of arctic Alaska. This system does not occur in arctic lowlands. Common slope positions include valleys, sideslopes, and summits and ridges. The canopy is sparse due to extreme exposure, exposed bedrock or unstable substrates. Sites are typically dry to mesic and occur on non-acidic substrates. Soils are typically thin, stony, and well-drained. Non-acidic sites are more common near floodplains, on carbonate substrates, and loess deposition areas. Patch size is small to large. Total vascular plant cover is 10-25%, and lichen cover is <25%. Common dwarf-shrubs include *Dryas octopetala, Dryas integrifolia, Saxifraga oppositifolia, Rhododendron lapponicum, Salix arctica, Salix reticulata, Cassiope tetragona,* and *Arctostaphylos rubra*. Herbaceous species may include *Lupinus arcticus, Hedysarum boreale ssp. mackenziei (= Hedysarum mackenziei), Carex scirpoidea, Carex rupestris, Oxytropis nigrescens, Potentilla uniflora, Artemisia senjavinensis, Artemisia globularia, Artemisia furcata, Saxifraga oppositifolia,* and *Equisetum* spp. Lichens such as *Thamnolia* spp. and *Cetraria islandica* also occur.
Classification Comments: This system is known as Non-Acidic Sparse Vegetation by the Alaska Natural Heritage Program.

DISTRIBUTION

Range: This system occurs throughout arctic Alaska, from the Bristol Bay lowlands in southwestern Alaska to the North Slope on the Arctic Ocean.
Divisions: 102:C; 104:C
Nations: CA, US
Subnations: AK
Map Zones: 67:C, 68:C, 69:C, 72:C, 76:C
TNC Ecoregions: 73:C, 74:C, 75:C, 79:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818182#references
Description Author: K. Boggs
Version: 08 Oct 2008 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKA ARCTIC SCRUB BIRCH-ERICACEOUS SHRUBLAND (CES104.170)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Arctic (104)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch, Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Shrubland (Shrub-dominated); Polar [Polar Oceanic]; Dwarf-Shrub; Betula nana, Vaccinium uliginosum, Ledum palustre ssp. decumbens
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Deciduous dwarf-shrubland
National Mapping Codes: EVT 2682; ESLF 5277; ESP 1682

CONCEPT

Summary: This system is common throughout arctic Alaska on mesic mountain slopes, hillslopes and flats. Patch size is small to matrix-forming. Soils are mesic. The total low- and tall-shrub cover is >25%, and *Betula nana, Vaccinium uliginosum*, or *Ledum palustre ssp. decumbens* typically dominate or codominate. *Salix* spp. (such as *Salix pulchra*) do not dominate but may codominate. This system does not include tussock-dominated (>35% tussocks) sites. Dwarf-shrubs such as *Empetrum nigrum* and *Vaccinium vitis-idaea* may be common under the low-shrub layer. Herbaceous species are sparse, and feathermosses (*Hylocomium splendens* and *Pleurozium schreberi*) and lichens may be common.
Classification Comments: This system is known as Birch Ericaceous Low Shrub by the Alaska Natural Heritage Program.
Related Concepts:
- II.B.1.c - Shrub birch (closed) (Viereck et al. 1992) Intersecting
- II.B.1.e - Shrub birch-willow (closed) tall (Viereck et al. 1992) Intersecting
- II.B.2.c - Shrub birch (open) (Viereck et al. 1992) Intersecting
- II.B.2.e - Shrub birch-willow (open) tall (Viereck et al. 1992) Intersecting
- II.C.1.a - Shrub birch (Viereck et al. 1992) Intersecting
- II.C.1.c - Shrub birch-willow (closed) low (Viereck et al. 1992) Intersecting
- II.C.1.d - Ericaceous shrub (Viereck et al. 1992) Intersecting
- II.C.2.c - Mesic shrub birch-ericaceous shrub (Viereck et al. 1992) Intersecting
- II.C.2.f - Shrub birch-willow (open) low (Viereck et al. 1992) Intersecting

DESCRIPTION

Dynamics: Expert review suggests that the fire-return interval may be 200 years in fire-prone regions of western Alaska, but may be 1000 years on the Beaufort Coastal Plain. After a fire, mesic herbaceous species may dominate initially, and self-replacement may occur within 5 to 25 years.

DISTRIBUTION

Range: This system occurs throughout arctic Alaska, from the Bristol Bay lowlands in southwestern Alaska to the North Slope on the Arctic Ocean.
Divisions: 102:C; 104:C
Nations: CA, US
Subnations: AK
Map Zones: 67:C, 68:C, 69:C, 72:C, 76:C
TNC Ecoregions: 73:C, 74:C, 75:C, 79:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818176#references
Description Author: K. Boggs
Version: 08 Oct 2008 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKA SUB-BOREAL AVALANCHE SLOPE SHRUBLAND (CES105.111)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Montane]; Shrubland (Shrub-dominated); Avalanche chute; Boreal [Boreal Subcontinental]; Avalanche; Broad-Leaved Deciduous Shrub
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Deciduous shrubland
National Mapping Codes: EVT 2608; ESLF 5329; ESP 1608

CONCEPT

Summary: This system occurs commonly throughout the boreal transition region and infrequently in boreal Alaska on mountain slopes where slopes are steep enough to produce frequent snow slides thus preventing forest development. Slopes that produce regular avalanches typically have an upper slope angle of at least 70%, but the lower slopes and run-out zones may be much less steep. The dominant shrub species is typically *Alnus viridis ssp. sinuata*, but other shrubs, including *Sambucus racemosa, Salix* spp., and *Spiraea stevenii*, may be common. Herbaceous patches are often dominated by *Calamagrostis canadensis* and *Chamerion angustifolium*; other common herbs include *Athyrium filix-femina*, *Dryopteris expansa*, and *Veratrum viride*. Tree seedlings and saplings may be common on some slopes but do not emerge as an overstory due to frequent snow avalanche.
Classification Comments: This system is known as Boreal Transition Avalanche Slope Shrubland by the Alaska Natural Heritage Program. It is similar in species composition to Alaska Sub-boreal Mesic Subalpine Alder Shrubland (CES105.112), but it occurs below the subalpine zone, and tree growth is limited by avalanche frequency not elevation as in the subalpine system. Avalanche slopes occur from alpine to lower slopes; however, we do not plan to map or model the alpine avalanche slopes. Alaska Sub-boreal Avalanche Slope Shrubland (CES105.111) can be differentiated from Alaskan Pacific Maritime Avalanche Slope Shrubland (CES204.162) by geographic region and by the lack of species common to the Pacific Northwest coast such as *Rubus spectabilis*.
Similar Ecological Systems:
- Alaska Sub-boreal Mesic Subalpine Alder Shrubland (CES105.112)
- Alaskan Pacific Maritime Avalanche Slope Shrubland (CES204.162)

Related Concepts:
- II.B.1.b - Alder (closed) (Viereck et al. 1992) Intersecting
- II.B.1.d - Alder-willow (closed) (Viereck et al. 1992) Intersecting
- II.B.2.b - Alder (open) (Viereck et al. 1992) Intersecting
- II.B.2.d - Alder-willow (open) (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: Avalanche slopes occur where mountain slopes are steep enough to produce frequent snow slides thus preventing forest development. Upper avalanche slopes typically have a slope angle of at least 70%, but the lower slopes and run-out zones may be much less steep. Soils are shallow and stony, underlain by colluvium, glacial till, and residuum.
Vegetation: The dominant shrub species is typically *Alnus viridis ssp. sinuata*, but other shrubs, including *Sambucus racemosa, Salix* spp., and *Spiraea stevenii (= Spiraea beauverdiana)*, may be common. Herbaceous patches are often dominated by *Calamagrostis canadensis* and *Chamerion angustifolium*; other common herbs include *Athyrium filix-femina*, *Dryopteris expansa*, and *Veratrum viride* (Viereck et al. 1992). Tree seedlings and saplings may be common on some slopes but do not emerge as an overstory due to frequent snow avalanche.
Dynamics: This system represents a topoedaphic climax (Viereck et al. 1992). *Alnus viridis ssp. sinuata* has a growth form that tolerates avalanche disturbance and can maintain dominance on the site. Frequent snow slides prevent tree seedlings and saplings from reaching the upper canopy. On sites with a less frequent avalanche cycle, trees may temporarily dominate the overstory.

DISTRIBUTION

Range: Boreal transition is the dominant region, but this system also occurs infrequently in boreal Alaska.
Divisions: 105:C; 204:C
Nations: US
Subnations: AK
Map Zones: 69:C, 70:C, 71:C, 72:C, 73:C, 74:C, 75:C, 76:C
TNC Ecoregions: 70:C, 71:C, 72:C, 74:C, 76:C, 77:C, 78:C

SOURCES

References: Viereck et al. 1992, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817390#references
Description Author: T. Boucher

Version: 08 Aug 2008
Concept Author: Western Ecology Group and Alaska Natural Heritage Program

Stakeholders: West
ClassifResp: West

ALASKA SUB-BOREAL MESIC SUBALPINE ALDER SHRUBLAND (CES105.112)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Montane]; Shrubland (Shrub-dominated); Boreal [Boreal Subcontinental]; Broad-Leaved Deciduous Shrub
Non-Diagnostic Classifiers: Montane [Upper Montane]
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Deciduous shrubland
National Mapping Codes: EVT 2609; ESLF 5330; ESP 1609

CONCEPT

Summary: This system is widespread on upper mountain slopes above treeline throughout south-central and southwestern Alaska. It occurs less commonly throughout the northern boreal region to the southern slopes of the Brooks Range. This system often appears as a band of alder above treeline and below alpine systems. Low shrub replaces this system as the dominant subalpine shrub type in the northern boreal region of the state. *Alnus viridis ssp. sinuata* is the dominant shrub species, but other shrubs including *Salix* spp. (sometimes the dominant shrub), *Sambucus racemosa*, and *Spiraea stevenii (= Spiraea beauverdiana)* may be common. In the boreal transition region, the alder zone is intermixed with mesic herbaceous meadows (*Calamagrostis canadensis* and *Chamerion angustifolium*); in boreal Alaska, low-shrub tundra is more common in the gaps between alder patches.
Classification Comments: This system is known as Boreal Transition Tall Shrub by the Alaska Natural Heritage Program. It is similar in species composition to Alaska Sub-boreal Avalanche Slope Shrubland (CES105.111), but it occurs in the subalpine zone and tree growth is limited by elevation not avalanche frequency. Alaskan Pacific Maritime Subalpine Alder-Salmonberry Shrubland (CES204.152) occupies a similar landscape position along the Gulf Coast of Alaska, but this system may be dominated by *Rubus spectabilis*, which does not occur in boreal regions.
Similar Ecological Systems:
- Alaska Sub-boreal Avalanche Slope Shrubland (CES105.111)
- Alaskan Pacific Maritime Subalpine Alder-Salmonberry Shrubland (CES204.152)

Related Concepts:
- II.B.1.b - Alder (closed) (Viereck et al. 1992) Intersecting. also occurs on avalanche slopes
- II.B.1.d - Alder-willow (closed) (Viereck et al. 1992) Intersecting. also occurs on avalanche slopes
- II.B.2.b - Alder (open) (Viereck et al. 1992) Intersecting. also occurs on avalanche slopes
- II.B.2.d - Alder-willow (open) (Viereck et al. 1992) Intersecting. also occurs on avalanche slopes

DESCRIPTION

Environment: This system is widespread on upper mountain slopes above treeline throughout south-central and southwestern Alaska (Viereck 1979). It occurs less commonly throughout the northern boreal region to the southern slopes of the Brooks Range. This system occurs on well-drained mesic sites. Soils are shallow and stony, underlain by colluvium, glacial till, and residuum.
Vegetation: *Alnus viridis ssp. sinuata* is the dominant shrub species, but other shrubs including *Salix* spp. (sometimes the dominant shrub), *Sambucus racemosa*, and *Spiraea stevenii* may be common. Herbaceous patches often occur within the shrub zone and may be dominated by *Calamagrostis canadensis* and *Chamerion angustifolium*; other common herbs include *Athyrium filix-femina, Dryopteris expansa, Veratrum viride, Valeriana sitchensis, Lupinus nootkatensis*, and *Sanguisorba canadensis (= Sanguisorba sitchensis)* (Viereck et al. 1992).
Dynamics: This system represents a topoedaphic climax (Viereck et al. 1992). It occurs above treeline and is not controlled by avalanche activity, although avalanches may occur. This system may be extending further into the alpine in recent decades. Alder will resprout following fire, but no studies exist on fire effects in this type. The fire-return interval is likely long, possibly 500 to 1000 years. Early-season fire prior to green-up would be more likely to carry than late-season fire. Alder is also affected by insects and diseases.

DISTRIBUTION

Range: This system occurs at mid-elevation through subalpine in the boreal transition and, less commonly, boreal regions of Alaska.
Divisions: 105:C; 204:C
Nations: US
Subnations: AK
Map Zones: 68:C, 69:?, 70:C, 71:C, 72:C, 73:C, 74:C, 75:C
TNC Ecoregions: 70:C, 71:C, 72:C, 74:C, 75:?, 76:C, 77:C, 78:C, 79:?

SOURCES

References: Viereck 1979, Viereck et al. 1992, Western Ecology Working Group n.d.
Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817393#references
Description Author: T. Boucher
Version: 08 Aug 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKAN PACIFIC MARITIME ALPINE SPARSE SHRUB AND FELL-FIELD (CES204.318)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Alpine/AltiAndino [Alpine/AltiAndino]; Alpine Mosaic; Shrubland (Shrub-dominated); Temperate [Temperate Oceanic]; W-Landscape/High Intensity; Dwarf-Shrub
Non-Diagnostic Classifiers: Fell-field; Ridge/Summit/Upper Slope; Sideslope
FGDC Crosswalk: Vegetated, Shrub-dominated, Dwarf-shrubland, Deciduous dwarf-shrubland
National Mapping Codes: EVT 2674; ESLF 5109; ESP 1674

CONCEPT

Summary: This sparsely vegetated ecological system occurs on exposed summits, windswept ridges, and fell-fields. These sites are characterized by harsh environmental conditions. Slopes vary from moderately sloped to flat. Dominant species include *Empetrum nigrum, Vaccinium uliginosum, Loiseleuria procumbens, Phyllodoce aleutica, Harrimanella stelleriana*, and *Luetkea pectinata*. Lichens may be common. Total vegetation cover ranges from 10 to 25%.
Classification Comments: This system is known as Maritime Alpine Sparse Dwarf-Shrub by the Alaska Natural Heritage Program.
Similar Ecological Systems:
- Western North American Boreal Alpine Dwarf-Shrub Summit (CES105.129)

Related Concepts:
- II.D.2.d - Mountain-heath tundra (Viereck et al. 1992) Intersecting
- II.D.2.e - Cassiope tundra (Viereck et al. 1992) Intersecting

DISTRIBUTION

Range: This system occurs in the Alaska Range south and east throughout southeastern Alaska.
Divisions: 204:C
Nations: US
Subnations: AK
Map Zones: 75:C, 77:C, 78:C
TNC Ecoregions: 69:C, 70:C

SOURCES

References: Viereck et al. 1992, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.820182#references
Description Author: K. Boggs
Version: 09 Dec 2008
Stakeholders: West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program
ClassifResp: West

ALASKAN PACIFIC MARITIME AVALANCHE SLOPE SHRUBLAND (CES204.162)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Montane [Montane]; Shrubland (Shrub-dominated); Rockfall avalanche; Soil creep slope; Avalanche chute; Temperate [Temperate Oceanic]; Avalanche; Broad-Leaved Deciduous Shrub; Rubus spectabilis
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Deciduous shrubland
National Mapping Codes: EVT 2680; ESLF 5331; ESP 1680

CONCEPT

Summary: This system occurs on mountain sideslopes from sea level to treeline where slopes are steep enough to produce frequent snowslides preventing forest development. Mass wasting, including rockfall and soil creep, also contributes to the disturbance cycle. This system is similar in species composition to Alaskan Pacific Maritime Subalpine Alder-Salmonberry Shrubland (CES204.152), but it occurs below the subalpine zone, and tree growth is limited by disturbance frequency, not elevation and temperature as in the subalpine system. Sites are usually dominated by *Alnus viridis ssp. sinuata* and *Rubus spectabilis*. Other shrubs may include *Sambucus racemosa, Salix alaxensis, Salix barclayi*, and *Oplopanax horridus*. Herbaceous patches are common and are dominated by *Calamagrostis canadensis* and *Chamerion angustifolium*. Other common herbs include *Athyrium filix-femina, Veratrum viride, Heracleum maximum, Streptopus amplexifolius*, and *Aruncus dioicus*. Near treeline, forb-sedge meadows replace *Calamagrostis* meadows. Tree seedlings and saplings may be abundant on some slopes but do not emerge as an overstory due to frequent disturbance.
Classification Comments: This system is known as Tall Shrub Avalanche Slopes by the Alaska Natural Heritage Program. Avalanche slopes in the Cascades and mountains of southern British Columbia are probably drier than these found farther north in Alaska, where the precipitation regime does not have a seasonal component to it. Hence, these have been split into two different systems. Exactly where they transition from one to another is yet to be determined.
Similar Ecological Systems:
- Alaska Sub-boreal Avalanche Slope Shrubland (CES105.111)
- Alaskan Pacific Maritime Subalpine Alder-Salmonberry Shrubland (CES204.152)
- North Pacific Avalanche Chute Shrubland (CES204.854)

Related Concepts:
- II.B.1.b - Alder (closed) (Viereck et al. 1992) Intersecting
- II.B.1.d - Alder-willow (closed) (Viereck et al. 1992) Intersecting
- II.B.2.b - Alder (open) (Viereck et al. 1992) Intersecting
- II.B.2.d - Alder-willow (open) (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: Avalanche slopes occur from sea level to treeline where mountain slopes are steep enough to produce frequent snow slides preventing forest development. Upper avalanche slopes typically have a slope angle of at least 70% but the lower slopes and run-out zones may be much less steep. Soils are shallow and stony, underlain by colluvium, glacial till, and residuum.
Vegetation: Sites are usually dominated by *Alnus viridis ssp. sinuata* and *Rubus spectabilis*. Other shrubs may include *Sambucus racemosa, Salix alaxensis, Salix barclayi*, and *Oplopanax horridus*. Herbaceous patches are common and are dominated by *Calamagrostis canadensis* and *Chamerion angustifolium*. Other common herbs include *Athyrium filix-femina, Veratrum viride, Heracleum maximum, Streptopus amplexifolius*, and *Aruncus dioicus* (Viereck et al. 1992, DeVelice et al. 1999). Near treeline, forb-sedge meadows replace *Calamagrostis* meadows. Tree seedlings and saplings may be abundant on some slopes but do not emerge as an overstory due to frequent disturbance.
Dynamics: This shrubland system is maintained by frequent disturbance and represents a topoedaphic climax (Viereck et al. 1992). Severe slides often with a debris component may break branches, bury, or kill shrubs, but recolonization through resprouting is usually rapid. On sites with a less frequent avalanche cycle, trees may temporarily dominate the overstory. Herbaceous seres may be present on sites with very frequent avalanche cycles. On older landscapes *Rubus spectabilis* may be dominant or codominant.

DISTRIBUTION

Range: This system occurs from Kodiak Island through southeastern Alaska into British Columbia, but the southern boundary needs to be determined.
Divisions: 204:C
Nations: CA, US
Subnations: AK, BC
Map Zones: 77:C, 78:C
TNC Ecoregions: 69:C, 70:C

SOURCES

References: DeVelice et al. 1999, Viereck et al. 1992, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817784#references
Description Author: T. Boucher
Version: 11 Sep 2008 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKAN PACIFIC MARITIME SUBALPINE ALDER-SALMONBERRY SHRUBLAND (CES204.152)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Shrubland (Shrub-dominated); Temperate [Temperate Oceanic]; Broad-Leaved Deciduous Shrub
Non-Diagnostic Classifiers: Montane [Upper Montane]; Montane [Montane]
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Deciduous shrubland
National Mapping Codes: EVT 2652; ESLF 5332; ESP 1652

CONCEPT

Summary: This ecological system typically occurs just above treeline and below the alpine throughout the maritime region of Alaska. Soils are typically mesic, well-drained, shallow, and stony, and underlain by colluvium, glacial till or residuum. *Alnus viridis ssp. sinuata* is often the dominant species, but *Rubus spectabilis* may be codominant. Other common species include *Sambucus racemosa, Oplopanax horridus*, and *Elliottia pyroliflorus*. The tall shrub system is often mosaiced with the mesic herbaceous meadow system. Common herbaceous species include *Calamagrostis canadensis, Chamerion angustifolium, Veratrum viride, Heracleum maximum, Athyrium filix-femina, Dryopteris expansa, Phegopteris connectilis, Equisetum arvense, Streptopus amplexifolius, Lupinus nootkatensis, Valeriana sitchensis, Geranium erianthum, Aconitum delphiniifolium, Castilleja unalaschcensis, Sanguisorba canadensis*, and *Carex macrochaeta*.

This system also includes partially vegetated bedrock ridges and cliffs in the alpine and subalpine, where it is found primarily on or near ridgetops and is exposed to extremely harsh growing conditions. More exposed sites subject the vegetation to a very short growing season, freeze-thaw pattern, and desiccating winds. Exposed bedrock or talus is usually a major component of the sites. In the more extreme locations, the vegetation cover is often fragmented or sparse and includes a complex of sparse tall or low shrubs, dwarf-shrubs, and herbaceous species.

This system appears to be relatively stable, although there may be an upward trend in the elevation of this system. Treeline conifers appear to be invading from below in some areas, and the elevational limit of low and tall shrub establishment appears to be rising.
Classification Comments: This system combines those known as Maritime Tall Shrub and Maritime Sparse Alder by the Alaska Natural Heritage Program. P. Krosse (USFS ecologist, pers. comm.) comments regarding the alpine sparse alder: "We have this type mapped in our soil survey with bedrock and talus ranging from 25 to 40%. We also have map units that are predominantly rock outcrop (85%) with no more than 15% shrub and herbaceous vegetation contained within this map unit." On Kodiak Island, alder shrublands are placed into Aleutian Mesic Alder-Salmonberry Shrubland (CES105.147).
Similar Ecological Systems:
- Alaska Sub-boreal Mesic Subalpine Alder Shrubland (CES105.112)
- Alaskan Pacific Maritime Avalanche Slope Shrubland (CES204.162)
- Aleutian Mesic Alder-Salmonberry Shrubland (CES105.147)

Related Concepts:
- II.B.1.b - Alder (closed) (Viereck et al. 1992) Intersecting
- II.B.2.b - Alder (open) (Viereck et al. 1992) Intersecting

DESCRIPTION

Dynamics: This system appears to be relatively stable (Mitchell 1968, Viereck et al. 1992). It is hypothesized that infrequent soil disturbance can lead to a short-lived herbaceous sere. The climate is likely too cold to allow fires to burn in this system.

DISTRIBUTION

Range: This system occurs from Prince William Sound through southeastern Alaska.
Divisions: 204:C
Nations: US
Subnations: AK
Map Zones: 77:C, 78:C
TNC Ecoregions: 69:C, 70:C

SOURCES

References: DeVelice et al. 1999, Krosse pers. comm., Mitchell 1968, Talbot et al. 2005, Viereck et al. 1992, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817693#references
Description Author: T. Boucher, mod. M.S. Reid
Version: 10 Dec 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKAN PACIFIC MARITIME SUBALPINE COPPERBUSH SHRUBLAND (CES204.316)

CLASSIFIERS

Conf.: 3 - Weak **Classification Status:** Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Shrubland (Shrub-dominated); Temperate [Temperate Oceanic]; Broad-Leaved Deciduous Shrub
Non-Diagnostic Classifiers: Alpine/AltiAndino [Alpine/AltiAndino]; Montane [Upper Montane]; Montane [Montane]
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Deciduous shrubland
National Mapping Codes: EVT 2672; ESLF 5280; ESP 1672

CONCEPT

Summary: This ecological system occurs in the lower alpine and subalpine. *Elliottia pyroliflorus* dominates the overstory (10 to 80% cover) and ranges in height from 0.6-1.5 m (2-5 feet). Other species include *Phyllodoce aleutica, Nephrophyllidium crista-galli, Cornus suecica, Luetkea pectinata, Athyrium filix-femina, Cassiope mertensiana, Dryopteris expansa, Gymnocarpium dryopteris, Viola glabella*, and *Rubus spectabilis*. Krummholz *Tsuga mertensiana* occur in some sites. Adjacent to this system at higher elevations are alpine herbaceous meadows or dwarf-shrublands; at lower elevations *Tsuga mertensiana* forests or woodlands are common.
Classification Comments: This system is poorly documented and not well-understood. It is included in the systems classification for Alaska because it is somewhat different floristically from the other shrubland systems in the maritime. With further information, it is possible it will be merged with another ecological system. This system is known as Maritime Alpine Low Shrub (Copperbush) by the Alaska Natural Heritage Program.
Related Concepts:
- *Elliottia pyroliflora* (Boggs et al. 2008b) Undetermined
- *Elliottia pyroliflora* (DeVelice et al. 1999) Undetermined
- II.C.1.d - Ericaceous shrub (Viereck et al. 1992) Broader

DISTRIBUTION

Range: This system occurs in the Alaska Range south and east throughout southeastern Alaska.
Divisions: 204:C
Nations: US
Subnations: AK
Map Zones: 75:?, 77:C, 78:C
TNC Ecoregions: 69:C, 70:C

SOURCES

References: Boggs et al. 2008b, DeVelice et al. 1999, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.820179#references
Description Author: K. Boggs
Version: 09 Dec 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALEUTIAN MESIC ALDER-SALMONBERRY SHRUBLAND (CES105.147)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch, Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Shrubland (Shrub-dominated); Boreal [Boreal Oceanic]; Rubus spectabilis
Non-Diagnostic Classifiers: Flat; Slope; Colluvial slope
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Deciduous shrubland
National Mapping Codes: EVT 2718; ESLF 5333; ESP 1718

CONCEPT

Summary: The alder-salmonberry system is matrix-forming on the Alaska Peninsula and Kodiak Island, diminishes moving west, and is absent by Dutch Harbor. It occurs on flat to steep slopes (0-50 degrees) at low to mid elevations (1-1000 m) in valleys, hills and mountains. The slopes are typically ash-covered, colluvium, or glacial drift. Total low- and tall-shrub cover is >25%, and *Alnus viridis* or *Rubus spectabilis* contribute greater than 50% of the total shrub cover. *Rubus spectabilis* is dominant primarily on the oldest stabilized talus slopes and stable colluvial slopes (older substrates), while *Alnus viridis* may be the dominant shrub on recently disturbed sites, wind-sheltered sites or recent ash deposits. Common codominants include *Sambucus racemosa, Oplopanax horridus, Spiraea stevenii*, and tall willows such as *Salix barclayi* or *Salix glauca*. *Alnus viridis ssp. sinuata* is the most common alder species, however, *Alnus viridis ssp. fruticosa* dominates some sites. Alder height ranges from 0.5 m at higher elevations to 8 m downslope. In closed-canopy sites, *Sambucus racemosa* and *Rubus spectabilis* shrubs are usually woven in among and around the edges of the alder thickets, and the understory is sparse, often with *Athyrium filix-femina*, graminoids and sparse *Rubus spectabilis*. Litter cover is high. Sites codominated by tall willows typically occur along streams and at the upper limits of alder growth. Some *Rubus spectabilis* sites are mixed with herbaceous species of equal height, including *Athyrium filix-femina, Aconitum maximum, Calamagrostis canadensis, Chamerion angustifolium ssp. angustifolium, Deschampsia caespitosa, Dryopteris expansa, Heracleum maximum*, and *Veratrum viride*. In sites where patches of alder are mosaiced with mesic herbaceous meadows, common species include *Athyrium filix-femina, Aconitum maximum, Calamagrostis canadensis, Chamerion angustifolium ssp. angustifolium, Deschampsia caespitosa, Dryopteris expansa, Heracleum maximum, Lupinus nootkatensis, Solidago* spp., and *Veratrum viride.*
Classification Comments: This system combines those known as Alder and *Rubus spectabilis* by the Alaska Natural Heritage Program.
Similar Ecological Systems:
- Alaskan Pacific Maritime Subalpine Alder-Salmonberry Shrubland (CES204.152)

Related Concepts:
- *Alnus viridis ssp. fruticosa / Athyrium filix-femina* (Boggs et al. 2003) Finer
- *Alnus viridis ssp. fruticosa / Oplopanax horridus* (Boggs et al. 2003) Finer
- *Alnus viridis ssp. fruticosa / Spiraea stevenii / Deschampsia caespitosa* (Boggs et al. 2003) Finer
- *Alnus viridis ssp. sinuata - Salix* spp. / *Calamagrostis canadensis* (Boggs et al. 2003) Finer
- *Alnus viridis ssp. sinuata - Sambucus racemosa - Rubus spectabilis* (Boggs et al. 2003) Finer
- *Alnus viridis ssp. sinuata - Sambucus racemosa / Calamagrostis canadensis* (Boggs et al. 2003) Finer
- *Alnus viridis ssp. sinuata / Calamagrostis canadensis* (Boggs et al. 2003) Finer
- *Alnus viridis ssp. sinuata / Rubus spectabilis - Calamagrostis canadensis* (Boggs et al. 2003) Finer
- *Alnus viridis ssp. sinuata* / Fern (Boggs et al. 2003) Finer
- *Rubus spectabilis / Calamagrostis canadensis* (Boggs et al. 2003) Finer
- II.B.1.b - Alder (closed) (Viereck et al. 1992) Intersecting
- II.B.1.d - Alder-willow (closed) (Viereck et al. 1992) Intersecting
- II.B.2.b - Alder (open) (Viereck et al. 1992) Intersecting
- II.B.2.d - Alder-willow (open) (Viereck et al. 1992) Intersecting
- II.C.1.e - Low alder-willow (closed) (Viereck et al. 1992) Intersecting
- II.C.2.k - Low alder-willow (open) (Viereck et al. 1992) Intersecting
- II.C.2.l - Low alder (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: The alder-salmonberry system is matrix-forming on the Alaska Peninsula and Kodiak Island, diminishes moving west, and is absent by Dutch Harbor. It occurs on flat to steep slopes (0-50 degrees) at low to mid elevations (1-1000 m) in valleys, hills and mountains. The slopes are typically ash-covered, colluvium, or glacial drift.
Vegetation: Total low- and tall-shrub cover is >25%, and *Alnus viridis* or *Rubus spectabilis* contribute greater than 50% of the total shrub cover. *Rubus spectabilis* is dominant primarily on the oldest stabilized talus slopes and stable colluvial slopes (older substrates), while *Alnus viridis* may be the dominant shrub on recently disturbed sites, wind-sheltered sites or recent ash deposits. Common codominants include *Sambucus racemosa, Oplopanax horridus, Spiraea stevenii*, and tall willows such as *Salix barclayi* or *Salix*

glauca. *Alnus viridis ssp. sinuata* is the most common alder species, however, *Alnus viridis ssp. fruticosa* dominates some sites. Alder height ranges from 0.5 m at higher elevations to 8 m downslope. In closed-canopy sites, *Sambucus racemosa* and *Rubus spectabilis* shrubs are usually woven in among and around the edges of the alder thickets, and the understory is sparse, often with *Athyrium filix-femina*, graminoids and sparse *Rubus spectabilis*. Litter cover is high. Sites codominated by tall willows typically occur along streams and at the upper limits of alder growth. Some *Rubus spectabilis* sites are mixed with herbaceous species of equal height, including *Athyrium filix-femina, Aconitum maximum, Calamagrostis canadensis, Chamerion angustifolium ssp. angustifolium, Deschampsia caespitosa, Dryopteris expansa, Heracleum maximum*, and *Veratrum viride*. In sites where patches of alder are mosaiced with mesic herbaceous meadows, common species include *Athyrium filix-femina*, *Aconitum maximum, Calamagrostis canadensis, Chamerion angustifolium ssp. angustifolium, Deschampsia caespitosa*, *Dryopteris expansa, Heracleum maximum, Lupinus nootkatensis, Solidago* spp., and *Veratrum viride*.

Dynamics: Alder's response to fire in this system is unknown. Alder can often dominate new ash deposits on the Alaska Peninsula. It is also affected by insects and diseases.

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:

- Aleutian Crowberry-Herbaceous Heath (CES105.230)
- Aleutian Mesic Herbaceous Meadow (CES105.232)

DISTRIBUTION

Range: This system occurs on the Alaska Peninsula and Kodiak Island, diminishes moving west, and is absent by Dutch Harbor.
Divisions: 102:C; 105:C
Nations: US
Subnations: AK
Map Zones: 76:C
TNC Ecoregions: 70:C, 72:C

SOURCES

References: Boggs et al. 2003, Fleming and Spencer 2007, Talbot et al. 1984, Talbot et al. 2005, Talbot et al. 2006, Viereck et al. 1992, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818540#references
Description Author: K. Boggs
Version: 15 Oct 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALEUTIAN MESIC-WET WILLOW SHRUBLAND (CES105.148)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Saturated Soil; Lake terrace; Shrubland (Shrub-dominated); Stream terrace (undifferentiated); Boreal [Boreal Oceanic]
Non-Diagnostic Classifiers: Slope; Valley
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Deciduous shrubland
National Mapping Codes: EVT 2640; ESLF 5278; ESP 1640

CONCEPT

Summary: This willow shrubland system is relatively uncommon yet widespread on the eastern Alaska Peninsula and Kodiak Island at low to mid elevations (range of 3-657 m in Katmai National Park and Preserve) and diminishes moving west. It typically occurs as small patches in broad valleys, on mountain sideslopes with slopes ranging from 0 to 30 degrees. It is also frequently found on wet sites in lowlands, along streams, terraces, lakeshores and the edge of small streams, as well as adjacent to peatlands and wet meadows. Some sites are not wet and support predominantly tall willows, but this is probably <10% of sites. The soil substrates range from mineral to peat. Total tall- and low-shrub cover (>20 cm height) is >25%, and *Salix* spp. contribute greater than 25% of the total shrub cover. The dominant willow species is *Salix barclayi*, although *Salix alaxensis, Salix commutata, Salix glauca*, and *Salix pulchra* are also important. *Alnus viridis ssp. sinuata* may codominate. Understory shrub species include *Betula nana, Empetrum nigrum, Vaccinium vitis-idaea*, and *Vaccinium uliginosum*. Understory herbaceous species include *Achillea millefolium var. borealis, Angelica lucida, Calamagrostis canadensis, Chamerion angustifolium ssp. angustifolium, Equisetum arvense, Geranium erianthum, Heracleum maximum, Rubus arcticus*, and *Sanguisorba canadensis*. Wetter sites support *Carex lenticularis var. lipocarpa, Carex aquatilis var. aquatilis, Carex utriculata*, and *Equisetum pratense*.
Classification Comments: This system combines those known as Tall Willow and Low Willow by the Alaska Natural Heritage Program.
Related Concepts:
- *Salix barclayi - Salix alaxensis* (Boggs et al. 2003) Finer
- *Salix barclayi - Salix commutata* (Boggs et al. 2003) Finer
- *Salix barclayi / Calamagrostis canadensis* (Boggs et al. 2003) Finer
- *Salix barclayi / Carex utriculata* (Boggs et al. 2003) Finer
- *Salix barclayi / Equisetum arvense* (Boggs et al. 2003) Finer
- *Salix barclayi / Myrica gale* (Boggs et al. 2003) Finer
- *Salix barclayi* (Boggs et al. 2003) Finer
- *Salix barclayi* / Ericaceous shrub (Boggs et al. 2003) Finer
- *Salix barclayi* / Mixed herbaceous (Boggs et al. 2003) Finer
- *Salix commutata* (Boggs et al. 2003) Finer
- *Salix glauca / Betula nana* (Boggs et al. 2003) Finer
- *Salix pulchra - Salix barclayi* (Boggs et al. 2003) Finer
- *Salix pulchra / Calamagrostis canadensis* (Boggs et al. 2003) Finer
- *Salix pulchra* (Boggs et al. 2003) Finer
- II.B.1.a - Willow (closed) (Viereck et al. 1992) Intersecting
- II.B.1.d - Alder-willow (closed) (Viereck et al. 1992) Intersecting
- II.B.2.a - Willow (open) (Viereck et al. 1992) Intersecting
- II.B.2.d - Alder-willow (open) (Viereck et al. 1992) Intersecting
- II.C.1.b - Low willow (Viereck et al. 1992) Intersecting
- II.C.1.e - Low alder-willow (closed) (Viereck et al. 1992) Intersecting
- II.C.2.g - Willow low (open) (Viereck et al. 1992) Intersecting
- II.C.2.k - Low alder-willow (open) (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: This willow shrubland system is relatively uncommon yet widespread on the eastern Alaska Peninsula and Kodiak Island at low to mid elevations (range of 3-657 m in Katmai National Park and Preserve) and diminishes moving west. It typically occurs as small patches in broad valleys, on mountain sideslopes with slopes ranging from 0 to 30 degrees. It is also frequently found on wet sites in lowlands, along streams, terraces, lakeshores and the edge of small streams, as well as adjacent to peatlands and wet meadows. Some sites are not wet and support predominantly tall willows, but this is probably <10% of sites. The soil substrates range from mineral to peat.
Vegetation: Total tall- and low-shrub cover (>20 cm height) is >25%, and *Salix* spp. contribute greater than 25% of the total shrub

cover. The dominant willow species is *Salix barclayi*, although *Salix alaxensis, Salix commutata, Salix glauca*, and *Salix pulchra* are also important. *Alnus viridis ssp. sinuata* may codominate. Understory shrub species include *Betula nana, Empetrum nigrum, Vaccinium vitis-idaea*, and *Vaccinium uliginosum*. Understory herbaceous species include *Achillea millefolium var. borealis, Angelica lucida, Calamagrostis canadensis, Chamerion angustifolium ssp. angustifolium, Equisetum arvense, Geranium erianthum, Heracleum maximum, Rubus arcticus*, and *Sanguisorba canadensis*. Wetter sites support *Carex lenticularis var. lipocarpa, Carex aquatilis var. aquatilis, Carex utriculata*, and *Equisetum pratense*.

DISTRIBUTION

Range: This willow shrubland system is relatively uncommon yet widespread on the eastern Alaska Peninsula and Kodiak Island at low to mid elevations and diminishes moving west.
Divisions: 102:C; 105:C
Nations: US
Subnations: AK
Map Zones: 76:C
TNC Ecoregions: 70:C, 72:C, 73:C

SOURCES

References: Boggs et al. 2003, Fleming and Spencer 2007, Viereck et al. 1992, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818543#references
Description Author: K. Boggs
Version: 15 Oct 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALEUTIAN OVAL-LEAF BLUEBERRY SHRUBLAND (CES105.229)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Lower Montane]; Shrubland (Shrub-dominated); Sideslope; Boreal [Boreal Oceanic]
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Deciduous shrubland
National Mapping Codes: EVT 2731; ESLF 5279; ESP 1731

CONCEPT

Summary: This ecological system grows primarily on low- to mid-elevation mountain slopes of the Aleutian Islands. Total low-shrub cover is >25%, and *Vaccinium ovalifolium* typically contributes >50% of the total shrub cover. Herbaceous species and dwarf-shrubs are common, including *Athyrium filix-femina, Chamerion angustifolium ssp. angustifolium, Calamagrostis canadensis, Cornus suecica, Sanguisorba canadensis, Achillea millefolium var. borealis,* and *Geum calthifolium. Empetrum nigrum* may also be common.
Classification Comments: This system is known as Low Shrub by the Alaska Natural Heritage Program.
Related Concepts:
- II.C.1.d - Ericaceous shrub (Viereck et al. 1992) Broader

DISTRIBUTION

Range: This system grows primarily on low- to mid-elevation mountain slopes of the Aleutian Islands.
Divisions: 105:C
Nations: US
Subnations: AK
Map Zones: 76:C
TNC Ecoregions: 73:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818546#references
Description Author: K. Boggs
Version: 10 Dec 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALEUTIAN SPARSE HEATH AND FELL-FIELD (CES105.307)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch, Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Shrubland (Shrub-dominated); Ridge/Summit/Upper Slope; Boreal [Boreal Oceanic]; Dwarf-Shrub
Non-Diagnostic Classifiers: Ridge; Fell-field; Cliff (Landform)
FGDC Crosswalk: Vegetated, Shrub-dominated, Dwarf-shrubland, Deciduous dwarf-shrubland
National Mapping Codes: EVT 2730; ESLF 5108; ESP 1730

CONCEPT

Summary: This system typically occurs at mid to high elevations on cliffs, rocky outcrops, exposed summits, windswept ridges, and fell-fields characterized by harsh environmental conditions. Slopes vary from flat to steep. Total vascular plant cover is 10-25%. Sites typically support vegetation similar to the adjacent ecological systems. The higher elevation windswept ridges, fell-fields and discontinuous heaths include *Harrimanella stelleriana, Phyllodoce aleutica, Salix arctica, Salix rotundifolia, Empetrum nigrum, Cassiope lycopodioides*, and *Arctostaphylos alpina*. Herbaceous species include *Carex macrochaeta, Carex aquatilis var. dives, Carex circinata, Lupinus nootkatensis, Geum calthifolium, Polygonum viviparum, Agrostis mertensii, Heuchera glabra, Potentilla villosa, Saxifraga bronchialis, Saxifraga oppositifolia, Veronica wormskjoldii var. stelleri*, and *Tofieldia coccinea*.
Classification Comments: This system is known as Aleutian Sparse Vegetation by the Alaska Natural Heritage Program.
Related Concepts:
- II.D.2.d - Mountain-heath tundra (Viereck et al. 1992) Intersecting
- II.D.2.e - Cassiope tundra (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: This system typically occurs at mid to high elevations on cliffs, rocky outcrops, exposed summits, windswept ridges, and fell-fields characterized by harsh environmental conditions. Slopes vary from flat to steep.
Vegetation: Total vascular plant cover is 10-25%. Sites typically support vegetation similar to the adjacent ecological systems. The higher elevation windswept ridges, fell-fields and discontinuous heaths include *Harrimanella stelleriana, Phyllodoce aleutica, Salix arctica, Salix rotundifolia, Empetrum nigrum, Cassiope lycopodioides*, and *Arctostaphylos alpina*. Herbaceous species include *Carex macrochaeta, Carex aquatilis var. dives, Carex circinata, Lupinus nootkatensis, Geum calthifolium, Polygonum viviparum, Agrostis mertensii, Heuchera glabra, Potentilla villosa, Saxifraga bronchialis, Saxifraga oppositifolia, Veronica wormskjoldii var. stelleri*, and *Tofieldia coccinea* (Shacklette et al. 1969).

DISTRIBUTION

Range: This system occurs on the Alaska Peninsula, Aleutian Islands and Kodiak Island.
Divisions: 102:C; 105:C
Nations: US
Subnations: AK
Map Zones: 76:C
TNC Ecoregions: 70:C, 72:C, 73:C

SOURCES

References: Byrd 1984, Shacklette et al. 1969, Talbot et al. 2006, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818607#references
Description Author: K. Boggs
Version: 16 Oct 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

APACHERIAN-CHIHUAHUAN MESQUITE UPLAND SCRUB (CES302.733)

CLASSIFIERS

Conf.: 3 - Weak **Classification Status:** Standard
Primary Division: North American Warm Desert (302)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland [Foothill]; Lowland [Lowland]; Shrubland (Shrub-dominated); Thorn Shrub; Prosopis spp.-dominated
Non-Diagnostic Classifiers: Tropical/Subtropical [Tropical Xeric]; Temperate [Temperate Xeric]; Aridic; Intermediate Disturbance Interval; F-Patch/High Intensity [Seasonality/Winter Fire]
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Mixed evergreen-deciduous shrubland
National Mapping Codes: EVT 2095; ESLF 5301; ESP 1095

CONCEPT

Summary: This ecological system often occurs as invasive upland shrublands that are concentrated in the extensive desert grassland in foothills and piedmonts of the Chihuahuan Desert, extending into the Sky Island region to the west. Substrates are typically derived from alluvium, often gravelly without a well-developed argillic or calcic soil horizon that would limit infiltration and storage of winter precipitation in deeper soil layers. *Prosopis* spp. and other deep-rooted shrubs exploit this deep-soil moisture that is unavailable to grasses and cacti. Vegetation is typically dominated by *Prosopis glandulosa* or *Prosopis velutina* and succulents. Other desert scrub species that may codominate include *Acacia neovernicosa, Acacia constricta, Juniperus monosperma,* or *Juniperus coahuilensis*. *Larrea tridentata* is typically absent or has low cover. Grass cover is typically low and composed of desert grasses such as *Dasyochloa pulchella (= Erioneuron pulchellum), Muhlenbergia porteri, Muhlenbergia setifolia,* and *Pleuraphis mutica*. During the last century, the area occupied by this system has increased through conversion of desert grasslands as a result of drought, overgrazing by livestock, and/or decreases in fire frequency. It is similar to Chihuahuan Mixed Desert and Thornscrub (CES302.734) but is generally found at higher elevations where *Larrea tridentata* and other desert scrub are not codominant. It is also similar to Chihuahuan Stabilized Coppice Dune and Sand Flat Scrub (CES302.737) but does not occur on eolian-deposited substrates (sandsheets), although some stands may have evidence of wind erosion and deposition.
Classification Comments: This system is similar to Chihuahuan Mixed Desert and Thornscrub (CES302.734) but is generally found at higher elevations where *Larrea tridentata* and other desert scrub are not codominant. It is also similar to Chihuahuan Stabilized Coppice Dune and Sand Flat Scrub (CES302.737) but does not occur on eolian-deposited substrates. This system includes mesquite-dominated types resulting from conversion of desert grasslands to shrublands. Landfire mapzone 25 modeling workshops limited BpS to naturally occurring mesquite shrublands found on rocky outcrop and foothills. During the last century, the area occupied by the uncharacteristic portion of this system has increased through conversion of desert grasslands as a result of drought, overgrazing and seed dispersion by livestock, and/or decreases in fire frequency. The boundary between Apacherian-Chihuahuan Mesquite Upland Scrub (CES302.733) and Tamaulipan Mesquite Upland Scrub (CES301.984) needs to be defined.
Similar Ecological Systems:
- Apacherian-Chihuahuan Semi-Desert Grassland and Steppe (CES302.735)
- Chihuahuan Mixed Desert and Thornscrub (CES302.734)
- Chihuahuan Stabilized Coppice Dune and Sand Flat Scrub (CES302.737)
- Tamaulipan Mesquite Upland Scrub (CES301.984)

Related Concepts:
- Grama -Muhly - Threeawn (713) (Shiflet 1994) Intersecting
- Mesquite (729) (Shiflet 1994) Broader
- Mesquite (western type): 242 (Eyre 1980) Broader

DESCRIPTION

Environment: This desert scrub occurs on substrates that are typically derived from alluvium, often gravelly without a well-developed argillic or calcic soil horizon that would limit infiltration and storage of winter precipitation in deeper soil layers. *Prosopis* spp. and other deep-rooted shrubs exploit this deep-soil moisture that is unavailable to grasses and cacti (Burgess 1995).
Vegetation: Vegetation is typically dominated by *Prosopis glandulosa* or *Prosopis velutina* and succulents. Other desert scrub species that may codominate include *Acacia neovernicosa, Acacia constricta, Juniperus monosperma,* or *Juniperus coahuilensis*. Grass cover is variable and ranges from sparse to moderately dense. Common species may include *Aristida purpurea, Bothriochloa barbinodis, Bouteloua curtipendula, Dasyochloa pulchella (= Erioneuron pulchellum), Muhlenbergia porteri, Muhlenbergia setifolia, Pleuraphis mutica,* and *Setaria leucopila*. The deeper soils help support good grass cover beneath the shrub canopy. Areas of higher annual rainfall and deeper soils allow for a more diverse plant community.
Dynamics: During the last century, the area occupied by this system has increased through conversion of desert grasslands as a result of drought, overgrazing and *Prosopis glandulosa* seed dispersion by livestock, and/or decreases in fire frequency (Buffington and Herbel 1965, Brown and Archer 1987). It is believed that this system formerly occurred in relatively minor amounts and was largely confined to drainages until cattle distributed seed upland from the bosques into desert grasslands (Brown and Archer 1987, 1989).

Shrublands dominated by *Prosopis* spp. have replaced large areas of desert grasslands, especially those formerly dominated by *Bouteloua eriopoda*, in Trans Pecos Texas, southern New Mexico and southeastern Arizona (York and Dick-Peddie 1969, Hennessy et al. 1983). Studies on the Jornada Experimental Range suggest that combinations of drought, overgrazing by livestock, wind and water erosion, seed dispersal by livestock, fire suppression, shifting dunes, and changes in the seasonal distribution of precipitation have caused this recent, dramatic shift in vegetation physiognomy (Buffington and Herbel 1965, Herbel et al. 1972, Humphrey 1974, McLaughlin and Bowers 1982, Gibbens et al. 1983, Hennessy et al. 1983, Schlesinger et al. 1990, McPherson 1995).

Historical natural-ignition fires were relatively small, probably 10-15 acres in size. Repeated fire is thought to help maintain a general mosaic pattern between open grassland and shrub-dominated areas (Johnston 1963). Wright et al. (1976) found that *Prosopis glandulosa* is very fire-tolerant when only 3 years old. Most plants resprout after being top-killed by fire. Thus, prior to livestock grazing reducing fire frequency, repeated grassland fires probably maintained lower stature of shrubs and prevented new establishment by killing seedlings.

Drought is a relatively common occurrence in this desert scrub, generally occurring every 10-15 years and lasting 2-3 years with occasional long-term drought periods (10-15 years duration). *Prosopis* spp. and other shrubs have extensive root systems that allow them to exploit deep-soil water that is unavailable to shallower rooted grasses and cacti (Burgess 1995). This strategy works well, especially during drought. However, on sites that have well-developed argillic or calcic soil horizons that limit infiltration and storage of winter moisture in the deeper soil layers, *Prosopis* spp. invasion can be limited to a few, small individuals (McAuliffe 1995). This has implications in plant geography and desert grassland restoration work in the southwestern United States.

Component Associations:
- *Fouquieria splendens* Shrubland (CEGL004452, GNR)
- *Prosopis glandulosa / Bouteloua gracilis* Shrubland (CEGL001383, G5)
- *Prosopis glandulosa / Muhlenbergia porteri* Shrubland (CEGL001511, G5)
- *Prosopis glandulosa / Sporobolus airoides* Shrubland (CEGL001385, G5)
- *Prosopis glandulosa var. torreyana* Shrubland (CEGL001381, G3)
- *Prosopis velutina - Acacia greggii* Shrubland (CEGL001388, GUQ)
- *Prosopis velutina / Celtis laevigata var. reticulata* Shrubland (CEGL001390, GNR)
- *Prosopis velutina / Muhlenbergia porteri* Shrubland (CEGL001391, G3Q)

DISTRIBUTION

Range: This system is found on foothills and piedmont in the Chihuahuan Desert, extending into the Sky Island region and into the lower Mogollon Rim to the west.
Divisions: 302:C
Nations: MX, US
Subnations: AZ, MXCH(MX), MXSO(MX), NM, TX
Map Zones: 13:P, 14:C, 15:C, 24:C, 25:C, 26:C, 27:C, 35:?, 36:?
USFS Ecomap Regions: 313C:CC, 315A:CC, 315B:CC, 315H:CC, 321A:CC, 322A:CC, 322B:CC, 322C:CP, M313A:CC, M313B:CC
TNC Ecoregions: 22:C, 24:C, 29:?, 30:P

SOURCES

References: Brown and Archer 1987, Brown and Archer 1989, Buffington and Herbel 1965, Burgess 1995, Comer et al. 2003, Gibbens et al. 1983, Gibbens et al. 2005, Hennessy et al. 1983, Herbel et al. 1972, Humphrey 1974, Johnston 1963, MacMahon 1988, McAuliffe 1995, McLaughlin and Bowers 1982, McPherson 1995, Muldavin et al. 2002, Schlesinger et al. 1990, Shiflet 1994, Wright et al. 1976, York and Dick-Peddie 1969
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722939#references
Description Author: K.A. Schulz
Version: 25 Jan 2007 **Stakeholders:** Latin America, Southeast, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

BAJA SEMI-DESERT COASTAL SUCCULENT SCRUB (CES206.934)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland [Lowland]; Mediterranean [Mediterranean Desertic-Oceanic]; Xeric
Non-Diagnostic Classifiers: Headland; Shrubland (Shrub-dominated); Sideslope; Salt Spray; Bluff; Coast
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Mixed evergreen-deciduous shrubland
National Mapping Codes: EVT 2073; ESLF 5250; ESP 1073

CONCEPT

Summary: This ecological system includes succulent-rich shrublands along maritime coastal bluffs and terraces that are restricted to isolated locations from Baja Norte, Mexico, north to Orange County and Catalina Island, California. This system is very localized and patchy from San Diego County south into Baja California and on the Channel Islands. These areas are frost-free and receive the least annual precipitation of the California coastal shrublands, a significant proportion of which falls in summer from rare summer thunderstorms or is augmented by summer fog drip. Characteristic plant species include *Lycium californicum, Rhus integrifolia, Opuntia californica var. parkeri (= Opuntia parryi), Opuntia prolifera, Opuntia littoralis, Yucca schidigera, Ferocactus viridescens, Agave shawii, Euphorbia misera, Bergerocactus emoryi*, and *Simmondsia chinensis*.

Component Associations:
- *Opuntia littoralis* Shrubland (CEGL003066, G3G4)

DISTRIBUTION

Range: This system occurs from Baja Norte, Mexico, north to Orange County and Catalina Island, California. This system is very localized and patchy from San Diego County south into Baja California and on the Channel Islands.
Divisions: 206:C
Nations: MX, US
Subnations: CA, MXBC(MX)
Map Zones: 4:C
TNC Ecoregions: NT1301:P, 16:C

SOURCES

References: Barbour and Major 1988, Comer et al. 2003, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722747#references
Description Author: P. Comer, T. Keeler-Wolf
Version: 07 Oct 2005
Stakeholders: Latin America, West
Concept Author: P. Comer, T. Keeler-Wolf
ClassifResp: West

BOREAL DRY SCRUB BIRCH SHRUBLAND (CES105.322)

CLASSIFIERS

Classification Status: Standard

Primary Division: Montane Boreal (105)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Boreal
National Mapping Codes: ESLF 5287

CONCEPT

Summary: This ecological system encompasses open, dry, lichen-covered scrublands dominated by *Betula glandulosa* with an occasional stunted *Picea glauca*.
Classification Comments: This ecological system was developed for the purpose of capturing the coarse filter of terrestrial biodiversity in the interior of British Columbia Ecoregional Assessment, conducted by The Nature Conservancy of Canada, with NatureServe's assistance. This system was designed to be equivalent to those developed for neighboring ecoregions: Canadian Rocky Mountains (7), Okanagan (68), Alaska Coastal Forest and Mountains (69), and the North Cascades (3).
Related Concepts:

- Sw - Scrub birch - Cladina (SWBmk/02) (DeLong 2000) Intersecting
- Sw - Scrub birch - Cladina (SWBmk/02) (Banner et al. 1993) Intersecting

DISTRIBUTION

Range: This ecological system is found in northern boreal British Columbia and fingers down into the interior regions of British Columbia.
Divisions: 105:C; 207:C
Nations: CA
Subnations: BC
TNC Ecoregions: 139:C, 144:C

SOURCES

References: Banner et al. 1993, DeLong 2000, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.820926#references
Description Author: G. Kittel
Version: 25 Jan 2009
Concept Author: G. Kittel
Stakeholders: Canada, West
ClassifResp: West

BOREAL DRY SHRUB-STEPPE (CES105.325)

CLASSIFIERS

Classification Status: Standard

Primary Division: Montane Boreal (105)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Boreal
National Mapping Codes: ESLF 5471

CONCEPT

Summary: This ecological system encompasses open dry to mesic shrublands, typically found on well-drained soils and south-facing (warm) slopes or river bluffs. Shrub cover ranges up to about 30%, dominated by *Juniperus communis, Juniperus horizontalis, Arctostaphylos uva-ursi, Shepherdia canadensis, Dasiphora fruticosa ssp. floribunda (= Pentaphylloides floribunda), Vaccinium vitis-idaea*, or *Rosa acicularis*. More mesic dips or swales might have *Symphoricarpos occidentalis, Amelanchier alnifolia, Prunus* spp., or *Elaeagnus commutata*. The herbaceous component will typically include both graminoids and forbs, including *Leymus innovatus, Koeleria macrantha, Festuca altaica (= Festuca scabrella)*, and dry sedges such as *Carex concinnoides* (in British Columbia). Forbs include *Hedysarum boreale, Zigadenus elegans*, and *Solidago multiradiata*. Trees such as *Picea glauca* or *Pinus contorta* may be present with <5% cover. Sites are on warm aspects of coarse colluvial soils.
Classification Comments: This system should possibly be combined with Western Canadian Boreal Dry Grassland and Bluff (CES103.864), and the concept include dry grasslands, bluffs and dry shrubby grasslands throughout western Canada. This ecological system was developed for the purpose of capturing the coarse filter of terrestrial biodiversity in the interior of British Columbia Ecoregional Assessment, conducted by The Nature Conservancy of Canada, with NatureServe's assistance. This system was designed to be equivalent to those developed for neighboring ecoregions: Canadian Rocky Mountains (7), Okanagan (68), Alaska Coastal Forest and Mountains (69), and the North Cascades (3).
Related Concepts:
- Sw - Juniper - Wildrye (SWBmk/03) (DeLong 2000) Intersecting
- Sw - Juniper - Wildrye (SWBmk/03) (Banner et al. 1993) Intersecting

DISTRIBUTION

Range: This ecological system is found in northern boreal British Columbia and fingers down into the interior regions of British Columbia.
Divisions: 105:C; 207:C
Nations: CA
Subnations: BC
TNC Ecoregions: 140:C, 144:C

SOURCES

References: Banner et al. 1993, DeLong 2000, Stone et al. 2007, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.820929#references
Description Author: G. Kittel
Version: 30 Mar 2010 **Stakeholders:** Canada, West
Concept Author: G. Kittel **ClassifResp:** West

BOREAL WET SCRUB BIRCH SHRUBLAND (CES105.326)

CLASSIFIERS

Classification Status: Standard

Primary Division: Montane Boreal (105)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Boreal
National Mapping Codes: ESLF 9398

CONCEPT

Summary: This ecological system consists of hydric and subhydric fluvial benches dominated by about 55% willow and birch shrubs. Tree cover may be as high as 15%, mostly *Picea glauca*. The herb layer has about 20% cover with *Mertensia paniculata, Equisetum arvense*, and *Chamerion angustifolium (= Epilobium angustifolium).*
Classification Comments: This ecological system was developed for the purpose of capturing the coarse filter of terrestrial biodiversity in the interior of British Columbia Ecoregional Assessment, conducted by The Nature Conservancy of Canada, with NatureServe's assistance. This system was designed to be equivalent to those developed for neighboring ecoregions: Canadian Rocky Mountains (7), Okanagan (68), Alaska Coastal Forest and Mountains (69), and the North Cascades (3).
Related Concepts:

- Sw - Scrub birch - Bluejoint (SWBmk/07) (DeLong 2000) Intersecting
- Sw - Scrub birch - Bluejoint (SWBmk/07) (Banner et al. 1993) Intersecting
- Sw - Shrubby cinquefoil - Horsetail (SWBmk/08) (DeLong 2000) Intersecting
- Sw - Shrubby cinquefoil - Horsetail (SWBmk/08) (Banner et al. 1993) Intersecting

DISTRIBUTION

Range: This ecological system is found in northern boreal British Columbia and fingers down into the interior regions of British Columbia.
Divisions: 105:C; 207:C
Nations: CA
Subnations: BC
TNC Ecoregions: 144:C

SOURCES

References: Banner et al. 1993, DeLong 2000, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.820932#references
Description Author: G. Kittel
Version: 25 Jan 2009
Concept Author: G. Kittel
Stakeholders: Canada, West
ClassifResp: West

CALIFORNIA MARITIME CHAPARRAL (CES206.929)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Shrubland (Shrub-dominated); Mediterranean [Mediterranean Xeric-Oceanic]; Udic; Evergreen Sclerophyllous Shrub
Non-Diagnostic Classifiers: Lowland [Lowland]; Herbaceous; Sideslope; Sand Soil Texture
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Evergreen shrubland
National Mapping Codes: EVT 2096; ESLF 5302; ESP 1096

CONCEPT

Summary: This ecological system includes chaparral in patches restricted by edaphic conditions (sands, sandstones, other marine sediments, and stabilized sand dunes) within the fog belt throughout the central and northern California coast. This system is characterized by a combination of locally endemic species of *Arctostaphylos* and *Ceanothus*, species that primarily reproduce by seed rather than resprouting. Shrubs vary in height (up to 3 m tall) and occur in variable densities. More open patches support herbaceous vegetation, while occurrences of high shrub density have no understory. Characteristic species include *Arctostaphylos tomentosa, Arctostaphylos nummularia (= Arctostaphylos sensitiva), Arctostaphylos tomentosa ssp. crustacea (= Arctostaphylos crustacea), Arctostaphylos hookeri, Arctostaphylos pajaroensis, Arctostaphylos montaraensis* (and others), *Ceanothus masonii, Ceanothus griseus,* and *Ceanothus verrucosus*. In occurrences in southern Oregon, *Arctostaphylos hispidula* is the predominant chaparral shrub. Southernmost stands (San Diego County) can include *Cneoridium* spp. and *Comarostaphylis diversifolia*. Other common widespread woody taxa can include *Adenostoma fasciculatum, Eriogonum fasciculatum, Salvia mellifera, Frangula californica (= Rhamnus californica), Rhamnus crocea,* and *Quercus agrifolia*. Controlled burns have resulted in poor survivorship of the *Arctostaphylos* spp., and current theories are that they need long fire-free intervals to develop a viable seedbank that can reproduce following fire. This system often co-occurs with California Coastal Closed-Cone Conifer Forest and Woodland (CES206.922).
Related Concepts:
- Ceanothus Mixed Chaparral (208) (Shiflet 1994) Intersecting
- Chamise Chaparral (206) (Shiflet 1994) Intersecting

DESCRIPTION

Environment: This system is restricted by edaphic conditions (sands, sandstones, other marine sediments, and stabilized sand dunes) within the summer coastal fog belt throughout the central and northern California coast, usually below 300 m (1000 feet) in elevation (Keeley and Davis 2007, Sawyer et al. 2009). The climate is distinctly Mediterranean, with warm, dry summers and cool, moist winters. Rainfall is rather variable due to the large latitudinal range. Sandy soils with low nutrient levels tend to be the norm, usually within just a few kilometers of the ocean.
Dynamics: These shrublands are characterized by species that primarily reproduce by seed rather than resprouting, and are fire-dependent. Infrequent fire results in encroachment of trees and a decline in shrub vigor and seedbank quality. Frequent fire tends to convert the stands to coastal scrub or grassland. Recent studies of many sites that have been fire-free for decades suggest that at least some of the species of *Ceanothus* may be able to germinate without fire and thus sustain populations for long fire-free intervals. Controlled burns have resulted in poor survivorship of the *Arctostaphylos* spp., and current theories are that they need long fire-free intervals to develop a viable seedbank that can reproduce following fire (Keeley and Davis 2007). Most of the dominant shrubs are nitrogen fixers.

Landfire (2007a) model: Chaparral burns in high-intensity, stand-replacing crown fires that burn large acreages in a single event. However, there is a considerable range in the flammability of shrub species (e.g., chamise is "flashier" than manzanita). Large, stand-replacement events can interact with seed availability and, hence, influence post-fire successional pathways differently than for smaller, less severe fires. Mean fire-return intervals are variable and longer than intervals of other chaparral types. Fire intervals can exceed 100 years, and the specimens can grow to large size. Season of burning plays a large part in species composition. Occasionally, frost affects mortality and increases fuel buildup.

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- California Coastal Closed-Cone Conifer Forest and Woodland (CES206.922)

Adjacent Ecological System Comments: This system often co-occurs with California Coastal Closed-Cone Conifer Forest and Woodland (CES206.922).

DISTRIBUTION

Range: This systems occurs within the fog belt from southern California to the Mendocino coast of northern California. It extends north into coastal Oregon in very small patches.
Divisions: 206:C

Nations: US
Subnations: CA, OR
Map Zones: 2:C, 3:C, 4:C, 13:?
USFS Ecomap Regions: 261B:CC, 263A:CC, M242A:PP, M261A:PP, M261B:PP
TNC Ecoregions: 14:C, 15:C

SOURCES

References: Barbour and Billings 2000, Barbour and Major 1988, Barbour et al. 2007, Comer et al. 2003, Davis and Borchert 2006, Greelee and Langenheim 1990, Griffin 1978, Holland and Keil 1995, Keeley 2002, Keeley 2006, Keeley and Davis 2007, Keeley and Fotheringham 2001a, Keeley and Fotheringham 2001b, Landfire 2007a, PRBO Conservation Science 2011, Sawyer et al. 2009, Shiflet 1994, Van Dyke et al. 2001, Wells 1962

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722752#references

Description Author: P. Comer and T. Keeler-Wolf, mod. M.S. Reid
Version: 14 Jan 2014 **Stakeholders:** West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

CALIFORNIA MESIC CHAPARRAL (CES206.926)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland [Foothill]; Shrubland (Shrub-dominated); Mediterranean [Mediterranean Xeric-Oceanic]; Udic; Quercus berberidifolia
Non-Diagnostic Classifiers: Sideslope; Ustic; Intermediate Disturbance Interval; F-Landscape/High Intensity
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Evergreen shrubland
National Mapping Codes: EVT 2097; ESLF 5303; ESP 1097

CONCEPT

Summary: This ecological system occurs in mesic site conditions, such as north-facing slopes, concavities, or toeslopes, with well-drained soils throughout Mediterranean California away from the coastal fog belt. It occurs most commonly on north-facing slopes up to 1500 m (4550 feet) in elevation and up to 1830 m (6000 feet) in southern California. This system tends to be dominated by a variety of mixed or single-species, evergreen, sclerophyllous shrubs that resprout from lignotubers following fire. Common species include *Quercus berberidifolia, Quercus wislizeni var. frutescens, Cercocarpus montanus var. glaber (= Cercocarpus betuloides), Fraxinus dipetala, Garrya flavescens, Garrya elliptica, Heteromeles arbutifolia, Lonicera* spp., *Prunus ilicifolia, Rhamnus crocea, Rhamnus ilicifolia, Toxicodendron diversilobum, Ribes* spp., and *Sambucus* spp. Weakly re-sprouting or obligate seeders that also commonly occur in this system include arborescent *Ceanothus* spp., such as *Ceanothus spinosus, Ceanothus oliganthus, Ceanothus tomentosus*, and *Ceanothus leucodermis*. *Umbellularia californica* and *Aesculus californica* can also occur as shrubs and, lacking disturbance, can grow to tree size, as do some of the other chaparral shrubs (some old-growth stands can reach 10.6 m [35 feet] in height!). Most chaparral species are fire-adapted, resprouting vigorously after burning or producing fire-resistant seeds. This is not a system that requires frequent fire for perpetuation.
Related Concepts:
- Montane Shrubland (209) (Shiflet 1994) Broader. Some portions of SRM type 209 are ncluded in the Mesic Chaparral system.
- Scrub Oak Mixed Chaparral (207) (Shiflet 1994) Equivalent. These are basically equivalent.

DESCRIPTION

Dynamics: TNC fire model information: Chaparral burns in high-intensity stand-replacing crown fires that burn thousands of acres in a single event. However, there is a considerable range in the flammability of shrub species (e.g., chamise is "flashier" than manzanita). Large, stand-replacement events can interact with seed availability and, hence, influence post-fire successional pathways differently than for smaller, less severe fires. Mean fire-return intervals are highly variable across the state depending on species composition and other factors. Sediment cores taken from the Santa Barbara Channel in central California dating from the 16th and 17th centuries indicate that large fires burned the Santa Ynez and Santa Lucia mountains every 40-60 years. Season of burning plays a large part in species composition. Occasionally, frost affects mortality and increases fuel buildup. In the last century, the high frequency of human ignitions has reduced the mean fire-return interval to 30-35 years in southern California.

Component Associations:
- *Cercocarpus montanus var. glaber* Sierran Chaparral Shrubland (CEGL008638, G4?)
- *Prunus ilicifolia / Sanicula crassicaulis* Shrubland (CEGL003342, G2)

DISTRIBUTION

Range: This system occurs throughout Mediterranean California away from the coastal fog belt. It may occur as very small patches in southwestern Oregon, but it isn't clearly documented from there.
Divisions: 206:C
Nations: US
Subnations: CA
Map Zones: 3:C, 4:C, 5:C, 6:C
USFS Ecomap Regions: 261B:CC, 262A:??, 263A:CC, M261A:C?, M261B:CC, M261C:CC, M261D:CC, M261E:CC, M261F:CC
TNC Ecoregions: 5:C, 12:C, 13:C, 14:C, 15:C, 16:C

SOURCES

References: Barbour and Billings 2000, Barbour and Major 1988, Comer et al. 2003, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722755#references
Description Author: P. Comer, T. Keeler-Wolf, mod. G. Kittel
Version: 12 Jan 2012
Stakeholders: West
Concept Author: P. Comer, T. Keeler-Wolf
ClassifResp: West

CALIFORNIA MONTANE WOODLAND AND CHAPARRAL (CES206.925)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Short (50-100 yrs) Persistence; Shrubland (Shrub-dominated); Mediterranean [Mediterranean Xeric-Oceanic]; Shallow Soil
Non-Diagnostic Classifiers: Montane [Montane]; Sideslope; Xeric; F-Patch/Medium Intensity
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Evergreen shrubland
National Mapping Codes: EVT 2098; ESLF 5304; ESP 1098

CONCEPT

Summary: This ecological system includes chaparral or open shrubby woodlands found among montane forests above 1500 m (4550 feet) elevation from the southern Cascades of Oregon to the Peninsular Ranges of California into Baja California, Mexico, where much annual precipitation occurs as snow. These are often locations with steep, exposed slopes with rocky and/or shallow soils, often glaciated. Stands are not found in the foothills but rather occur commonly above 1524 m (5000 feet) in elevation. These are mosaics of woodlands with chaparral understories, shrub-dominated chaparral, or short-lived chaparral with conifer species invading, if good seed source is available. Shrubs will often have higher densities than the trees, which are more limited due to the rocky/thin soils. These can also be short-duration chaparrals in previously forested areas that have experienced crown fires. Trees tend to have a scattered open canopy or can be clustered, over a usually continuous dense shrub layer. Trees can include *Pinus jeffreyi, Abies concolor, Abies magnifica, Pinus monticola, Pinus lambertiana, Pinus coulteri, Pinus attenuata, Cupressus forbesii, Cupressus arizonica ssp. stephensonii*, and *Cupressus arizonica ssp. nevadensis (= Cupressus nevadensis)*. Typical sclerophyllous chaparral shrubs include *Arctostaphylos nevadensis, Arctostaphylos patula, Arctostaphylos glandulosa, Ceanothus cordulatus, Ceanothus diversifolius, Ceanothus pinetorum, Ceanothus velutinus*, and *Chrysolepis sempervirens (= Castanopsis sempervirens)*. Some stands can be dominated by winter deciduous shrubs, such as *Prunus emarginata, Prunus subcordata* and *Ceanothus sanguineus* (in Oregon), *Prunus virginiana, Ceanothus integerrimus, Holodiscus discolor (= Holodiscus microphyllus)*, and *Quercus garryana var. breweri*. Most chaparral species are fire-adapted, resprouting vigorously after burning or producing fire-resistant seeds. Occurrences of this system likely shift across montane forested landscapes with catastrophic fire events.
Classification Comments: Two phases are recognized: first, early-seral and post-fire shrub fields with conifers, and second, edaphically controlled sites, with soils that are too dry or shallow-soiled for trees, hence sites where shrubs stay dominant (such as *Quercus vacciniifolia, Arctostaphylos patula, Chrysolepis sempervirens*). This treatment combines "interior closed-cone conifer" woodlands (obligate fire-reproducing species) with montane chaparral and may need to be revisited.
Related Concepts:
- Bittercherry (419) (Shiflet 1994) Intersecting. Sierran chaparral on east-side includes *Prunus emarginata* shrublands.
- Montane Shrubland (209) (Shiflet 1994) Broader. This ecological system includes early-seral and post-fire shrub fields with conifers, and secondly edaphically-controlled sites, with soils that are too dry or shallow-soiled for trees, hence sites where shrubs stay dominant. Nearly equivalent to 209.
- Sierra Nevada Mixed Conifer: 243 (Eyre 1980) Intersecting

Component Associations:
- *Arctostaphylos patula* Sierran Chaparral Shrubland (CEGL005820, G5?)
- *Arctostaphylos viscida* Sierran Chaparral Shrubland (CEGL005817, G5?)
- *Ceanothus cordulatus* / Sparse Understory Sierran Shrubland (CEGL005821, G4?)
- *Ceanothus cordulatus* Shrubland (CEGL003023, G3?)
- *Chrysolepis sempervirens* / Sparse Understory Sierran Shrubland (CEGL008695, G3)
- *Chrysolepis sempervirens* Shrubland (CEGL003039, G4?)
- *Holodiscus discolor - Sambucus racemosa* Shrubland (CEGL003130, GNR)
- *Holodiscus discolor / Sedum obtusatum ssp. boreale - Cryptogramma acrostichoides* Shrubland (CEGL003129, GNR)
- *Prunus emarginata* Sierran Chaparral Shrubland (CEGL005822, G3?)

DISTRIBUTION

Range: This system occurs above 1500 m (4550 feet) elevation from the southern Cascades of Oregon to the Klamath Mountains and Peninsular Ranges of California into Baja California, Mexico.
Divisions: 206:C
Nations: MX, US
Subnations: CA, MXBC(MX), OR
Map Zones: 2:C, 3:C, 4:C, 6:C, 7:C, 12:P, 13:?
USFS Ecomap Regions: 261B:CC, 263A:CC, 322A:??, 341D:CC, 342B:CC, M242B:??, M261A:CC, M261B:CC, M261C:CC, M261D:CC, M261E:CC, M261F:CC, M261G:CC

TNC Ecoregions: 5:C, 12:C, 14:C, 15:C, 16:C

SOURCES

References: Barbour and Billings 2000, Barbour and Major 1988, Comer et al. 2003, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722756#references

Description Author: P. Comer, T. Keeler-Wolf, mod. G. Kittel

Version: 12 Jan 2012 **Stakeholders:** Latin America, West

Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

CALIFORNIA XERIC SERPENTINE CHAPARRAL (CES206.927)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Mediterranean [Mediterranean Xeric-Oceanic]; Ultramafic with low Ca:Mg ratio; Very Shallow Soil; Xeric; Broad-Leaved Evergreen Shrub; Cupressus macnabiana
Non-Diagnostic Classifiers: Montane [Lower Montane]; Lowland [Foothill]; Shrubland (Shrub-dominated); Serpentine; Consolidated
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Evergreen shrubland
National Mapping Codes: EVT 2099; ESLF 5305; ESP 1099

CONCEPT

Summary: This ecological system occurs throughout Mediterranean California (excluding far southern California) on thin, rocky, ultramafic (gabbro, peridotite, serpentinite) soils and in areas below winter snow accumulations that typically experience hot and dry summers. Not all ultramafic outcrops support distinct vegetation; only those with very low Ca:Mg ratios impact biotic composition. This system is highly variable and spotty in distribution. Characteristic plant species include *Cupressus macnabiana, Quercus durata, Arctostaphylos viscida, Arctostaphylos pungens*, and *Arctostaphylos glauca*. Common associates include *Adenostoma fasciculatum, Ceanothus cuneatus, Fremontodendron californicum, Quercus sadleriana, Quercus vacciniifolia, Garrya* spp., *Umbellularia californica, Ceanothus pumilus, Frangula californica (= Rhamnus californica)*, and *Arctostaphylos nevadensis*. California endemics such as *Ceanothus jepsonii* also occur. *Pinus sabiniana* can occur at varying cover from trace to more abundant. Many locally endemic and often rare forbs can occur, such as *Streptanthus* spp., *Hesperolinon* spp., *Eriogonum* spp., *Madia* spp., *Mimulus* spp., *Allium* spp., and *Asclepias solanoana*. This chaparral type tends to have fewer trees than mesic chaparral.
Classification Comments: Xeric serpentine chaparral shrublands occurring in the Klamath-Siskiyou region of northwestern California are placed into the similar Klamath-Siskiyou Xeromorphic Serpentine Savanna and Chaparral (CES206.150). However, the distribution of these two systems, as currently described, overlaps somewhat. Further review and clarification of their differences and differing distributions are desirable.
Related Concepts:
- Chamise Chaparral (206) (Shiflet 1994) Intersecting. Includes sepentine chaparral

DESCRIPTION

Environment: This system occurs on thin, rocky, ultramafic (gabbro, peridotite, serpentinite) soils and in areas below winter snow accumulations that typically experience hot and dry summers. Not all ultramafic outcrops support distinct vegetation; only those with very low Ca:Mg ratios impact biotic composition. Soils on ultramafics are usually shallow and skeletal, with little profile development. Ultramafic soils impose the following stresses on plants: imbalance of calcium and magnesium, magnesium toxicity, low availability of molybdenum, toxic levels of heavy metals, sometime high alkalinity, low concentrations of some essential nutrients, and low soil water storage capacity (Sanchez-Mata 2007). In some cases, the steepness of the slopes and general sparseness of the vegetation result in continual erosion.
Dynamics: Landfire (2007a) model: Due to the poor soil nutrient levels, biomass accumulation tends to be significantly lower in these serpentine systems than in neighboring patches of sandstone chaparral. As a result, fire frequency and fire severity are reduced. A study at the McLaughlin Reserve (Safford and Harrison 2008) found that time since last fire was nearly four times longer than on non-serpentine sites, and severity was also significantly reduced. The effects of fire on diversity in these systems are less pronounced than in non-serpentine systems, though they may be longer lasting (Safford and Harrison 2004); these authors found that few species on serpentine depended on fire for germination.

DISTRIBUTION

Range: This system occurs throughout Mediterranean California (excluding far southern California) into Oregon, on thin, rocky, ultramafic soils.
Divisions: 206:C
Nations: US
Subnations: CA, OR
Map Zones: 2:C, 3:C, 4:C, 5:C, 6:C, 7:?
USFS Ecomap Regions: 261B:PP, 262A:PP, 263A:PP, M261A:CC, M261B:CC, M261C:CC, M261D:CC, M261E:CC, M261F:C?
TNC Ecoregions: 5:P, 13:P, 14:C, 15:P

SOURCES

References: Barbour and Major 1988, Brooks and Minnich 2006, Comer et al. 2003, Harrison et al. 2003, Holland and Keil 1995, Kruckberg 1984, Landfire 2007a, PRBO Conservation Science 2011, Safford and Harrison 2004, Safford and Harrison 2008, Sanchez-Mata 2007, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Shiflet 1994

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722754#references
Description Author: P. Comer and T. Keeler-Wolf, mod. M.S. Reid
Version: 14 Jan 2014 **Stakeholders:** West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

CHIHUAHUAN CREOSOTEBUSH DESERT SCRUB (CES302.731)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: North American Warm Desert (302)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Shrubland (Shrub-dominated); Tropical/Subtropical [Tropical Xeric]; Temperate [Temperate Xeric]; Xeromorphic Shrub
Non-Diagnostic Classifiers: Lowland [Lowland]; Toeslope/Valley Bottom; Alkaline Soil; Aridic
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Mixed evergreen-deciduous shrubland
National Mapping Codes: EVT 2074; ESLF 5251; ESP 1074

CONCEPT

Summary: This ecological system is the common lower elevation desert scrub that occurs throughout much of the Chihuahuan Desert and has recently expanded into former desert grasslands in the northern portion of its range. Stands typically occur in flat to gently sloping desert basins and on alluvial plains, extending up into lower to mid positions of piedmont slopes (bajada). Substrates range from coarse-textured loams on gravelly plains to finer-textured silty and clayey soils in basins. Soils are alluvial, typically loamy and non-saline, and frequently calcareous as they are often derived from limestone, and to a lesser degree igneous rocks. The vegetation is characterized by a moderate to sparse shrub layer (<10% cover on extremely xeric sites) that is typically strongly dominated by *Larrea tridentata* with *Flourensia cernua* often present to codominant. A few scattered shrubs or succulents may also be present, such as *Agave lechuguilla, Parthenium incanum, Jatropha dioica, Koeberlinia spinosa, Lycium* spp., and *Yucca* spp. Additionally, *Flourensia cernua* will often strongly dominate in silty basins that are included in this ecological system. In general, shrub diversity is low as this ecological system lacks codominant thornscrub and other mixed desert scrub species that are common on the gravelly mid to upper piedmont slopes. However, shrub diversity and cover may increase locally where soils are deeper and along minor drainages with occasional *Atriplex canescens, Gutierrezia sarothrae*, or *Prosopis glandulosa*. Herbaceous cover is usually low and composed of grasses. Common species may include *Bouteloua eriopoda, Dasyochloa pulchella (= Erioneuron pulchellum), Muhlenbergia porteri, Pleuraphis mutica, Scleropogon brevifolius*, and *Sporobolus airoides*. Included in this ecological system are *Larrea tridentata*-dominated shrublands with a sparse understory that occur on gravelly to silty, upper basin floors and alluvial plains. A pebbly desert pavement may be present on the soil surface.
Classification Comments: NRCS Ecological Site Description MLRA 42 SD-2 Loamy Ecological Site descriptions describe this system on the Jornada Experimental Range with State-and-Transition Model showing shifts in species composition with land use. Historic stands are thought to have been *Pleuraphis mutica*- and *Bouteloua eriopoda*-dominated desert grassland with few scrubs present. During Landfire mapzone 25 BpS modeling workshops, experts considered this type to be non-reference condition, shrub-invaded Chihuahuan Tobosa Flats and Loamy Plains Desert Grassland (BpS) at the Jornada.
Related Concepts:
- Chihuahuan Desert Scrub (*Larrea* Scrub Phase) (Henrickson and Johnston 1986) Equivalent
- MLRA 42 - Southern Desertic Basin (SD-1) Loamy (NRCS 2006a) Broader
- MLRA 42 - Southern Desertic Basin (SD-2) Gravelly Loam (NRCS 2006a) Broader
- MLRA 42 - Southern Desertic Basin (SD-2) Loamy (NRCS 2006a) Broader
- MLRA 42 - Southern Desertic Basin (SD-3) Loamy (NRCS 2006a) Broader
- MLRA 42 - Southern Desertic Basin (SD-4) Loamy (NRCS 2006a) Broader

DESCRIPTION

Environment: This ecological system is the common lower elevation desert scrub that occurs throughout much of the Chihuahuan Desert and has recently expanded into former desert grasslands in the northern portion of its range. Stands typically occur in flat to gently sloping, desert basins and on alluvial plains, extending up into the lower to mid positions of piedmont slopes (bajada). Substrates range from coarse-textured loams on gravelly plains to finer-textured silty and clayey soils in basins. Soils are alluvial, typically loamy and non-saline, and frequently calcareous as they are often derived from limestone, and to a lesser degree igneous rocks (Brown 1982, MacMahon and Wagner 1985, Henrickson and Johnston 1986, MacMahon 1988, Dick-Peddie 1993).
Vegetation: This alluvial plains desert scrub is characterized by a moderate to sparse shrub layer (<10% cover on extremely xeric sites) that is typically strongly dominated by *Larrea tridentata* with *Flourensia cernua* often present to codominant (Brown 1982, MacMahon and Wagner 1985, Henrickson and Johnston 1986, MacMahon 1988, Dick-Peddie 1993). A few scattered shrubs or succulents may also be present such as *Agave lechuguilla, Parthenium incanum, Jatropha dioica, Koeberlinia spinosa, Lycium* spp., and *Yucca torreyi*. Additionally, *Flourensia cernua* will often strongly dominate in silty basins that are included in this ecological system. In general, shrub diversity is low as this ecological system lacks codominant thornscrub and other mixed desert scrub species that are common on the gravelly mid to upper piedmont slopes. However, shrub diversity and cover may increase locally where soils are deeper and along minor drainages with occasional *Atriplex canescens, Gutierrezia sarothrae*, or *Prosopis glandulosa*. In the southern Chihuahuan Desert, stands are dominated by *Larrea tridentata* with *Agave parryi (= Agave scabra), Opuntia kleiniae, Opuntia imbricata*, and *Yucca filifera* (Huerta-Martinez et al. 2004). Herbaceous cover is usually low and composed of grasses.

Common species may include *Bouteloua eriopoda, Dasyochloa pulchella, Muhlenbergia porteri, Pleuraphis mutica, Scleropogon brevifolius*, and *Sporobolus airoides*. Included in this ecological system are *Larrea tridentata*-dominated shrublands with a sparse understory that occur on gravelly to silty, upper basin floors and alluvial plains. A pebbly desert pavement may be present on the soil surface.

Dynamics: In the U.S., much of this scrubland is thought to be a result of recent expansion of *Larrea tridentata* into former desert grasslands in the last 150 years as a result of drought, overgrazing by livestock, and/or decreases in fire over the last 70-250 years (Buffington and Herbel 1965, Ahlstrand 1979, Donart 1984, Dick-Peddie 1993, Gibbens et al. 2005). This system includes vast areas of loamy plains that have been converted from *Pleuraphis mutica* and *Bouteloua eriopoda* desert grasslands to *Larrea tridentata* scrub. This system also includes invasive *Flourensia cernua* shrublands that occur in former (degraded) tobosa (*Pleuraphis mutica*) flats and loamy plains. Presence of *Scleropogon brevifolius* is common in these invasive stands. Dick-Peddie (1993) suggested that absence of *Flourensia cernua* as codominant and presence of *Dasyochloa pulchella, Acourtia nana (= Perezia nana)*, and *Yucca elata* may be indicators of recent conversion of desert grasslands into desert scrub, but more research is needed. Conversely, shrublands with a sparse understory of *Larrea tridentata* on remnant early Holocene erosional surfaces often with desert pavement may indicate historic distributions of *Larrea tridentata* desert scrub in the Chihuahuan Desert (Muldavin et al. 2000b).

Component Associations:
- *Larrea tridentata - Parthenium incanum* Shrubland (CEGL001274, G5)
- *Larrea tridentata / Bouteloua eriopoda* Shrubland (CEGL001265, G4)
- *Larrea tridentata / Dasyochloa pulchella* Shrubland (CEGL001269, G5)
- *Larrea tridentata / Muhlenbergia porteri* Shrubland (CEGL001272, GNR)
- *Larrea tridentata* / Sparse Understory Shrubland (CEGL001276, GNR)
- *Larrea tridentata / Sporobolus airoides* Shrubland (CEGL001277, GNR)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Chihuahuan Mixed Desert and Thornscrub (CES302.734)
- North American Warm Desert Playa (CES302.751)

Adjacent Ecological System Comments: This ecological system occurs on loamy substrates typically below Chihuahuan Mixed Desert and Thornscrub (CES302.734) that is characteristic of gravelly mid to upper piedmont slopes.

DISTRIBUTION

Range: This extensive, lower elevation desert scrub ecological system occurs in the Chihuahuan Desert in broad desert basins and alluvial plains extending up into the lower bajada.
Divisions: 302:C
Nations: MX, US
Subnations: AZ, MXCH(MX), MXSO?(MX), NM, TX
Map Zones: 14:C, 15:P, 24:?, 25:C, 26:C
USFS Ecomap Regions: 313C:PP, 315A:CC, 321A:CC, 322B:CC, M313A:CC, M313B:CC
TNC Ecoregions: 22:C, 24:C

SOURCES

References: Ahlstrand 1979, Brown 1982a, Buffington and Herbel 1965, Comer et al. 2003, Dick-Peddie 1993, Donart 1984, Gibbens et al. 2005, Huerta-MartÃ-nez et al. 2004, MacMahon 1988, MacMahon and Wagner 1985, Muldavin et al. 2000b, Muldavin et al. 2002
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722941#references
Description Author: K.A. Schulz
Version: 29 Jan 2007 **Stakeholders:** Latin America, Southeast, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

CHIHUAHUAN MIXED DESERT AND THORNSCRUB (CES302.734)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: North American Warm Desert (302)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland [Foothill]; Lowland [Lowland]; Shrubland (Shrub-dominated)
Non-Diagnostic Classifiers: Toeslope/Valley Bottom; Tropical/Subtropical [Tropical Xeric]; Temperate [Temperate Xeric]; Aridic; Xeromorphic Shrub; Thorn Shrub
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Mixed evergreen-deciduous shrubland
National Mapping Codes: EVT 2100; ESLF 5306; ESP 1100

CONCEPT

Summary: This ecological system is the widespread desert scrub that occurs on gravelly mid to upper bajadas, foothills and dissected gravelly alluvial fans in the Chihuahuan Desert and has recently expanded into former desert grasslands in the northern portion of its range. It generally occurs on mid to upper piedmonts above the desert plains Chihuahuan Creosotebush Desert Scrub (CES302.731) and extends up to the chaparral zone. Soils are typically well-drained, non-saline, gravelly loams often with a petrocalic layer. Substrates are frequently derived from limestone although igneous rocks are common in some areas. Vegetation is characterized by the presence of *Larrea tridentata*, typically mixed with thornscrub or other desert scrub such as *Agave lechuguilla, Aloysia wrightii, Baccharis pteronioides, Dasylirion leiophyllum, Flourensia cernua* (not bottomland), *Fouquieria splendens, Koeberlinia spinosa, Krameria erecta, Leucophyllum minus, Mimosa aculeaticarpa var. biuncifera, Mortonia scabrella (= Mortonia sempervirens ssp. scabrella), Opuntia engelmannii, Parthenium incanum, Prosopis glandulosa*, and *Rhus microphylla* (in drainages). Stands of *Acacia constricta-, Acacia neovernicosa-* or *Acacia greggii*-dominated thornscrub are included in this system, and limestone substrates appear important for at least these species. If present, *Prosopis glandulosa* has relatively low cover and does not dominate the shrub layer. This system also includes upper piedmont stands of desert scrub that are strongly dominated by *Larrea tridentata*. Grasses are common but generally have lower cover than shrubs. Common species may include *Bouteloua curtipendula, Bouteloua eriopoda, Bouteloua gracilis, Bouteloua hirsuta, Bouteloua ramosa, Dasyochloa pulchella*, and *Muhlenbergia porteri*. Also included in this ecological system are shrublands with a sparse understory of *Larrea tridentata* that occur on gravelly piedmont slopes that may extend down gravelly upper basins. A pebbly desert pavement may be present on the soil surface. This may indicate remnant erosional surfaces from the early Holocene that are thought to be some of the historic distribution of *Larrea tridentata* desert scrub in the Chihuahuan Desert. Historically, much of this desert scrub was thought to be a steppe characterized by perennial desert grasses (typically *Bouteloua eriopoda)* with an open creosotebush - mixed desert shrub layer.

Similar Ecological Systems:
- Apacherian-Chihuahuan Mesquite Upland Scrub (CES302.733)
- Tamaulipan Mesquite Upland Scrub (CES301.984)

Related Concepts:
- Chihuahuan Desert Scrub (Mixed Desert Scrub Phase) (Henrickson and Johnston 1986) Equivalent
- Creosotebush - Tarbush (508) (Shiflet 1994) Finer
- Grama -Muhly - Threeawn (713) (Shiflet 1994) Intersecting
- MLRA 42 - Southern Desertic Basin (SD-2) Gravelly (NRCS 2006a) Broader
- MLRA 42 - Southern Desertic Basin (SD-2) Gravelly Loam (NRCS 2006a) Broader
- MLRA 42 - Southern Desertic Basin (SD-2) Gravelly Sand (NRCS 2006a) Broader
- MLRA 42 - Southern Desertic Basin (SD-2) Limy (NRCS 2006a) Broader

DESCRIPTION

Environment: This ecological system is the widespread desert scrub that occurs on gravelly mid to upper bajadas, foothills and dissected gravelly alluvial fans in the Chihuahuan Desert and has recently expanded into former desert grasslands in the northern portion of its range. It generally occurs on mid to upper piedmonts above the desert plains Chihuahuan Creosotebush Desert Scrub (CES302.731) and extends up to the chaparral zone. Soils are typically well-drained, non-saline, gravelly loams often with a petrocalic layer. Substrates are frequently derived from limestone, although igneous rocks are common in some areas (Brown 1982, MacMahon and Wagner 1985, Henrickson and Johnston 1986, MacMahon 1988, Dick-Peddie 1993).

Vegetation: This mid to upper piedmont ecological system is characterized by the presence of *Larrea tridentata* typically mixed with thornscrub or other desertscrub such as *Agave lechuguilla, Aloysia wrightii, Baccharis pteronioides, Dasylirion leiophyllum, Flourensia cernua* (not bottomland), *Fouquieria splendens, Koeberlinia spinosa, Krameria erecta, Leucophyllum minus, Mimosa aculeaticarpa var. biuncifera, Mortonia scabrella (= Mortonia sempervirens ssp. scabrella), Opuntia engelmannii, Parthenium incanum, Prosopis glandulosa*, and *Rhus microphylla* (in drainages). Stands of *Acacia constricta-, Acacia neovernicosa-* or *Acacia greggii*-dominated thornscrub are included in this system, and limestone substrates appear important for at least these species. If present, *Prosopis glandulosa* has lower cover than other shrubs and does not dominate the shrub layer. This system also includes upper piedmont stands of desert scrub that are strongly dominated by *Larrea tridentata*. Grasses are common but generally have lower

cover than shrubs. Common species may include *Bouteloua curtipendula, Bouteloua eriopoda, Bouteloua gracilis, Bouteloua hirsuta, Bouteloua ramosa, Dasyochloa pulchella,* and *Muhlenbergia porteri*. Also included in this ecological system are shrublands with a sparse understory of *Larrea tridentata* that occur on gravelly piedmont slopes that may extend down gravelly upper basins. A pebbly desert pavement may be present on the soil surface. This may indicate remnant erosional surfaces from the early Holocene that are thought to be some of the historic distribution of *Larrea tridentata* desert scrub in the Chihuahuan Desert (Muldavin et al. 2000b). Historically, much of this desert scrub was thought to be a steppe characterized by perennial desert grasses such as *Bouteloua eriopoda, Bouteloua ramosa, Muhlenbergia porteri, Bothriochloa barbinodis*, or *Digitaria californica* with an open creosotebush - mixed desert shrub layer.

Dynamics: In the U.S., much of this scrubland is thought to be a result of recent expansion of *Larrea tridentata* into former desert grasslands and steppe in the last 150 years as a result of drought, overgrazing by livestock, and/or decreases in fire over the last 70-250 years (Buffington and Herbel 1965, Ahlstrand 1979, Donart 1984, Dick-Peddie 1993, Gibbens et al. 2005). Dick-Peddie (1993) suggested that absence of *Flourensia cernua* as codominant and presence of *Dasyochloa pulchella, Acourtia nana,* and *Yucca elata* may be indicators of recent conversion of desert grasslands into desert scrub, but more research is needed. Conversely, sparse understory *Larrea tridentata* shrublands on remnant early Holocene erosional surfaces often with shallow calcareous soils and desert pavement may indicate historic distributions of *Larrea tridentata* desert scrub in the Chihuahuan Desert (Stein and Ludwig 1979, Muldavin et al. 2000b).

In the northern Chihuahuan Desert, this creosotebush mixed desert and thornscrub shrubland ecological system is thought to occur in presettlement conditions largely as mixed desert shrub-steppe on upper bajada gravelly soils and dissected gravelly alluvial fans (S. Yanoff pers. comm. 2006). This grama grass steppe with an open canopy of desert scrub species is a mostly historical grama grass steppe BpS that was described during Landfire MZ25 BpS modeling workshops as Chihuahuan Grama Grass Creosote Steppe. It is distinct from creosotebush mixed shrublands on similar sites because it has an open shrub layer characterized by dense perennial grasses (typically black grama).

Component Associations:
- *Acacia neovernicosa / Bouteloua hirsuta - Bouteloua gracilis - Bouteloua eriopoda* Shrub Herbaceous Vegetation (CEGL004244, GNR)
- *Acacia neovernicosa / Flourensia cernua* Shrubland (CEGL001341, G4)
- *Acacia neovernicosa / Muhlenbergia porteri* Shrubland (CEGL001342, GNRQ)
- *Flourensia cernua / Achnatherum eminens* Shrubland (CEGL001338, GNRQ)
- *Flourensia cernua / Bouteloua curtipendula* Shrubland (CEGL001336, GNRQ)
- *Fouquieria splendens / Bouteloua curtipendula* Shrubland (CEGL001376, GNR)
- *Fouquieria splendens / Bouteloua hirsuta* Shrubland (CEGL001377, G3?)
- *Fouquieria splendens / Parthenium incanum* Shrubland (CEGL001378, GNR)
- *Fouquieria splendens / Petrophyton caespitosum* Shrubland (CEGL001379, G3)
- *Larrea tridentata - Flourensia cernua* Shrubland (CEGL001270, G5?)
- *Larrea tridentata - Hechtia texensis* Shrubland (CEGL004565, G3?)
- *Larrea tridentata - Jatropha dioica var. graminea* Shrubland (CEGL004566, G3?)
- *Larrea tridentata - Parthenium incanum* Shrubland (CEGL001274, G5)
- *Larrea tridentata - Prosopis glandulosa* Shrubland (CEGL001275, GUQ)
- *Larrea tridentata / Bouteloua eriopoda* Shrubland (CEGL001265, G4)
- *Larrea tridentata / Bouteloua gracilis* Shrubland (CEGL001266, GNR)
- *Larrea tridentata / Bouteloua hirsuta - Bouteloua gracilis - Bouteloua eriopoda* Shrub Herbaceous Vegetation (CEGL004246, GNR)
- *Larrea tridentata / Bouteloua ramosa* Shrubland (CEGL004563, G3?)
- *Larrea tridentata / Dasyochloa pulchella* Shrubland (CEGL001269, G5)
- *Larrea tridentata* / Sparse Understory Shrubland (CEGL001276, GNR)
- *Lycium berlandieri - Larrea tridentata var. tridentata* Shrubland (CEGL001380, GUQ)
- *Mortonia scabrella / Dasylirion wheeleri* Shrubland (CEGL001279, G4)

Spatial Characteristics

Adjacent Ecological Systems:
- Chihuahuan Creosotebush Desert Scrub (CES302.731)

Adjacent Ecological System Comments: This system occurs on gravelly substrates typically above Chihuahuan Creosotebush Desert Scrub (CES302.731) that is characteristic of alluvial plains and broad desert basins.

Distribution

Range: This system occurs in the Chihuahuan Desert.
Divisions: 302:C
Nations: MX, US
Subnations: AZ, MXCH(MX), MXSO(MX), NM, TX
Map Zones: 14:C, 15:C, 24:P, 25:C, 26:C, 27:C
USFS Ecomap Regions: 313B:CP, 313C:CC, 315A:CC, 315B:CC, 315H:CC, 321A:CC, 322B:CC, M313A:CC, M313B:CC
TNC Ecoregions: 22:C, 24:C

SOURCES

References: Ahlstrand 1979, Brown 1982a, Buffington and Herbel 1965, Comer et al. 2003, Dick-Peddie 1993, Donart 1984, Gibbens et al. 2005, MacMahon 1988, MacMahon and Wagner 1985, Muldavin et al. 2000b, Muldavin et al. 2002, Stein and Ludwig 1979, Yanoff pers. comm.

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722938#references

Description Author: K.A. Schulz

Version: 29 Jan 2007 **Stakeholders:** Latin America, Southeast, West

Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

CHIHUAHUAN MIXED SALT DESERT SCRUB (CES302.017)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: North American Warm Desert (302)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland [Lowland]; Shrubland (Shrub-dominated); Tropical/Subtropical [Tropical Xeric]; Temperate [Temperate Xeric]; Atriplex spp.
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Evergreen shrubland
National Mapping Codes: EVT 2075; ESLF 5252; ESP 1075

CONCEPT

Summary: This ecological system includes extensive open-canopied shrublands of typically saline basins in the Chihuahuan Desert. Stands often occur on alluvial flats and around playas, as well as in floodplains along the Rio Grande and Pecos rivers, possibly also extending into the San Simon of Southeastern Arizona. Substrates are generally fine-textured, saline soils. Vegetation is typically composed of one or more *Atriplex* species such as *Atriplex canescens, Atriplex obovata,* or *Atriplex polycarpa* along with species of *Allenrolfea, Flourensia, Salicornia, Suaeda*, or other halophytic plants. Graminoid species may include *Sporobolus airoides, Pleuraphis mutica*, or *Distichlis spicata* at varying densities.

DESCRIPTION

Environment: This system includes extensive open-canopied shrublands of typically saline basins in the Chihuahuan Desert. Stands often occur on alluvial flats, around playas and floodplains of the Rio Grande and Pecos rivers, possibly also extending into the San Simon of southeastern Arizona. Sites are flat to gently sloping with slopes up to 3%. Elevation ranges from 1000-1300 m (3300-4300 feet). Substrates are generally fine-textured, saline soils but may include moderately coarse-textured alluvium in the floodplains. Water tables are generally shallow but fluctuate within reach of deep-rooted plants, and in most places are high enough that salts accumulate on the surface of the soil.
Vegetation: Vegetation is typically composed of one or more *Atriplex* species, such as *Atriplex canescens, Atriplex obovata*, or *Atriplex polycarpa*, along with species of *Allenrolfea, Flourensia, Salicornia, Suaeda*, or other halophytic plants. Graminoid species may include *Sporobolus airoides, Sporobolus wrightii, Pleuraphis mutica*, or *Distichlis spicata* at varying densities. Occasional riparian species may be present near watercourses, such as *Prosopis pubescens* or *Populus deltoides ssp. wislizeni*.

Component Associations:
- *Atriplex canescens / Parthenium confertum* Shrubland (CEGL001290, GNRQ)
- *Atriplex canescens / Sporobolus airoides* Shrubland (CEGL001291, G5?)
- *Atriplex canescens / Sporobolus wrightii* Shrubland (CEGL001292, GNRQ)
- *Atriplex obovata / Tidestromia carnosa* Dwarf-shrubland (CEGL004575, G2?)
- *Atriplex polycarpa / Pleuraphis mutica* Shrubland (CEGL001319, GU)
- *Distichlis spicata* Herbaceous Vegetation (CEGL001770, G5)
- *Flourensia cernua / Achnatherum eminens* Shrubland (CEGL001338, GNRQ)
- *Flourensia cernua / Bouteloua curtipendula* Shrubland (CEGL001336, GNRQ)
- *Flourensia cernua / Pleuraphis mutica* Shrubland (CEGL001541, G4)
- *Flourensia cernua / Sporobolus airoides* Shrubland (CEGL001337, GNRQ)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- North American Warm Desert Playa (CES302.751)

DISTRIBUTION

Range: This ecological system occurs in saline basins in the Chihuahuan Desert. Stands often occur around playas and on alluvial flats, as well as in floodplains along the Rio Grande and Pecos rivers, possibly also extending into the San Simon of southeastern Arizona.
Divisions: 302:C
Nations: MX, US
Subnations: AZ, MXCH(MX), MXCO(MX), MXDU(MX), MXNU(MX), MXSO(MX), NM, TX
Map Zones: 14:C, 15:P, 24:C, 25:C, 26:C, 27:P, 34:?, 35:?, 36:P
USFS Ecomap Regions: 313C:CC, 315A:CC, 315B:CC, 315H:CC, 321A:CC, 322B:CC, M313A:CC, M313B:CC
TNC Ecoregions: 22:C, 24:C, 28:C, 29:?, 30:P

SOURCES

References: Brown 1982a, Comer et al. 2003, Dick-Peddie 1993, Muldavin et al. 2000b, Muldavin et al. 2002, Shreve and Wiggins 1964

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722688#references
Description Author: K.A. Schulz
Version: 29 Jan 2007 **Stakeholders:** Latin America, Southeast, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

CHIHUAHUAN STABILIZED COPPICE DUNE AND SAND FLAT SCRUB (CES302.737)

CLASSIFIERS

Conf.: 3 - Weak **Classification Status:** Standard
Primary Division: North American Warm Desert (302)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland [Lowland]; Plain; Shrubland (Shrub-dominated); Tropical/Subtropical [Tropical Xeric]; Temperate [Temperate Xeric]; Sand Soil Texture; Aridic; Very Short Disturbance Interval; W-Landscape/High Intensity; Thorn Shrub; Prosopis spp.-dominated
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Mixed evergreen-deciduous shrubland
National Mapping Codes: EVT 2076; ESLF 5253; ESP 1076

CONCEPT

Summary: This ecological system includes the open desert scrub of vegetated coppice dunes and sandsheets found in the Chihuahuan Desert. Stands are usually dominated by *Prosopis glandulosa* or *Artemisia filifolia* but also include *Atriplex canescens, Ephedra torreyana, Ephedra trifurca, Poliomintha incana*, and *Rhus microphylla* coppice and sand flat scrub usually with 10-30% total vegetation cover. *Yucca elata, Gutierrezia sarothrae, Bouteloua eriopoda*, and *Sporobolus flexuosus* are commonly present. In northern stands, *Artemisia filifolia* dominates and *Prosopis glandulosa* becomes less common or absent. This system includes degraded sandy desert plains grasslands now dominated by *Artemisia filifolia*.
Classification Comments: Heavy grazing in late 1800s and early 1900s may have caused mesquite to increase. Naturally occurring coppice dunes may have been limited to areas peripheral to active dunes. Coppice dunes in the Tularosa Basin and elsewhere are currently more extensive, resulting from sand movement due to degradation of desert grasslands and steppe. For Landfire mapzone 25 BpS modeling, this system is considered to be historically uncharacteristic of most sites where it occurs. Much of the current extent of this system is thought to have been formerly Chihuahuan Sandy Plains Semi-Desert Grassland (CES302.736).
Similar Ecological Systems:
- Apacherian-Chihuahuan Mesquite Upland Scrub (CES302.733)

Related Concepts:
- Mesquite (729) (Shiflet 1994) Intersecting
- MLRA 42 - Southern Desertic Basin (SD-1) Deep Sand (NRCS 2006a) Broader
- MLRA 42 - Southern Desertic Basin (SD-1) Sandy (NRCS 2006a) Broader
- MLRA 42 - Southern Desertic Basin (SD-2) Deep Sand (NRCS 2006a) Broader
- MLRA 42 - Southern Desertic Basin (SD-2) Sandy (NRCS 2006a) Broader

DESCRIPTION

Dynamics: *Prosopis glandulosa* is more common on warmer, drier sites on sands with clays or carbonate substrates, whereas *Artemisia filifolia* is more common on relatively cooler/moisture sites with coarse, deep sand (S. Yanoff pers. comm. 2007).

Component Associations:
- *Atriplex canescens / Sporobolus wrightii* Shrubland (CEGL001292, GNRQ)
- *Ephedra torreyana - Achnatherum hymenoides* Hummock Shrubland (CEGL005802, GNR)
- *Prosopis glandulosa / Atriplex canescens* Shrubland (CEGL001382, G5)
- *Prosopis glandulosa / Bouteloua gracilis* Shrubland (CEGL001383, G5)
- *Prosopis glandulosa / Muhlenbergia porteri* Shrubland (CEGL001511, G5)
- *Prosopis glandulosa / Sporobolus flexuosus* Shrubland (CEGL001386, G4)
- *Psorothamnus scoparius / Sporobolus flexuosus* Shrubland (CEGL001695, G5)
- *Rhus microphylla / Bouteloua curtipendula* Shrubland (CEGL001354, GNR)

DISTRIBUTION

Range: This system occurs on dunes and sandsheets found in the Chihuahuan Desert.
Divisions: 302:C
Nations: MX, US
Subnations: MXCH(MX), NM, TX
Map Zones: 14:P, 15:P, 25:C, 26:C, 27:P
USFS Ecomap Regions: 313C:CC, 315A:CC, 315B:CC, 315H:CP, 321A:CC, 322B:??, M313A:CP, M313B:CC
TNC Ecoregions: 24:C

SOURCES

References: Bowers 1982, Bowers 1984, Comer et al. 2003, Dick-Peddie 1993, Muldavin et al. 2000b, Yanoff pers. comm.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722935#references
Description Author: K.A. Schulz

Version: 29 Jan 2007
Concept Author: NatureServe Western Ecology Team

Stakeholders: Latin America, Southeast, West
ClassifResp: West

CHIHUAHUAN SUCCULENT DESERT SCRUB (CES302.738)

CLASSIFIERS

Conf.: 3 - Weak **Classification Status:** Standard
Primary Division: North American Warm Desert (302)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Temperate [Temperate Xeric]; Succulent Shrub; Cacti-dominated
Non-Diagnostic Classifiers: Lowland [Foothill]; Lowland [Lowland]; Shrubland (Shrub-dominated); Tropical/Subtropical [Tropical Xeric]; Aridic
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Evergreen shrubland
National Mapping Codes: EVT 2077; ESLF 5254; ESP 1077

CONCEPT

Summary: This ecological system is found in the Chihuahuan Desert on colluvial slopes, upper bajadas, sideslopes, ridges, canyons, hills and mesas. Sites are hot and dry, typically with southerly aspects. Gravel and rock are often abundant on the ground surface. The vegetation is characterized by the relatively high cover of succulent species such as *Agave lechuguilla, Euphorbia antisyphilitica, Fouquieria splendens, Ferocactus* spp., *Opuntia engelmannii, Opuntia imbricata, Opuntia spinosior, Yucca baccata*, and many others. Perennial grass cover is generally low. The abundance of succulents is diagnostic of this desert scrub system, but desert shrubs are usually present. Stands in rolling topography may form a mosaic with more mesic desert scrub or desert grassland ecological systems that would occur on less xeric northerly slopes. *Agave lechuguilla* is more abundant in stands in the southern part of the mapzone. This system does not include loamy plains desert grasslands or shrub-steppe with a strong cacti component such as cholla grasslands.
Similar Ecological Systems:
- Tamaulipan Mesquite Upland Scrub (CES301.984)

Related Concepts:
- MLRA 42 - Southern Desertic Basin (SD-2) Limestone Hills (NRCS 2006a) Broader
- MLRA 42 - Southern Desertic Basin (SD-2) SD2 Hills (NRCS 2006a) Broader
- MLRA 42 - Southern Desertic Basin (SD-2) SD2 Malpais (NRCS 2006a) Broader
- Sideoats Grama - Sumac - Juniper (735) (Shiflet 1994) Undetermined

Component Associations:
- *Larrea tridentata - Agave lechuguilla* Shrubland (CEGL004562, G4?)
- *Larrea tridentata - Euphorbia antisyphilitica* Shrubland (CEGL004564, G3)
- *Larrea tridentata - Opuntia schottii* Shrubland (CEGL004567, G4?)

DISTRIBUTION

Range: This Chihuahuan Desert ecological system occurs on colluvial slopes, upper bajadas, sideslopes and mesas. It extends east to the Devils River in Texas.
Divisions: 302:C
Nations: MX, US
Subnations: AZ, MXCH(MX), NM, TX
Map Zones: 14:C, 15:C, 24:P, 25:C, 26:C
USFS Ecomap Regions: 313C:CC, 315A:CC, 321A:CC, 322B:CC, M313A:CC, M313B:CC
TNC Ecoregions: 22:P, 24:C, 29:?, 30:P

SOURCES

References: Comer et al. 2003, MacMahon 1988, Muldavin et al. 2000b, Muldavin et al. 2002
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722934#references
Description Author: NatureServe Western Ecology Team
Version: 29 Jan 2007 **Stakeholders:** Latin America, Southeast, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

COLORADO PLATEAU BLACKBRUSH-MORMON-TEA SHRUBLAND (CES304.763)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland [Foothill]; Shrubland (Shrub-dominated); Temperate [Temperate Xeric]; Aridic
Non-Diagnostic Classifiers: Ridge/Summit/Upper Slope; Sideslope; Alkaline Soil; Sand Soil Texture; Very Long Disturbance Interval; F-Patch/High Intensity
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Mixed evergreen-deciduous shrubland
National Mapping Codes: EVT 2078; ESLF 5255; ESP 1078

CONCEPT

Summary: This ecological system occurs in the Colorado Plateau on benchlands, colluvial slopes, pediments or bajadas. Elevation ranges from 560-1650 m. Substrates are shallow, typically calcareous, non-saline and gravelly or sandy soils over sandstone or limestone bedrock, caliche or limestone alluvium. It also occurs in deeper soils on sandy plains where it may have invaded desert grasslands. The vegetation is characterized by extensive open shrublands dominated by *Coleogyne ramosissima* often with *Ephedra viridis, Ephedra torreyana*, or *Grayia spinosa*. Sandy portions may include *Artemisia filifolia* as codominant. The herbaceous layer is sparse and composed of graminoids such as *Achnatherum hymenoides, Pleuraphis jamesii*, or *Sporobolus cryptandrus*.
Related Concepts:
- Blackbush (212) (Shiflet 1994) Broader

DESCRIPTION

Environment: This ecological system typically occurs on gentle to steep, bouldery or rocky slopes of mountains, canyons, and mesas with varying aspects. This system is an evergreen, microphyllous desert scrub with succulents, half-shrubs, and scattered deciduous shrubs typically found at elevations ranging from 580 to 1650 m. (1903-5413 feet). This shrubland system occurs in an arid to semi-arid climate with annual precipitation in the form of summer monsoons and winter storms averaging approximately 20 cm. Soils are highly variable and parent materials may include shale, sandstone, limestone, quartzites, and igneous rocks. Soils are generally coarse-textured, often rocky, shallow and well-drained. Effective soil moisture appears to be primarily controlled by regolith depth and position in relation to the water table. This brushland system occupies most sites where regolith is uniformly shallow. In association with blackbrush (*Coleogyne ramosissima*) sites, the soil moisture is concentrated on top of impermeable bedrock at a shallow depth. This perching effect allows for gradual uptake of moisture by the plants roots (Loope and West 1979). This permits growth of plants with more mesic habitat requirements (Warren et al. 1982). On sites with deep soil, blackbrush may occur in almost pure occurrences with only a few associated species (Warren et al. 1982). Dark-colored cryptogamic soil crusts, composed of lichens, mosses, fungi, and algae, are often present in this system in fairly undisturbed areas. Sandy soils may have more cryptogamic crusts than clayish or silty soil surfaces.
Vegetation: This ecological system is dominated by sparse to moderately dense shrubs. Dominant shrubs include *Coleogyne ramosissima, Ephedra nevadensis*, and *Ephedra viridis* (which may codominate with *Grayia spinosa, Salvia dorrii*, and *Lycium andersonii*). There is usually a sparse herbaceous layer with some perennial grasses and forbs. Annual grasses and forbs are present seasonally. Some characteristic species associated with this system include the shrubs *Gutierrezia sarothrae, Chrysothamnus viscidiflorus, Yucca baccata*, and *Krameria grayi*, succulents such as *Ferocactus cylindraceus (= Ferocactus acanthodes), Opuntia* spp., *Echinocereus* spp., *Echinocactus* spp., and *Agave* spp., the graminoid *Pleuraphis rigida*, and perennial forbs such as *Machaeranthera pinnatifida* and *Sphaeralcea ambigua*.
Dynamics: Fire does not appear to play a role in maintenance of shrublands within this system. Topographic breaks dissect the landscape, and isolated pockets of vegetation are separated by rock walls or steep canyons. Blackbrush is fire-intolerant (Loope and West 1979). Following fires, these communities are often colonized by non-native grasses, which serve to encourage recurrent fires and delay shrub regeneration (IVC 1999). In shallow regolith situations, secondary succession, in the sense of site preparation by seral plants, may not occur at all (Loope and West 1979).

Component Associations:
- *Artemisia filifolia / Bouteloua eriopoda* Shrubland (CEGL001077, G4)
- *Artemisia filifolia* Colorado Plateau Shrubland (CEGL002697, GNR)
- *Coleogyne ramosissima - Purshia stansburiana - Quercus havardii var. tuckeri* Shrubland (CEGL002348, G3G4)
- *Coleogyne ramosissima / Pleuraphis jamesii* Shrubland (CEGL001334, G5)
- *Coleogyne ramosissima* Shrubland (CEGL001332, G4G5)
- *Coleogyne ramosissima* Sparse Shrubland (CEGL003834, GNR)
- *Ephedra (torreyana, viridis)* / Mixed Semi-desert Grasses Shrubland (CEGL005113, GNR)
- *Ephedra nevadensis / Achnatherum hymenoides* Shrubland (CEGL001255, G4)
- *Ephedra torreyana - (Atriplex canescens, Atriplex confertifolia)* Sparse Vegetation (CEGL005801, GNR)
- *Ephedra torreyana* - (*Atriplex* spp.) / Nonvascular Gypsum Sparse Vegetation (CEGL002349, GNR)

- *Ephedra torreyana - Opuntia basilaris* Shrubland (CEGL005107, GNR)
- *Ephedra torreyana / Achnatherum hymenoides - Pleuraphis jamesii* Shrubland (CEGL002352, GNR)
- *Ephedra torreyana / Bouteloua eriopoda* Shrub Herbaceous Vegetation (CEGL001731, G2)
- *Ephedra torreyana / Bouteloua gracilis - Pleuraphis jamesii* Shrubland (CEGL002351, GNR)
- *Ephedra torreyana / Pleuraphis jamesii* Shrubland (CEGL003772, GNR)
- *Ephedra viridis / (Achnatherum hymenoides, Hesperostipa comata)* Shrubland (CEGL002354, GNR)
- *Ephedra viridis / Achnatherum hymenoides - Bouteloua gracilis* Shrub Herbaceous Vegetation (CEGL001648, G2G4)
- *Ephedra viridis / Achnatherum hymenoides - Sporobolus cryptandrus* Shrub Herbaceous Vegetation (CEGL001649, G2G4)
- *Ephedra viridis / Bouteloua gracilis* Shrubland (CEGL003934, GNR)
- *Ephedra viridis / Pleuraphis jamesii* Shrubland (CEGL002356, GNR)
- *Ephedra viridis / Pleuraphis rigida* Shrubland (CEGL001257, G3)
- *Eriogonum leptocladon / Muhlenbergia pungens* Dwarf-shrubland (CEGL002821, GNR)
- *Grayia spinosa* Shrubland (CEGL002358, GNR)
- *Poliomintha incana - Artemisia filifolia - Vanclevea stylosa* Shrubland (CEGL002418, GNR)
- *Quercus havardii var. tuckeri* Shrubland (CEGL002486, GNR)

SPATIAL CHARACTERISTICS

Adjacent Ecological System Comments: Adjacent vegetation often includes *Atriplex* dominated shrubland communities and upland areas of pinyon-juniper woodlands. Grasslands dominated by *Pleuraphis jamesii, Hesperostipa comata,* and *Achnatherum hymenoides* also occur.

DISTRIBUTION

Range: Occurs in the Colorado Plateau on benchlands, colluvial slopes, pediments or bajadas. Elevation ranges from 560-1600 m.
Divisions: 304:C
Nations: US
Subnations: AZ, CO, NM, UT
Map Zones: 13:C, 14:?, 15:C, 16:P, 17:C, 23:C, 24:C, 28:?
USFS Ecomap Regions: 313A:CC, 313B:CC, 313D:CC, 322A:CC, 341B:CC, 341C:C?, 341F:CP, M331E:PP, M331H:PP, M341B:CC, M341C:CP
TNC Ecoregions: 18:C, 19:C

SOURCES

References: Comer et al. 2003, Loope and West 1979, Thatcher 1975, Tuhy and MacMahon 1988, Tuhy et al. 2002, Warren et al. 1982, West 1983d
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722909#references
Description Author: NatureServe Western Ecology Team
Version: 05 Oct 2004 **Stakeholders:** West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

COLORADO PLATEAU MIXED LOW SAGEBRUSH SHRUBLAND (CES304.762)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Lower Montane]; Lowland [Foothill]; Shrubland (Shrub-dominated); Ridge/Summit/Upper Slope; Temperate [Temperate Xeric]; Aridic
Non-Diagnostic Classifiers: Alkaline Soil
FGDC Crosswalk: Vegetated, Shrub-dominated, Dwarf-shrubland, Evergreen dwarf-shrubland
National Mapping Codes: EVT 2064; ESLF 5201; ESP 1064

CONCEPT

Summary: This ecological system occurs in the Colorado Plateau, Tavaputs Plateau and Uinta Basin in canyons, gravelly draws, hilltops, and dry flats at elevations generally below 1800 m. Soils are often rocky, shallow, and alkaline. This type extends across northern New Mexico into the southern Great Plains on limestone hills. It includes open shrublands and steppe dominated by *Artemisia nova* or *Artemisia bigelovii* sometimes with *Artemisia tridentata ssp. wyomingensis* codominant. Semi-arid grasses such as *Achnatherum hymenoides, Aristida purpurea, Bouteloua gracilis, Hesperostipa comata, Pleuraphis jamesii*, or *Poa fendleriana* are often present and may form a graminoid layer with over 25% cover.

Related Concepts:
- Black Sagebrush (405) (Shiflet 1994) Intersecting
- Other Sagebrush Types (408) (Shiflet 1994) Intersecting. *Artemisia bigelovii* shrublands are included in this ecological system.

Component Associations:
- *Artemisia arbuscula ssp. longiloba / Elymus lanceolatus* Shrubland (CEGL002585, GNR)
- *Artemisia bigelovii - Ephedra (viridis, torreyana)* Talus Shrubland (CEGL003755, GNR)
- *Artemisia bigelovii / Achnatherum hymenoides* Shrubland (CEGL000990, G3Q)
- *Artemisia bigelovii / Bouteloua eriopoda* Dwarf-shrub Herbaceous Vegetation (CEGL001741, GNRQ)
- *Artemisia bigelovii / Bouteloua gracilis* Dwarf-shrub Herbaceous Vegetation (CEGL001742, GNR)
- *Artemisia bigelovii* Shrubland (CEGL000276, GNR)
- *Artemisia frigida - (Bouteloua gracilis, Achnatherum hymenoides, Poa secunda)* - Lichens Rocky Mesa Dwarf-shrubland (CEGL002344, GNR)
- *Artemisia nova - Ericameria nana* Shrubland (CEGL002773, G3)
- *Artemisia nova - Gutierrezia sarothrae / Bouteloua gracilis - Pleuraphis jamesii* Shrubland (CEGL001419, G4)
- *Artemisia nova / Achnatherum hymenoides* Shrubland (CEGL001422, G4G5)
- *Artemisia nova / Elymus elymoides* Shrubland (CEGL001418, G4G5)
- *Artemisia nova / Hesperostipa comata* Shrubland (CEGL001425, G3?)
- *Artemisia nova / Pleuraphis jamesii* Shrubland (CEGL001420, G3G5)
- *Artemisia nova / Poa fendleriana* Shrubland (CEGL002698, GNR)
- *Artemisia nova / Poa secunda* Shrubland (CEGL001423, G3)
- *Artemisia nova / Pseudoroegneria spicata* Shrubland (CEGL001424, G4G5)
- *Artemisia nova* Shrubland (CEGL001417, G3G5)
- *Artemisia tridentata ssp. wyomingensis / Bouteloua gracilis* Shrubland (CEGL001041, G5)

DISTRIBUTION

Range: Occurs in the Colorado Plateau, Tavaputs Plateau and Uinta Basin in canyons, gravelly draws, hilltops, and dry flats at elevations generally below 1800 m.
Divisions: 303:C; 304:C
Nations: US
Subnations: AZ, CO, NM, UT
Map Zones: 15:P, 16:C, 17:P, 23:C, 24:C, 25:C, 27:C, 28:C, 34:P
USFS Ecomap Regions: 313A:CC, 313B:CC, 313D:CC, 315A:C?, 315B:CC, 315H:CC, 321A:CC, 331B:CC, 341A:CC, 341B:CC, 341C:CC, 342G:??, M313A:CC, M313B:CC, M331D:CC, M331E:CC, M331F:CP, M331G:CC, M331H:CP, M341B:CC, M341C:CC
TNC Ecoregions: 18:C, 19:C, 20:C, 27:C, 28:C

SOURCES

References: Brown 1982a, Comer et al. 2003, Dick-Peddie 1993, Francis 1986
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722910#references

Description Author: NatureServe Western Ecology Team
Version: 20 Feb 2003
Concept Author: NatureServe Western Ecology Team

Stakeholders: West
ClassifResp: West

COLORADO PLATEAU PINYON-JUNIPER SHRUBLAND (CES304.766)

CLASSIFIERS

Conf.: 3 - Weak **Classification Status:** Standard
Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland [Foothill]; Mesa; Ridge/Summit/Upper Slope; Sedimentary Rock; Temperate [Temperate Xeric]; Aridic; Pinus edulis, Juniperus osteosperma
Non-Diagnostic Classifiers: Foothill(s); Shrubland (Shrub-dominated); Sideslope; Alkaline Soil; Long Disturbance Interval; F-Patch/Medium Intensity
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Evergreen shrubland
National Mapping Codes: EVT 2102; ESLF 5308; ESP 1102

CONCEPT

Summary: This ecological system is characteristic of the rocky mesatops and slopes on the Colorado Plateau and western slope of Colorado, but these stunted tree shrublands may extend further upslope along the low-elevation margins of taller pinyon-juniper woodlands. Sites are drier than Colorado Plateau Pinyon-Juniper Woodland (CES304.767). Substrates are shallow/rocky and shaly soils at lower elevations (1200-2000 m). Sparse examples of the system grade into Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765). The vegetation is dominated by dwarfed (usually <3 m tall) *Pinus edulis* and/or *Juniperus osteosperma* trees forming extensive tall shrublands in the region along low-elevation margins of pinyon-juniper woodlands. Other shrubs, if present, may include *Artemisia nova, Artemisia tridentata ssp. wyomingensis, Chrysothamnus viscidiflorus,* or *Coleogyne ramosissima*. Herbaceous layers are sparse to moderately dense and typically composed of xeric graminoids.

Similar Ecological Systems:
- Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765)
- Colorado Plateau Pinyon-Juniper Woodland (CES304.767)

Related Concepts:
- Juniper - Pinyon Pine Woodland (504) (Shiflet 1994) Intersecting
- Juniper - Pinyon Woodland (412) (Shiflet 1994) Intersecting

Component Associations:
- *Juniperus osteosperma - (Pinus edulis) / Coleogyne ramosissima - Purshia stansburiana - Quercus havardii var. tuckeri* Wooded Shrubland (CEGL003774, GNR)
- *Juniperus osteosperma / Bouteloua gracilis* Woodland (CEGL002361, GNR)
- *Juniperus osteosperma / Cercocarpus intricatus* Woodland (CEGL000733, GNR)
- *Juniperus osteosperma* / Mixed Shrubs Talus Woodland (CEGL002266, GNR)
- *Pinus edulis - Juniperus osteosperma / (Shepherdia rotundifolia, Amelanchier utahensis)* Wooded Shrubland (CEGL002334, G3G4)
- *Pinus edulis - Juniperus osteosperma / Arctostaphylos patula* Woodland (CEGL002939, GNR)
- *Pinus edulis - Juniperus osteosperma / Arctostaphylos pungens* Woodland (CEGL000775, G3)
- *Pinus edulis - Juniperus osteosperma / Cercocarpus intricatus* Woodland (CEGL000779, G3)
- *Pinus edulis - Juniperus osteosperma / Cercocarpus ledifolius* Woodland (CEGL002940, GNR)
- *Pinus edulis - Juniperus osteosperma / Coleogyne ramosissima* Woodland (CEGL000781, G3)
- *Pinus edulis - Juniperus osteosperma / Ephedra torreyana - Artemisia bigelovii* Woodland (CEGL002369, GNR)
- *Pinus edulis - Juniperus osteosperma* / Mixed Shrubs Talus Woodland (CEGL002328, GNR)
- *Pinus edulis - Juniperus osteosperma / Muhlenbergia pungens* Woodland (CEGL002373, GNR)
- *Pinus edulis - Juniperus osteosperma / Pseudoroegneria spicata* - Cushion Plant Woodland (CEGL002819, GNR)
- *Pinus edulis - Juniperus osteosperma / Purshia stansburiana* Woodland (CEGL000782, G4?)
- *Pinus edulis - Juniperus osteosperma / Purshia tridentata* Woodland (CEGL000789, G5)
- *Pinus edulis - Juniperus osteosperma / Quercus turbinella* Woodland (CEGL004007, GNR)
- *Pinus edulis - Juniperus* spp. / *Cercocarpus montanus* - Mixed Shrubs Woodland (CEGL000780, G5)
- *Pinus edulis* / Rockland Woodland (CEGL000794, G5)

DISTRIBUTION

Range: Rocky mesa tops and slopes on the Colorado Plateau.
Divisions: 304:C; 306:?
Nations: US
Subnations: AZ, CO, NM, UT
Map Zones: 13:P, 15:P, 16:C, 23:C, 24:C, 25:C, 28:P
USFS Ecomap Regions: 313A:CC, 313B:CC, 313D:CP, 322A:??, 341B:CC, 341C:CC, 342G:CC, M331D:CC, M331E:CC, M331G:CC, M331H:CC, M341B:CC, M341C:CC

TNC Ecoregions: 18:C, 19:C, 20:?

SOURCES

References: Comer et al. 2003, Tuhy et al. 2002, West et al. 1998

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722906#references

Description Author: NatureServe Western Ecology Team

Version: 05 Oct 2004 **Stakeholders:** West

Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

COLUMBIA PLATEAU SCABLAND SHRUBLAND (CES304.770)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland [Lowland]; Shrubland (Shrub-dominated); Basalt; Shallow Soil
Non-Diagnostic Classifiers: Plain; Plateau; Toeslope/Valley Bottom; Temperate [Temperate Continental]; Aridic
FGDC Crosswalk: Vegetated, Shrub-dominated, Dwarf-shrubland, Evergreen dwarf-shrubland
National Mapping Codes: EVT 2065; ESLF 5202; ESP 1065

CONCEPT

Summary: This ecological system is found in the Columbia Plateau region and forms extensive low shrublands. These xeric shrublands occur under relatively extreme soil-moisture conditions. Substrates are typically shallow lithic soils with limited water-holding capacity over fractured basalt. Because of poor drainage through basalt, these soils are often saturated from fall to spring by winter precipitation but typically dry out completely to bedrock by midsummer. Total vegetation cover is typically low, generally less than 50% and often much less than that. Vegetation is characterized by an open dwarf-shrub canopy dominated by *Artemisia rigida* along with other shrub and dwarf-shrub species, particularly *Eriogonum* spp. Other shrubs are uncommon in this system; mixes of *Artemisia rigida* and other *Artemisia* species typically belong to different ecological systems than this. Low cover of perennial bunch grasses, such as *Danthonia unispicata, Elymus elymoides, Festuca idahoensis*, or primarily *Poa secunda*, as well as scattered forbs, including species of *Allium, Antennaria, Balsamorhiza, Lomatium, Phlox*, and *Sedum*, characterize these sites. Individual sites can be dominated by grasses and semi-woody forbs, such as *Stenotus stenophyllus*. Annuals may be seasonally abundant, and cover of moss and lichen is often high in undisturbed areas (1-60% cover).

Related Concepts:
- Bluegrass Scabland (106) (Shiflet 1994) Finer
- Stiff Sagebrush (407) (Shiflet 1994) Finer

DESCRIPTION

Environment: This ecological system is found in the Columbia Plateau region and forms extensive low shrublands. These xeric shrublands occur under relatively extreme soil-moisture conditions. Substrates are typically shallow lithic soils with limited water-holding capacity over fractured basalt. Because of poor drainage through basalt, these soils are often saturated from fall to spring by winter precipitation but typically dry out completely to bedrock by midsummer.

Vegetation: Total vegetation cover is typically low, generally less than 50% and often much less than that. Vegetation is characterized by an open dwarf-shrub canopy dominated by *Artemisia rigida* along with other shrub and dwarf-shrub species, particularly *Eriogonum* spp. Other shrubs are uncommon in this system; mixes of *Artemisia rigida* and other *Artemisia* species typically belong to different ecological systems than this. Low cover of perennial bunch grasses, such as *Danthonia unispicata, Elymus elymoides, Festuca idahoensis*, or primarily *Poa secunda*, as well as scattered forbs, including species of *Allium, Antennaria, Balsamorhiza, Lomatium, Phlox*, and *Sedum*, characterize these sites. Individual sites can be dominated by grasses and semi-woody forbs, such as *Stenotus stenophyllus*. Annuals may be seasonally abundant, and cover of moss and lichen is often high in undisturbed areas (1-60% cover).

Component Associations:
- *(Balsamorhiza serrata) - Poa secunda* Herbaceous Vegetation (CEGL001782, G2)
- *Artemisia rigida / Festuca idahoensis* Shrub Herbaceous Vegetation (CEGL002995, G2)
- *Artemisia rigida / Poa secunda* Shrub Herbaceous Vegetation (CEGL001528, G4)
- *Artemisia rigida / Pseudoroegneria spicata* Shrub Herbaceous Vegetation (CEGL001529, G3)
- *Danthonia californica - Festuca idahoensis* Herbaceous Vegetation (CEGL001607, G1Q)
- *Danthonia unispicata - Poa secunda* Herbaceous Vegetation (CEGL001783, G3)
- *Eriogonum compositum / Poa secunda* Dwarf-shrub Herbaceous Vegetation (CEGL001784, G2)
- *Eriogonum douglasii / Poa secunda* Dwarf-shrub Herbaceous Vegetation (CEGL001785, G2)
- *Eriogonum microthecum - Physaria oregona* Dwarf-shrubland (CEGL001737, G2)
- *Eriogonum niveum / Poa secunda* Dwarf-shrub Herbaceous Vegetation (CEGL001786, G3)
- *Eriogonum sphaerocephalum / Poa secunda* Dwarf-shrub Herbaceous Vegetation (CEGL001448, G3)
- *Eriogonum strictum / Poa secunda* Dwarf-shrub Herbaceous Vegetation (CEGL001788, G3)
- *Eriogonum thymoides / Poa secunda* Dwarf-shrub Herbaceous Vegetation (CEGL001449, G3)
- *Lomatium cous - Poa secunda* Herbaceous Vegetation (CEGL001790, G4)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Columbia Plateau Vernal Pool (CES304.057)

DISTRIBUTION

Range: This system occurs in the Columbia Plateau region of southern Idaho, eastern Oregon and eastern Washington, and extreme northern Nevada.
Divisions: 304:C
Nations: US
Subnations: CA?, ID, NV, OR, UT?, WA
Map Zones: 1:C, 7:C, 8:C, 9:C, 12:?, 17:?, 18:P
USFS Ecomap Regions: 331A:CC, 341E:C?, 341G:CC, 342B:CC, 342C:CC, 342D:CC, 342H:CC, 342I:CC, 342J:CC, M242C:CC, M242D:CC, M261D:C?, M261G:CC, M332G:CC, M333A:PP, M341A:CC
TNC Ecoregions: 6:C, 7:C, 68:C

SOURCES

References: Comer et al. 2003, Copeland 1980a, Daubenmire 1970, Ganskopp 1979, Hall 1973, Johnson and Simon 1985, Poulton 1955
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722902#references
Description Author: Western Ecology Group, mod. M.S. Reid
Version: 25 Apr 2006 **Stakeholders:** West
Concept Author: J. Kagan **ClassifResp:** West

EDWARDS PLATEAU LIMESTONE SHRUBLAND (CES303.041)

CLASSIFIERS

Classification Status: Standard

Primary Division: Western Great Plains (303)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Plain; Plateau; Shrubland (Shrub-dominated); Alkaline Soil; Very Shallow Soil; Xeric
Non-Diagnostic Classifiers: Lowland [Foothill]; Calcareous
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Mixed evergreen-deciduous shrubland
National Mapping Codes: EVT 2393; ESLF 5324; ESP 1393

CONCEPT

Summary: This ecological system occurs as a matrix on relatively thin-soiled surfaces of plateaus of the massive limestones such as the Edwards limestone. These short to tall shrublands are variable in density depending on the relative amount of, and depth to, bedrock. *Quercus sinuata var. breviloba* is an important component of the system, with some areas dominated by *Quercus fusiformis*. *Juniperus ashei* is often an important component of this system. Important components in western examples may include *Pinus remota, Quercus mohriana, Quercus vaseyana*, and *Juniperus pinchotii*. Herbaceous cover may be patchy and is generally graminoid with species including *Schizachyrium scoparium, Bouteloua curtipendula, Bouteloua rigidiseta, Bouteloua trifida, Hilaria belangeri, Bothriochloa laguroides ssp. torreyana, Nassella leucotricha, Erioneuron pilosum, Aristida* spp., and others. Disturbances such as fire may be important processes maintaining this system. However, it appears to persist on thin-soiled sites. In the western portions of the Edwards Plateau, more xeric conditions lead to the slow succession of sites to woodlands, resulting in long-persisting shrublands.
Classification Comments: This system represents naturally occurring shrublands that are maintained over long periods (greater than 50 years) as shrublands. It tends to occur on shallow soils over massive hard-bedded limestone formations and/or in the western and drier portions of the Edwards Plateau of Texas. Early-successional vegetation of Edwards Plateau Limestone Savanna and Woodland (CES303.660) may exhibit a composition and structure similar to the vegetation described and classified here, but the temporal dynamics are different. This system was modeled for mapzone 26, however, Edwards Plateau Limestone Savanna and Woodland (CES303.660) was not. Both systems occur on the far eastern edge of the mapzone on the Stockton Plateau.
Similar Ecological Systems:
- Edwards Plateau Limestone Savanna and Woodland (CES303.660)
- Llano Uplift Acidic Forest, Woodland and Glade (CES303.657)
- Tamaulipan Calcareous Thornscrub (CES301.986)
- Tamaulipan Ramadero (CES301.992)

Related Concepts:
- Ashe Juniper - Redberry (Pinchot) Juniper: 66 (Eyre 1980) Intersecting
- Edwards Plateau: Ashe Juniper / Live Oak Shrubland (1205) [CES303.041.7] (Elliott 2011) Finer
- Edwards Plateau: Ashe Juniper / Live Oak Slope Shrubland (1225) [CES303.041.17] (Elliott 2011) Finer
- Edwards Plateau: Shin Oak Shrubland (1206) [CES303.041.8] (Elliott 2011) Finer
- Edwards Plateau: Shin Oak Slope Shrubland (1226) [CES303.041.18] (Elliott 2011) Finer

DESCRIPTION

Environment: This system occurs on thin soils over massive limestone such as Edwards or related formations in the Edwards Plateau of Texas. It may occur on plateaus or slopes and may often form a discontinuous band around a plateau edge as it breaks into the adjacent slope. Soils are characterized by Shallow or Very Shallow Ecological Sites, but may also be found on Low Stony Hill Ecological Sites (Elliott 2011).
Vegetation: This system may be represented by extensive continuous shrub cover, or occur as a discontinuous shrubland, often with scattered emergent overstory trees. *Quercus sinuata var. breviloba*, *Quercus fusiformis*, and/or *Juniperus ashei* may be important components of the system. In the interior of the Edwards Plateau ecoregion, *Quercus sinuata var. breviloba* is an important component, with some areas dominated by a shinnery of *Quercus fusiformis*, although monotypic stands of *Quercus fusiformis* occupying the shrub layer are uncommon. In the west, *Pinus remota* may also contribute to a scattered emergent overstory. Shrub cover may be dominated by these species, or may be represented as an assemblage of a rather diverse array of species including *Rhus virens, Rhus lanceolata, Cercis canadensis var. texensis, Forestiera pubescens, Forestiera reticulata, Ungnadia speciosa, Sophora secundiflora, Diospyros texana, Salvia ballotiflora, Mimosa borealis, Condalia hookeri, Rhus trilobata, Opuntia engelmannii var. lindheimeri*, and *Mahonia trifoliolata*. In the northwest corner of the ecoregion, this system may occur as a *Quercus mohriana*-dominated shrubland (a type more common in the Southern Shortgrass Prairie ecoregion), often sharing dominance with *Juniperus pinchotii*. Towards the southwest, *Quercus vaseyana (= Quercus pungens var. vaseyana)* becomes an important component of the system, and areas dominated by *Sophora secundiflora, Diospyros texana*, and other shrub species become more common. In the southwest corner of the ecoregion, on the Stockton Plateau, this system may be represented by *Acacia berlandieri* shrublands. Where shrub cover is distributed in a patchy mosaic, such sites may be used by black-capped vireos (*Vireo atricapilla*). Herbaceous cover may be patchy and is generally graminoid-dominated with species including *Schizachyrium scoparium, Bouteloua curtipendula,*

Bouteloua rigidiseta, Bouteloua trifida, Hilaria belangeri, Bothriochloa laguroides ssp. torreyana, Nassella leucotricha, Erioneuron pilosum, Aristida spp., and others (Elliott 2011).

Dynamics: This system occurs in a steady state on thin-soiled xeric sites. Shrub cover can be 100% in patches, but overall cover may be 40-50%. Patches of dense shrubs may be interspersed with bare rock and grasslands over shallow soil. Farther west this system grades into other shallow-soiled shrubland systems. Disturbances such as fire may be important processes maintaining this system. However, it appears to persist on thin-soiled sites. In the western portions of the Edwards Plateau, more xeric conditions lead to the slow succession of sites to woodlands resulting in long-persisting shrublands.

Component Associations:
- *Quercus mohriana - Juniperus pinchotii / Bouteloua curtipendula* Scrub (CEGL002173, G4)
- *Quercus sinuata var. breviloba* Scrub (CEGL004453, G2G3)

Spatial Characteristics

Adjacent Ecological Systems:
- Edwards Plateau Carbonate Glade and Barrens (CES303.655)
- Edwards Plateau Cliff (CES303.653)
- Edwards Plateau Dry-Mesic Slope Forest and Woodland (CES303.656)
- Edwards Plateau Floodplain Terrace (CES303.651)
- Edwards Plateau Limestone Savanna and Woodland (CES303.660)
- Edwards Plateau Mesic Canyon (CES303.038)
- Edwards Plateau Riparian (CES303.652)
- Edwards Plateau Upland Depression (CES303.654)
- Llano Uplift Acidic Forest, Woodland and Glade (CES303.657)

Distribution

Range: This system is limited in occurrence to the Edwards Plateau of Texas.
Divisions: 302:P; 303:C
Nations: US
Subnations: TX
Map Zones: 26:C, 27:?, 34:?, 35:C
USFS Ecomap Regions: 255E:CC, 315C:CC, 315D:CC, 315G:CC, 321B:CC
TNC Ecoregions: 24:P, 28:P, 29:C

Sources

References: Comer et al. 2003, Elliott 2011, Eyre 1980, TNC 2004b
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722668#references
Description Author: L. Elliott and K.A. Schulz, mod. J. Teague
Version: 28 May 2013 **Stakeholders:** Southeast, West
Concept Author: L. Elliott, K. Schulz **ClassifResp:** Southeast

FLORIDA PENINSULA INLAND SCRUB (CES203.057)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Xeric; F-Patch/High Intensity; Needle-Leaved Tree
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Mixed evergreen-deciduous shrubland
National Mapping Codes: EVT 2387; ESLF 5318; ESP 1387

CONCEPT

Summary: This system appears in many forms, but generally consists of xeromorphic shrub vegetation (mostly evergreen oak species) with or without an emergent overstory of *Pinus clausa*. The shrubs can be very thick in places, but usually there are open patches. Ground cover is always sparse, and bare soil patches are typically evident. It is found on a sequence of sand ridges and ancient dune fields which are oriented essentially north-south in the Florida Peninsula. The appearance, floristics, and boundary of Florida scrub may contrast dramatically with the "high pine" or sandhill vegetation which is often adjacent, although lack of fire can blur these boundaries.

Related Concepts:

- Sand Pine: 69 (Eyre 1980) Intersecting
- Scrub (FNAI 1990) Finer
- Scrub (FNAI 2010a) Broader
- Southern Scrub Oak: 72 (Eyre 1980) Finer

DESCRIPTION

Environment: This system is restricted to a sequence of north/south-trending sand ridges, ancient dune fields, and former shorelines in the Florida peninsula. The largest inland scrub is found in two primary areas, essentially isolated from one another. The so called "Big Scrub" of the Ocala National Forest is the largest expanse of this system, with a somewhat smaller, more southerly area associated with the Lake Wales Ridge. According to Myers (1990), inland scrub occurs on Quartzipsamments which are excessively well-drained, nearly pure siliceous sands low in nutrients. Although all scrub soils are Entisols, there is considerable variation in soil color. This color variation appears to be related to the amount of leaching which has taken place, and appears to be related to the amount of time a site has been occupied by scrub vegetation. Excessive leaching, due to inferred long occupation by scrub vegetation, is believed to bleach upper soil horizons and develop pure white soils (such as the St. Lucie series), while moderate leaching, due to shorter occupation by scrub, contributes to less bleaching and consequently more yellow-colored soils (Paola and Orsino series).
Vegetation: This system is dominated by xeromorphic, evergreen shrub species with or without an emergent layer of *Pinus clausa*. The shrub layer composition is relatively constant, as is the abundance of individual species. *Quercus myrtifolia, Quercus inopina, Serenoa repens, Quercus geminata, Quercus chapmanii, Lyonia ferruginea,* and *Ceratiola ericoides* are the most important species. Myers (1990) indicates that much of the variability in Florida scrub is due to variation in fire-return interval, ranging from once every 10 to 100 years. Ground cover is always sparse but typically includes *Licania michauxii, Rhynchospora megalocarpa, Andropogon floridanus,* and a variety of lichens (*Cladonia* and *Cladina* species). There are a number of endemic plant species which may occur in inland Florida scrubs, including at least 13 federally listed species; many of the rarest scrub species are found only in the Lake Wales region.

This system has long been noted for its unique and interesting vegetation by authors such as Vignoles (1823), Harper (1914), Mulvania (1931), Kurz (1942), and Laessle (1958, 1968). More recent treatments by Myers (1990) and Menges (1999) have provided the most comprehensive summaries of scrub available. According to Harper (1927), "the nearly pure white sand of the ground surface, when viewed from a short distance, gives the impression of a thin rift of wind-driven snow. The vegetation is mostly dwarfed, gnarled and crooked, and presents a tangled, scraggly aspect." The appearance, floristics, and boundary of Florida scrub contrast dramatically with the "high pine" or sandhill vegetation which is often adjacent (Laessle 1968), although lack of fire can blur these boundaries. Scrub generally consists of xeromorphic shrub vegetation, such as evergreen *Ceratiola ericoides, Lyonia* spp., *Quercus* spp., *Sabal etonia, Sabal palmetto*, and *Serenoa repens*, with or without an emergent overstory of *Pinus clausa*.
Dynamics: Florida scrub is a pyrogenic system with floral and faunal components adapted to fire. Unlike most ecological systems of the Gulf and Atlantic coastal plains, this system is maintained by high-intensity, infrequent fires. Litter-fall rates are high, while turnover rates are low, contributing to fuel buildup (Lugo and Zucca 1983, Schmalzer and Hinkle 1996). However, scrub typically lacks fine-textured fuels necessary to ignite fires; most scrub fires ignite in other adjacent ecological systems. If fire spreads into scrub it is often under severe conditions of high wind, low humidity, and low fuel moisture. When fires occur in scrub they can be stand-replacing events. *Pinus clausa*, if present, is killed outright but may regenerate from seed released from serotinous cones. In parts of fires that burn completely, the shrub layer is typically killed back to ground layer but rapidly resprouts and returns to prefire levels of cover (Abrahamson 1984, Schmalzer and Hinkle 1992b). Other species such as *Ceratiola ericoides* may regenerate from seeds stored in soil (Johnson 1982). *Eryngium cuneifolium* and *Dicerandra christmanii* are narrowly endemic herb species which exhibit peaks in survival, recruitment, and density after fire (Menges 1999, Menges et al. 1999, Menges and Quintana-Ascencio 2004).

Many scrub fires burn heterogeneously with resulting patches of unburned fuels. This gap dynamics can be significant (Weekley and Menges 2003), especially in the most xeric types like rosemary scrub (Menges 1994). In the sustained absence of fire, smaller shrubs and herbs may be lost as a consequence of increasing dominance of oak stems (Menges et al. 1993).

This system has likely persisted on fossil dunes since the Pleistocene (Laessle 1968), but remaining examples are merely remnants of an ecosystem once expansive in the late Pleistocene (Myers 1990). The stature and appearance of Florida scrub may be due primarily to nutrient-poor soils, to which many of the scrub species have adapted evergreen habits (Monk 1966). Drought stress is most likely during winter and early spring, but frequent fog during these periods may ameliorate such conditions (Menges 1994). Surprisingly, given the excessively well-drained soils, drought stress may not be an important ecological factor except to limit seedling establishment (Myers 1987, 1990).

Component Associations:
- *Carya floridana - Quercus myrtifolia - Quercus geminata* Shrubland (CEGL007997, G1)
- *Ceratiola ericoides - Quercus geminata - (Quercus inopina) - Serenoa repens / Cladonia* spp. - *Cladina* spp. Shrubland (CEGL003863, G2G3)
- *Pinus clausa / Ceratiola ericoides - Sabal etonia / Cladonia* spp. Woodland (CEGL003553, G1)
- *Pinus clausa / Quercus geminata - Quercus myrtifolia - (Quercus laevis) / Garberia heterophylla* Forest (CEGL007074, G2)
- *Pinus clausa / Quercus inopina* Woodland (CEGL003555, G1G2)
- *Pinus clausa / Quercus myrtifolia - Quercus geminata* Woodland (CEGL003556, G2)
- *Quercus inopina - Quercus geminata - Quercus chapmanii* Shrubland (CEGL003823, G2)
- *Quercus myrtifolia - Quercus geminata - Lyonia lucida - Lyonia ferruginea* Shrubland (CEGL008593, G1?)
- *Quercus myrtifolia - Quercus geminata - Quercus chapmanii* Shrubland (CEGL003825, G3)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Florida Longleaf Pine Sandhill (CES203.284)

DISTRIBUTION

Range: This system is endemic to the Florida Peninsula. It is most common in two discrete islands or patches, the Big Scrub of Ocala and the Lake Wales Ridge, which is now highly fragmented and mostly lost to agriculture and development (Weekley et al. 2008).
Divisions: 203:C
Nations: US
Subnations: FL
Map Zones: 55:C, 56:C
USFS Ecomap Regions: 232D:CC, 232G:CC, 232K:CC
TNC Ecoregions: 55:C

SOURCES

References: Abrahamson 1984, Breininger et al. 1996, Comer et al. 2003, Eyre 1980, FNAI 1990, Harper 1914, Harper 1927, Hokit et al. 1999, Johnson 1982, Kurz 1942, Laessle 1958, Laessle 1968, Lugo and Zucca 1983, MacAllister and Harper 1998, Menges 1994, Menges 1999, Menges 2007, Menges and Gordon 2010, Menges and Quintana-Ascencio 2004, Menges et al. 1993, Menges et al. 1999, Monk 1966, Mulvania 1931, Myers 1987, Myers 1990, Schmalzer and Hinkle 1992b, Schmalzer and Hinkle 1996, Vignoles 1823, Weekley and Menges 2003, Weekley et al. 2008
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723253#references
Description Author: R. Evans, mod. C.W. Nordman
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: R. Evans **ClassifResp:** Southeast

GREAT BASIN SEMI-DESERT CHAPARRAL (CES304.001)

CLASSIFIERS

Classification Status: Standard

Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Lower Montane]; Lowland [Foothill]; Shrubland (Shrub-dominated); Temperate [Temperate Continental]; Broad-Leaved Evergreen Shrub
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Evergreen shrubland
National Mapping Codes: EVT 2103; ESLF 5309; ESP 1103

CONCEPT

Summary: This system includes chaparral on sideslopes transitioning from low-elevation desert landscapes up into pinyon-juniper woodlands of the western and central Great Basin. There are limited occurrences extending as far west as the inner Coast Ranges in central California. These are typically fairly open-canopy shrublands with open spaces either bare or supporting patchy grasses and forbs. Characteristic species may include *Arctostaphylos patula, Arctostaphylos pungens, Ceanothus greggii, Ceanothus velutinus, Cercocarpus montanus var. glaber, Cercocarpus intricatus, Eriogonum fasciculatum, Garrya flavescens, Quercus turbinella, Purshia stansburiana*, and *Rhus trilobata*. *Cercocarpus ledifolius* is generally absent. Typical fire regime in these systems varies with the amount of organic accumulation.

Related Concepts:
- Bittercherry (419) (Shiflet 1994) Intersecting
- Chokecherry - Serviceberry - Rose (421) (Shiflet 1994) Intersecting. Moister inclusions of this system can be dominated by chokecherry, serviceberry and rose.
- Littleleaf Mountain-Mahogany (417) (Shiflet 1994) Intersecting
- Snowbush (420) (Shiflet 1994) Intersecting

Component Associations:
- *Arctostaphylos patula - Artemisia tridentata (ssp. vaseyana, ssp. wyomingensis)* Shrubland (CEGL002694, GNR)
- *Arctostaphylos patula - Quercus gambelii - (Amelanchier utahensis)* Shrubland (CEGL002695, GNR)
- *Arctostaphylos patula / Ceanothus velutinus - Ceanothus prostratus* Shrubland (CEGL000957, G3)
- *Arctostaphylos patula* Shrubland (CEGL002696, GNR)
- *Arctostaphylos pungens* Shrubland (CEGL000958, G4)
- *Purshia stansburiana / Pseudoroegneria spicata* Shrubland (CEGL001053, G2G4)
- *Purshia stansburiana* Shrubland (CEGL002957, GNR)
- *Quercus turbinella - (Amelanchier utahensis)* Colluvial Shrubland (CEGL002950, GNR)
- *Quercus turbinella - Ephedra viridis* Shrubland (CEGL000980, G3?)
- *Quercus turbinella - Juniperus osteosperma* Shrubland (CEGL000981, G4?)

DISTRIBUTION

Range: Western and central Great Basin.
Divisions: 206:C; 304:C
Nations: US
Subnations: CA, NV
Map Zones: 4:?, 6:C, 7:P, 9:C, 12:C, 13:C, 15:C, 16:?, 17:C, 18:C
USFS Ecomap Regions: 313A:??, 341A:CP, 341D:CC, 341E:CC, 341F:CC, 341G:CC, 342B:CC, 342C:CC, 342J:CP, M261E:CC, M341A:CC, M341D:CP
TNC Ecoregions: 11:C, 12:C, 15:P

SOURCES

References: Barbour and Major 1977, Comer et al. 2003, Sawyer and Keeler-Wolf 1995
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722704#references
Description Author: K. Schulz, P. Comer
Version: 24 Mar 2003
Concept Author: K. Schulz, P. Comer
Stakeholders: West
ClassifResp: West

GREAT BASIN XERIC MIXED SAGEBRUSH SHRUBLAND (CES304.774)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland [Foothill]; Shrubland (Shrub-dominated); Ridge/Summit/Upper Slope; Aridic; Low Artemisia spp.
Non-Diagnostic Classifiers: Montane [Montane]; Montane [Lower Montane]; Foothill(s); Hill(s); Piedmont; Plain; Plateau; Alluvial fan; Sideslope; Alluvial plain; Temperate [Temperate Continental]; Alkaline Soil; Shallow Soil
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Mixed evergreen-deciduous shrubland
National Mapping Codes: EVT 2079; ESLF 5256; ESP 1079

CONCEPT

Summary: This ecological system occurs in the Great Basin on dry flats and plains, alluvial fans, rolling hills, rocky hillslopes, saddles and ridges at elevations between 1000 and 2600 m. Sites are dry, often exposed to desiccating winds, with typically shallow, rocky, non-saline soils. Shrublands are dominated by *Artemisia nova* (mid and low elevations), *Artemisia arbuscula ssp. longicaulis*, or *Artemisia arbuscula ssp. longiloba* (higher elevation) and may be codominated by *Artemisia tridentata ssp. wyomingensis* or *Chrysothamnus viscidiflorus*. Other shrubs that may be present include *Atriplex confertifolia, Ephedra* spp., *Ericameria* spp., *Grayia spinosa, Lycium shockleyi, Picrothamnus desertorum, Sarcobatus vermiculatus*, and *Tetradymia* spp. The herbaceous layer is likely sparse and composed of perennial bunch grasses, such as *Achnatherum hymenoides, Achnatherum speciosum, Achnatherum thurberianum, Elymus elymoides*, or *Poa secunda*.

Related Concepts:
- Black Sagebrush (405) (Shiflet 1994) Intersecting
- Low Sagebrush (406) (Shiflet 1994) Intersecting. Drier portions of this SRM type overlap with this system.
- Wyoming Big Sagebrush (403) (Shiflet 1994) Intersecting. Drier portions of this SRM type overlap with this ecological system in the Great Basin region.

DESCRIPTION

Environment: This ecological system is widely distributed in the western United States. Climate is generally arid with 20 to 30 cm of annual precipitation and warm summers and cold winters. This shrubland system occurs at elevations from 1000 to 2600 m in the southwestern United States. It occupies flat to steeply sloping upland sites, on a wide variety of landform positions. These include toeslopes, lower and middle slopes, badly eroded badland slopes, and foothills. Sites with little slope tend to have deep soils, while those with steeper slopes have shallow to moderately deep soils that are well-drained. Sloping sites tend to have southerly aspects. Soil texture is loam, sandy loam, or clay loam (Hansen and Hoffman 1988), and there is often a significant amount of coarse fragments in the soil profile. Hironaka et al. (1983) reported that most of the habitat occurred on calcareous soils, often with a cemented duripan or silica hardpan at about 1 m in depth.
Dynamics: This shrubland system is associated with shallow, rocky soils which experience extreme drought in summer. The plants are low and widely spaced, which tends to decrease the risk of fire (Chappell et al. 1997). Barbour and Major (1988) report that *Artemisia nova* is utilized by livestock to a much greater degree than other species of *Artemisia*, resulting in low, pruned plants. *Artemisia nova* dwarf-shrublands grow in more xeric sites than other *Artemisia* shrublands. Blackburn and Tueller (1970) noted rapid invasion of these communities by *Juniperus osteosperma* and *Pinus monophylla* in Nevada, citing overgrazing coupled with fire suppression, and possibly climate change as causative variables.

Component Associations:
- *Artemisia arbuscula ssp. longicaulis - Grayia spinosa* Shrubland (CEGL002984, G4)
- *Artemisia arbuscula ssp. longicaulis / Elymus elymoides* Shrubland (CEGL002986, G3)
- *Artemisia arbuscula ssp. longiloba / Festuca idahoensis* Shrub Herbaceous Vegetation (CEGL001522, G2)
- *Artemisia arbuscula ssp. longiloba / Pascopyrum smithii* Shrub Herbaceous Vegetation (CEGL001415, GU)
- *Artemisia arbuscula ssp. longiloba / Poa secunda* Shrub Herbaceous Vegetation (CEGL001523, G3Q)
- *Artemisia arbuscula ssp. longiloba / Pseudoroegneria spicata* Shrub Herbaceous Vegetation (CEGL001416, GNR)
- *Artemisia arbuscula ssp. longiloba* Shrubland (CEGL001414, G4G5)
- *Artemisia nova - Ericameria nana* Shrubland (CEGL002773, G3)
- *Artemisia nova - Gutierrezia sarothrae / Bouteloua gracilis - Pleuraphis jamesii* Shrubland (CEGL001419, G4)
- *Artemisia nova / Achnatherum hymenoides* Shrubland (CEGL001422, G4G5)
- *Artemisia nova / Elymus elymoides* Shrubland (CEGL001418, G4G5)
- *Artemisia nova / Hesperostipa comata* Shrubland (CEGL001425, G3?)
- *Artemisia nova / Pleuraphis jamesii* Shrubland (CEGL001420, G3G5)
- *Artemisia nova / Poa fendleriana* Shrubland (CEGL002698, GNR)
- *Artemisia nova / Poa secunda* Shrubland (CEGL001423, G3)
- *Artemisia nova / Pseudoroegneria spicata* Shrubland (CEGL001424, G4G5)

- *Artemisia nova* Shrubland (CEGL001417, G3G5)
- *Artemisia tridentata ssp. wyomingensis - Atriplex confertifolia* Shrubland (CEGL001040, G3G5)
- *Artemisia tridentata ssp. wyomingensis - Purshia tridentata / Pseudoroegneria spicata* Shrubland (CEGL001050, G3Q)
- *Artemisia tridentata ssp. wyomingensis / Achnatherum hymenoides* Shrubland (CEGL001046, G5)
- *Artemisia tridentata ssp. wyomingensis / Achnatherum thurberianum* Shrubland (CEGL001052, G2)
- *Artemisia tridentata ssp. wyomingensis / Balsamorhiza sagittata* Shrubland (CEGL000994, G5)
- *Artemisia tridentata ssp. wyomingensis / Bouteloua gracilis* Shrubland (CEGL001041, G5)
- *Artemisia tridentata ssp. wyomingensis / Elymus elymoides* Shrubland (CEGL001043, G4G5)
- *Artemisia tridentata ssp. wyomingensis / Hesperostipa comata* Shrubland (CEGL001051, G2)
- *Artemisia tridentata ssp. wyomingensis* / Mixed Grasses Shrub Herbaceous Vegetation (CEGL001534, G5)
- *Artemisia tridentata ssp. wyomingensis / Poa secunda* Shrubland (CEGL001049, G4)
- *Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata* Shrub Herbaceous Vegetation (CEGL001535, G4)
- *Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata* Shrubland (CEGL001009, G5?)
- *Grayia spinosa / Achnatherum hymenoides* Shrubland (CEGL001350, G4)
- *Grayia spinosa / Artemisia nova / Achnatherum speciosum* Shrubland (CEGL001344, G4)

DISTRIBUTION

Range: This system occurs in the Great Basin on dry flats and plains, alluvial fans, rolling hills, rocky hillslopes, saddles and ridges at elevations between 1000 and 2600 m.
Divisions: 206:C; 304:C
Nations: US
Subnations: CA, ID?, NV, OR, UT, WY
Map Zones: 4:?, 6:P, 7:?, 9:C, 10:C, 12:C, 13:P, 16:C, 17:C, 18:C
USFS Ecomap Regions: 322A:CC, 341A:CC, 341D:CC, 341E:CC, 341F:CC, 341G:CC, 342B:CC, 342C:CC, 342D:CC, 342H:CC, 342J:CC, M261E:CC, M261G:C?, M331D:CC, M332G:CC, M341A:CC, M341C:CP, M341D:CC
TNC Ecoregions: 6:P, 11:C, 12:C, 18:P

SOURCES

References: Baker and Kennedy 1985, Barbour and Major 1988, Blackburn and Tueller 1970, Chappell et al. 1997, Comer et al. 2003, Hansen and Hoffman 1988, Hironaka et al. 1983, West 1983a
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722898#references
Description Author: Western Ecology Group, mod. M.S. Reid
Version: 25 Apr 2006 **Stakeholders:** West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

HAWAI'I ALPINE DWARF-SHRUBLAND (CES412.401)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Northern Polynesia (412)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Alpine/AltiAndino [Alpine/AltiAndino]; Lava; Cinder; Tropical/Subtropical [Tropical Xeric]; Dwarf-Shrub
Non-Diagnostic Classifiers: Long (>500 yrs) Persistence; Mountain(s); Shrubland (Shrub-dominated); Ridge/Summit/Upper Slope; Basalt
FGDC Crosswalk: Vegetated, Shrub-dominated, Dwarf-shrubland, Evergreen dwarf-shrubland
National Mapping Codes: EVT 2824; ESLF 5211; ESP 1824

CONCEPT

Summary: This ecological system occurs on dry alpine slopes of Maui and Hawai'i from near 3000 to 3400 m (9835-11,150 feet) elevation sometime extending down into the subalpine 2600 m (8525 feet) in arid zones. The wet trade winds frequently do not rise above 1900 m, being suppressed by the tropical inversion layer, leaving upper slopes too dry to support wet vegetation. Annual rainfall is generally 750-1250 mm and falls from October to March. Sites are wind-exposed. Frost is frequent, even during summer months. Substrates are well-drained and gravelly and derived from cinder and ash, but they can include glacial moraine. Vegetation is characterized by scattered dwarf-shrubs (10-20%) of *Argyroxiphium* spp., *Dubautia menziesii, Silene struthioloides*, and sometimes scattered *Coprosma ernodeoides, Geranium* spp., *Styphelia tameiameiae, Tetramolopium humile*, or *Vaccinium* spp. Also present may be scattered grasses (*Agrostis sandwicensis, Deschampsia nubigena, Trisetum glomeratum*), forbs (*Pseudognaphalium sandwicensium (= Gnaphalium sandwicensium)*), ferns (*Pellaea ternifolia, Asplenium adiantum-nigrum, Asplenium trichomanes*), lichens (*Lecanora melaena*), and mosses (*Grimmia haleakalae, Racomitrium* spp.).
Classification Comments: Dwarf-shrub refers to short shrubs (usually less than a half meter tall), not necessarily shrubs dwarfed by adverse environmental conditions.
Similar Ecological Systems:
- Hawai'i Alpine Bedrock and Scree (CES412.400)

Related Concepts:
- 'Ahinahina/Na'ena'e (*Argyroxiphium/Dubautia*) Shrubland (Gagne and Cuddihy 1990) Finer

DESCRIPTION

Environment: This alpine ecological system is restricted to the arid zone (Zone 1) of the 7 Moisture Zones developed for the Hawaiian Islands by Price et al. (2007). This ecological system occurs on dry alpine slopes of Maui and Hawai'i from near 3000 to 3400 m (9835-11,150 feet) elevation extending down into the subalpine (Gagne and Cuddihy 1990). The wet trade winds frequently do not rise above 1900 m, being suppressed by the tropical inversion layer, leaving upper slopes too dry to support wet vegetation (Mueller-Dombois and Fosberg 1998). Annual rainfall is generally 750-1250 mm and falls from October to March. Sites are wind exposed. Frost is frequent even during summer months. Substrates are well-drained and gravelly derived from cinder and ash, but can include glacial moraine.
Vegetation: Vegetation is characterized by scattered dwarf-shrubs (10-20%) of *Argyroxiphium* spp., *Dubautia menziesii, Silene struthioloides*, and sometimes scattered *Coprosma ernodeoides, Geranium* spp., *Styphelia tameiameiae, Tetramolopium humile*, or *Vaccinium* spp. (Gagne and Cuddihy 1990). Also present may be scattered grasses (*Agrostis sandwicensis, Deschampsia nubigena, Trisetum glomeratum*), forbs (*Pseudognaphalium sandwicensium (= Gnaphalium sandwicensium)*), ferns (*Pellaea ternifolia, Asplenium adiantum-nigrum, Asplenium trichomanes*), lichens (*Lecanora melaena*), and mosses (*Grimmia haleakalae, Racomitrium* spp.). *Coprosma ernodeoides* is a diagnostic species.

Component Associations:
- *Argyroxiphium sandwicense - Dubautia menziesii* Dry Dwarf-shrubland (CEGL008082, G1)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Hawai'i Montane-Subalpine Dry Forest and Woodland (CES412.402)
- Hawai'i Montane-Subalpine Dry Shrubland (CES412.403)

DISTRIBUTION

Range: This ecological system is restricted to dry alpine and upper subalpine slopes of Haleakala, Maui and Mauna Kea and Mauna Loa, Hawai'i above 3000 m.
Divisions: 412:C
Nations: US
Subnations: HI
Map Zones: 79:C
USFS Ecomap Regions: M423:C

TNC Ecoregions: 65:C

SOURCES

References: Gagne and Cuddihy 1990, Mueller-Dombois and Fosberg 1998, Price et al. 2007, Wagner et al. 1999, Western Ecology Working Group n.d.

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.821096#references

Description Author: K.A. Schulz, mod. S. Gon III

Version: 05 Mar 2009 **Stakeholders:** West

Concept Author: K.A. Schulz **ClassifResp:** West

HAWAI'I DRY CLIFF (CES412.414)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Primary Division: Northern Polynesia (412)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Tropical/Subtropical [Tropical Xeric]; Cliff (Landform)
Non-Diagnostic Classifiers: Montane; Lowland; Shrubland (Shrub-dominated); Very Shallow Soil; W-Landscape/Medium Intensity
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Evergreen shrubland
National Mapping Codes: EVT 2825; ESLF 5282; ESP 1825

CONCEPT

Summary: This ecological system occurs on dry cliffs away from the direct influence of the shoreline (surf, wind and salt spray) on the larger islands, extending up to montane and subalpine slopes on Maui and Hawai'i, from 15 to 3000 m (50-9835 feet) elevation. Stands occur on the leeward sides of islands in the rainshadows. Annual rainfall is generally low (500-1500 mm). Substrates include sandy loam soils derived from cinder, volcanic ash, and weathered basaltic lava with little soil development. Many sites are wind-exposed. Vegetation is variable but is generally sparse, composed of an open shrub or herbaceous layer, and restricted to ledges or less steep slopes. Common grass and fern species include *Deschampsia nubigena*, *Heteropogon contortus*, *Peperomia tetraphylla*, *Plectranthus parviflorus*, and *Trisetum glomeratum*, and shrubs such as *Artemisia mauiensis*, *Chamaesyce celastroides*, and *Psydrax odorata*. Stands are often weedy, being invaded by several introduced species such as *Melinis repens*, *Lantana camara*, *Leucaena leucocephala*, *Acacia farnesiana*, and *Prosopis pallida*.
Classification Comments: This system is based on a Hawaiian Mixed Shrub Lowland Dry Cliff (Gon and HNHP 2006). It should include higher elevation examples, up to subalpine on Maui, with notes on some different species present in higher vs. lower examples.
Related Concepts:
- Hawaiian Mixed Shrub Lowland Dry Cliff (Gon and HNHP 2006) Finer
- Vegetation on Dry Cliffs (Mueller-Dombois and Fosberg 1998) Equivalent

DESCRIPTION

Environment: This lowland to montane dry cliff ecological system occurs over a broad moisture range within the arid, very dry, and moderately dry zones (Zones 1, 2 and 3) of the 7 Moisture Zones developed for the Hawaiian Islands by Price et al. (2007). This ecological system occurs on dry cliffs away from the direct influence of the shoreline (surf, wind and salt spray) on the larger islands, extending up to montane and subalpine slopes on Maui and Hawai'i, from 15 to 3000 m (50-9835 feet) elevation. Stands occur on the leeward sides of islands in the rainshadows. Annual rainfall is generally low (500-1500 mm). Substrates include sandy loam soils derived from cinder, volcanic ash, and weathered basaltic lava with little soil development. Many sites are wind-exposed.
Vegetation: Vegetation is variable but is generally sparse, composed of an open shrub or herbaceous layer, and restricted to ledges or less steep slopes. Common grass and fern species include *Deschampsia nubigena*, *Heteropogon contortus*, *Peperomia tetraphylla*, *Plectranthus parviflorus*, and *Trisetum glomeratum*, and shrubs include *Artemisia mauiensis*, *Chamaesyce celastroides*, and *Psydrax odorata*. Stands are often weedy, being invaded by several introduced species such as *Melinis repens*, *Lantana camara*, *Leucaena leucocephala*, *Acacia farnesiana*, and *Prosopis pallida*.
Dynamics: Goats have destroyed the vegetation in many dry cliff areas to where the original vegetation is unknown (Mueller-Dombois and Fosberg 1998). Landslides are the only common natural disturbance. Fire could possibly burn because of pili grass presence, but does not really affect vegetation structure and composition.

DISTRIBUTION

Range: This ecological system occurs on the larger Hawai'ian islands on dry cliffs away from the direct influence of the shoreline.
Divisions: 412:C
Nations: US
Subnations: HI
Map Zones: 79:C
USFS Ecomap Regions: M423:C
TNC Ecoregions: 65:C

SOURCES

References: Gagne and Cuddihy 1990, Gon and HNHP 2006, Mueller-Dombois and Fosberg 1998, Price et al. 2007, Shaw and Castillo 1997, Wagner et al. 1999, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.821141#references
Description Author: K.A. Schulz, mod. S. Gon III
Version: 02 Feb 2009
Stakeholders: West
Concept Author: K.A. Schulz
ClassifResp: West

HAWAI'I DRY COASTAL STRAND (CES412.418)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Northern Polynesia (412)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Shoreline; Grassland, Savanna, Steppe (graminoid-dominated); Tropical/Subtropical [Tropical Xeric]; Salt Spray; Coast
Non-Diagnostic Classifiers: Lowland [Lowland]; Shrubland (Shrub-dominated); Woody-Herbaceous; Herbaceous; Beach (Substrate); Lava; Basalt
FGDC Crosswalk: Vegetated, Shrub-dominated, Dwarf-shrubland, Evergreen dwarf-shrubland
National Mapping Codes: EVT 2826; ESLF 5212; ESP 1826

CONCEPT

Summary: This coastal ecological system occurs on the drier leeward side of the larger Hawaiian Islands and on all sides of the smaller, arid islands and atolls that are widespread in the northwestern Hawaiian Islands. Annual precipitation is usually less than 1200 mm. Stands are restricted to the shoreline and the zone immediately back of it where sites are strongly influenced by surf, wind and salt spray. Substrates are variable, ranging from gentle to steep rocky, cobbly shores, derived from tuff or disintegrating lava or raised coral beds (limestone), and lava flows (basalt) to flat surf-pounded sandy beaches, some with adjacent dunes or low alkaline flats above the saturated zone and behind the high-tide mark. Vegetation varies largely with substrate but tends to be sparse and patchy. Stands include succulent herbs, low wind-sheared shrubs, grasslands, a mix of shrub and grass or taller shrublands. Native species that may be dominant locally include graminoids *Fimbristylis cymosa, Eragrostis variabilis*, or *Sporobolus virginicus*, or forbs *Boerhavia acutifolia, Boerhavia repens, Nama sandwicense*, and *Sesuvium portulacastrum*, or *Sida fallax* mats with *Jacquemontia ovalifolia ssp. sandwicensis* or *Scaevola sericea* shrubs. Other shrubs, such as *Chamaesyce celastroides, Chenopodium oahuense, Gossypium tomentosum, Heliotropium anomalum, Lipochaeta* spp., *Myoporum sandwicense, Scaevola coriacea, Tetramolopium rockii, Tribulus cistoides*, and *Vitex rotundifolia*, may also dominate stands.
Classification Comments: Wet salt marshes belong to Northern Polynesia Tidal Salt Marsh (CES412.224) which includes barren beaches to thick dry grasses on the back sides of sand dunes.
Similar Ecological Systems:
- Hawai'i Lowland Dry Grassland (CES412.410)
- Hawai'i Lowland Dry Shrubland (CES412.409)
- Hawai'i Mesic Coastal Forest (CES412.417)

DESCRIPTION

Environment: This coastal ecological system occurs on the drier leeward side of the larger Hawaiian Islands and on all sides of the smaller, arid islands and atolls that are widespread in the Northwest Hawaiian Islands. Annual precipitation is usually less than 1200 mm. This arid to moderately dry coastal strand ecological system occurs within the arid, very dry, and moderately dry zones (Zones 1, 2 and 3) of the 7 Moisture Zones developed for the Hawaiian Islands by Price et al. (2007). Stands are restricted to the shoreline and the zone immediately back of it where sites are strongly influenced by surf, wind and salt spray. Substrates are variable, ranging from gentle to steep rocky, cobbly shores, derived from tuff or disintegrating lava or raised coral beds (limestone), and lava flows (basalt) to flat surf-pounded sandy beaches, some with adjacent dunes or low alkaline flats above the saturated zone and behind the high-tide mark. This habitat is driven by its proximity to the sea, with wind and salt spray and dry climate.
Vegetation: The dry strand vegetation varies largely with substrate but tends to be sparse and patchy. Stands include succulent herbs, low wind-sheared shrubs, grasslands, a mix of shrub and grass or taller shrublands. Native species that may be dominant locally include graminoids *Fimbristylis cymosa, Eragrostis variabilis*, or *Sporobolus virginicus*, or forbs *Boerhavia acutifolia, Boerhavia repens, Nama sandwicense*, and *Sesuvium portulacastrum*, or *Sida fallax* mats with *Jacquemontia ovalifolia ssp. sandwicensis* or *Scaevola sericea* shrub. Other shrubs, such as *Chamaesyce celastroides, Chenopodium oahuense, Gossypium tomentosum, Heliotropium anomalum, Lipochaeta* spp., *Myoporum sandwicense, Scaevola coriacea, Tetramolopium rockii, Tribulus cistoides*, and *Vitex rotundifolia*, may also dominate stands. Other common native dry strand species are *Capparis sandwichiana, Chamaesyce degeneri, Chamaesyce skottsbergii, Cocos nucifera, Cordia subcordata, Cyperus javanicus, Lycium sandwicense, Heliotropium curassavicum, Heteropogon contortus, Ipomoea pes-caprae, Nama sandwicense, Pandanus tectorius, Panicum fauriei, Panicum torridum, Pseudognaphalium sandwicensium, Sesbania tomentosa, Solanum nelsonii, Tetramolopium rockii, Vigna marina*, and *Waltheria indica* (Warshauer et al. 2008). Many species occur in both dry strand and wet-mesic strand, including *Chenopodium oahuense, Nama sandwicense, Panicum fauriei, Panicum torridum, Sesbania tomentosa, Tetramolopium rockii*, and Waltheria indica (Warshauer et al. 2008). Disturbed stands are often weedy, being invaded by several introduced species such as *Melinis repens, Lantana camara, Leucaena leucocephala, Acacia farnesiana*, and *Prosopis pallida*.

Component Associations:
- *Chamaesyce celastroides* Coastal Dry Dwarf-shrubland (CEGL008075, G1)
- *Chenopodium oahuense* Coastal Dry Dwarf-shrubland (CEGL008083, G2)

- *Eragrostis variabilis* Coastal Dry Herbaceous Vegetation (CEGL008087, G3)
- *Gossypium tomentosum* Coastal Dry Shrubland (CEGL008064, G1)
- *Heliotropium anomalum* Coastal Dry Dwarf-shrubland (CEGL008084, G3)
- *Ipomoea* spp. Herbaceous Vegetation (CEGL008096, G3)
- *Lipochaeta* spp. Coastal Dry Dwarf-shrubland (CEGL008076, G3)
- *Myoporum sandwicense* Coastal Dry Shrubland (CEGL008050, G1)
- *Scaevola coriacea* Coastal Dry Dwarf-shrubland (CEGL008072, G1)
- *Scaevola sericea* Coastal Dry Shrubland (CEGL008054, G4)
- *Sida fallax* Coastal Dry Dwarf-shrubland (CEGL008078, G3)
- *Sida fallax* Coastal Dry Shrubland (CEGL008055, G3)
- *Sporobolus virginicus* Coastal Dry Shrub Herbaceous Vegetation (CEGL008094, G4)
- *Tetramolopium rockii* Coastal Dry Dwarf-shrubland (CEGL008099, G1)
- *Tribulus cistoides* Coastal Dry Dwarf-shrubland (CEGL008079, G2)
- *Vitex rotundifolia* Coastal Dry Dwarf-shrubland (CEGL008073, G3)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Hawai'i Mesic Coastal Forest (CES412.417)

DISTRIBUTION

Range: This ecological system occurs on sandy coastlines on Midway Atoll and all of the main Hawaiian Islands.
Divisions: 412:C
Nations: US
Subnations: HI
Map Zones: 79:C
USFS Ecomap Regions: M423:C
TNC Ecoregions: 65:C

SOURCES

References: Gagne and Cuddihy 1990, Mueller-Dombois and Fosberg 1998, Price et al. 2007, Wagner et al. 1999, Warshauer et al. 2008, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.821170#references
Description Author: K.A. Schulz
Version: 03 Feb 2009 **Stakeholders:** West
Concept Author: Western Ecology Working Group **ClassifResp:** West

HAWAI'I LOWLAND DRY SHRUBLAND (CES412.409)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Northern Polynesia (412)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland; Shrubland (Shrub-dominated); Tropical/Subtropical [Tropical Xeric]
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Evergreen shrubland
National Mapping Codes: EVT 2817; ESLF 5283; ESP 1817

CONCEPT

Summary: Dry lowland shrublands occur mostly on the leeward side of all the main islands except Ni'ihau and Kaho'olawe, and are found between 10 and 1000 m in elevation. These shrublands are generally less than 2 m in height. These shrublands occur on open gentle slopes to steep ridges of dissected slopes. Rainfall is 500-1500 mm, mostly restricted to the winter months, with summers hot and dry. Soils vary from silty loams to relatively unweathered pÃ¢hoehoe lava. Vegetation consists of a low shrubland dominated by *Dodonaea viscosa, Bidens* spp., *Sesbania tomentosa*, or *Wikstroemia* spp. Indicators species of this system include *Abutilon* spp., *Achyranthes* spp., *Capparis sandwichiana, Gossypium* spp., *Hibiscus brackenridgei, Plectranthus parviflorus (= Plectranthus australis), Portulaca* spp., and *Waltheria* spp. Stands often have other native shrubs such as *Argemone glauca, Canthium odoratum, Canavalia* spp., *Chamaesyce* spp., *Cassytha filiformis, Ipomoea* spp., *Lipochaeta* spp., *Nototrichium* spp., *Osteomeles anthyllidifolia, Peperomia tetraphylla, Peperomia leptostachya, Santalum ellipticum, Senna gaudichaudii, Sicyos* spp., *Myoporum sandwicense, Sida fallax*, and *Styphelia tameiameiae*; fern species of *Doryopteris* and *Pellaea*; and grass species of *Panicum* and also alien grasses such as *Pennisetum setaceum*. The density and height of shrubs may be reduced by recent fire or increased with increased moisture, for example when near riparian areas. Lowland dry shrublands are relatively intolerant to grazing pressure and fire and are replaced by alien-dominated communities when subject to these disturbances.
Classification Comments: This dry shrubland system grades into the dry coastal strand system near the leeward coasts. Coastal dry shrublands that are affected by immediate sea coast processes (salt spray and salinity) are classified in the dry coastal strand ecological system.
Similar Ecological Systems:
- Hawai'i Dry Coastal Strand (CES412.418)
- Hawai'i Lowland Dry Grassland (CES412.410)

Related Concepts:
- Nehe (*Lipochaeta*) Shrubland (Gagne and Cuddihy 1990) Finer

DESCRIPTION

Environment: This lowland ecological system occurs over a broad moisture range within the arid, very dry, moderately dry, and seasonally mesic zones (Zones 1, 2, 3 and 4) of the 7 Moisture Zones developed for the Hawaiian Islands by Price et al. (2007). Dry lowland shrublands occur mostly on the leeward side of all the main islands except Ni'ihau and Kaho'olawe, and are found between 10 and 1000 m in elevation. These shrublands are generally less than 2 m in height. These shrublands occur on open gentle slopes to steep ridges of dissected slopes. Rainfall is 500-1500 mm, mostly restricted to the winter months, with summers hot and dry. Soils vary from silty loams to relatively unweathered pÃ¢hoehoe lava.
Vegetation: Vegetation consists of a low shrubland dominated by *Dodonaea viscosa, Bidens* spp., *Sesbania tomentosa*, or *Wikstroemia* spp. Indicators species of this system include *Abutilon* spp., *Achyranthes* spp., *Capparis sandwichiana, Gossypium* spp., *Hibiscus brackenridgei, Plectranthus parviflorus (= Plectranthus australis), Portulaca* spp., and *Waltheria* spp. Stands often have other native shrubs such as *Argemone glauca, Canthium odoratum, Canavalia* spp., *Chamaesyce* spp., *Cassytha filiformis, Ipomoea* spp., *Lipochaeta* spp., *Nototrichium* spp., *Osteomeles anthyllidifolia, Peperomia tetraphylla, Peperomia leptostachya, Santalum ellipticum, Senna gaudichaudii, Sicyos* spp., *Myoporum sandwicense, Sida fallax*, and *Styphelia tameiameiae*; fern species of *Doryopteris* and *Pellaea*; and grass species of *Panicum* and as well as alien grasses such as *Pennisetum setaceum*.
Dynamics: The density and height of shrubs may be reduced by recent fire or increased with increased moisture, for example when near riparian areas. Lowland dry shrublands are relatively intolerant to grazing pressure and fire and are replaced by alien-dominated communities when subject to these disturbances. Severe drought can favor grasses. Burning by early Hawaiians to encourage *Heteropogon contortus* may have suppressed shrubs in favor of grasses.

Component Associations:
- *Artemisia australis - Dodonaea viscosa* Lowland Dry Dwarf-shrubland (CEGL008065, G3)
- *Bidens* spp. Lowland Dry Dwarf-shrubland (CEGL008067, G3)
- *Canthium odoratum* Lowland Dry Shrubland (CEGL008056, G2)
- *Dodonaea viscosa* Lowland Dry Shrubland (CEGL008059, G4)
- *Sesbania tomentosa* Lowland Dry Dwarf-shrubland (CEGL008077, G1)
- *Wikstroemia* spp. / *Dodonaea* spp. / *Osteomeles anthyllidifolia* Lowland Dry Dwarf-shrubland (CEGL008074, G3)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:

- Hawai'i Lowland Mesic Shrubland (CES412.412)

DISTRIBUTION

Range: This dry lowland forest ecological system occurs on the leeward side of all islands except Ni'ihau and Kaho'olawe.
Divisions: 412:C
Nations: US
Subnations: HI
Map Zones: 79:C
USFS Ecomap Regions: M423:C
TNC Ecoregions: 65:C

SOURCES

References: Gagne and Cuddihy 1990, Price et al. 2007, Wagner et al. 1999, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.821126#references
Description Author: G. Kittel, mod. K.A. Schulz
Version: 05 Mar 2009 **Stakeholders:** West
Concept Author: K.A. Schulz **ClassifResp:** West

HAWAI'I LOWLAND MESIC SHRUBLAND (CES412.412)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Northern Polynesia (412)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland; Shrubland (Shrub-dominated); Tropical/Subtropical [Tropical Pluviseasonal]; Very Shallow Soil
Non-Diagnostic Classifiers: Ridge/Summit/Upper Slope
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Evergreen shrubland
National Mapping Codes: EVT 2818; ESLF 5334; ESP 1818

CONCEPT

Summary: Communities in this ecological system occur between 30 and 850 m (262-2800 feet) elevation on all of the main islands except Kaho'olawe; they are well-developed on leeward Moloka'i and leeward western Maui. The climate is seasonal, with hot dry summers and primarily winter rainfall (up to 2000 mm annually). These shrublands develop where forests cannot be supported, such as ridgetops subject to seasonal drought. Soils are often thin and easily dried out. Vegetation has an open to closed canopy, up to 3 m (10 feet) in height, with varying herbaceous undergrowth. Common species include shrubby *Metrosideros polymorpha, Chamaesyce* spp., *Cladonia* (lichen), *Cocculus* spp., *Dicranopteris* spp., *Dodonaea viscosa, Korthalsella* spp., *Lobelia yuccoides, Osteomeles anthyllidifolia, Pittosporum* spp., *Sadleria* spp., *Scaevola gaudichaudiana, Scaevola gaudichaudii, Odontosoria (= Sphenomeris), Styphelia tameiameiae, Vaccinium* spp., and *Wikstroemia* spp. Grass cover is relatively sparse, usually less than 10% in historic times. Common graminoids are *Carex* spp., *Dianella* spp., *Eragrostis variabilis, Gahnia* spp., and *Luzula* spp.
Related Concepts:
- 'Ã›lei (*Osteomeles*) Shrubland (Gagne and Cuddihy 1990) Finer
- Ã”hi'a (*Metrosideros polymorpha*) Shrubland (Gagne and Cuddihy 1990) Finer
- Iliau (*Wilkesia*) Shrubland (Gagne and Cuddihy 1990) Finer
- PÃ»kiawe/'A'ali'i (*Styphelia/Dodoneae*) Shrubland (Gagne and Cuddihy 1990) Finer

DESCRIPTION

Environment: This lowland ecological system occurs mostly within the seasonally mesic and moist mesic zones (Zones 4 and 5) of the 7 Moisture Zones developed for the Hawaiian Islands by Price et al. (2007), but may extend into the moderately dry (Zone 3) at lower elevation (<300 m). Communities in this ecological system occur between 30 and 850 m (262-2800 feet) elevation on all of the main islands except Kaho'olawe; they are well-developed on leeward Moloka'i and leeward western Maui. The climate is seasonal, with hot dry summers and primarily winter rainfall (up to 2000 mm annually). These shrublands develop where forests cannot be supported, such as ridgetops subject to seasonal drought. They occupy large bands below mesic forest and above lowland dry systems. Soils are often thin and easily dried out.
Vegetation: Vegetation has an open to closed canopy, up to 3 m (10 feet) in height, with varying herbaceous undergrowth. Common species include shrubby *Metrosideros polymorpha, Chamaesyce* spp., *Cladonia* (lichen), *Cocculus* spp., *Dicranopteris* spp., *Dodonaea viscosa, Korthalsella* spp., *Lobelia yuccoides, Osteomeles anthyllidifolia, Pittosporum* spp., *Sadleria* spp., *Scaevola gaudichaudiana, Scaevola gaudichaudii, Odontosoria (= Sphenomeris), Styphelia tameiameiae, Vaccinium* spp., and *Wikstroemia* spp. Grass cover is relatively sparse, usually less than 10% in historic times. Common graminoids are *Carex* spp., *Dianella* spp., *Eragrostis variabilis, Gahnia* spp., and *Luzula* spp.

Component Associations:
- *Dodonaea viscosa - Styphelia tameiameiae* Lowland Mesic Shrubland (CEGL008058, G3)
- *Metrosideros polymorpha* Lowland Mesic Shrubland (CEGL008062, G3)
- *Osteomeles anthyllidifolia* Lowland Mesic Dwarf-shrubland (CEGL008070, G3)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Hawai'i Lowland Dry Shrubland (CES412.409)
- Hawai'i Lowland Mesic Forest (CES412.411)

DISTRIBUTION

Range: This system occurs on all of the main islands except Kaho'olawe.
Divisions: 412:C
Nations: US
Subnations: HI
Map Zones: 79:C
USFS Ecomap Regions: M423:C
TNC Ecoregions: 65:C

SOURCES

References: Gagne and Cuddihy 1990, Mueller-Dombois and Fosberg 1998, Price et al. 2007, Wagner et al. 1999, Western Ecology Working Group n.d.

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.821135#references

Description Author: G. Kittel, mod. Sam Gon III and K.A. Schulz

Version: 05 Mar 2009 **Stakeholders:** West

Concept Author: K.A. Schulz **ClassifResp:** West

HAWAI'I MONTANE-SUBALPINE DRY SHRUBLAND (CES412.403)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Northern Polynesia (412)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Upper Montane]; Montane [Montane]; Shrubland (Shrub-dominated); Tropical/Subtropical [Tropical Xeric]; Broad-Leaved Evergreen Shrub
Non-Diagnostic Classifiers: Mountainside
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Evergreen shrubland
National Mapping Codes: EVT 2821; ESLF 5284; ESP 1821

CONCEPT

Summary: This ecological system occurs on dry slopes of higher mountains of Maui and Hawai'i, from near 900 to 3000 m (2950-9835 feet) elevation. An inversion layer of warmer air forms 50-70% of the time between 1600 and 3000 m that dramatically reduces precipitation at higher elevations. This is because the wet trade winds generally do not rise above 1900 m (6230 feet) and are deflected around the mountains, leaving upper slopes too dry to support rain forests. Stands also occur at lower elevations on leeward sides of islands where there is a strong rainshadow effect. Annual rainfall is generally 400-1500 mm. Many sites are wind-exposed. Substrates include cinder, well-drained, sandy loam soils derived from volcanic ash, and weathered 'a'Ã¢ or pÃ¢hoehoe basaltic lava with little soil development. Vegetation is often dominated by an open to dense shrub layer dominated by one or more of *Dodonaea viscosa, Styphelia tameiameiae, Chenopodium oahuense*, shrubby *Metrosideros*, and *Vaccinium* spp. *Dubautia linearis* is a diagnostic species. Other shrubs may include *Argyroxiphium* spp., *Bidens menziesii, Chamaesyce* spp., *Dubautia ciliolata, Dianella* spp., *Exocarpos* spp., *Geranium cuneatum, Lipochaeta* spp., *Osteomeles anthyllidifolia, Sida fallax, Silene* spp., and *Tetramolopium* spp. Scattered *Metrosideros polymorpha, Sophora chrysophylla*, or *Myoporum sandwicense* trees may be present in some stands. Shrubs extend up to 3 m on relatively mesic, protected sites. Native bunch grasses and forbs (especially rosettes) and ferns are present (e.g., *Sadleria cyatheoides, Pellaea ternifolia, Asplenium* spp.), but contribute low cover at higher elevation. Grasses can be more abundant at montane elevations but are generally sparse. Native graminoids include *Eragrostis atropioides, Deschampsia nubigena (= Deschampsia australis), Eragrostis deflexa, Gahnia* spp., and *Luzula* spp. Fire-adapted exotic grasses such as *Pennisetum setaceum* are invasive and threaten these dry shrublands by increasing fire intensity, frequency and size. The exotic rosette forb *Verbascum thapsus* is a common in many stands.

Similar Ecological Systems:
- Hawai'i Lowland Dry Grassland (CES412.410)
- Hawai'i Montane-Subalpine Dry Forest and Woodland (CES412.402)
- Hawai'i Montane-Subalpine Dry Grassland (CES412.405)
- Hawai'i Montane-Subalpine Mesic Forest (CES412.406)

Related Concepts:
- *Chenopodium* Scrub (Mueller-Dombois and Fosberg 1998) Finer
- *Chenopodium* Shrubland (Shaw and Castillo 1997) Finer
- *Dodonaea* Mixed Shrubland (Shaw and Castillo 1997) Finer
- *Styphelia-Dodonaea* Shrubland (Shaw and Castillo 1997) Finer
- *Styphelia* Mixed Shrubland (Shaw and Castillo 1997) Finer
- *Styphelia*-dominated Heath Scrub (Mueller-Dombois and Fosberg 1998) Finer
- Montane Dry Shrubland (Gagne and Cuddihy 1990) Equivalent
- Open *Dodonaea* Shrubland (Shaw and Castillo 1997) Finer
- Subalpine Dry Shrubland (Gagne and Cuddihy 1990) Equivalent

DESCRIPTION

Environment: This montane to subalpine ecological system occurs within the very dry and moderately dry zones (Zones 2 and 3) of the 7 Moisture Zones developed for the Hawaiian Islands by Price et al. (2007). This ecological system occurs on dry slopes of higher mountains of Maui and Hawai'i, from near 900 to 3000 m (2950-9835 feet) elevation. An inversion layer of warmer air forms 50-70% of the time between 1600 and 3000 m that dramatically reduces precipitation at higher elevations (Gagne and Cuddihy 1990). This is because the wet trade winds generally do not rise above 1900 m (6230 feet) and are deflected around the mountains, leaving upper slopes too dry to support rain forests (Mueller-Dombois and Fosberg 1998). Stands also occur at lower elevations on leeward sides of islands where there is a strong rainshadow effect. Annual rainfall is generally 400-1500 mm. Many sites are wind-exposed. Substrates include cinder, well-drained, sandy loam soils derived from volcanic ash, and weathered 'a'Ã¢ or pÃ¢hoehoe basaltic lava with little soil development.

Vegetation: Vegetation is often dominated by an open to dense shrub layer dominated by one or more of *Dodonaea viscosa, Styphelia tameiameiae, Chenopodium oahuense*, shrubby *Metrosideros*, and *Vaccinium* spp. *Dubautia linearis* is a diagnostic species. Other shrubs may include *Bidens menziesii, Chamaesyce* spp., *Dubautia ciliolata, Dianella* spp., *Exocarpos* spp., *Geranium*

cuneatum, Osteomeles anthyllidifolia, Silene spp., *Argyroxiphium* spp., *Lipochaeta* spp., *Sida fallax,* and *Tetramolopium* spp. Scattered *Metrosideros polymorpha, Sophora chrysophylla,* or *Myoporum sandwicense* trees may be present in some stands. Shrubs extend up to 3 m on relatively mesic, protected sites. Native bunch grasses and forbs (especially rosettes) and ferns are present (e.g., *Sadleria cyatheoides, Pellaea ternifolia, Asplenium* spp.), but contribute low cover at higher elevation. Grasses can be more abundant at montane elevations but are generally sparse. Native graminoids include *Eragrostis atropioides, Deschampsia nubigena (= Deschampsia australis), Eragrostis deflexa, Gahnia* spp., and *Luzula* spp. Fire-adapted exotic grasses such as *Pennisetum setaceum* are invasive and threaten these dry shrublands by increasing fire intensity, frequency and size (Castillo 1997). The exotic rosette forb *Verbascum thapsus* is a common in many stands.

Dynamics: These dry shrublands have broad transition zones with dry woodlands dominated by *Metrosideros polymorpha, Sophora chrysophylla,* or *Myoporum sandwicense* trees. In areas below upper treeline, these shrublands may exist as a persistent seral stage maintained by disturbance such as periodic fire. More frequent burning because of presence of fire-adapted exotic grasses such as *Pennisetum setaceum* has converted stands of this dry shrubland to introduced grassland (Castillo 1997).

Component Associations:

- *Chenopodium oahuense* Subalpine Dry Shrubland (CEGL008053, G1)
- *Dodonaea viscosa* Subalpine Dry Shrubland (CEGL008060, G3)
- *Metrosideros polymorpha / Dodonaea viscosa* Montane Dry Shrubland (CEGL008061, G3)
- *Styphelia tameiameiae* Subalpine Dry Shrubland (CEGL008063, G3)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:

- Hawai'i Alpine Dwarf-Shrubland (CES412.401)
- Hawai'i Montane-Subalpine Dry Forest and Woodland (CES412.402)
- Hawai'i Montane-Subalpine Dry Grassland (CES412.405)

DISTRIBUTION

Range: This shrubland ecological system is restricted to drier upper slopes of the higher mountains of Maui (Haleakala) and Hawai'i (Mauna Kea, Mauna Loa, and Hualalai).
Divisions: 412:C
Nations: US
Subnations: HI
Map Zones: 79:C
USFS Ecomap Regions: M423:C
TNC Ecoregions: 65:C

SOURCES

References: Castillo 1997, Gagne and Cuddihy 1990, Mueller-Dombois and Fosberg 1998, Price et al. 2007, Shaw and Castillo 1997, Wagner et al. 1999, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.821102#references
Description Author: K.A. Schulz
Version: 06 Aug 2009 **Stakeholders:** West
Concept Author: K.A. Schulz **ClassifResp:** West

HAWAI'I SUBALPINE MESIC SHRUBLAND (CES412.404)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Northern Polynesia (412)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Upper Montane]; Shrubland (Shrub-dominated); Tropical/Subtropical [Tropical Pluviseasonal]
Non-Diagnostic Classifiers: Mountainside
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Evergreen shrubland
National Mapping Codes: EVT 2828; ESLF 5285; ESP 1828

CONCEPT

Summary: This ecological system occurs on mesic, windward slopes of eastern Maui and outer north slopes of Haleakala Crater, from 1950 to 2300 m elevation and the upper Kaupo Gap area east-southeast of Haleakala Crater. Sites include ridges and upper slopes that are dissected. Annual precipitation is 1300-1900 mm with rain distributed fairly evenly throughout the year. The thin cinder-derived soil has many rock outcrops. Vegetation is a closed shrubland dominated by *Sadleria cyatheoides* and *Vaccinium calycinum*. At higher elevations and on ridges, there is a single shrub layer 1-1.2 m tall; at lower elevation, stands often have two shrub layers: a tall *Vaccinium*-dominated shrub layer (2 m tall) emergent over a 1-m tall dense shrub layer dominated by other shrubs. Other characteristic shrubs include *Coprosma ernodeoides, Geranium multiflorum, Rubus hawaiensis, Rubus macraei,* and *Vaccinium reticulatum*. *Lycopodium venustulum* is important in the Kipahulu Valley stands. *Dodonaea viscosa* and *Styphelia tameiameiae* are important shrubs in the upper Kaupo Gap area east-southeast of Haleakala Crater. Herbaceous species are generally sparse, e.g., *Deschampsia nubigena* and *Fragaria chiloensis ssp. sandwicensis*. Ferns include *Dryopteris wallichiana* and *Pteridium aquilinum*.
Similar Ecological Systems:
- Hawai'i Montane-Subalpine Mesic Forest (CES412.406)

Related Concepts:
- Subalpine Mesic Shrubland (Gagne and Cuddihy 1990) Equivalent

DESCRIPTION

Environment: This montane to subalpine ecological system occurs within the seasonal mesic zone (Zone 4) of the 7 Moisture Zones developed for the Hawaiian Islands by Price et al. (2007). This ecological system occurs on mesic, windward slopes of eastern Maui and outer north slopes of Haleakala Crater, from 1950 to 2300 m elevation. It extends to the upper Kaupo Gap area east-southeast of Haleakala Crater Sites include ridges and upper slopes that are dissected. Annual precipitation is 1300-1900 mm with rain distributed fairly evenly throughout the year. The thin cinder-derived soil has many rock outcrops (Gagne and Cuddihy 1990, J. Jacobi pers. comm.).

Vegetation: Vegetation is a closed shrubland dominated by *Sadleria cyatheoides* and *Vaccinium calycinum*. At higher elevations and on ridges, there is a single shrub layer 1-1.2 m tall; at lower elevation, stands often have two shrub layers: a tall *Vaccinium*-dominated shrub layer (2 m tall) emergent over a 1-m tall dense shrub layer dominated by other shrubs. Other characteristic shrubs include *Coprosma ernodeoides, Geranium multiflorum, Rubus hawaiensis, Rubus macraei,* and *Vaccinium reticulatum*. *Lycopodium venustulum* is important in the Kipahulu Valley stands. *Dodonaea viscosa* and *Styphelia tameiameiae* are important shrubs in the upper Kaupo Gap area east-southeast of Haleakala Crater. Herbaceous species are generally sparse, e.g., *Deschampsia nubigena* and *Fragaria chiloensis ssp. sandwicensis*. Ferns include *Dryopteris wallichiana* and *Pteridium aquilinum*. Diagnostic species for this system are *Vaccinium calycinum, Geranium multiflorum, Rubus hawaiensis,* and *Rubus macraei*.

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Hawai'i Montane Rainforest (CES412.215)
- Hawai'i Montane-Subalpine Mesic Forest (CES412.406)

Adjacent Ecological System Comments: There is a narrow band of mesic forest below that transitions quickly to the rainforest. Above is the dry shrubland

DISTRIBUTION

Range: These mesic shrublands have a narrow range and are only found in a relative narrow subalpine band on the windward side of Haleakala on eastern Maui, Hawai'i.
Divisions: 412:C
Nations: US
Subnations: HI
Map Zones: 79:C
USFS Ecomap Regions: M423:C
TNC Ecoregions: 65:C

SOURCES

References: Gagne and Cuddihy 1990, Jacobi pers. comm., Price et al. 2007, Wagner et al. 1999, Western Ecology Working Group n.d.

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.821105#references

Description Author: K.A. Schulz

Version: 06 Aug 2009 **Stakeholders:** West

Concept Author: K.A. Schulz **ClassifResp:** West

HAWAI'I WET CLIFF AND RIDGE CREST SHRUBLAND (CES412.218)

CLASSIFIERS

Classification Status: Standard

Primary Division: Northern Polynesia (412)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Ridge; Shrubland (Shrub-dominated); Ridge/Summit/Upper Slope; Tropical/Subtropical [Tropical Pluvial]; Tropical/Subtropical [Tropical Pluviseasonal]; Landslide; Cliff (Landform)
Non-Diagnostic Classifiers: Montane; Lowland
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Evergreen shrubland
National Mapping Codes: EVT 2811; ESLF 5274; ESP 1811

CONCEPT

Summary: This ecological system occupies crests of steep ridges and cliff faces throughout the main Hawaiian Islands. These environments are characterized by regularly windy and usually foggy and wet conditions. Soils are generally thin over soft, highly weathered rock and thin mucky clays. Vegetation is windswept and variable, ranging from dense dwarf-shrublands to dominant sedges with few scattered shrubs to sparse rock with very little plant life. Wind-stunted trees and shrubs are 1-3 m in height, are clothed with masses of epiphytic cryptogams, and have a diverse array of native shrubs, vines, herbs and ferns. Woody plants become so stunted in some sites that sedges and ferns form a continuous canopy with them. Dominant species vary according to island and abiotic factors but generally include wind-stunted species of *Metrosideros, Cibotium, Melicope, Myrsine*, and *Vaccinium*. Other species include *Asplenium* spp., *Astelia menziesiana, Bidens* spp., *Broussaisia arguta, Cyrtandra* spp., *Diplopterygium pinnatum, Dicranopteris linearis, Dubautia* spp., *Eurya sandwicensis, Freycinetia arborea, Hedyotis terminalis, Lycopodiella cernua, Lobelia* spp., *Machaerina angustifolia, Peperomia* spp., *Phyllostegia* spp., *Scaevola* spp., *Sadleria pallida, Tetraplasandra* spp., *Trematolobelia* spp., and several rare endemic species including the orchid *Anoectochilus sandvicensis*.

DESCRIPTION

Environment: This system occupies crests of steep ridges and cliff faces throughout the main Hawaiian Islands. Climate is moderately wet to very wet (Zones 6 and 7) of the 7 Moisture Zones developed for the Hawaiian Islands by Price et al. (2007). These environments are characterized by regularly windy and usually foggy and wet conditions. Soils are generally thin over soft, highly weathered rock and thin mucky clays.
Vegetation: Vegetation is windswept and variable, ranging from dense dwarf-shrublands to dominant sedges with few scattered shrubs to sparse rock with very little plant life. Wind-stunted trees and shrubs are 1-3 m in height, are clothed with masses of epiphytic cryptogams, and have a diverse array of native shrubs, vines, herbs and ferns. Woody plants become so stunted in some sites that sedges and ferns form a continuous canopy with them. Dominant species vary according to island and abiotic factors but may include wind-stunted *Metrosideros, Cibotium, Melicope, Myrsine*, and *Vaccinium*. Other species include *Asplenium* spp., *Astelia menziesiana, Bidens* spp., *Broussaisia arguta, Cyrtandra* spp., *Diplopterygium pinnatum, Dicranopteris linearis, Dubautia* spp., *Eurya sandwicensis, Freycinetia arborea, Hedyotis terminalis, Lycopodiella cernua, Lobelia* spp., *Machaerina angustifolia, Peperomia* spp., *Phyllostegia* spp., *Scaevola* spp., *Sadleria pallida, Tetraplasandra* spp., *Trematolobelia* spp., and several rare endemic species.
Dynamics: Landslides occur occasionally in this system, uncovering bare mineral soils, which are colonized by pioneer species such as *Metrosideros, Dicranopteris*, and other ruderal natives.

Component Associations:
- *Metrosideros polymorpha* Montane Wet Dwarf-shrubland (CEGL008069, G3)

SPATIAL CHARACTERISTICS

Adjacent Ecological System Comments: This system is found adjacent to montane cloud forest, montane rainforest, and lowland rainforest.

DISTRIBUTION

Range: This system occurs between 200 and 900 m (650-2950 feet) elevation on Kaua'i, O'ahu, Moloka'i, LÃ¢na'i, Maui, and Hawai'i.
Divisions: 412:C
Nations: US
Subnations: HI
Map Zones: 79:C
USFS Ecomap Regions: M423:C
TNC Ecoregions: 65:C

SOURCES

References: Gagne and Cuddihy 1990, Mueller-Dombois and Fosberg 1998, Price et al. 2007, Wagner et al. 1999, Western Ecology Working Group n.d.

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.770638#references
Description Author: M. Castillo, mod. S. Gon III, D. Johnson, K.A. Schulz
Version: 05 Mar 2009 **Stakeholders:** West
Concept Author: M. Castillo and G. Kittel **ClassifResp:** West

HAWAI'I WET-MESIC COASTAL STRAND (CES412.419)

CLASSIFIERS

Classification Status: Standard

Primary Division: Northern Polynesia (412)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Shoreline; Grassland, Savanna, Steppe (graminoid-dominated); Tropical/Subtropical [Tropical Pluvial]; Tropical/Subtropical [Tropical Pluviseasonal]; Salt Spray; Coast
Non-Diagnostic Classifiers: Lowland [Lowland]; Shrubland (Shrub-dominated); Woody-Herbaceous; Herbaceous
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Evergreen shrubland
National Mapping Codes: EVT 2827; ESLF 5286; ESP 1827

CONCEPT

Summary: This mesic to wet coastline ecosystem is found on the windward sides of the larger Hawaiian Islands except Kaho'olawe and Lanai. Stands are restricted to seasonally mesic to wet shoreline and the zone immediately back of it. Substrates are variable and include a mix of sand, cobble and/or bedrock. Elevation is generally below 30 m. Annual precipitation ranges from over 3500 mm down to 1200 mm on seasonally mesic sites. Vegetation is variable depending largely on substrate and may include shrublands, grasslands or may be sparse. Scattered trees may be present but generally do not form a canopy, except on disturbed sites invaded by introduced trees such as *Casuarina* spp. Species characteristic of the wet strand are *Cyclosorus interruptus, Deschampsia nubigena, Machaerina angustifolia, Pilea peploides, Scleria testacea, Selaginella arbuscula*, and *Wikstroemia oahuensis*. Characteristic species of mesic or seasonally moist strand are *Artemisia australis, Bacopa monnieri, Bidens hillebrandiana, Bidens molokaiensis, Chenopodium oahuense, Cyperus javanicus, Cyperus phleoides, Diospyros sandwicensis, Eragrostis variabilis, Ischaemum byrone, Lipochaeta succulenta, Lysimachia mauritiana, Osteomeles anthyllidifolia, Pandanus tectorius, Plectranthus parviflorus, Sadleria cyatheoides, Schiedea globosa*, and *Solanum americanum*.
Classification Comments: Strand with native tree canopy is classified a Hawai'i Mesic Coastal Forest (CES412.417).
Similar Ecological Systems:
- Hawai'i Mesic Coastal Forest (CES412.417)

DESCRIPTION

Environment: This mesic to wet coastal ecological system is found on the windward sides of the larger Hawaiian Islands except Kaho'olawe and Lanai. Stands are restricted to seasonally mesic to wet shoreline and the zone immediately back of it. Elevation is generally below 30 m. Annual precipitation ranges from over 3500 mm down to 1200 mm on seasonally mesic sites. This wet to mesic strand occurs within the seasonally mesic, moist mesic, and moderately wet zones (Zones 4, 5 and 6) of the 7 Moisture Zones developed for the Hawaiian Islands by Price et al. (2007). Substrates are variable and include a mix of sand, cobble and/or bedrock.
Vegetation: Vegetation is variable depending largely on substrate and includes shrublands, grasslands or may be sparse. Scattered trees may be present but generally do not form a canopy, except on disturbed sites invaded by introduced trees such as *Casuarina* spp. Species characteristic of the wet strand are *Thelypteris interrupta (= Cyclosorus interruptus), Deschampsia nubigena, Machaerina angustifolia, Pilea peploides, Scleria testacea, Selaginella arbuscula*, and *Wikstroemia oahuensis*. Characteristic species of mesic or seasonally moist strand are *Artemisia australis, Bacopa monnieri, Bidens hillebrandiana, Bidens molokaiensis, Chenopodium oahuense, Cyperus javanicus, Cyperus phleoides, Diospyros sandwicensis, Eragrostis variabilis, Ischaemum byrone, Lipochaeta succulenta, Lysimachia mauritiana, Osteomeles anthyllidifolia, Pandanus tectorius, Plectranthus parviflorus, Sadleria cyatheoides, Schiedea globosa*, and *Solanum americanum*. Other common native mesic to wet strand species are *Capparis sandwichiana, Cocos nucifera, Cordia subcordata, Cyperus polystachyos, Fimbristylis cymosa, Fimbristylis dichotoma, Hedyotis st.-johnii, Ipomoea pes-caprae, Jacquemontia ovalifolia, Lycium sandwicense, Scaevola sericea, Scaevola sericea var. taccada (= Scaevola taccada), Sida fallax, Vigna marina, Vitex rotundifolia*, and *Waltheria indica* (Warshauer et al. 2008). Many species occur in both dry strand and wet-mesic strand such as *Chenopodium oahuense, Nama sandwicense, Panicum fauriei, Panicum torridum, Sesbania tomentosa, Tetramolopium rockii*, and *Waltheria indica* (Warshauer et al. 2008).
Dynamics: Coastal processes such as surf, wind and salt spray define this system. Wave action from occasional strong storms maintains seral vegetation on many sites.

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Hawai'i Mesic Coastal Forest (CES412.417)

DISTRIBUTION

Range: This ecological system occurs along the coastline and the zone immediately back of it on the windward sides of the larger Hawaiian Islands except Kaho'olawe and LÃ¢na'i.
Divisions: 412:C
Nations: US
Subnations: HI

Map Zones: 79:C
USFS Ecomap Regions: M423:C
TNC Ecoregions: 65:C

SOURCES

References: Gagne and Cuddihy 1990, Mueller-Dombois and Fosberg 1998, Price et al. 2007, Wagner et al. 1999, Warshauer et al. 2008, Western Ecology Working Group n.d.

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.821173#references

Description Author: K.A. Schulz
Version: 05 Mar 2009
Concept Author: Western Ecology Working Group

Stakeholders: West
ClassifResp: West

INTER-MOUNTAIN BASINS BIG SAGEBRUSH SHRUBLAND (CES304.777)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland [Lowland]; Shrubland (Shrub-dominated); Toeslope/Valley Bottom; Deep Soil; Aridic; Artemisia tridentata ssp. tridentata
Non-Diagnostic Classifiers: Plain; Alluvial plain; Temperate [Temperate Continental]; Alkaline Soil; Xeromorphic Shrub
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Evergreen shrubland
National Mapping Codes: EVT 2080; ESLF 5257; ESP 1080

CONCEPT

Summary: This ecological system occurs throughout much of the western U.S., typically in broad basins between mountain ranges, plains and foothills between 800 and 2500 m elevation. Soils are typically deep, well-drained and non-saline. These shrublands are dominated by *Artemisia tridentata ssp. tridentata* (not as common in Wyoming or Montana but possibly on stabilized part of Killpecker Dunes in Wyoming) and/or *Artemisia tridentata ssp. wyomingensis* (predominant in Wyoming and Montana). Scattered *Juniperus* spp., *Sarcobatus vermiculatus*, and *Atriplex* spp. may be present in some stands. *Ericameria nauseosa, Chrysothamnus viscidiflorus, Purshia tridentata* (not commonly in Montana or Wyoming), or *Symphoricarpos oreophilus* may codominate disturbed stands (e.g., in burned stands, these may become more predominant). Perennial herbaceous components typically contribute less than 25% vegetative cover. Common graminoid species can include *Achnatherum hymenoides, Bouteloua gracilis, Elymus lanceolatus, Festuca idahoensis* (not in Montana or Wyoming), *Hesperostipa comata, Leymus cinereus, Pleuraphis jamesii* (not present in northeastern portions of the range), *Pascopyrum smithii, Poa secunda*, or *Pseudoroegneria spicata* (not in Wyoming). Some semi-natural communities are included that often originate on abandoned agricultural land/or on other disturbed sites. In these locations, *Bromus tectorum* or other annual bromes and invasive weeds can be abundant. Most *Artemisia tridentata ssp. wyomingensis* communities in Wyoming are placed in Inter-Mountain Basins Big Sagebrush Steppe (CES304.778); the shrubland system is more restricted in environmental setting than the steppe. Dunes in the Red Desert have areas of large basin big sage with very dense canopies. In Wyoming, this system is likely to only contain *Artemisia tridentata ssp. tridentata*.

Related Concepts:

- Basin Big Sagebrush (401) (Shiflet 1994) Intersecting
- Bitterbrush (210) (Shiflet 1994) Intersecting. *Purshia tridentata* shrublands included in this ecological system.
- Bitterbrush - Bluebunch Wheatgrass (317) (Shiflet 1994) Finer. Bitterbrush-dominated communities are included in the big sage steppe and shrubland systems.
- Bitterbrush - Idaho Fescue (318) (Shiflet 1994) Finer. Bitterbrush-dominated communities are included in the big sage steppe and shrubland systems.
- Bitterbrush - Rough Fescue (319) (Shiflet 1994) Finer. Bitterbrush-dominated communities are included in the big sage steppe and shrubland systems.
- Threetip Sagebrush - Idaho Fescue (324) (Shiflet 1994) Broader. *Artemisia tripartita ssp. tripartita* communities are included in this ecological system.
- Wyoming Big Sagebrush (403) (Shiflet 1994) Intersecting

DESCRIPTION

Environment: This widespread interior western U.S. shrubland occurs in broad basins between mountain ranges, plains and foothills with its core distribution in the Great Basin region. Elevations range from 800 to 2500 m depending on latitude. The climate is semi-arid with annual precipitation ranging from 15-40 cm and high inter-annual variation. Much of the precipitation falls as snow, and growing-season drought is characteristic. Temperatures are continental with large annual and diurnal variation. In drier regions, these shrublands are usually associated with perennial or ephemeral stream drainages with water tables less than 3 m from the soil surface. Sites supporting this system include sloping fans, footslopes, rolling hills, swales, draws, and deep, well-drained alluvial bottomlands. Substrates are typically deep, well-drained and non-saline, fine- to medium-textured alluvial soils with some source of subirrigation during the summer season, but moderately deep upland soils with ample moisture storage also support these shrublands. Some stands occur on deep, sandy soils, or soils that are highly calcareous (Hironaka et al. 1983). Although this system may grade into sites with alkaline soils at the edge of internally drained basins, *Artemisia tridentata* is a non-halophyte and requires low salinity for optimum growth. The importance of perennial bunch grasses, the most typical herbaceous associates, is favored with greater spring and summer rain, which increases northward and eastward. Open shrublands occur on sand deposits/stabilized dunes in the Red Desert of Wyoming.

Dynamics: Complex ecological interactions of fire regimes, grazing history, and climate patterns result in equally complex patterns of species structure and composition in *Artemisia tridentata* stands. Prolonged drought on the more xeric sites may reduce shrub cover or cause plant mortality. Flooding may also cause mortality if the soil remains saturated for an extended period of time. The Aroga moth is capable of defoliating large acreages (i.e., >1000 acres, but usually 10-100 acres). Heavy grazing by wildlife can remove the

fine fuels that support mixed-severity fires and result in woody fuel buildup that leads to severe, stand-replacement fires (Landfire BpS 1210800) (Landfire 2007a). Big sagebrush stands are reduced by fire as *Artemisia tridentata* does not sprout after burning (Tirmenstein 1999c). Excessive grazing may decrease fire frequency due to consumption of herbaceous forage (fine fuels) resulting in increased shrub density. However, vast areas with depleted understory sagebrush shrublands have burned because of recent extreme fire/weather conditions. Change in fire frequency will lead to altered species composition (West 1983a). Increasing fire frequency significantly can eliminate the shrubs from the stands (Daubenmire 1970, Tirmenstein 1999c). Locally, in areas with a high fire frequency (every 2-5 years) or high-severity fire, perennial grasses and shrubs may be eliminated and non-native annual grasses such as *Bromus tectorum* can dominate. At fire-return intervals of 10-30 years, short-lived resprouting shrubs such as *Chrysothamnus* or *Tetradymia* spp. dominate. At fire-return intervals of 30-70 years, a mixture of perennial bunch grasses and non-sprouting shrubs is maintained (Johnson 2000b). Finally, in the complete absence of fire, deep-rooted shrubs such as *Artemisia tridentata* become dominant. At higher-elevation sites with absence of fire (>100 years), *Pinus monophylla* and *Juniperus osteosperma* trees may invade and eventually dominate sites (Tirmenstein 1999c).

Insects are an important component of many shrub-steppe and grassland systems. Mormon crickets and grasshoppers are natural components of many rangeland systems (USDA-APHIS 2003, 2010). There are almost 400 species of grasshoppers that inhabit the western United States with 15-45 species occurring in a given rangeland system (USDA-APHIS 2003). Mormon crickets are also present in many western rangelands and, although flightless, are highly mobile and can migrate large distances consuming much of the forage while travelling in wide bands (USDA-APHIS 2010). Following a high population year for grasshoppers or Mormon crickets and under relatively warm dry spring environmental conditions that favor egg hatching and grasshopper and Mormon cricket survival, there may be large population outbreaks that can utilize 80% or more of the forage in areas as large as 2000 square mile (USDA-APHIS 2010). Conversely, relatively cool and wet spring weather can limit the potential for outbreaks. These outbreaks are naturally occurring cycles and, especially during drought, can denude an area of vegetation leaving it exposed to increased erosion rates from wind and water (USDA-APHIS 2003).

Component Associations:

- *Artemisia tridentata (ssp. tridentata, ssp. xericensis) / Pseudoroegneria spicata - Poa secunda* Shrub Herbaceous Vegetation (CEGL001019, G1)
- *Artemisia tridentata (ssp. tridentata, ssp. xericensis) / Pseudoroegneria spicata* Shrub Herbaceous Vegetation (CEGL001018, G1)
- *Artemisia tridentata - Ephedra nevadensis* Shrubland (CEGL001002, G5)
- *Artemisia tridentata - Ephedra* spp. Shrubland (CEGL001003, G5)
- *Artemisia tridentata / Achnatherum hymenoides* Shrubland (CEGL001006, G3G5)
- *Artemisia tridentata / Achnatherum lettermanii* Shrubland (CEGL001011, G5)
- *Artemisia tridentata / Bouteloua gracilis - Pascopyrum smithii* Shrubland (CEGL000997, G5)
- *Artemisia tridentata / Bouteloua gracilis - Pleuraphis jamesii* Shrubland (CEGL000996, G5)
- *Artemisia tridentata / Bouteloua gracilis* Shrubland (CEGL000995, G4)
- *Artemisia tridentata / Chrysothamnus viscidiflorus / Poa secunda* Shrubland (CEGL000999, G5)
- *Artemisia tridentata / Elymus elymoides* Shrubland (CEGL001001, G5?)
- *Artemisia tridentata / Ericameria nauseosa* Shrubland (CEGL000998, G5)
- *Artemisia tridentata / Festuca idahoensis* Shrub Herbaceous Vegetation (CEGL001530, G4Q)
- *Artemisia tridentata / Leymus cinereus* Shrub Herbaceous Vegetation (CEGL001458, G2G4)
- *Artemisia tridentata / Pleuraphis jamesii* Shrubland (CEGL001005, G5)
- *Artemisia tridentata / Symphoricarpos longiflorus* Shrubland (CEGL001012, G5)
- *Artemisia tridentata* Shrubland (CEGL000991, G5?)
- *Artemisia tridentata ssp. tridentata - Grayia spinosa* Shrubland (CEGL001004, G5)
- *Artemisia tridentata ssp. tridentata / Distichlis spicata* Shrubland (CEGL001000, G5)
- *Artemisia tridentata ssp. tridentata / Festuca idahoensis* Shrubland (CEGL001014, G4?)
- *Artemisia tridentata ssp. tridentata / Hesperostipa comata* Shrubland (CEGL002966, G4?)
- *Artemisia tridentata ssp. tridentata / Leymus cinereus* Shrubland (CEGL001016, G2)
- *Artemisia tridentata ssp. tridentata / Pascopyrum smithii - (Elymus lanceolatus)* Shrubland (CEGL001017, G3?)
- *Artemisia tridentata ssp. tridentata / Pleuraphis jamesii* Shrubland (CEGL001015, G2G4)
- *Artemisia tridentata ssp. tridentata / Poa secunda* Shrubland (CEGL001008, G3G5)
- *Artemisia tridentata ssp. tridentata / Sporobolus airoides* Shrubland (CEGL002200, GNR)
- *Artemisia tridentata ssp. vaseyana / Pascopyrum smithii* Shrubland (CEGL001028, G3?)
- *Artemisia tridentata ssp. wyomingensis - Peraphyllum ramosissimum / Festuca idahoensis* Shrubland (CEGL001048, G2)
- *Artemisia tridentata ssp. wyomingensis - Purshia tridentata / Pseudoroegneria spicata* Shrubland (CEGL001050, G3Q)
- *Artemisia tridentata ssp. wyomingensis / Achnatherum hymenoides* Shrubland (CEGL001046, G5)
- *Artemisia tridentata ssp. wyomingensis / Achnatherum pinetorum* Shrubland (CEGL002810, GNR)
- *Artemisia tridentata ssp. wyomingensis / Achnatherum thurberianum* Shrubland (CEGL001052, G2)
- *Artemisia tridentata ssp. wyomingensis / Balsamorhiza sagittata* Shrubland (CEGL000994, G5)
- *Artemisia tridentata ssp. wyomingensis / Bouteloua gracilis* Shrubland (CEGL001041, G5)
- *Artemisia tridentata ssp. wyomingensis / Carex filifolia* Shrubland (CEGL001042, G1Q)
- *Artemisia tridentata ssp. wyomingensis / Elymus albicans* Shrubland (CEGL001044, G4)
- *Artemisia tridentata ssp. wyomingensis / Elymus elymoides* Shrubland (CEGL001043, G4G5)

- *Artemisia tridentata ssp. wyomingensis / Hesperostipa comata* Colorado Plateau Shrubland (CEGL002761, GNR)
- *Artemisia tridentata ssp. wyomingensis / Hesperostipa comata* Shrubland (CEGL001051, G2)
- *Artemisia tridentata ssp. wyomingensis / Leymus ambiguus* Shrubland (CEGL001045, G2)
- *Artemisia tridentata ssp. wyomingensis / Leymus salinus* Shrubland (CEGL002813, GNR)
- *Artemisia tridentata ssp. wyomingensis* / Mixed Grasses Shrub Herbaceous Vegetation (CEGL001534, G5)
- *Artemisia tridentata ssp. wyomingensis / Pascopyrum smithii* Shrub Herbaceous Vegetation (CEGL001047, G4)
- *Artemisia tridentata ssp. wyomingensis / Pleuraphis jamesii* Shrubland (CEGL002084, GNR)
- *Artemisia tridentata ssp. wyomingensis / Poa fendleriana* Shrubland (CEGL002775, GNR)
- *Artemisia tridentata ssp. wyomingensis / Poa secunda* Shrubland (CEGL001049, G4)
- *Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata* Shrub Herbaceous Vegetation (CEGL001535, G4)
- *Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata* Shrubland (CEGL001009, G5?)
- *Artemisia tridentata ssp. wyomingensis* / Sparse Understory Shrubland (CEGL002768, GNR)
- *Artemisia tridentata* Upperzone Community Shrubland (CEGL001013, G5?)
- *Ericameria nauseosa* Shrubland (CEGL002713, G5)
- *Grayia spinosa / Achnatherum hymenoides* Shrubland (CEGL001350, G4)
- *Krascheninnikovia lanata / Hesperostipa comata* Dwarf-shrubland (CEGL001327, G3)
- *Purshia tridentata / Carex pensylvanica - Achnatherum occidentale* Shrub Herbaceous Vegetation (CEGL001492, G2)

DISTRIBUTION

Range: This system occurs throughout much of the western U.S., typically in broad basins between mountain ranges, plains and foothills. Its core distribution is in the Great Basin, but it extends north into the Columbia Basin and west into the foothills of the Sierra Nevada and Cascades, and east into the Colorado Plateau, Wyoming Basins and central and eastern Montana, although much of the sagebrush in this region is more steppe in physiognomy.
Divisions: 303:C; 304:C; 306:C
Nations: US
Subnations: CA, CO, ID, MT, NV, OR, UT, WA, WY
Map Zones: 6:P, 7:C, 8:C, 9:C, 10:C, 12:C, 13:C, 15:C, 16:C, 17:C, 18:C, 19:C, 20:C, 21:C, 22:C, 23:C, 24:C, 25:P, 27:?, 28:C, 29:C, 30:P, 31:?, 33:?
USFS Ecomap Regions: 313A:CC, 313B:CC, 313D:CC, 315H:CC, 321A:??, 322A:CC, 331A:CC, 331D:CP, 331E:CP, 331F:CC, 331G:CC, 331H:C?, 331J:CC, 331K:CC, 331L:CP, 331M:CP, 341A:CC, 341B:CC, 341C:CC, 341D:CC, 341E:CC, 341F:CC, 341G:CC, 342A:CC, 342B:CC, 342C:CC, 342D:CC, 342E:CC, 342F:CC, 342G:CC, 342H:CC, 342I:CC, 342J:CC, M242C:CC, M242D:CC, M261D:CC, M261E:CC, M261G:CC, M313A:CC, M313B:C?, M331A:CC, M331B:CC, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M331J:CC, M332A:CC, M332B:CP, M332D:CC, M332E:CC, M332F:CC, M332G:CC, M333A:CC, M333C:C?, M333D:CC, M341A:CC, M341B:CC, M341C:CC, M341D:CC
TNC Ecoregions: 4:C, 6:C, 8:C, 9:C, 10:C, 11:C, 18:C, 19:C, 20:C, 26:C, 27:C

SOURCES

References: Barbour and Billings 1988, Barbour and Major 1977, Bunting et al. 1987, Burkhardt 1996, CNHP 2010b, Comer et al. 2003, Daubenmire 1970, Davies et al. 2009, Hironaka et al. 1983, Holland and Keil 1995, Johnson 2000b, Johnson and Swanson 2005, Knight 1994, Landfire 2007a, Mack and Thompson 1982, Pellant 1990, Pellant 1996, Quinn 2004, Rosentreter and Eldridge 2002, Sawyer et al. 2009, Shiflet 1994, Tirmenstein 1999c, TNC 2013, USDA-APHIS 2003, USDA-APHIS 2010, Vander Haegen et al. 2000, Vander Haegen et al. 2001, West 1983a, West and Young 2000, WNHP 2011, Wright et al. 1979
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722895#references
Description Author: NatureServe Western Ecology Team, mod. K.A. Schulz
Version: 14 Jan 2014 **Stakeholders:** Midwest, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

INTER-MOUNTAIN BASINS MAT SALTBUSH SHRUBLAND (CES304.783)

CLASSIFIERS

Conf.: 3 - Weak **Classification Status:** Standard
Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland [Lowland]; Plain; Shrubland (Shrub-dominated); Alluvial flat; Alluvial plain; Alkaline Soil; Saline Substrate Chemistry; Calcareous; Silt Soil Texture; Clay Soil Texture; Dwarf-Shrub; Atriplex spp.
Non-Diagnostic Classifiers: Temperate [Temperate Continental]; Oligotrophic Soil; Basin floor
FGDC Crosswalk: Vegetated, Shrub-dominated, Dwarf-shrubland, Evergreen dwarf-shrubland
National Mapping Codes: EVT 2066; ESLF 5203; ESP 1066

CONCEPT

Summary: This ecological system occurs on gentle slopes and rolling plains in the northern Colorado Plateau and Uinta Basin on Mancos shale and arid, windswept basins and plains across parts of Wyoming. It is also found in eastern Wyoming in Great Plains areas, and may extend north into Montana and Canada. Substrates are shallow, typically saline, alkaline, fine-textured soils developed from shale or alluvium and may be associated with shale badlands. Infiltration rate is typically low. These landscapes typically support dwarf-shrublands composed of relatively pure stands of *Atriplex* spp., such as *Atriplex corrugata* (in Colorado and Utah) or *Atriplex gardneri* (Wyoming and Montana into Canada). Other dominant or codominant dwarf-shrubs may include *Artemisia longifolia, Artemisia pedatifida* (very important in Wyoming, rare in Colorado stands), or *Picrothamnus desertorum*, sometimes with a mix of other low shrubs, such as *Krascheninnikovia lanata* or *Tetradymia spinosa*. *Atriplex confertifolia* or *Atriplex canescens* may be present but do not codominate. *Artemisia tridentata ssp. wyomingensis* can occur in patches within this system. The herbaceous layer is typically sparse. Scattered perennial forbs occur, such as *Xylorhiza glabriuscula* and *Sphaeralcea grossulariifolia*; perennial grasses *Achnatherum hymenoides, Bouteloua gracilis* (not in Wyoming), *Elymus elymoides, Elymus lanceolatus ssp. lanceolatus, Pascopyrum smithii, Poa secunda,* or *Sporobolus airoides* may dominate the herbaceous layer. In less saline areas, there may be inclusions of grasslands dominated by *Hesperostipa comata, Leymus salinus, Pascopyrum smithii*, or *Pseudoroegneria spicata*. In Wyoming and possibly elsewhere, inclusions of non-saline, gravelly barrens or rock outcrops dominated by cushion plants such as *Arenaria hookeri* and *Phlox hoodii* without dwarf-shrubs may be present (these are not restricted to this system). Annuals are seasonally present and may include *Eriogonum inflatum, Plantago tweedyi, Monolepis nuttalliana*, and the introduced annual grass *Bromus tectorum*. In Montana, *Atriplex gardneri* also occurs associated with badlands, and determining which system it falls into may be difficult.
Classification Comments: Reviewers have proposed renaming this system to be more "broad" than just mat saltbush (*Atriplex corrugata*), but an alternative name has not yet been identified.
Related Concepts:
- Other Sagebrush Types (408) (Shiflet 1994) Intersecting
- Saltbush - Greasewood (501) (Shiflet 1994) Intersecting

DESCRIPTION

Environment: This ecological system occurs on gentle slopes and rolling plains in the northern Colorado Plateau and Uinta Basin on Mancos shale and arid, windswept plains and basins across parts of Wyoming. Substrates are shallow, typically saline, alkaline, fine-textured soils developed from shale or alluvium and may be associated with shale badlands. Infiltration rate is typically low. In Wyoming and possibly elsewhere, inclusions of non-saline, gravelly barrens or rock outcrops may be present.
Vegetation: This ecological system typically supports dwarf-shrublands composed of relatively pure stands of *Atriplex* spp., such as *Atriplex corrugata* or *Atriplex gardneri*. Other dominant or codominant dwarf-shrub may include *Artemisia longifolia, Artemisia pedatifida*, or *Picrothamnus desertorum*, sometimes with a mix of other low shrubs, such as *Krascheninnikovia lanata* or *Tetradymia spinosa*. *Atriplex confertifolia* or *Atriplex canescens* may be present but do not codominate. The herbaceous layer is typically sparse. Scattered perennial forbs occur, such as *Xylorhiza glabriuscula* and *Sphaeralcea grossulariifolia*, and the perennial grasses *Achnatherum hymenoides, Bouteloua gracilis, Elymus elymoides, Elymus lanceolatus ssp. lanceolatus, Pascopyrum smithii*, or *Sporobolus airoides* may dominate the herbaceous layer. In less saline areas, there may be inclusions of grasslands dominated by *Hesperostipa comata, Leymus salinus, Pascopyrum smithii*, or *Pseudoroegneria spicata*. In Wyoming and possibly elsewhere, vegetation dominated by cushion plants such as *Arenaria hookeri* and *Phlox hoodii* without dwarf-shrubs may be present and occurs on inclusions of non-saline, gravelly barrens or rock outcrops. Annuals are seasonally present and may include *Eriogonum inflatum, Plantago tweedyi*, and the introduced annual grass *Bromus tectorum*.

Component Associations:
- *Artemisia pedatifida / Elymus elymoides* Shrubland (CEGL001450, G3?)
- *Artemisia pedatifida / Festuca idahoensis* Shrubland (CEGL001526, G2?)
- *Artemisia pedatifida / Pascopyrum smithii* Shrubland (CEGL001451, G3?)
- *Artemisia pedatifida / Pseudoroegneria spicata* Shrubland (CEGL001527, G3)
- *Atriplex corrugata* Dwarf-shrubland (CEGL001437, G5)
- *Atriplex cuneata - Frankenia jamesii / Sporobolus airoides* Shrubland (CEGL001316, G1?)

- *Atriplex gardneri - Picrothamnus desertorum* Dwarf-shrubland (CEGL001439, G2G3)
- *Atriplex gardneri / Achnatherum hymenoides* Dwarf-shrubland (CEGL001444, G3)
- *Atriplex gardneri / Artemisia tridentata* Dwarf-shrubland (CEGL001440, G3)
- *Atriplex gardneri / Leymus salinus* Dwarf-shrubland (CEGL001442, G2?)
- *Atriplex gardneri / Monolepis nuttalliana* Dwarf-shrubland (CEGL001443, G3?)
- *Atriplex gardneri / Pascopyrum smithii* Dwarf-shrubland (CEGL001445, G3)
- *Atriplex gardneri / Pleuraphis jamesii* Dwarf-shrubland (CEGL001441, G3G5)
- *Atriplex gardneri / Xylorhiza venusta* Dwarf-shrubland (CEGL001446, G3G5)
- *Atriplex gardneri* Dwarf-shrubland (CEGL001438, G3G5)

DISTRIBUTION

Range: This system occurs on gentle slopes and rolling plains in the northern Colorado Plateau and Uinta Basin on Mancos shale and arid, windswept basins and plains across parts of Wyoming, and possibly into Montana and Canada.
Divisions: 304:C
Nations: US
Subnations: AZ, CO, MT, NM, UT, WY
Map Zones: 13:?, 15:?, 16:P, 20:C, 22:C, 23:C, 24:P, 28:P, 29:C
USFS Ecomap Regions: 313A:CC, 313B:CC, 341B:CC, 341C:CC, 342E:C?, 342F:C?, 342G:CC, 342J:C?, M331B:CC, M331D:C?, M331E:CC, M331G:CC, M331H:CC, M331J:C?, M341B:CC, M341C:CC
TNC Ecoregions: 10:C, 19:C

SOURCES

References: Branson et al. 1976, Comer et al. 2003, Knight 1994, Potter et al. 1985, Welsh 1957
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722889#references
Description Author: NatureServe Western Ecology Team
Version: 26 Jan 2007 **Stakeholders:** West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

INTER-MOUNTAIN BASINS MIXED SALT DESERT SCRUB (CES304.784)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland [Lowland]; Plain; Shrubland (Shrub-dominated); Alluvial flat; Alluvial plain; Alkaline Soil; Saline Substrate Chemistry; Calcareous; Silt Soil Texture; Clay Soil Texture; Xeromorphic Shrub; Dwarf-Shrub; Atriplex spp.
Non-Diagnostic Classifiers: Temperate [Temperate Continental]; Oligotrophic Soil; Basin floor
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Evergreen shrubland
National Mapping Codes: EVT 2081; ESLF 5258; ESP 1081

CONCEPT

Summary: This extensive ecological system includes open-canopied shrublands of typically saline basins, alluvial slopes and plains across the Intermountain western U.S. This type also extends in limited distribution into the southern Great Plains. Substrates are often saline and calcareous, medium- to fine-textured, alkaline soils, but include some coarser-textured soils. The vegetation is characterized by a typically open to moderately dense shrubland composed of one or more *Atriplex* species, such as *Atriplex confertifolia, Atriplex canescens, Atriplex polycarpa*, or *Atriplex spinifera*. *Grayia spinosa* tends to occur on coppice dunes that may have a silty component to them. Northern occurrences lack *Atriplex* species and are typically dominated by *Grayia spinosa, Krascheninnikovia lanata*, and/or *Artemisia tridentata*. Other shrubs present to codominant may include *Artemisia tridentata ssp. wyomingensis, Chrysothamnus viscidiflorus, Ericameria nauseosa, Ephedra nevadensis, Grayia spinosa, Krascheninnikovia lanata, Lycium* spp., *Picrothamnus desertorum*, or *Tetradymia* spp. In Wyoming, occurrences are typically a mix of *Atriplex confertifolia, Grayia spinosa, Artemisia tridentata ssp. wyomingensis, Sarcobatus vermiculatus, Krascheninnikovia lanata*, and various *Ericameria* or *Chrysothamnus* species. Some places are a mix of *Atriplex confertifolia* and *Artemisia tridentata ssp. wyomingensis*. In the Great Basin, *Sarcobatus vermiculatus* is generally absent but, if present, does not codominate. The herbaceous layer varies from sparse to moderately dense and is dominated by perennial graminoids such as *Achnatherum hymenoides, Bouteloua gracilis, Elymus lanceolatus ssp. lanceolatus, Pascopyrum smithii, Pleuraphis jamesii, Pleuraphis rigida, Poa secunda*, or *Sporobolus airoides*. Various forbs are also present
Similar Ecological Systems:
- Inter-Mountain Basins Active and Stabilized Dune (CES304.775)

Related Concepts:
- Salt Desert Shrub (414) (Shiflet 1994) Broader
- Saltbush - Greasewood (501) (Shiflet 1994) Intersecting

DESCRIPTION

Environment: This salt-desert shrubland system is a matrix system in the Intermountain West. This system is comprised of arid to semi-arid shrublands on lowland and upland sites usually at elevations between 1520 and 2200 m (4987-7218 feet). Sites can be found on all aspects and include valley bottoms, alluvial and alkaline flats, mesas and plateaus, playas, drainage terraces, washes and interdune basins, bluffs, and gentle to moderately steep sandy or rocky slopes. Slopes are typically gentle to moderately steep but are sometimes unstable and prone to surface movement. Many areas within this system are degraded due to erosion and may resemble "badlands." Soil surface is often very barren in occurrences of this system. The interspaces between the characteristic plant clusters are commonly covered by a microphytic crust (West 1982).

This is typically a system of extreme climatic conditions, with warm to hot summers and freezing winters. Annual precipitation ranges from approximately 13-33 cm. In much of the ecological system, the period of greatest moisture will be mid- to late summer, although in the more northern areas a moist period is to be expected in the cold part of the year. However, plotted seasonality of occurrence is probably of less importance on this desert system than in other ecosystems because desert precipitation comes with an extreme irregularity that does not appear in graphs of long-term seasonal or monthly averages (Blaisdell and Holmgren 1984). Soils are shallow to moderately deep, poorly developed, and a product of an arid climate and little precipitation. Soils are often alkaline or saline. Vegetation within this system is tolerant of these soil conditions but not restricted to it. The shallow soils of much of the area are poorly developed Entisols. Vegetation within this system can occur on level pediment remnants where coarse-textured and well-developed soil profiles have been derived from sandstone gravel and are alkaline, or on Mancos shale badlands, where soil profiles are typically fine-textured and non-alkaline throughout (West and Ibrahim 1968). They can also occur in alluvial basins where parent materials from the other habitats have been deposited over Mancos shale and the soils are heavy-textured and saline-alkaline throughout the profile (West and Ibrahim 1968).

Vegetation: Occurrences of this ecological system vary from almost pure occurrences of single species to fairly complex mixtures. The characteristic mix of low shrubs and grasses is sparse, with large open spaces between the plants (Blaisdell and Holmgren 1984). Occurrences have a sparse to moderately dense cover of woody species that is dominated by *Atriplex canescens* (may codominate with *Artemisia tridentata*), *Atriplex confertifolia* (may codominate with *Lycium andersonii*), *Atriplex obovata, Picrothamnus desertorum*, or *Krascheninnikovia lanata*. Other shrubs that may occur within these occurrences include *Purshia stansburiana, Psorothamnus polydenius, Ephedra* spp., *Acacia greggii, Encelia frutescens, Tiquilia latior, Parthenium confertum, Atriplex polycarpa, Atriplex*

lentiformis, Atriplex spinifera, Picrothamnus desertorum (= Artemisia spinescens), Frankenia salina, Artemisia frigida, Chrysothamnus spp., *Lycium* ssp., *Suaeda* spp., *Yucca glauca,* and *Tetradymia spinosa*. Dwarf-shrubs include *Gutierrezia sarothrae* and *Eriogonum* spp. Warm-season medium-tall and short perennial grasses dominate in the sparse to moderately dense graminoid layer. The species present depend on the geographic range of the grasses, alkalinity/salinity and past land use. Species may include *Pleuraphis jamesii, Bouteloua gracilis, Sporobolus airoides, Sporobolus cryptandrus, Achnatherum hymenoides, Elymus elymoides, Distichlis spicata, Leymus salinus, Pascopyrum smithii, Hesperostipa comata, Pseudoroegneria spicata, Poa secunda, Leymus ambiguus,* and *Muhlenbergia torreyi*. A number of annual species may also grow in association with the shrubs and grasses of this system, although they are usually rare and confined to areas of recent disturbance (Blaisdell and Holmgren 1984). Forb cover is generally sparse. Perennial forbs that might occur include *Sphaeralcea coccinea, Chaetopappa ericoides, Xylorhiza venusta, Descurainia sophia,* and *Mentzelia* species. Annual natives include *Plantago* spp., *Vulpia octoflora,* or *Monolepis nuttalliana*. Associated halophytic annuals include *Salicornia rubra, Salicornia bigelovii,* and *Suaeda* species. Exotic annuals that may occur include *Salsola kali, Bromus rubens,* and *Bromus tectorum*. Cacti like *Opuntia* spp. and *Echinocereus* spp. may be present in some occurrences. Trees are not usually present but some scattered *Juniperus* spp. may be found.

Dynamics: West (1982) stated that "salt desert shrub vegetation occurs mostly in two kinds of situations that promote soil salinity, alkalinity, or both. These are either at the bottom of drainages in enclosed basins or where marine shales outcrop." However, salt-desert shrub vegetation may be an indication of climatically dry as well as physiologically dry soils (Blaisdell and Holmgren 1984). Not all salt-desert shrub soils are salty, and their hydrologic characteristics may often be responsible for the associated vegetation (Naphan 1966). Species of the salt-desert shrub complex have different degrees of tolerance to salinity and aridity, and they tend to sort themselves out along a moisture/salinity gradient (West 1982). Species and communities are apparently sorted out along physical, chemical, moisture, and topographic gradients through complex relations that are not understood and are in need of further study (Blaisdell and Holmgren 1984).

The winter months within this system are a good time for soil moisture accumulation and storage. There is generally at least one good snow storm per season that will provide sufficient moisture to the vegetation. The winter moisture accumulation amounts will affect spring plant growth. Plants may grow as little as a few inches to 1 m. Unless more rains come in the spring, the soil moisture will be depleted in a few weeks, growth will slow and ultimately cease, and the perennial plants will assume their various forms of dormancy (Blaisdell and Holmgren 1984). If effective rain comes later in the warm season, some of the species will renew their growth from the stage at which it had stopped. Others, having died back, will start over as if emerging from winter dormancy (Blaisdell and Holmgren 1984). *Atriplex confertifolia* shrubs often develop large leaves in the spring, which increase the rate of photosynthesis. As soil moisture decreases, the leaves are lost, and the plant takes on a dead appearance. During late fall, very small overwintering leaves appear which provide some photosynthetic capability through the remainder of the year (IVC 1999). Other communities are maintained by intra- or inter-annual cycles of flooding followed by extended drought, which favor accumulation of transported salts. The moisture supporting these intermittently flooded wetlands is usually derived off-site, and they are dependent upon natural watershed function for persistence (Reid et al. 1999).

In summary, desert communities of perennial plants are dynamic and changing. The composition within this system may change dramatically and may be both cyclic and unidirectional. Superimposed on the compositional change is great variation from year to year in growth of all the vegetation, the sum of varying growth responses of individual species to specific conditions of different years (Blaisdell and Holmgren 1984). Desert plants grow when temperature is satisfactory, but only if soil moisture is available at the same time. Because amount of moisture is variable from year to year and because different species flourish under different seasons of soil moisture, seldom do all components of the vegetation thrive in the same year (Blaisdell and Holmgren 1984).

Component Associations:

- *Artemisia tridentata - Atriplex canescens - Sarcobatus vermiculatus / (Achnatherum hymenoides)* Shrubland (CEGL001355, G1)
- *Artemisia tridentata ssp. wyomingensis - Atriplex confertifolia* Shrubland (CEGL001040, G3G5)
- *Atriplex canescens - Artemisia tridentata* Shrubland (CEGL001282, G4)
- *Atriplex canescens - Ephedra viridis* Talus Shrubland (CEGL001287, G4)
- *Atriplex canescens - Krascheninnikovia lanata* Shrubland (CEGL001285, G5)
- *Atriplex canescens / Achnatherum hymenoides* Shrubland (CEGL001289, G3G5)
- *Atriplex canescens / Bouteloua gracilis* Shrubland (CEGL001283, G3)
- *Atriplex canescens / Calycoseris parryi* Shrubland (CEGL001284, G2)
- *Atriplex canescens / Muhlenbergia porteri* Shrubland (CEGL005385, GNR)
- *Atriplex canescens / Parthenium confertum* Shrubland (CEGL001290, GNRQ)
- *Atriplex canescens / Pleuraphis jamesii* Shrubland (CEGL001288, G3G4)
- *Atriplex canescens / Purshia stansburiana* Shrubland (CEGL001286, GUQ)
- *Atriplex canescens / Sporobolus airoides* Shrubland (CEGL001291, G5?)
- *Atriplex canescens / Sporobolus wrightii* Shrubland (CEGL001292, GNRQ)
- *Atriplex canescens* Shrubland (CEGL001281, G5)
- *Atriplex confertifolia - Ephedra nevadensis* Shrubland (CEGL001303, G5)
- *Atriplex confertifolia - Krascheninnikovia lanata* Shrubland (CEGL001301, G3G5)
- *Atriplex confertifolia - Lycium andersonii* Shrubland (CEGL001308, G3)
- *Atriplex confertifolia - Lycium pallidum / Mirabilis pudica* Shrubland (CEGL001309, G3G4Q)
- *Atriplex confertifolia - Lycium shockleyi* Shrubland (CEGL001310, G4)
- *Atriplex confertifolia - Picrothamnus desertorum / Achnatherum hymenoides* Shrubland (CEGL001297, G5?)

- *Atriplex confertifolia - Picrothamnus desertorum / Krascheninnikovia lanata* Shrubland (CEGL001296, G5?)
- *Atriplex confertifolia - Picrothamnus desertorum / Sarcobatus vermiculatus* Shrubland (CEGL001298, G5?)
- *Atriplex confertifolia - Picrothamnus desertorum* Shrubland (CEGL001295, G5)
- *Atriplex confertifolia - Sarcobatus vermiculatus* Shrubland (CEGL001313, G5)
- *Atriplex confertifolia / Achnatherum hymenoides* Shrubland (CEGL001311, G3)
- *Atriplex confertifolia / Elymus elymoides* Shrubland (CEGL001302, G3G5)
- *Atriplex confertifolia / Ericameria nauseosa* Shrubland (CEGL001300, G3Q)
- *Atriplex confertifolia / Hesperostipa comata* Shrubland (CEGL001314, G2)
- *Atriplex confertifolia / Kochia americana* Shrubland (CEGL001305, G3G5)
- *Atriplex confertifolia / Leymus salinus* Shrubland (CEGL001307, G3G5)
- *Atriplex confertifolia / Leymus salinus ssp. salmonis* Shrubland (CEGL001306, G2Q)
- *Atriplex confertifolia / Pleuraphis jamesii* Shrubland (CEGL001304, G3G5)
- *Atriplex confertifolia / Pseudoroegneria spicata* Shrubland (CEGL001312, G3)
- *Atriplex confertifolia / Tetradymia glabrata* Shrubland (CEGL001315, G3G5)
- *Atriplex confertifolia* Great Basin Shrubland (CEGL001294, G5)
- *Atriplex confertifolia* Wyoming Basins Shrubland (CEGL001293, G5)
- *Atriplex obovata / Sporobolus airoides - Pleuraphis jamesii* Shrub Herbaceous Vegetation (CEGL001775, GU)
- *Atriplex obovata / Sporobolus airoides - Sporobolus cryptandrus* Dwarf-shrubland (CEGL001447, G1Q)
- *Atriplex obovata / Tidestromia carnosa* Dwarf-shrubland (CEGL004575, G2?)
- *Atriplex obovata* Talus Dwarf-shrubland (CEGL001789, GNR)
- *Atriplex polycarpa / Pleuraphis mutica* Shrubland (CEGL001319, GU)
- *Atriplex polycarpa* Shrubland (CEGL001318, G5)
- *Krascheninnikovia lanata / Achnatherum hymenoides* Dwarf-shrubland (CEGL001323, G4)
- *Krascheninnikovia lanata / Hesperostipa comata* Dwarf-shrubland (CEGL001327, G3)
- *Krascheninnikovia lanata* Dwarf-shrubland (CEGL001320, G5?)
- *Picrothamnus desertorum* Shrubland (CEGL001452, G3G4)

DISTRIBUTION

Range: This system occurs in the Intermountain western U.S., extending in limited distribution into the southern Great Plains. In Wyoming, this system occurs in the Great Divide and Bighorn basins.
Divisions: 303:C; 304:C; 306:C
Nations: US
Subnations: AZ, CA, CO, ID, MT, NM, NV, OR, UT, WA, WY
Map Zones: 6:P, 7:C, 8:P, 9:C, 10:C, 12:C, 13:C, 15:C, 16:C, 17:C, 18:C, 19:C, 21:?, 22:C, 23:C, 24:C, 25:C, 27:P, 28:C, 29:C, 30:?, 33:?, 34:P
USFS Ecomap Regions: 313A:CC, 313B:CC, 313D:CC, 315A:CC, 315B:CP, 315H:CC, 321A:CC, 322A:CC, 331A:CP, 331B:CC, 331F:CC, 331G:CC, 331H:CC, 331I:CC, 331J:CC, 341A:CC, 341B:CC, 341C:CC, 341D:CC, 341E:CC, 341F:CC, 341G:CC, 342A:CC, 342B:CC, 342C:CC, 342D:CC, 342E:CC, 342F:CC, 342G:CC, 342H:CC, 342I:CC, 342J:CC, M242C:PP, M261D:CP, M261E:CP, M261G:CC, M313A:CC, M313B:CC, M331A:CC, M331B:CC, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M331J:C?, M332A:CP, M332E:CC, M332F:CC, M332G:CP, M341A:CC, M341B:CC, M341C:CC, M341D:CC
TNC Ecoregions: 4:?, 6:C, 8:?, 9:C, 10:C, 11:C, 18:C, 19:C, 20:C, 21:C, 26:C, 27:C, 28:C

SOURCES

References: Barbour and Major 1988, Blaisdell and Holmgren 1984, Branson et al. 1967, Branson et al. 1976, Brown 1982a, Campbell 1977, Comer et al. 2003, Francis 1986, Holland and Keil 1995, Knight 1994, Knight et al. 1987, Reid et al. 1999, Shiflet 1994, West 1979, West 1982, West 1983b, West and Ibrahim 1968
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722888#references
Description Author: NatureServe Western Ecology Team
Version: 26 Jan 2007 **Stakeholders:** Midwest, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

MADREAN ORIENTAL CHAPARRAL (CES302.031)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Warm Desert (302)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Lower Montane]; Shrubland (Shrub-dominated); Shallow Soil; Xeric; F-Patch/High Intensity
Non-Diagnostic Classifiers: Temperate [Temperate Xeric]
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Evergreen shrubland
National Mapping Codes: EVT 2101; ESLF 5307; ESP 1101

CONCEPT

Summary: This ecological system occurs in mountains across southeastern New Mexico (Guadalupe Mountains), Trans-Pecos Texas (Chisos and Davis mountains) and Madrean Oriental in northern Mexico. It often dominates along the mid-elevation transition from the Chihuahuan Desert into mountains (1700-2500 m). It occurs on foothills, mountain slopes and canyons in drier habitats below the encinal and pine woodlands, and is often associated with more xeric and coarse-textured substrates such as limestone, basalt or alluvium, especially in transition areas with more mesic woodlands. The moderate to dense shrub canopy includes many shrub oak species, such as *Quercus emoryi, Quercus grisea, Quercus intricata, Quercus invaginata, Quercus laceyi, Quercus mohriana, Quercus pringlei, Quercus pungens*, and *Quercus vaseyana*, and several widespread chaparral species, such as *Arctostaphylos pungens, Ceanothus greggii, Cercocarpus montanus, Fallugia paradoxa*, and *Garrya wrightii*; other species characteristic of this system include *Arbutus xalapensis (= Arbutus texana), Fraxinus greggii, Fendlera rigida (= Fendlera linearis), Garrya ovata, Purshia mexicana, Rhus virens var. choriophylla (= Rhus choriophylla), Salvia lycioides (= Salvia ramosissima), Salvia roemeriana*, and *Salvia regla*. In the Trans-Pecos of Texas, disjunct *Quercus gambelii* may occur as a significant component of this shrubland. Most chaparral species are fire-adapted, resprouting vigorously after burning or producing fire-resistant seeds. Stands occurring within montane woodlands are seral and a result of recent fires. Grass cover may be significant. Dominant grasses often include *Bouteloua curtipendula, Bouteloua hirsuta*, and *Muhlenbergia emersleyi*.
Classification Comments: The similar Mogollon chaparral system has floristics mostly derived from the Sierra Madre Occidentale, whereas floristics of this system are derived from the Sierra Madre Oriental. However, this system is not mattoral (thornscrub) as it is typically dominated by shrubby evergreen oaks and chaparral species, not thornscrub species. More survey is needed to determine if *Quercus turbinella*, common in the Mogollon Chaparral system, also occurs in the Madrean Oriental Chaparral.
Related Concepts:
- Sideoats Grama - Sumac - Juniper (735) (Shiflet 1994) Undetermined

DESCRIPTION

Vegetation: The moderate to dense shrub canopy includes many shrub oak species, such as *Quercus emoryi, Quercus grisea, Quercus intricata, Quercus invaginata, Quercus laceyi, Quercus mohriana, Quercus pringlei, Quercus pungens*, and *Quercus vaseyana*, and several widespread chaparral species, such as *Arctostaphylos pungens, Ceanothus greggii, Cercocarpus montanus, Fallugia paradoxa*, and *Garrya wrightii*; other species characteristic of this system include *Arbutus xalapensis (= Arbutus texana), Fraxinus greggii, Fendlera rigida (= Fendlera linearis), Garrya ovata, Purshia mexicana, Rhus virens var. choriophylla (= Rhus choriophylla), Salvia lycioides (= Salvia ramosissima), Salvia roemeriana*, and *Salvia regla*. In the Trans-Pecos of Texas, disjunct *Quercus gambelii* may occur as a significant component of this shrubland. Most chaparral species are fire-adapted, resprouting vigorously after burning or producing fire-resistant seeds. Stands occurring within montane woodlands are seral and a result of recent fires. Grass cover may be significant. Dominant grasses often include *Bouteloua curtipendula, Bouteloua hirsuta*, and *Muhlenbergia emersleyi*.

Component Associations:
- *Cercocarpus montanus / Muhlenbergia pauciflora* Shrubland (CEGL001089, GNR)
- *Quercus intricata - Dasylirion leiophyllum* Shrubland (CEGL004530, GNR)
- *Quercus pungens - Cercocarpus montanus* Shrubland (CEGL003832, G3?)
- *Rhus virens var. choriophylla / Cercocarpus montanus var. paucidentatus* Shrubland (CEGL001123, G3)

DISTRIBUTION

Range: This system is found on mountains across southeastern New Mexico, Trans-Pecos Texas and northern Mexico. It often dominants along the mid-elevation transition from the Chihuahuan Desert into mountains (1700-2500 m elevation).
Divisions: 301:P; 302:C; 305:P; 306:C
Nations: MX, US
Subnations: MXCH(MX), MXCO(MX), NM, TX
Map Zones: 25:C, 26:C, 27:P
USFS Ecomap Regions: 315A:PP, 321A:CC, M313B:CC
TNC Ecoregions: 21:P, 22:P, 24:P

SOURCES

References: Brown 1982a, Comer et al. 2003, Dick-Peddie 1993, Muldavin et al. 1994a, Muldavin et al. 2000b, Muldavin et al. 2003

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722675#references

Description Author: K. Schulz and P. Comer

Version: 10 Apr 2007 **Stakeholders:** Latin America, Southeast, West

Concept Author: K. Schulz and P. Comer **ClassifResp:** West

MEDITERRANEAN CALIFORNIA ALPINE FELL-FIELD (CES206.900)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Alpine/AltiAndino [Alpine/AltiAndino]; Alpine Mosaic; Ridge/Summit/Upper Slope; Temperate [Temperate Oceanic]; Very Shallow Soil; Cushion plants
Non-Diagnostic Classifiers: Shrubland (Shrub-dominated); Herbaceous; Moss/Lichen (Nonvascular); Talus (Landform); Sideslope; Talus (Substrate); Avalanche chute; Glaciated; W-Landscape/High Intensity; Dwarf-Shrub; Nonvascular; Cirque; Colluvial slope
FGDC Crosswalk: Vegetated, Shrub-dominated, Dwarf-shrubland, Mixed evergreen-deciduous dwarf-shrubland
National Mapping Codes: EVT 2067; ESLF 5204; ESP 1067

CONCEPT

Summary: This ecological system occurs in limited alpine environments mostly concentrated in the Sierra Nevada but also on Mount Shasta and as far south as the Peninsular Ranges and White Mountains. Alpine elevations begin around 3500 m (10,600 feet) in the southern mountain ranges and 2700 m (8200 feet) in the southern Cascades. Wind scours fell-fields free of snow in the winter, exposing the plants to severe environmental stress. These systems typically have immature soils. Most fell-field plants are cushioned or matted, frequently succulent, flat to the ground in rosettes, and often densely hairy and thickly cutinized. Common species include *Ribes cereum, Leptodactylon pungens, Ericameria discoidea, Castilleja nana, Minuartia nuttallii (= Arenaria nuttallii), Phlox condensata, Draba densifolia, Oxyria digyna*, and *Aquilegia pubescens*. Plants cover 15-50%, while exposed rock makes up the rest. Fell-fields are usually nested within or adjacent to alpine tundra dry meadows.
Related Concepts:
- Alpine Grassland (213) (Shiflet 1994) Broader. SRM type 213 includes all alpine communities in Sierra, Klamath and California Cascades, both herbaceous and shrub dominated, and wet meadows.

DESCRIPTION

Environment: These are wind-scoured fell-fields that are free of snow in the winter, such as ridgetops and exposed saddles, exposing the plants to severe environmental stress. Soils on these windy unproductive sites are shallow, stony, low in organic matter, and poorly developed; wind deflation often results in a gravelly pavement. Fell is Gaelic for stone, and these are stone fields. Sites are stable for 100s to 1000s of years as soils develop. Alpine elevations begin around 3500 m (10,600 feet) in the southern Sierra Nevada and 2700 m (8200 feet) in the southern Cascades.
Dynamics: TNC model information: Avalanches on steeper slopes where soil accumulates can cause infrequent soil-slips, which expose bare ground.

Very small burns of a few square meters (replacement fire) caused by lightning strikes are a rare disturbance, although lighting storms are frequent in those elevations. The calculation of lightning strike frequency was not based on fire-return intervals but on the number of strikes (in this case, five) per 1000 possible locations per year, thus 0.005.

Alpine rodents (pikas, marmots, etc.) cause common but generally small-scale disturbances in this system. Native herbivores (Rocky Mountain bighorn sheep, mule deer, and elk) were common in the alpine but probably did not greatly affect vegetation cover because animals move frequently as they reduce vegetation cover.

SPATIAL CHARACTERISTICS

Spatial Summary: This ecological system can occupy large areas of the alpine. Patch size varies from a few acres to 1000 acres on mountain ridges and tops. Stand-replacement fires may be caused by lightning strikes that do not spread due to the sparse cover of fine fuels and extensive barren areas acting as firebreaks.

DISTRIBUTION

Range: This system occurs in limited alpine environments mostly concentrated in the Sierra Nevada but also on Mount Shasta and as far south as the Peninsular Ranges and White Mountains.
Divisions: 206:C
Nations: MX, US
Subnations: CA, MXBC(MX), NV, OR
Map Zones: 3:?, 4:P, 6:C, 7:C
USFS Ecomap Regions: M261D:CP, M261E:CC
TNC Ecoregions: 5:C, 12:C, 16:C

SOURCES

References: Barbour and Billings 2000, Barbour and Major 1988, Comer et al. 2003, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995
Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722781#references
Description Author: P. Comer, T. Keeler-Wolf, mod. G. Kittel
Version: 12 Jan 2012 **Stakeholders:** Latin America, West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

MOGOLLON CHAPARRAL (CES302.741)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: North American Warm Desert (302)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Lower Montane]; Lowland [Foothill]; Intermediate Disturbance Interval; F-Patch/High Intensity; Evergreen Sclerophyllous Shrub
Non-Diagnostic Classifiers: Montane [Montane]; Shrubland (Shrub-dominated); Temperate [Temperate Continental]; Temperate [Temperate Xeric]; Xeric; Aridic; Broad-Leaved Evergreen Shrub
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Evergreen shrubland
National Mapping Codes: EVT 2104; ESLF 5310; ESP 1104

CONCEPT

Summary: This ecological system occurs across central Arizona (Mogollon Rim), western New Mexico, and southern Utah and Nevada. It often dominates along the mid-elevation transition from the Mojave, Sonoran, and northern Chihuahuan deserts into mountains (1000-2200 m). It occurs on foothills, mountain slopes and canyons in hotter and drier habitats below the encinal and *Pinus ponderosa* woodlands. Stands are often associated with more xeric and coarse-textured substrates such as limestone, basalt or alluvium, especially in transition areas with more mesic woodlands. The moderate to dense shrub canopy includes species such as *Quercus turbinella, Quercus toumeyi, Cercocarpus montanus var. paucidentatus, Canotia holacantha, Ceanothus greggii, Garrya wrightii, Purshia stansburiana, Rhus ovata, Rhus trilobata,* and *Arctostaphylos pungens* and *Arctostaphylos pringlei* at higher elevations. Scattered remnant pinyon and juniper trees may be present. Most chaparral species are fire-adapted, resprouting vigorously after burning or producing fire-resistant seeds. Stands occurring within montane woodlands are seral and a result of recent fires.
Related Concepts:
- Arizona Chaparral (503) (Shiflet 1994) Equivalent

Component Associations:
- *Arctostaphylos patula - Quercus gambelii - (Amelanchier utahensis)* Shrubland (CEGL002695, GNR)
- *Arctostaphylos patula* Shrubland (CEGL002696, GNR)
- *Arctostaphylos pungens* Shrubland (CEGL000958, G4)
- *Cercocarpus montanus / Garrya flavescens* Shrubland (CEGL001088, GNR)
- *Cercocarpus montanus / Muhlenbergia pauciflora* Shrubland (CEGL001089, GNR)
- *Mortonia scabrella / Dasylirion wheeleri* Shrubland (CEGL001279, G4)
- *Purshia stansburiana - Arctostaphylos patula* Shrubland (CEGL002948, GNR)
- *Quercus pungens - Cercocarpus montanus* Shrubland (CEGL003832, G3?)
- *Quercus toumeyi / Bouteloua curtipendula* Scrub (CEGL000975, G1)
- *Quercus turbinella - (Amelanchier utahensis)* Colluvial Shrubland (CEGL002950, GNR)
- *Quercus turbinella - Cercocarpus montanus* Shrubland (CEGL000979, G4)
- *Quercus turbinella - Coleogyne ramosissima* Shrubland (CEGL000982, G4)
- *Quercus turbinella - Ephedra viridis* Shrubland (CEGL000980, G3?)
- *Quercus turbinella - Garrya flavescens - Arctostaphylos pungens* Shrubland (CEGL000977, G4)
- *Quercus turbinella - Juniperus osteosperma* Shrubland (CEGL000981, G4?)
- *Quercus turbinella / Bouteloua eriopoda* Shrubland (CEGL000978, GNR)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Sonoran Mid-Elevation Desert Scrub (CES302.035)

DISTRIBUTION

Range: This system occurs across central Arizona (Mogollon Rim), western New Mexico and southern Utah. It often dominates along the mid-elevation transition from the Mojave, Sonoran, and northern Chihuahuan deserts into mountains (1000-2200 m elevation). It does not occur as far west as California.
Divisions: 302:C; 304:P; 306:P
Nations: MX? , US
Subnations: AZ, MXSO?(MX), NM, NV, UT
Map Zones: 12:?, 13:P, 14:C, 15:C, 16:P, 17:C, 23:C, 24:C, 25:C, 26:C, 27:P, 28:?
USFS Ecomap Regions: 313A:CC, 313B:CC, 313C:CC, 313D:CC, 315A:CC, 315H:CC, 321A:CC, 322A:CC, 322B:CC, 341A:CP, 341F:CC, M313A:CC, M313B:CC, M341C:CC
TNC Ecoregions: 17:C, 19:C, 21:C, 22:C, 23:C, 24:C

SOURCES

References: Carmichael et al. 1978, Comer et al. 2003, Dick-Peddie 1993, Muldavin et al. 1994a, Muldavin et al. 2000b

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722931#references

Description Author: NatureServe Western Ecology Team

Version: 16 Jan 2009 **Stakeholders:** Latin America, West

Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

MOJAVE MID-ELEVATION MIXED DESERT SCRUB (CES302.742)

CLASSIFIERS

Conf.: 3 - Weak **Classification Status:** Standard
Primary Division: North American Warm Desert (302)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland [Foothill]; Shrubland (Shrub-dominated); Evergreen Sclerophyllous Tree
Non-Diagnostic Classifiers: Sideslope; Temperate [Temperate Xeric]; Aridic; Xeromorphic Shrub; Succulent Shrub
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Mixed evergreen-deciduous shrubland
National Mapping Codes: EVT 2082; ESLF 5259; ESP 1082

CONCEPT

Summary: This ecological system represents the extensive desert scrub in the transition zone above *Larrea tridentata - Ambrosia dumosa* desert scrub and below the lower montane woodlands (700-1800 m elevations) that occur in the eastern and central Mojave Desert. It is also common on lower piedmont slopes in the transition zone into the southern Great Basin. The vegetation in this ecological system is quite variable. Codominants and diagnostic species include *Coleogyne ramosissima, Eriogonum fasciculatum, Ephedra nevadensis, Grayia spinosa, Lycium* spp., *Menodora spinescens, Nolina* spp., *Opuntia acanthocarpa, Salazaria mexicana, Viguiera parishii, Yucca brevifolia,* or *Yucca schidigera*. Less common are stands with scattered Joshua trees and a saltbush short-shrub layer dominated by *Atriplex canescens, Atriplex confertifolia,* or *Atriplex polycarpa,* or occasionally *Hymenoclea salsola*. In some areas in the western Mojave, *Juniperus californica* is common with the yuccas. Desert grasses, including *Achnatherum hymenoides, Achnatherum speciosum, Muhlenbergia porteri, Pleuraphis jamesii, Pleuraphis rigida,* or *Poa secunda,* may form an herbaceous layer. Scattered *Juniperus osteosperma* or desert scrub species may also be present.

Related Concepts:
- Blackbush (212) (Shiflet 1994) Broader
- Creosote Bush Scrub (211) (Shiflet 1994) Broader

Component Associations:
- *Acacia greggii* Shrubland (CEGL005053, GNR)
- *Artemisia tridentata ssp. tridentata - Grayia spinosa* Shrubland (CEGL001004, G5)
- *Canotia holacantha* Grand Canyon Shrubland (CEGL005296, GNR)
- *Coleogyne ramosissima - Ephedra* spp. Warm Desert Shrubland (CEGL005297, GNR)
- *Coleogyne ramosissima - Eriogonum fasciculatum* Shrubland (CEGL001333, G5)
- *Coleogyne ramosissima - Purshia stansburiana* Shrubland (CEGL002720, G4?)
- *Coleogyne ramosissima - Thamnosma montana* Shrubland (CEGL002718, G4?)
- *Coleogyne ramosissima* Shrubland (CEGL001332, G4G5)
- *Encelia farinosa - Ephedra (fasciculata, nevadensis)* Shrubland (CEGL001252, G3)
- *Ephedra fasciculata* / Mixed Semi-desert Grasses Shrubland (CEGL005084, GNR)
- *Ephedra fasciculata* Shrubland (CEGL005090, GNR)
- *Ephedra nevadensis - Ericameria cooperi* Shrubland (CEGL001253, G3G4)
- *Ephedra nevadensis - Eriogonum fasciculatum* Shrubland (CEGL001254, G4)
- *Ephedra nevadensis / Achnatherum hymenoides* Shrubland (CEGL001255, G4)
- *Ephedra viridis / Pleuraphis rigida* Shrubland (CEGL001257, G3)
- *Eriogonum fasciculatum* Rock Outcrop Shrubland (CEGL001260, G5?)
- *Eriogonum fasciculatum* Shrubland (CEGL001258, G5)
- *Grayia spinosa - Lycium andersonii* Shrubland (CEGL001347, G5)
- *Grayia spinosa - Lycium pallidum* Shrubland (CEGL001348, G5)
- *Grayia spinosa - Menodora spinescens* Shrubland (CEGL001349, G5)
- *Gutierrezia (sarothrae, microcephala) - Ephedra* spp. - *Agave utahensis* Dwarf-shrubland (CEGL005130, GNR)
- *Juniperus californica* Wooded Shrubland (CEGL003058, G4?)
- *Lycium andersonii - Ephedra (torreyana, viridis)* Shrubland (CEGL005150, GNR)
- *Nolina bigelovii* Shrubland (CEGL003064, G3?)
- *Opuntia bigelovii* Shrubland (CEGL003065, G4?)
- *Opuntia polyacantha / Pleuraphis jamesii* Shrubland (CEGL002299, GNR)
- *Pleuraphis rigida* Herbaceous Vegetation (CEGL003051, G3G4)
- *Psorothamnus fremontii* Shrubland (CEGL005154, GNR)
- *Salazaria mexicana* Shrubland (CEGL005293, GNR)
- *Yucca brevifolia - Juniperus osteosperma / Artemisia tridentata* Wooded Shrubland (CEGL002744, G2G3)
- *Yucca brevifolia / Coleogyne ramosissima* Wooded Shrubland (CEGL005294, GNR)
- *Yucca brevifolia / Pleuraphis rigida* Wooded Herbaceous Vegetation (CEGL002725, G2?)

- *Yucca schidigera - Larrea tridentata - Ambrosia dumosa* Shrubland (CEGL005295, GNR)

SPATIAL CHARACTERISTICS

Spatial Summary: Transition zone shrublands desert scrub above Mojave desert scrub and below the lower montane woodlands.

DISTRIBUTION

Range: This system is found in the eastern and central Mojave Desert and on lower piedmont slopes in the transition zone into the southern Great Basin.
Divisions: 206:P; 302:C; 304:P
Nations: MX? , US
Subnations: AZ, CA, NV, UT
Map Zones: 4:C, 6:?, 12:C, 13:C, 14:C, 15:C, 16:?, 17:C, 23:P, 24:?
USFS Ecomap Regions: 313A:CC, 322A:CC, 322B:CC, 322C:CC, 341D:CP, 341E:C?, 341F:CC, 342B:PP, M261E:CC, M341A:CC, M341D:C?
TNC Ecoregions: 11:C, 12:P, 17:C, 23:P

SOURCES

References: Barbour and Major 1988, Beatley 1976, Comer et al. 2003, Holland and Keil 1995, MacMahon 1988, Ostler et al. 2000, Sawyer and Keeler-Wolf 1995, Thomas et al. 2004
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722930#references
Description Author: NatureServe Western Ecology Team
Version: 16 Jan 2009 **Stakeholders:** Latin America, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

NORTH PACIFIC AVALANCHE CHUTE SHRUBLAND (CES204.854)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Montane]; Shrubland (Shrub-dominated); Avalanche
Non-Diagnostic Classifiers: Montane [Upper Montane]; Montane [Lower Montane]; Temperate [Temperate Continental]
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Mixed evergreen-deciduous shrubland
National Mapping Codes: EVT 2083; ESLF 5260; ESP 1083

CONCEPT

Summary: This tall shrubland system occurs throughout mountainous regions of the Pacific Northwest, from the southern Cascades and Coast Ranges north into the mountains of British Columbia. This system occurs on sideslopes of mountains on glacial till or colluvium. These habitats range from moderately xeric to wet and occur on snow avalanche chutes at montane elevations. In the mountains of Washington, talus sites and snow avalanche chutes very often coincide spatially. On the west side of the Cascades, the major dominant species are *Acer circinatum, Alnus viridis ssp. sinuata, Rubus parviflorus*, and small trees, especially *Chamaecyparis nootkatensis*. Forbs, grasses, or other shrubs can also be locally dominant. *Prunus virginiana, Amelanchier alnifolia, Vaccinium membranaceum* or *Vaccinium scoparium*, and *Fragaria* spp. are common species on drier avalanche tracks on the east side of the Cascades. The main feature of this system is that it occurs on steep, frequently disturbed (snow avalanches) slopes. Avalanche chutes can be quite long, extending from the subalpine into the montane and foothill toeslopes.
Classification Comments: Avalanche slopes in the Cascades and mountains of southern British Columbia are probably drier than those found further north in Alaska, where the precipitation regime does not have a seasonal component to it. Hence, these have been split into two different systems. Exactly where they transition from one to another is yet to be determined.
Similar Ecological Systems:
- Alaskan Pacific Maritime Avalanche Slope Shrubland (CES204.162)

Related Concepts:
- $Sitka alder - Devil's club (ICHvc/51) (Banner et al. 1993) Intersecting
- $Sitka alder - Devil's club (ICHwc/51) (Banner et al. 1993) Intersecting
- Avalanche track (CWHvm1/51) (Banner et al. 1993) Intersecting
- Avalanche track (CWHvm2/51) (Banner et al. 1993) Intersecting
- Avalanche track (CWHwm/51) (Banner et al. 1993) Intersecting
- Avalanche track (CWHws2/51) (Banner et al. 1993) Intersecting
- Avalanche track (ESSFmc/51) (Banner et al. 1993) Intersecting
- Avalanche track (ESSFmk/51) (Banner et al. 1993) Intersecting
- Avalanche track (ESSFwv/51) (Banner et al. 1993) Intersecting
- Avalanche track (MHmm1/51) (Banner et al. 1993) Intersecting
- Avalanche track (MHmm2/51) (Banner et al. 1993) Intersecting

Component Associations:
- *Alnus viridis ssp. sinuata / Acer circinatum* Shrubland (CEGL001155, G4G5)
- *Chamaecyparis nootkatensis / Oplopanax horridus* Forest (CEGL000349, G3)

DISTRIBUTION

Range: This system occurs throughout mountainous regions of the Pacific Northwest, from the southern Cascades and Coast Ranges north to the mountains of British Columbia.
Divisions: 204:C
Nations: CA, US
Subnations: AK, BC, OR, WA
Map Zones: 1:C, 2:C, 6:?, 7:C
USFS Ecomap Regions: 242A:CC, 242B:CP, 342I:PP, M242A:CC, M242B:CC, M242C:CC, M242D:CC, M332G:CC
TNC Ecoregions: 1:C, 3:C, 4:C, 69:C, 81:C

SOURCES

References: Comer et al. 2003, Ecosystems Working Group 1998, Franklin and Dyrness 1973
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722821#references
Description Author: K. Boggs and G. Kittel, mod. C. Chappell and M.S. Reid
Version: 08 Dec 2008
Stakeholders: Canada, West
Concept Author: K. Boggs and G. Kittel
ClassifResp: West

NORTH PACIFIC DRY AND MESIC ALPINE DWARF-SHRUBLAND, FELL-FIELD AND MEADOW (CES204.862)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Alpine/AltiAndino [Alpine/AltiAndino]; Shrubland (Shrub-dominated)
Non-Diagnostic Classifiers: Long (>500 yrs) Persistence; Temperate [Temperate Oceanic]; W-Landscape/High Intensity
FGDC Crosswalk: Vegetated, Shrub-dominated, Dwarf-shrubland, Mixed evergreen-deciduous dwarf-shrubland
National Mapping Codes: EVT 2068; ESLF 5205; ESP 1068

CONCEPT

Summary: This system occurs above the environmental limit of trees, at the highest elevations of the mountain regions of the Pacific Northwest Coast. It is confined to the coldest, wind-blown areas above treeline and above the subalpine parkland. This system is found at elevations above 2350 m (7200 feet) in the Klamath Mountains and Cascades north into the Cascade and Coastal mountains of British Columbia. It is commonly comprised of a mosaic of plant communities with characteristic species including *Cassiope mertensiana, Phyllodoce empetriformis, Phyllodoce glanduliflora, Luetkea pectinata, Saxifraga tolmiei,* and *Carex* spp. It occurs on slopes and depressions where snow lingers, the soil has become relatively stabilized, and the water supply is more or less constant. Vegetation in these areas is controlled by snow retention, wind desiccation, permafrost, and a short growing season. This system includes all vegetated areas in the alpine zone of the North Pacific. Typically it is a mosaic of dwarf-shrublands, fell-fields, tundra (sedge turfs), and sparsely vegetated snowbed communities. Small patches of krummholz (shrub-form trees) are also part of this system and occur at the lower elevations. Communities are dominated by graminoids, foliose lichens, dwarf-shrubs, and/or forbs. Vegetation cover ranges from about 5 or 10% (snowbeds) to nearly 100%. The alpine tundra of the northern Cascades has floristic affinities with many mountain regions in western North America. The strongest relationships are with the Arctic and Cordilleran regions to the north and east.
Classification Comments: Alpine systems in Alaska are placed into different types than this.
Related Concepts:
- Alpine Idaho Fescue (108) (Shiflet 1994) Intersecting
- AM Alpine Meadow (Ecosystems Working Group 1998) Broader
- AT Alpine Tundra (Ecosystems Working Group 1998) Broader
- no data (CMAunp/) (BCMF 2006) Intersecting
- no data (IMAunp/) (BCMF 2006) Intersecting

DESCRIPTION

Dynamics: Landfire VDDT models: #RALME includes this and Rocky Mountain alpine systems.

Component Associations:
- *Antennaria lanata* Herbaceous Vegetation (CEGL001949, G4)
- *Arctostaphylos uva-ursi* Dwarf-shrubland (CEGL001392, G3G4)
- *Calamagrostis purpurascens* Herbaceous Vegetation (CEGL001850, G2)
- *Carex breweri* Herbaceous Vegetation (CEGL001805, G3?)
- *Carex capitata* Herbaceous Vegetation (CEGL001807, G3?)
- *Carex nardina* Scree Herbaceous Vegetation (CEGL001812, GNR)
- *Carex pellita* Herbaceous Vegetation (CEGL001809, G3)
- *Carex proposita* Herbaceous Vegetation (CEGL001859, G3?)
- *Carex scirpoidea ssp. pseudoscirpoidea* Herbaceous Vegetation (CEGL001865, G3?)
- *Cassiope mertensiana - Phyllodoce empetriformis* Dwarf-shrubland (CEGL001398, G5)
- *Cassiope mertensiana / Luetkea pectinata* Dwarf-shrubland (CEGL001397, G3G4)
- *Cassiope mertensiana* Dwarf-shrubland (CEGL001395, G3G4)
- *Dryas octopetala* Dwarf-shrub Herbaceous Vegetation (CEGL001891, G3?)
- *Empetrum nigrum / Lupinus sellulus var. lobbii* Dwarf-shrubland (CEGL001400, G3G4)
- *Empetrum nigrum* Dwarf-shrubland (CEGL001399, G3G4)
- *Erigeron aureus - Lupinus sellulus var. lobbii* Herbaceous Vegetation (CEGL001961, G3G4)
- *Eriogonum pyrolifolium - Luzula piperi* Herbaceous Vegetation (CEGL001963, G4)
- *Festuca roemeri - Delphinium glareosum* Herbaceous Vegetation (CEGL001613, G2)
- *Festuca roemeri - Phlox diffusa ssp. longistylis* Herbaceous Vegetation (CEGL001622, G2)
- *Pedicularis contorta - Carex spectabilis* Herbaceous Vegetation (CEGL001977, G3?)
- *Phlox diffusa ssp. longistylis - Arenaria capillaris* Herbaceous Vegetation (CEGL001978, G3?)
- *Phlox diffusa ssp. longistylis - Carex spectabilis* Herbaceous Vegetation (CEGL001979, GNR)
- *Phyllodoce glanduliflora / Oreostemma alpigenum* Dwarf-shrubland (CEGL001408, G3G4)

- *Salix cascadensis / Festuca brachyphylla* Dwarf-shrubland (CEGL001433, G3G4)
- *Salix nivalis / Festuca brachyphylla* Dwarf-shrubland (CEGL001434, G3G4)
- *Saxifraga tolmiei - Luzula piperi* Herbaceous Vegetation (CEGL001986, G4)

DISTRIBUTION

Range: This system occurs above the environmental limit of trees, at the highest elevations of the mountain regions of the Pacific Northwest Coast. Alpine systems in Alaska are placed into different types than this.
Divisions: 204:C
Nations: CA, US
Subnations: BC, OR, WA
Map Zones: 1:C, 2:C, 7:C
USFS Ecomap Regions: M242A:CC, M242B:CC, M242C:CC, M242D:CC
TNC Ecoregions: 1:C, 3:C, 69:?, 81:C

SOURCES

References: Comer et al. 2003, Ecosystems Working Group 1998, Franklin and Dyrness 1973, Holland and Keil 1995
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722813#references
Description Author: K. Boggs, C. Chappell, R. Crawford
Version: 31 Mar 2005 **Stakeholders:** Canada, West
Concept Author: K. Boggs, C. Chappell, R. Crawford **ClassifResp:** West

NORTH PACIFIC MONTANE SHRUBLAND (CES204.087)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Shrubland (Shrub-dominated)
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Mixed evergreen-deciduous shrubland
National Mapping Codes: EVT 2084; ESLF 5261; ESP 1084

CONCEPT

Summary: This system occurs as small to large patches scattered throughout the North Pacific region, but it is largely absent from the windward sides of the coastal mountains where fires are rare due to very wet climates. It is defined as long-lived seral shrublands that persist for several decades or more after major wildfires, or smaller patches of shrubland on dry sites that are marginal for tree growth and that have typically also experienced fire. This system occurs on ridgetops and upper to middle mountain slopes and is more common on sunny southern aspects. It occurs from about 152 m (500 feet) elevation up to the lower limits of subalpine parkland. Vegetation is mostly deciduous broadleaf shrubs, sometimes mixed with shrub-statured trees or sparse evergreen needleleaf trees. It can also be dominated by evergreen shrubs, especially *Xerophyllum tenax* (usually considered a forb). Species composition is highly variable; some of most common species include *Acer circinatum, Arctostaphylos nevadensis, Acer glabrum, Vaccinium membranaceum, Ceanothus velutinus, Holodiscus discolor, Shepherdia canadensis, Sorbus* spp., and *Rubus parviflorus*. On the west side of the Cascades, *Gaultheria shallon* is an important dominant.

Related Concepts:

- Snowbush (420) (Shiflet 1994) Intersecting. *Ceanothus velutinus* shrublands in the southern Cascades are included in this ecological system.

Component Associations:

- *Acer circinatum / Athyrium filix-femina - Tolmiea menziesii* Shrubland (CEGL003291, G5)
- *Amelanchier alnifolia / Xerophyllum tenax* Herbaceous Vegetation (CEGL001066, GNRQ)
- *Rubus parviflorus / Chamerion angustifolium - Heracleum maximum* Shrubland (CEGL001127, G4)
- *Vaccinium membranaceum / Xerophyllum tenax* Shrubland (CEGL005891, G3?)
- *Xerophyllum tenax - Sanguisorba officinalis* Herbaceous Vegetation (CEGL003439, G1)

DISTRIBUTION

Range: This system occurs as small to large patches scattered throughout mountainous regions of the Pacific Northwest, from the southern Cascade and Coast ranges north to southern British Columbia. Its northernmost distribution is not clear, but it does not appear to occur in Alaska.
Divisions: 204:C
Nations: CA, US
Subnations: BC, OR, WA
Map Zones: 1:C, 2:C, 7:C
USFS Ecomap Regions: 242A:CC, M242A:CC, M242B:CC, M242C:CC, M242D:CC
TNC Ecoregions: 1:C, 3:C, 4:C, 81:C

SOURCES

References: Chappell and Christy 2004, Franklin and Dyrness 1973, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.768078#references
Description Author: C. Chappell, mod. G. Kittel, M.S. Reid
Version: 21 Aug 2008
Concept Author: C. Chappell
Stakeholders: Canada, West
ClassifResp: West

NORTHERN AND CENTRAL CALIFORNIA DRY-MESIC CHAPARRAL (CES206.931)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Mediterranean [Mediterranean Xeric-Oceanic]; Sand Soil Texture; Ustic; Intermediate Disturbance Interval; F-Landscape/High Intensity; Ceanothus cuneatus, Adenostoma fasciculatum
Non-Diagnostic Classifiers: Montane [Lower Montane]; Lowland [Foothill]; Lowland [Lowland]; Shrubland (Shrub-dominated); Sideslope; Xeric
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Evergreen shrubland
National Mapping Codes: EVT 2105; ESLF 5311; ESP 1105

CONCEPT

Summary: This ecological system includes chaparral typically located inland from maritime chaparral up to 1500 m (4550 feet) elevation in central and northern California through the northern end of the Central Valley and north into Oregon. This system includes extensive areas on coarse-grained soils with annual precipitation up to 75 cm (winter rain but not snow). Adjacent fine-textured soils support savanna under similar climatic regimes. These areas have supported extensive stand-replacing wildfires. This system is made up of a mixture of mostly obligate seeders. Characteristic species include *Adenostoma fasciculatum, Ceanothus cuneatus, Arctostaphylos viscida, Arctostaphylos manzanita, Arctostaphylos glauca, Arctostaphylos glandulosa, Arctostaphylos stanfordiana, Fremontodendron californicum, Malacothamnus fasciculatus, Dendromecon rigida,* and *Pickeringia montana*. Common shrubs in Oregon include *Arctostaphylos viscida, Cercocarpus montanus var. glaber,* and *Ceanothus cordulatus*. Fire regimes are intense, stand-replacing crown fires. Scattered and young trees may occur, such as *Pinus ponderosa, Pinus sabiniana, Pseudotsuga menziesii,* and *Quercus wislizeni*.

Related Concepts:
- Ceanothus Mixed Chaparral (208) (Shiflet 1994) Broader
- Chamise Chaparral (206) (Shiflet 1994) Broader. SRM groups all *Adenostoma*-dominated communities into one range type; several ecological systems can have *Adenostoma fasciculatum* as a dominant.

Component Associations:
- *Adenostoma fasciculatum - Arctostaphylos glandulosa - Ceanothus jepsonii / Calamagrostis ophitidis* Shrubland (CEGL003176, G2)
- *Adenostoma fasciculatum - Arctostaphylos glandulosa - Quercus wislizeni* Shrubland (CEGL003177, G3)
- *Adenostoma fasciculatum - Ceanothus cuneatus* Sierran Chaparral Shrubland (CEGL003468, G4?)
- *Adenostoma fasciculatum - Diplacus aurantiacus* Shrubland (CEGL003178, G3)
- *Adenostoma fasciculatum* Sierran Chaparral Shrubland (CEGL005816, G5?)
- *Arctostaphylos glandulosa - Quercus wislizeni* Shrubland (CEGL003180, G3)
- *Arctostaphylos glauca* Shrubland (CEGL003008, G3G4)
- *Arctostaphylos viscida* Sierran Chaparral Shrubland (CEGL005817, G5?)
- *Ceanothus cuneatus* / Poaceae Shrubland (CEGL003158, GNR)
- *Ceanothus cuneatus* Shrubland (CEGL003025, G4?)

DISTRIBUTION

Range: This system is located inland from maritime chaparral up to 1500 m (4550 feet) elevation in central and northern California, and southwestern Oregon, through the north end of the California Central Valley.
Divisions: 206:C
Nations: US
Subnations: CA, OR
Map Zones: 2:C, 3:C, 4:C, 5:C, 6:C, 7:C
USFS Ecomap Regions: 242B:??, 262A:CC, 263A:CC, M242A:P?, M242B:PP, M261A:CC, M261B:CC, M261C:CC, M261D:CC, M261E:CC, M261F:CC, M261G:CC
TNC Ecoregions: 5:P, 12:C, 13:C, 14:C, 15:P

SOURCES

References: Barbour and Billings 2000, Barbour and Major 1988, Comer et al. 2003, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Shiflet 1994
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722750#references
Description Author: P. Comer, T. Keeler-Wolf, mod. M.S. Reid, G. Kittel
Version: 12 Jan 2012 **Stakeholders:** West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

NORTHERN ATLANTIC COASTAL PLAIN HEATHLAND AND GRASSLAND (CES203.895)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Glaciated plains; Shrubland (Shrub-dominated); Grassland, Savanna, Steppe (graminoid-dominated); North Atlantic Coastal Plain; Sandplains/Glacial Outwash or Flats; Temperate; Sand Soil Texture; Very Short Disturbance Interval; Coastal plain
Non-Diagnostic Classifiers: Salt Spray
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Deciduous shrubland
National Mapping Codes: EVT 2522; ESLF 5275; ESP 1522

CONCEPT

Summary: Sandplain grasslands and heathlands of the southern New England / New York coast are areas of graminoid- and shrub-dominated vegetation maintained by periodic fire or other disturbance, as well as exposure to maritime influences. Developing on acidic, nutrient-poor, and very well-drained soils within a few kilometers of the ocean, they may occur as heathlands, grasslands, or support a patchwork of grass and shrub vegetation. Characteristic species include *Gaylussacia baccata, Arctostaphylos uva-ursi, Corema conradii, Amelanchier nantucketensis, Hudsonia ericoides, Hudsonia tomentosa, Vaccinium angustifolium, Deschampsia flexuosa, Schizachyrium scoparium,* and *Carex pensylvanica*. They provide habitat for several rare or uncommon forbs including *Liatris scariosa var. novae-angliae* and *Agalinis acuta*. They are important habitat for several bird and other animal species including the short-eared owl and regal fritillary, and (along with brushy plains and woodlands) provided habitat for the extinct heath hen.
Classification Comments: This system includes both the very distinctive Hempstead Plains grasslands of Long Island, New York (which occur a bit further inland than other sites), as well as the maritime heathlands/grasslands of Cape Cod and nearby islands. Grass-dominated and shrub-dominated expressions are separated at the association level; they can occur together and intergrade at some sites. This system is related to dune grasslands but occurs on sandplains, not dunes, and lacks significant amounts of *Ammophila breviligulata*. In the absence of disturbance (fire, grazing, mowing), coverage by *Pinus rigida* and *Quercus ilicifolia* can increase, creating vegetation similar to a pitch pine - scrub oak barren (hence the inclusion of CEGL006315 in the associations list); or in some cases, a tall-shrub community can develop in the absence of fire (CEGL006379). Neither of these associations is core to the concept of this system. Its landscape position and dynamics are sufficiently distinct that it is segregated rather than being treated as a phase or a patch of the coastal pine barrens system.
Similar Ecological Systems:
- Northern Atlantic Coastal Plain Dune and Swale (CES203.264)
- Northern Atlantic Coastal Plain Pitch Pine Barrens (CES203.269)

Related Concepts:
- Coastal Heathland and Sandplain Grassland (Dunwiddie et al. 1996) Equivalent
- Coastal Heathland and Sandplain Grassland (Dunwiddie 1989) Equivalent
- Eastern Redcedar: 46 (Eyre 1980) Finer
- Maritime Heathland, Maritime Grassland, Hempstead Plains Grassland (Edinger et al. 2002) Equivalent
- Pitch Pine: 45 (Eyre 1980) Finer
- Post Oak - Blackjack Oak: 40 (Eyre 1980) Finer
- Sandplain Grassland and Sandplain Heathland (Swain and Kearsley 2000) Equivalent
- Sandplain Grassland and Sandplain Heathland (Lundgren et al. 2000) Equivalent

DESCRIPTION

Environment: Sandplain grasslands and heathlands of the southern New England / New York coast are areas of graminoid- and shrub-dominated vegetation maintained by extreme conditions and periodic fire or other disturbance. Developing on acidic, nutrient-poor, and very well-drained soils, they may occur as heathlands, grasslands, or support a patchwork of grass and shrub vegetation.
Vegetation: Characteristic species include *Gaylussacia baccata, Arctostaphylos uva-ursi, Corema conradii, Amelanchier nantucketensis, Hudsonia ericoides, Hudsonia tomentosa, Vaccinium angustifolium, Deschampsia flexuosa, Schizachyrium scoparium,* and *Carex pensylvanica*. They provide habitat for several rare or uncommon forbs including *Liatris scariosa var. novae-angliae* and *Agalinis acuta*.
Dynamics: The largely exposed locations experience extreme variations in temperature and moisture, and the sandy, nutrient-poor soils contribute to prevention of establishment of woody vegetation. Coastal occurrences maintain their open nature with the stress and killing of woody plant tissue caused by high winds, desiccation, and salt spray. Examples that developed in slight depressions are also maintained by frost that persists longer into the growing season (MNHESP 2010a, 2010b). Prior to European settlement, this system is believed to have occurred as small patches in limited areas near the coast (Motzkin and Foster 2002); there may also have been patches in the vicinity of Native American settlements, based on the prevalence of charcoal in some palynological cores (Dunwiddie

1989). Presettlement grasslands appear to have been more likely on portions of Long Island (Hempstead Plains and Montauk) and Martha's Vineyard than on Nantucket, Block Island, or Cape Cod (Motzkin and Foster 2002). This native vegetation is often confused with similar semi-natural grasslands and heathlands characterized by a mixture of native and exotic species developed as a result of agriculture; some natural occurrences may have resulted as expansions of original native vegetation. They have increased in extent and largely post-date land clearing following European settlement (Foster et al. 2002). In addition, some heathlands may have developed on severely disturbed soils following the abandonment of agriculture and grazing (Motzkin and Foster 2002). Efforts to reverse the conversion of these heathlands and grasslands to tall shrublands or woodlands have generally used a mixture of prescribed fire and mowing, and less commonly grazing.

Component Associations:
- *Amelanchier canadensis - Viburnum* spp. - *Morella pensylvanica* Scrub Forest (CEGL006379, GNR)
- *Gaylussacia baccata - Vaccinium angustifolium - Arctostaphylos uva-ursi / Schizachyrium littorale* Dwarf-shrubland (CEGL006066, G3)
- *Morella pensylvanica / Schizachyrium littorale - Danthonia spicata* Shrub Herbaceous Vegetation (CEGL006067, G2)
- *Pinus rigida / Quercus ilicifolia / Morella pensylvanica* Woodland (CEGL006315, G3)
- *Quercus stellata - Sassafras albidum / Smilax glauca* Woodland (CEGL006372, GNR)
- *Schizachyrium scoparium - Sorghastrum nutans - Hypoxis hirsuta - Baptisia tinctoria* Herbaceous Vegetation (CEGL006187, G1Q)

SPATIAL CHARACTERISTICS

Spatial Summary: Occurs as a large-patch system, some presently reduced to small-patch.
Size: Historically occurred in small to large patches (100 ha plus, with the Hempstead Plains upward of 14,000 ha), but most have been reduced by land-use changes or conversion. Some of the remnants are naturally small, occurring on islands.
Adjacent Ecological Systems:
- Northern Atlantic Coastal Plain Dune and Swale (CES203.264)

DISTRIBUTION

Range: This system is endemic to a small area ranging from the southern New York coastline north to Cape Cod, Massachusetts.
Divisions: 203:C
Nations: US
Subnations: CT?, MA, NY, RI
Map Zones: 65:C
USFS Ecomap Regions: 221Ab:CCC, 221Ac:CCC, 221Ad:CCP, 221An:CCC
TNC Ecoregions: 62:C

SOURCES

References: Cain et al. 1937, Chase and Rothley 2007, Dunwiddie 1989, Dunwiddie and Caljouw 1990, Dunwiddie et al. 1993, Dunwiddie et al. 1996, Dunwiddie et al. 1997, Eastern Ecology Working Group n.d., Foster et al. 2002, Harper 1912, Lundgren et al. 2000, MNHESP 2010a, MNHESP 2010b, Motzkin and Foster 2002, Neidich 1980, NYNHP 2013f, NYNHP 2013j, NYNHP 2013k, Swain and Kearsley 2011
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.802851#references
Description Author: S.C. Gawler, mod. L.A. Sneddon
Version: 14 Jan 2014 **Stakeholders:** East
Concept Author: L.A. Sneddon **ClassifResp:** East

NORTHERN CALIFORNIA COASTAL SCRUB (CES206.932)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Woody-Herbaceous; Marine Sedimentary; Mediterranean [Mediterranean Xeric-Oceanic]; Bluff; Baccharis pilularis
Non-Diagnostic Classifiers: Dune (Landform); Lowland [Foothill]; Lowland [Lowland]; Shrubland (Shrub-dominated); Herbaceous; Terrace; Sideslope; Intermediate Disturbance Interval; F-Landscape/High Intensity
FGDC Crosswalk: Vegetated, Shrub-dominated, Herbaceous - shrub-steppe, Perennial graminoid steppe
National Mapping Codes: EVT 2128; ESLF 5457; ESP 1128

CONCEPT

Summary: This ecological system includes a variety of mixed and single-species-dominated shrublands along a narrow coastal strip with maritime and summer fog influences, on marine sediments, coastal bluffs, terraces, stabilized dunes, and hills below 500 m (1500 feet) elevation from southern Oregon south through central California. It is restricted to coastal plateaus and lower slopes of the Coast Ranges where precipitation ranges from 50-200 cm annually. These are dominated by evergreen, microphyllous-leaved or hemi-sclerophyllous shrub taxa; drought-deciduous species are unimportant or absent in this system. Dense shrublands typically include a well-developed woody and herbaceous understory. Characteristic species include *Baccharis pilularis, Lupinus arboreus, Ceanothus thyrsiflorus, Eriophyllum stoechadifolium, Diplacus aurantiacus (= Mimulus aurantiacus), Toxicodendron diversilobum, Rubus ursinus, Rubus parviflorus, Rubus spectabilis, Frangula californica (= Rhamnus californica), Holodiscus discolor, Gaultheria shallon, Heracleum maximum (= Heracleum lanatum),* and *Polystichum munitum*. These areas have supported extensive stand-replacing wildfires. This system has direct seral relationships with California Northern Coastal Grassland (CES206.941) as, in the absence of fire and grazing, the grassland will usually succeed to this system. In the absence of fire in this system, conifers (*Abies grandis, Pseudotsuga menziesii*) can invade and become prominent.
Classification Comments: Transitions to Southern California Coastal Scrub (CES206.933) begin in the northern San Francisco Bay area where *Artemisia californica* begins to mix with *Baccharis* and others. Further south in the Santa Lucia Range (Big Sur area of Monterey County), *Baccharis pilularis* and *Artemisia californica* tend to codominate, and other southern coastal sage species such as *Salvia leucophylla* and *Eriogonum fasciculatum* become more prominent. South of Monterey County most of the northern California coastal scrub influence is gone, and coastal shrublands shift to Southern California Coastal Scrub (CES206.933). The combination of <30% relative cover of *Artemisia californica* or *Salvia* spp. and high cover *Baccharis* and *Rhamnus*, or having *Polystichum munitum, Gaultheria shallon*, and *Heracleum maximum* makes it Northern California Coastal Scrub (CES206.932).
Similar Ecological Systems:
- Southern California Coastal Scrub (CES206.933)

Related Concepts:
- North Coastal Shrub (204) (Shiflet 1994) Broader. Nearly equivalent, but SRM type includes coastal salal shrublands which are in a different ecological system.

Component Associations:
- *Baccharis pilularis - Artemisia californica* Shrubland (CEGL003184, G5)
- *Baccharis pilularis - Ceanothus thyrsiflorus* Shrubland (CEGL003186, G3)
- *Baccharis pilularis - Eriophyllum stoechadifolium* Shrubland (CEGL003190, G3)
- *Baccharis pilularis - Frangula californica - Rubus parviflorus* Shrubland (CEGL003191, G2)
- *Baccharis pilularis - Holodiscus discolor* Shrubland (CEGL003192, G3)
- *Baccharis pilularis - Lupinus (arboreus, chamissonis)* Shrubland (CEGL003193, G3)
- *Baccharis pilularis - Rubus ursinus* / Weedy Herbs Shrubland (CEGL003196, G5)
- *Baccharis pilularis - Toxicodendron diversilobum* Shrubland (CEGL003197, G5)
- *Baccharis pilularis* / Annual Grass - Herb Shrubland (CEGL003183, G5)
- *Baccharis pilularis / Carex obnupta - Juncus patens* Shrubland (CEGL003185, G3)
- *Baccharis pilularis / Danthonia californica* Shrubland (CEGL003187, G2)
- *Baccharis pilularis / Deschampsia caespitosa* Shrubland (CEGL003188, G2)
- *Baccharis pilularis / Dudleya farinosa* Shrubland (CEGL003189, G3)
- *Baccharis pilularis / Nassella pulchra* Shrubland (CEGL003194, G3)
- *Baccharis pilularis / Polystichum munitum* Shrubland (CEGL003195, G3)
- *Ceanothus thyrsiflorus - Baccharis pilularis - Toxicodendron diversilobum* Shrubland (CEGL003198, G4?)
- *Frangula californica ssp. californica - Baccharis pilularis / Scrophularia californica* Shrubland (CEGL003316, G4)
- *Rubus spectabilis* Wet Shrubland (CEGL003472, G4)
- *Toxicodendron diversilobum - Baccharis pilularis - Rubus parviflorus* Shrubland (CEGL003473, G3)

DISTRIBUTION

Range: This system occurs along a narrow coastal strip below 500 m (1500 feet) elevation from southern Oregon south through central California.
Divisions: 206:C
Nations: US
Subnations: CA, OR
Map Zones: 2:P, 3:C, 4:C
USFS Ecomap Regions: 263A:CC, M242A:PP
TNC Ecoregions: 14:C, 15:C

SOURCES

References: Barbour and Billings 2000, Barbour and Major 1988, Comer et al. 2003, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722749#references
Description Author: P. Comer, T. Keeler-Wolf
Version: 07 Oct 2005 **Stakeholders:** West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

NORTHERN ROCKY MOUNTAIN MONTANE-FOOTHILL DECIDUOUS SHRUBLAND (CES306.994)

CLASSIFIERS

Conf.: 3 - Weak **Classification Status:** Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Moderate (100-500 yrs) Persistence; Montane [Lower Montane]; Lowland [Foothill]; Shrubland (Shrub-dominated); Very Shallow Soil; Broad-Leaved Deciduous Shrub
Non-Diagnostic Classifiers: Sideslope; Toeslope/Valley Bottom; Temperate [Temperate Continental]; Ustic
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Mixed evergreen-deciduous shrubland
National Mapping Codes: EVT 2106; ESLF 5312; ESP 1106

CONCEPT

Summary: This shrubland ecological system is found in the lower montane and foothill regions around the Columbia Basin, and north and east into the northern Rockies, including Alberta and British Columbia. These shrublands typically occur below treeline, within the matrix of surrounding low-elevation grasslands and sagebrush shrublands. They also occur in the ponderosa pine and Douglas-fir zones, but rarely up into the subalpine zone (on dry sites). The shrublands are usually found on steep slopes of canyons and in areas with some soil development, either loess deposits or volcanic clays; they occur on all aspects. Fire, flooding and erosion all impact these shrublands, but they typically will persist on sites for long periods. These communities develop near talus slopes as garlands, at the heads of dry drainages, and toeslopes in the moist shrub-steppe and steppe zones. *Physocarpus malvaceus, Prunus emarginata, Prunus virginiana, Rosa* spp., *Rhus glabra, Acer glabrum, Amelanchier alnifolia, Symphoricarpos albus, Symphoricarpos oreophilus,* and *Holodiscus discolor* are the most common dominant shrubs, occurring alone or any combination. In the Alberta's Upper and Lower Foothills subregions, common shrubs include *Arctostaphylos uva-ursi, Juniperus communis, Symphoricarpos* spp., *Amelanchier alnifolia,* and *Rosa* spp. *Rubus parviflorus* and *Ceanothus velutinus* are other important shrubs in this system, being more common in montane occurrences than in subalpine situations. Occurrences in central and eastern Wyoming can include *Artemisia tridentata ssp. vaseyana* and *Cercocarpus montanus,* but neither of these are dominant, and where they occur, the stands are truly mixes of shrubs, often with *Amelanchier alnifolia, Prunus virginiana,* and others being the predominant taxa. In moist areas, *Crataegus douglasii* can be common. *Shepherdia canadensis* and *Spiraea betulifolia* can be abundant in some cases but also occur in Northern Rocky Mountain Subalpine Deciduous Shrubland (CES306.961). *Festuca idahoensis, Festuca campestris, Calamagrostis rubescens, Carex geyeri, Koeleria macrantha, Pseudoroegneria spicata,* and *Poa secunda* are the most important grasses. *Achnatherum thurberianum* and *Leymus cinereus* can be locally important. *Poa pratensis* and *Phleum pratense* are common introduced grasses. *Geum triflorum, Potentilla gracilis, Lomatium triternatum, Balsamorhiza sagittata,* and species of *Eriogonum, Phlox,* and *Erigeron* are important forbs.
Classification Comments: Seral shrub fields of comparable composition that typically will develop into a seral stage with trees (within 50 years) are excluded from this shrub system and are included in their appropriate forest system.
Related Concepts:
- Bittercherry (419) (Shiflet 1994) Intersecting
- Chokecherry - Serviceberry - Rose (421) (Shiflet 1994) Intersecting
- MS Montane Shrub/Grassland Dry Subdivision sites (Ecosystems Working Group 1998) Broader

Component Associations:
- *Amelanchier alnifolia* / (Mixed Grass, Forb) Shrubland (CEGL005885, GNR)
- *Crataegus douglasii / Rosa woodsii* Shrubland (CEGL001095, G2)
- *Physocarpus malvaceus - Symphoricarpos albus* Shrubland (CEGL001171, G3)
- *Prunus virginiana - (Prunus americana)* Shrubland (CEGL001108, G4Q)
- *Rhamnus alnifolia* Shrubland (CEGL001132, G3)
- *Rhus glabra / Aristida purpurea var. longiseta* Shrub Herbaceous Vegetation (CEGL001507, G1)
- *Rhus glabra / Pseudoroegneria spicata* Shrub Herbaceous Vegetation (CEGL001122, G2)
- *Rosa woodsii* Shrubland (CEGL001126, G5)
- *Spiraea betulifolia* Shrubland (CEGL005835, G3?)
- *Spiraea douglasii* Shrubland (CEGL001129, G5)
- *Symphoricarpos albus - Rosa nutkana* Shrubland (CEGL001130, G3)
- *Symphoricarpos albus* Shrubland (CEGL005890, G4?)

DISTRIBUTION

Range: This system is found in the lower montane and foothill regions around the Columbia Basin, and north and east into the northern Rockies, including east into central Montana around the "Sky Island" ranges. It also occurs farther south into central and eastern Wyoming, where it forms compositionally diverse shrublands.
Divisions: 304:C; 306:C
Nations: CA, US

Subnations: AB, BC, ID, MT, OR, WA, WY
Map Zones: 1:C, 7:C, 8:C, 9:C, 10:C, 16:?, 17:?, 18:C, 19:C, 20:C, 21:C, 22:C, 29:C
USFS Ecomap Regions: 331A:CC, 331D:CP, 331N:CC, 341G:PP, 342A:CP, 342B:CC, 342C:CC, 342D:CC, 342E:CC, 342H:CC, 342I:CC, 342J:CC, M242C:CC, M242D:CC, M261D:PP, M261G:P?, M331A:CC, M331B:CC, M331D:CC, M331J:CC, M332A:CC, M332B:CC, M332D:CC, M332E:CC, M332F:CC, M332G:CC, M333A:CC, M333B:CC, M333C:CC, M333D:CC, M334A:CC, M341A:PP
TNC Ecoregions: 6:C, 7:C, 8:C, 26:C, 68:C

SOURCES

References: Comer et al. 2003, Ecosystems Working Group 1998, Franklin and Dyrness 1973, Hall 1973, Johnson and Clausnitzer 1992, Johnson and Simon 1987, Knight 1994, Lane et al. 2000, Poulton 1955, Shiflet 1994, Tisdale 1986, Willoughby 2007
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722711#references
Description Author: M. Reid, J. Kagan, mod. R. Crawford
Version: 30 Mar 2010 **Stakeholders:** Canada, West
Concept Author: M. Reid, J. Kagan **ClassifResp:** West

NORTHERN ROCKY MOUNTAIN SUBALPINE DECIDUOUS SHRUBLAND (CES306.961)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Moderate (100-500 yrs) Persistence; Montane [Upper Montane]; Shrubland (Shrub-dominated); Very Shallow Soil; Broad-Leaved Deciduous Shrub
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Deciduous shrubland
National Mapping Codes: EVT 2169; ESLF 5326; ESP 1169

CONCEPT

Summary: This shrubland ecological system is found within the zone of continuous forest in the upper montane and lower subalpine zones of the northern Rocky Mountains. Soils tend to be moist to wet. Stands are typically initiated by fires and will persist on sites for long periods because of repeated burns and changes in the presence of volatile oils in the soil which impedes tree regeneration. *Menziesia ferruginea, Rhamnus alnifolia, Ribes lacustre, Rubus parviflorus, Alnus viridis, Rhododendron albiflorum, Sorbus scopulina, Sorbus sitchensis, Vaccinium myrtillus, Vaccinium scoparium*, and *Vaccinium membranaceum* are the most common dominant shrubs, occurring alone or in any combination. Other shrubs can include *Shepherdia canadensis* and *Ceanothus velutinus*, but these also commonly occur in Northern Rocky Mountain Montane-Foothill Deciduous Shrubland (CES306.994). *Rubus parviflorus* and *Ceanothus velutinus* are occasionally present, being more common in montane shrublands than in this subalpine system. Important forbs include *Xerophyllum tenax, Chamerion angustifolium*, and *Pteridium aquilinum*, reflecting the mesic nature of many of these shrublands.
Classification Comments: This system is floristically somewhat similar to Northern Rocky Mountain Avalanche Chute Shrubland (CES306.801), but the avalanche chutes originate from very different processes, tend to be more diverse within stands, and are wetter, being driven ecologically by snow-loading and concomitant snowmelt. Seral shrub fields of comparable composition that typically will develop into a seral stage with trees (within 50 years) are excluded from this shrub system and are included in their appropriate forest system.

Component Associations:
- *Menziesia ferruginea / Xerophyllum tenax* Shrubland (CEGL005888, G3G4)
- *Rhamnus alnifolia* Shrubland (CEGL001132, G3)
- *Vaccinium membranaceum / Xerophyllum tenax* Shrubland (CEGL005891, G3?)

DISTRIBUTION

Range: This system is found in the subalpine and upper montane zones in the northern Rockies, south and west around the Columbia Basin.
Divisions: 304:C; 306:C
Nations: CA, US
Subnations: AB, BC, ID, MT, OR, WA, WY
Map Zones: 1:C, 8:?, 9:C, 10:C, 18:P, 19:C, 20:C, 21:P, 22:?, 29:C
USFS Ecomap Regions: M331A:CP, M331B:CC, M331D:CP, M331E:CP, M331J:C?, M332A:CC, M332B:CC, M332D:CC, M332E:CC, M332F:CC, M332G:C?, M333A:CC, M333B:CC, M333C:CC, M333D:CC
TNC Ecoregions: 6:C, 7:C, 8:C, 26:C, 68:C

SOURCES

References: Comer et al. 2003, Ecosystems Working Group 1998, Franklin and Dyrness 1973, Hall 1973, Johnson and Clausnitzer 1992, Johnson and Simon 1987, Poulton 1955, Tisdale 1986, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.786451#references
Description Author: M.S. Reid
Version: 26 Jan 2007
Stakeholders: Canada, West
Concept Author: NatureServe Western Ecology Team
ClassifResp: West

NORTHWESTERN GREAT PLAINS SHRUBLAND (CES303.662)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Western Great Plains (303)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Non-Diagnostic Classifiers: Shrubland (Shrub-dominated); Temperate [Temperate Continental]; Ustic; G-Patch/Medium Intensity
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Mixed evergreen-deciduous shrubland
National Mapping Codes: EVT 2085; ESLF 5262; ESP 1085

CONCEPT

Summary: This ecological system ranges from South Dakota into southern Canada on moderately shallow to deep, fine to sandy loam soils. These sites are typically more mesic than most of the surrounding area. This system may be located along upper terraces of rivers and streams, gently inclined slopes near breaklands, and upland sandy loam areas throughout its range. This system is dominated by shrub species such as *Amelanchier alnifolia, Rhus trilobata, Symphoricarpos* spp., *Shepherdia argentea, Crataegus douglasii, Elaeagnus commutata, Dasiphora fruticosa ssp. floribunda*, and dwarf-shrubs such as *Juniperus horizontalis*. Midgrasses such as *Festuca* spp., *Koeleria macrantha*, and *Pseudoroegneria spicata* and species such as *Carex filifolia* can co-occur. This system differs from Northwestern Great Plains Mixedgrass Prairie (CES303.674) in that it contains greater than 10% cover in conjunction with topographic relief (breaks) of natural shrub species. Fire and grazing constitute the primary dynamics affecting this system; drought can also impact this system. This system may include areas of Northwestern Great Plains Mixedgrass Prairie (CES303.674) where fire suppression has allowed for a greater cover of shrub species. This system is similar to Northern Rocky Mountain Montane-Foothill Deciduous Shrubland (CES306.994) but occurs in the grassland matrix of the Great Plains, whereas the Rocky Mountain system occurs adjacent to the lower treeline of generally forested mountains and highlands. Floristically their shrub composition is similar, but associated grasses and forbs will differ somewhat given their respective adjacent vegetation types.
Classification Comments: This may not be a separate system from the prairie matrix. Those areas that have increased shrub cover due to fire suppression should be considered part of Northwestern Great Plains Mixedgrass Prairie (CES303.674). More information from Canada is probably needed to fully define this system.
Similar Ecological Systems:
- Northwestern Great Plains Mixedgrass Prairie (CES303.674)
- Southwestern Great Plains Canyon (CES303.664)

Related Concepts:
- Sagebrush - Grass (612) (Shiflet 1994) Intersecting. Some *Artemisia cana ssp. cana* shrublands occur in this ecological system if they are not associated with stream terraces.

DESCRIPTION

Environment: Climate and growing season length for the region this system occurs are intermediate to the shortgrass regions to the west and the tallgrass regions to the east with a shorter growing season with semi-arid moisture conditions. This system occurs on sites more mesic than most of the surrounding area such as upper river terraces, gently inclined slopes, and upland sandy areas. Soils range from shallow to deep and fine to sandy loams.
Vegetation: This system is dominated by shrub and dwarf-shrub species such as *Amelanchier alnifolia, Rhus trilobata, Symphoricarpos* spp., *Dasiphora fruticosa ssp. floribunda*, and *Juniperus horizontalis*. Mid grasses such as *Festuca* spp., *Koeleria macrantha*, and *Pseudoroegneria spicata* can also occur. This system differs from Northwestern Great Plains Mixedgrass Prairie (CES303.674) in that it contains greater than 60% cover of natural shrub species.
Dynamics: Fire and grazing constitute the primary dynamics affecting this system. Drought can also impact this system. Conversion to agriculture can impact this system, and its range has probably been decreased by human activities.

Component Associations:
- *Amelanchier alnifolia / Pseudoroegneria spicata* - Bunchgrass Shrubland (CEGL001065, G3G4Q)
- *Amelanchier alnifolia* Shrubland (CEGL002183, GNR)
- *Dasiphora fruticosa ssp. floribunda / Festuca campestris* Shrub Herbaceous Vegetation (CEGL001503, G4)
- *Dasiphora fruticosa ssp. floribunda / Festuca idahoensis* Shrub Herbaceous Vegetation (CEGL001502, G4)
- *Dasiphora fruticosa ssp. floribunda / Schizachyrium scoparium* Shrub Herbaceous Vegetation (CEGL002198, G3G4)
- *Elaeagnus commutata / Pascopyrum smithii* Shrubland (CEGL001099, G3?)
- *Juniperus horizontalis / Schizachyrium scoparium* Dwarf-shrubland (CEGL001394, G4)
- *Rhus trilobata / Calamovilfa longifolia* Shrub Herbaceous Vegetation (CEGL001457, G3Q)
- *Rhus trilobata / Carex filifolia* Shrub Herbaceous Vegetation (CEGL001504, G3)
- *Rhus trilobata / Festuca idahoensis* Shrub Herbaceous Vegetation (CEGL001505, G2?)
- *Rhus trilobata / Pseudoroegneria spicata* Shrub Herbaceous Vegetation (CEGL001120, G4)
- *Rhus trilobata / Schizachyrium scoparium* Shrub Herbaceous Vegetation (CEGL001506, G3)
- *Sarcobatus vermiculatus / Artemisia tridentata* Shrubland (CEGL001359, G4)

Spatial Characteristics

Adjacent Ecological Systems:
- Northwestern Great Plains Canyon (CES303.658)
- Northwestern Great Plains Mixedgrass Prairie (CES303.674)

Adjacent Ecological System Comments: This system may include areas of Northwestern Great Plains Mixedgrass Prairie (CES303.674) where fire suppression has allowed for a greater cover of shrub species.

Distribution

Range: This system extends from South Dakota into southern Canada, west into the foothills of north-central Montana. The U.S. range corresponds to Bailey et al. (1994) sections Northeast Glaciated Plains (332A), Western Glaciated Plains (332B), North Central Glaciated Plains - extreme western part (251B), and in Canada to the Moist Mixed Grassland and Fescue Grassland.
Divisions: 303:C
Nations: CA, US
Subnations: AB?, MB, MT, ND, SD, SK, WY?
Map Zones: 20:C, 29:C, 30:C, 31:C, 39:C, 40:C
USFS Ecomap Regions: 331D:CC, 331E:CC, 331F:CC, 331G:CC, 331K:CC, 331L:CC, 331M:CP, 331N:CC, 342F:CC, M334A:CC
TNC Ecoregions: 26:C, 34:C, 66:P, 67:P

Sources

References: Bailey et al. 1994, Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722996#references
Description Author: S. Menard and K. Kindscher, mod. G. Kittel and M.S. Reid
Version: 26 Jan 2007 **Stakeholders:** Canada, Midwest, West
Concept Author: S. Menard and K. Kindscher **ClassifResp:** Midwest

ROCKY MOUNTAIN ALPINE DWARF-SHRUBLAND (CES306.810)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Alpine Slopes; Alpine/AltiAndino [Alpine/AltiAndino]; Patterned ground (undifferentiated); Glaciated; Acidic Soil; Udic; Very Long Disturbance Interval; Dwarf-Shrub
Non-Diagnostic Classifiers: Shrubland (Shrub-dominated); Temperate [Temperate Continental]; Mineral: W/ A-Horizon >10 cm; Bryophyte
FGDC Crosswalk: Vegetated, Shrub-dominated, Dwarf-shrubland, Evergreen dwarf-shrubland
National Mapping Codes: EVT 2070; ESLF 5207; ESP 1070

CONCEPT

Summary: This widespread ecological system occurs above upper timberline throughout the Rocky Mountain cordillera, including alpine areas of ranges in Utah and Nevada, and north into Canada. Elevations are above 3360 m in the Colorado Rockies but drop to less than 2100 m in northwestern Montana and in the mountains of Alberta. This system occurs in areas of level or concave glacial topography, with late-lying snow and subirrigation from surrounding slopes. Soils have become relatively stabilized in these sites, are moist but well-drained, strongly acidic, and often with substantial peat layers. Vegetation in these areas is controlled by snow retention, wind desiccation, permafrost, and a short growing season. This ecological system is characterized by a semi-continuous layer of ericaceous dwarf-shrubs or dwarf willows which form a heath type ground cover less than 0.5 m in height. Dense tuffs of graminoids and scattered forbs occur. *Dryas octopetala* or *Dryas integrifolia* communities are not included here, except for one very moist association, because they occur on more windswept and drier sites than the heath communities. Within these communities. *Cassiope mertensiana, Salix arctica, Salix reticulata, Salix vestita*, or *Phyllodoce empetriformis* can be dominant shrubs. *Vaccinium* spp., *Ledum glandulosum, Phyllodoce glanduliflora*, and *Kalmia microphylla* may also be shrub associates. The herbaceous layer is a mixture of forbs and graminoids, especially sedges, including, *Erigeron* spp., *Luetkea pectinata, Antennaria lanata, Oreostemma alpigenum (= Aster alpigenus), Pedicularis* spp., *Castilleja* spp., *Deschampsia caespitosa, Caltha leptosepala, Erythronium* spp., *Juncus parryi, Luzula piperi, Carex spectabilis, Carex nigricans*, and *Polygonum bistortoides*. Fellfields often intermingle with the alpine dwarf-shrubland.

Related Concepts:
- Alpine Rangeland (410) (Shiflet 1994) Broader
- AT Alpine Tundra (Ecosystems Working Group 1998) Broader

Component Associations:
- *Cassiope mertensiana - Phyllodoce empetriformis* Dwarf-shrubland (CEGL001398, G5)
- *Cassiope mertensiana / Carex paysonis* Dwarf-shrubland (CEGL001396, G3?)
- *Dryas integrifolia - Carex* spp. Dwarf-shrub Herbaceous Vegetation (CEGL001890, G3Q)
- *Dryas octopetala - Polygonum viviparum* Dwarf-shrub Herbaceous Vegetation (CEGL001894, G3?)
- *Kalmia microphylla / Carex scopulorum* Dwarf-shrubland (CEGL001403, G3G4)
- *Phyllodoce empetriformis / Antennaria lanata* Dwarf-shrubland (CEGL001405, G3?)
- *Phyllodoce empetriformis / Lupinus latifolius* Dwarf-shrubland (CEGL001406, G4?)
- *Phyllodoce empetriformis / Vaccinium deliciosum* Dwarf-shrubland (CEGL001407, G4)
- *Phyllodoce empetriformis* Parkland Dwarf-shrubland (CEGL001404, G5)
- *Phyllodoce glanduliflora / Oreostemma alpigenum* Dwarf-shrubland (CEGL001408, G3G4)
- *Phyllodoce glanduliflora / Sibbaldia procumbens* Dwarf-shrubland (CEGL005877, G2G3)
- *Salix arctica - (Salix petrophila, Salix nivalis) / Polygonum bistortoides* Dwarf-shrubland (CEGL001431, G2G3Q)
- *Salix arctica - Salix nivalis* Dwarf-shrubland (CEGL001432, G2Q)
- *Salix arctica - Salix petrophila / Caltha leptosepala* Dwarf-shrubland (CEGL001429, G2G3)
- *Salix arctica / Carex nigricans* Dwarf-shrubland (CEGL005878, GNR)
- *Salix arctica / Geum rossii* Dwarf-shrubland (CEGL001430, G4)
- *Salix glauca* Shrubland (CEGL001136, G3?)
- *Salix nivalis / Geum rossii* Dwarf-shrubland (CEGL005936, GNR)
- *Salix reticulata / Caltha leptosepala* Dwarf-shrubland (CEGL001435, G3)
- *Vaccinium (caespitosum, scoparium)* Dwarf-shrubland (CEGL001140, G4)
- *Vaccinium (myrtillus, scoparium) / Luzula glabrata var. hitchcockii* Dwarf-shrubland (CEGL005879, G2G3)

DISTRIBUTION

Range: This system occurs above upper timberline throughout the Rocky Mountain cordillera, including alpine areas of ranges in Utah and Nevada, and north into Canada. Elevations are above 3360 m in the Colorado Rockies but drop to less than 2100 m in northwestern Montana.

Divisions: 304:C; 306:C
Nations: CA, US
Subnations: AB, AK?, BC, CO, ID, MT, NM, NV, OR, UT, WA, WY
Map Zones: 1:P, 9:P, 10:C, 16:C, 17:C, 18:?, 19:C, 21:C, 22:?, 23:P, 24:P, 25:C, 28:C, 29:?
USFS Ecomap Regions: 331J:CC, 341G:PP, 342J:PP, M242B:CC, M242C:C?, M242D:CC, M331A:CC, M331B:CC, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M331J:CC, M332A:CC, M332B:CC, M332D:CP, M332E:CC, M332F:CC, M332G:CP, M333A:CC, M333B:CC, M333C:CC, M333D:CC, M341A:PP, M341B:PP, M341C:PP
TNC Ecoregions: 4:P, 7:C, 8:C, 9:C, 11:C, 19:C, 20:C, 21:C, 68:P

SOURCES

References: Anderson 1999a, Bamberg 1961, Bamberg and Major 1968, Comer et al. 2003, Cooper et al. 1997, Douglas and Bliss 1977, Ecosystems Working Group 1998, Komarkova 1976, Komarkova 1980, Meidinger and Pojar 1991, NCC 2002, Neely et al. 2001, Schwan and Costello 1951, Thilenius 1975, Willard 1963
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722863#references
Description Author: NatureServe Western Ecology Team, mod. M.S. Reid
Version: 01 Sep 2005 **Stakeholders:** Canada, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

ROCKY MOUNTAIN GAMBEL OAK-MIXED MONTANE SHRUBLAND (CES306.818)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Shrubland (Shrub-dominated); Shallow Soil; Mineral: W/ A-Horizon <10 cm; Loam Soil Texture; Sand Soil Texture; Ustic; Unconsolidated; Intermediate Disturbance Interval [Periodicity/Polycyclic Disturbance]; Broad-Leaved Deciduous Shrub
Non-Diagnostic Classifiers: Short (50-100 yrs) Persistence; Montane [Montane]; Montane [Lower Montane]; Lowland [Foothill]; Ridge/Summit/Upper Slope; Sideslope; Temperate [Temperate Continental]; F-Patch/Medium Intensity; F-Landscape/Medium Intensity
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Mixed evergreen-deciduous shrubland
National Mapping Codes: EVT 2107; ESLF 5313; ESP 1107

CONCEPT

Summary: This ecological system occurs in the mountains, plateaus and foothills of the southern Rocky Mountains and Colorado Plateau, including the Uinta and Wasatch ranges and the Mogollon Rim. These shrublands are most commonly found along dry foothills, lower mountain slopes, and at the edge of the western Great Plains from approximately 2000 to 2900 m in elevation, and are often situated above pinyon-juniper woodlands. Substrates are variable and include soil types ranging from calcareous, heavy, fine-grained loams to sandy loams, gravelly loams, clay loams, deep alluvial sand, or coarse gravel. The vegetation is typically dominated by *Quercus gambelii* alone or codominant with *Amelanchier alnifolia, Amelanchier utahensis, Artemisia tridentata, Cercocarpus montanus, Prunus virginiana, Purshia stansburiana, Purshia tridentata, Robinia neomexicana, Symphoricarpos oreophilus*, or *Symphoricarpos rotundifolius*. There may be inclusions of other mesic montane shrublands with *Quercus gambelii* absent or as a relatively minor component. This ecological system intergrades with the lower montane-foothills shrubland system and shares many of the same site characteristics. Density and cover of *Quercus gambelii* and *Amelanchier* spp. often increase after fire.
Classification Comments: Disjunct *Quercus gambelii*-dominated shrublands found in the Davis Mountains and probably the Guadalupe Range in the Trans-Pecos of Texas are included in the concept of Madrean Oriental Chaparral (CES302.031).

Landfire modeled this BpS with Coahuilan Chaparral (Madrean Oriental Chaparral (CES302.031)). *Quercus gambelii* apparently occurs as a significant component of a shrubland of the Trans-Pecos of Texas, however, most of the other species that codominate in this system do not occur in the Trans-Pecos. This system is not currently attributed to Texas, and it seems more appropriate to modify the description of CES302.031 to allow for the presence of *Quercus gambelii* as a significant component of some occurrences. However, *Quercus gambelii / Symphoricarpos oreophilus* Shrubland (CEGL001117) is an association found in the Trans-Pecos. Also, there is a need to clarify the relationship with Rocky Mountain Lower Montane-Foothill Shrubland (CES306.822).
Similar Ecological Systems:
- Rocky Mountain Lower Montane-Foothill Shrubland (CES306.822)

Related Concepts:
- Gambel Oak (413) (Shiflet 1994) Equivalent

DESCRIPTION

Environment: This ecological system typically occupies the lower slope positions of the foothill and lower montane zones. They may occur on level to steep slopes, cliffs, escarpments, rimrock slopes, rocky outcrops, and scree slopes. Climate is semi-arid and characterized by mostly hot-dry summers with mild to cold winters and annual precipitation of 25 to 70 cm. Precipitation mostly occurs as winter snows but may also consist of some late-summer rains. Soils are typically poorly developed, rocky to very rocky, and well-drained. Parent materials include alluvium, colluvium, and residuum derived from igneous, metamorphic, or sedimentary rocks such as granite, gneiss, limestone, quartz, monzonite, rhyolite, sandstone, schist, and shale. Although this is a shrub-dominated system, some trees may be present. In older occurrences, or occurrences on mesic sites, some of the shrubs may acquire tree-like sizes. Adjacent communities often include woodlands or forests of *Abies concolor, Pinus ponderosa, Pseudotsuga menziesii*, or *Populus tremuloides* at higher elevations, and *Pinus edulis* and *Juniperus osteosperma* on the lower and adjacent elevations. Shrublands of *Artemisia tridentata* or grasslands of *Festuca* sp., *Stipa* sp., or *Pseudoroegneria* sp. may also be present at the lower elevations.
Vegetation: Vegetation types in this system may occur as sparse to dense shrublands composed of moderate to tall shrubs. Occurrences may be multi-layered, with some short shrubby species occurring in the understory of the dominant overstory species. In many occurrences of this system, the canopy is dominated by the broad-leaved deciduous shrub *Quercus gambelii*, which occasionally reaches small tree size. Occurrences can range from dense thickets with little understory to relatively mesic mixed-shrublands with a rich understory of shrubs, grasses and forbs. These shrubs often have a patchy distribution with grass growing in between. Scattered trees are occasionally present in stands and typically include species of *Pinus* or *Juniperus*. Characteristic shrubs that may co-occur, or be singularly dominant, include *Amelanchier alnifolia, Amelanchier utahensis, Arctostaphylos patula, Artemisia tridentata, Cercocarpus montanus, Ptelea trifoliata, Prunus virginiana, Purshia stansburiana, Robinia neomexicana, Rosa* spp., *Symphoricarpos oreophilus*, and *Symphoricarpos rotundifolius*. The herbaceous layer is sparse to moderately dense, ranging from 1-40% cover.

Perennial graminoids are the most abundant species, particularly *Bouteloua curtipendula, Bouteloua eriopoda, Bouteloua gracilis, Aristida* spp., *Carex inops, Carex geyeri, Elymus arizonicus, Eragrostis* spp., *Festuca* spp., *Koeleria macrantha, Muhlenbergia* spp., and *Stipa* spp. Many forb and fern species can occur, but none have much cover. Commonly present forbs include *Achillea millefolium, Artemisia* spp., *Geranium* spp., *Maianthemum stellatum, Thalictrum fendleri*, and *Vicia americana*. Ferns include species of *Cheilanthes* and *Woodsia*. Annual grasses and forbs are seasonally present, and weedy annuals are often present, at least seasonally.
Dynamics: Fire typically plays an important role in this system, causing die-back of the dominant shrub species in some areas, promoting stump sprouting of the dominant shrubs in other areas, and controlling the invasion of trees into the shrubland system. Natural fires typically result in a system with a mosaic of dense shrub clusters and openings dominated by herbaceous species. In some instances these associations may be seral to the adjacent *Pinus ponderosa, Abies concolor*, and *Pseudotsuga menziesii* woodlands and forests. Ream (1964) noted that on many sites in Utah, Gambel oak may be successional and replaced by bigtooth maple (*Acer grandidentatum)*.

Component Associations:
- *Amelanchier alnifolia* / (Mixed Grass, Forb) Shrubland (CEGL005885, GNR)
- *Amelanchier alnifolia / Artemisia tridentata / Festuca idahoensis* Shrubland (CEGL001064, G4Q)
- *Amelanchier alnifolia / Pseudoroegneria spicata* - Bunchgrass Shrubland (CEGL001065, G3G4Q)
- *Amelanchier alnifolia / Symphoricarpos oreophilus* Shrubland (CEGL002569, GNR)
- *Amelanchier utahensis* - Mixed Shrub / *Carex geyeri* Shrubland (CEGL001068, G2G3)
- *Amelanchier utahensis / Pseudoroegneria spicata* Shrubland (CEGL001069, G2G3)
- *Amelanchier utahensis* Shrubland (CEGL001067, G4)
- *Arctostaphylos patula - Quercus gambelii - (Amelanchier utahensis)* Shrubland (CEGL002695, GNR)
- *Ceanothus fendleri / Poa fendleriana* Shrub-Steppe Shrubland (CEGL005501, GNR)
- *Jamesia americana - (Physocarpus monogynus, Holodiscus dumosus)* Rock Outcrop Shrubland (CEGL002783, GNR)
- *Juniperus scopulorum - Quercus gambelii* Woodland (CEGL002967, GNR)
- *Ostrya knowltonii* Woodland (CEGL003971, GNR)
- *Quercus gambelii - Cercocarpus montanus / (Carex geyeri)* Shrubland (CEGL001113, G3)
- *Quercus gambelii - Holodiscus dumosus* Shrubland (CEGL002341, GNR)
- *Quercus gambelii - Robinia neomexicana / Carex inops ssp. heliophila* Shrubland (CEGL005379, GNR)
- *Quercus gambelii - Robinia neomexicana / Muhlenbergia montana* Shrubland (CEGL005380, GNR)
- *Quercus gambelii / Amelanchier alnifolia* Shrubland (CEGL001109, G3G5)
- *Quercus gambelii / Amelanchier utahensis* Shrubland (CEGL001110, G3G5)
- *Quercus gambelii / Artemisia tridentata* Shrubland (CEGL001111, G4G5)
- *Quercus gambelii / Carex geyeri* Shrubland (CEGL005995, GNR)
- *Quercus gambelii / Carex inops* Shrubland (CEGL001112, GU)
- *Quercus gambelii / Festuca thurberi* Shrubland (CEGL002805, GNR)
- *Quercus gambelii / Paxistima myrsinites* Shrubland (CEGL001114, GU)
- *Quercus gambelii / Poa fendleriana* Shrubland (CEGL002949, GNR)
- *Quercus gambelii / Prunus virginiana* Shrubland (CEGL005994, GNR)
- *Quercus gambelii / Rhus trilobata* Shrubland (CEGL002338, GNR)
- *Quercus gambelii / Robinia neomexicana / Symphoricarpos rotundifolius* Shrubland (CEGL001116, GU)
- *Quercus gambelii / Robinia neomexicana* Shrubland (CEGL001115, G4)
- *Quercus gambelii* / Sparse Understory Shrubland (CEGL002337, GNR)
- *Quercus gambelii / Symphoricarpos oreophilus* Shrubland (CEGL001117, G5)
- *Quercus gambelii* Shrubland (CEGL002477, GNR)
- *Robinia neomexicana / Carex inops ssp. heliophila* Shrubland (CEGL005375, GNR)
- *Robinia neomexicana* Shrubland (CEGL005505, GNR)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Rocky Mountain Bigtooth Maple Ravine Woodland (CES306.814)

DISTRIBUTION

Range: This system occurs in the mountains, plateaus and foothills of the southern Rocky Mountains and Colorado Plateau, including the Uinta and Wasatch ranges and the Mogollon Rim.
Divisions: 304:C; 306:C
Nations: US
Subnations: AZ, CO, NM, UT, WY
Map Zones: 12:?, 15:C, 16:C, 17:C, 22:C, 23:C, 24:C, 25:C, 27:C, 28:C, 33:?
USFS Ecomap Regions: 313A:CC, 313B:CC, 313C:C?, 313D:CC, 315A:CC, 315B:CC, 315H:CC, 321A:CC, 322A:CC, 331B:CC, 331F:CC, 331G:CC, 331I:CC, 331J:CC, 331M:CC, 341A:CC, 341B:CC, 341C:CC, 341F:CC, 342A:CC, 342E:CC, 342G:CC, 342J:CC, M313A:CC, M313B:CC, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M334A:??, M341A:CC, M341B:CC, M341C:CC
TNC Ecoregions: 10:P, 18:C, 19:C, 20:C, 21:C

SOURCES

References: Christensen 1955, Comer et al. 2002, Comer et al. 2003, Johnston and Hendzel 1985, Kunzler and Harper 1980, Kunzler et al. 1981, McKell 1950, Neely et al. 2001, Price and Brotherson 1987, Ream 1960, Ream 1964, Rondeau 2001, Shepperd 1990, Tuhy et al. 2002

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722855#references

Description Author: NatureServe Western Ecology Team

Version: 20 Feb 2003 **Stakeholders:** West

Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

ROCKY MOUNTAIN LOWER MONTANE-FOOTHILL SHRUBLAND (CES306.822)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Lower Montane]; Lowland [Foothill]; Shrubland (Shrub-dominated); Very Shallow Soil; Aridic; Intermediate Disturbance Interval [Periodicity/Polycyclic Disturbance]
Non-Diagnostic Classifiers: Short (50-100 yrs) Persistence; Foothill(s); Gulch; Midslope; Ridge; Temperate [Temperate Continental]; Mineral: W/ A-Horizon <10 cm; Canyon; Colluvial slope
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Mixed evergreen-deciduous shrubland
National Mapping Codes: EVT 2086; ESLF 5263; ESP 1086

CONCEPT

Summary: This ecological system is found in the foothills, canyon slopes and lower mountains of the Rocky Mountains and on outcrops and canyon slopes in the western Great Plains. It ranges from southern New Mexico, extending north into Wyoming, and west into the Intermountain West region. These shrublands occur between 1500 and 2900 m elevation and are usually associated with exposed sites, rocky substrates, and dry conditions, which limit tree growth. It is common where *Quercus gambelii* is absent, such as the northern Colorado Front Range and in drier foothills and prairie hills. This system is generally drier than Rocky Mountain Gambel Oak-Mixed Montane Shrubland (CES306.818) but may include mesic montane shrublands where *Quercus gambelii* does not occur. *Cercocarpus montanus* dominates pure stands in parts of Wyoming and Colorado. Scattered trees or inclusions of grassland patches or steppe may be present, but the vegetation is typically dominated by a variety of shrubs, including *Amelanchier utahensis, Cercocarpus montanus, Purshia tridentata, Rhus trilobata, Ribes cereum, Symphoricarpos oreophilus*, or *Yucca glauca*. Grasses are represented as species of *Muhlenbergia, Bouteloua, Hesperostipa,* and *Pseudoroegneria spicata*. Fires play an important role in this system as the dominant shrubs usually have a severe die-back, although some plants will stump sprout. *Cercocarpus montanus* requires a disturbance such as fire to reproduce, either by seed sprout or root-crown sprouting. Fire suppression may have allowed an invasion of trees into some of these shrublands, but in many cases sites are too xeric for tree growth. In Wyoming, stands where *Cercocarpus montanus* is a component of mixed shrublands are placed in Northern Rocky Mountain Montane-Foothill Deciduous Shrubland (CES306.994).
Classification Comments: Some reviewers have requested that this system be renamed in such a way as to more strongly indicate that it is dominated primarily by *Cercocarpus montanus*. However, while *Cercocarpus montanus* is an important shrub in this system, it is not the only dominant, and in many occurrences is not found at all.
Similar Ecological Systems:
- Rocky Mountain Gambel Oak-Mixed Montane Shrubland (CES306.818)

Related Concepts:
- Littleleaf Mountain-Mahogany (417) (Shiflet 1994) Intersecting
- Sideoats Grama - Sumac - Juniper (735) (Shiflet 1994) Intersecting
- Snowbush (420) (Shiflet 1994) Intersecting. CEAVEL dominated, CAN to CA to CO
- True Mountain-Mahogany (416) (Shiflet 1994) Finer

Component Associations:
- *Amelanchier (utahensis, alnifolia) - Cercocarpus montanus* Shrubland (CEGL001070, G2?)
- *Amelanchier utahensis / Pseudoroegneria spicata* Shrubland (CEGL001069, G2G3)
- *Amelanchier utahensis* Shrubland (CEGL001067, G4)
- *Artemisia frigida / Bouteloua gracilis* Dwarf-shrubland (CEGL002782, GNR)
- *Artemisia nova / Leymus salinus* Shrub Herbaceous Vegetation (CEGL001421, G1G2Q)
- *Ceanothus fendleri / Muhlenbergia montana* Shrubland (CEGL005376, GNR)
- *Cercocarpus intricatus - (Quercus turbinella)* Mixed Shrubland (CEGL005393, GNR)
- *Cercocarpus montanus - Artemisia tridentata* Shrubland (CEGL005805, GNR)
- *Cercocarpus montanus - Rhus trilobata / Andropogon gerardii* Shrubland (CEGL002912, G2G3)
- *Cercocarpus montanus / Achnatherum scribneri* Shrubland (CEGL002913, G3)
- *Cercocarpus montanus / Bouteloua curtipendula* Shrubland (CEGL001086, G5)
- *Cercocarpus montanus / Elymus lanceolatus ssp. lanceolatus* Shrubland (CEGL001087, GU)
- *Cercocarpus montanus / Garrya flavescens* Shrubland (CEGL001088, GNR)
- *Cercocarpus montanus / Hesperostipa comata* Shrubland (CEGL001092, G2)
- *Cercocarpus montanus / Hesperostipa neomexicana* Shrubland (CEGL002911, G2G3)
- *Cercocarpus montanus / Muhlenbergia emersleyi* Scrub (CEGL001500, G4)
- *Cercocarpus montanus / Muhlenbergia montana* Shrubland (CEGL002914, GU)
- *Cercocarpus montanus / Muhlenbergia pauciflora* Shrubland (CEGL001089, GNR)

- *Cercocarpus montanus / Pseudoroegneria spicata* Shrubland (CEGL001090, G4)
- *Cercocarpus montanus / Rhus trilobata var. trilobata* Shrubland (CEGL001091, GNRQ)
- *Cercocarpus montanus* Shale Shrubland (CEGL002798, GNR)
- *Cercocarpus montanus var. paucidentatus / Petrophyton caespitosum* Shrubland (CEGL004589, G3?)
- *Fallugia paradoxa - Brickellia* spp. - (*Holodiscus dumosus*) Scree Shrubland (CEGL003496, GNR)
- *Fallugia paradoxa - Rhus trilobata* Shrubland (CEGL002222, GNR)
- *Fallugia paradoxa* / Rockland Shrubland (CEGL002330, GNR)
- *Prunus virginiana - (Prunus americana)* Shrubland (CEGL001108, G4Q)
- *Purshia tridentata / Artemisia frigida / Hesperostipa comata* Shrubland (CEGL001055, G1G2)
- *Purshia tridentata / Muhlenbergia montana* Shrubland (CEGL001057, G2)
- *Quercus X pauciloba / Bouteloua curtipendula* Shrubland (CEGL005378, GNR)
- *Quercus X pauciloba / Cercocarpus montanus* Shrubland (CEGL001118, G4)
- *Rhus trilobata - Ribes cereum* Shrubland (CEGL002333, GNR)
- *Rhus trilobata / Festuca idahoensis* Shrub Herbaceous Vegetation (CEGL001505, G2?)
- *Rhus trilobata / Pseudoroegneria spicata* Shrub Herbaceous Vegetation (CEGL001120, G4)
- *Rhus trilobata* Rocky Mountain Shrub Herbaceous Vegetation (CEGL002910, G2)
- *Ribes cereum / Leymus ambiguus* Shrubland (CEGL001124, G2)
- *Spiraea betulifolia* Shrubland (CEGL005835, G3?)
- *Symphoricarpos occidentalis* Shrubland (CEGL001131, G4G5)
- *Symphoricarpos oreophilus* Shrubland (CEGL002951, GNR)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Northwestern Great Plains Canyon (CES303.658)

DISTRIBUTION

Range: This system is found in the foothills, canyon slopes and lower mountains of the Rocky Mountains and on outcrops and canyon slopes in the western Great Plains. It ranges from southern New Mexico, extending north into Wyoming, and west into the Intermountain West region.
Divisions: 303:C; 306:C
Nations: US
Subnations: AZ, CO, MT, NE?, NM, SD, WY
Map Zones: 1:C, 15:C, 16:C, 18:C, 21:P, 22:C, 23:C, 25:C, 26:C, 27:C, 28:C, 29:C, 30:?, 31:P, 33:C, 34:P
USFS Ecomap Regions: 313A:CC, 313B:CC, 315A:CC, 315B:CC, 315H:CP, 321A:CC, 331B:CC, 331F:CC, 331G:CC, 331H:CC, 331I:CC, 331J:CC, 341B:CC, 341C:CC, 342E:CC, 342F:CC, 342G:CC, M313B:CC, M331A:CP, M331B:CP, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M331J:CC, M332G:??, M334A:??, M341B:CC
TNC Ecoregions: 10:C, 19:C, 20:C, 21:C, 25:C, 26:C, 27:C

SOURCES

References: Comer et al. 2003, Dick-Peddie 1993, Hess 1981, Hess and Wasser 1982, Hoffman and Alexander 1987, Marriott and Faber-Langendoen 2000, Mueggler and Stewart 1980, Muldavin 1994, Muldavin et al. 2000b, Neely et al. 2001, Roughton 1972, Thilenius et al. 1995
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722851#references
Description Author: NatureServe Western Ecology Team
Version: 26 Jan 2007 **Stakeholders:** Midwest, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

SIERRA NEVADA ALPINE DWARF-SHRUBLAND (CES206.924)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Alpine/AltiAndino [Alpine/AltiAndino]; Alpine Mosaic; Shrubland (Shrub-dominated); Dwarf-Shrub
Non-Diagnostic Classifiers: Herbaceous; Ridge/Summit/Upper Slope; Temperate [Temperate Oceanic]; Shallow Soil; W-Patch/High Intensity
FGDC Crosswalk: Vegetated, Shrub-dominated, Dwarf-shrubland, Evergreen dwarf-shrubland
National Mapping Codes: EVT 2071; ESLF 5208; ESP 1071

CONCEPT

Summary: This ecological system is found only at the highest elevations, usually above 2800 m (8500 feet), throughout the Sierra Nevada and surrounding high mountain ranges. The system is commonly comprised of a mosaic of plant communities that include *Arenaria kingii, Cassiope mertensiana, Ericameria discoidea, Artemisia arbuscula, Phlox covillei, Eriogonum incanum, Eriogonum ovalifolium, Eriogonum roseum, Kalmia microphylla, Polygonum shastense, Leptodactylon pungens, Phyllodoce breweri, Salix arctica, Salix nivalis, Salix reticulata*, and *Vaccinium caespitosum*. Floristically, communities within this system have desert affinities, rather than cordilleran affinities. Vegetation in these areas is controlled by the absence of persistent snow, wind desiccation, permafrost, and a short growing season.

Related Concepts:
- Alpine Grassland (213) (Shiflet 1994) Broader. SRM type 213 includes all alpine communities in Sierra, Klamath and California Cascades, both herbaceous and shrub dominated, and wet meadows.

DESCRIPTION

Environment: Elevations are above 2800 m. This system occurs in areas of level or concave glacial topography, with late-lying snow, and subirrigation from surrounding slopes. Soils have become relatively stabilized in these sites, are moist, but well-drained, strongly acidic, and often with substantial peat layers.

Component Associations:
- *Phlox covillei - Elymus elymoides - Podistera nevadensis* Herbaceous Vegetation (CEGL003488, G3?)

SPATIAL CHARACTERISTICS

Spatial Summary: This ecological system occurs sporadically in variably sized patches of the alpine. Patch size varies from a few to 100 acres in mountain basins. Stand-replacement fires may be caused by lightning strikes that do not spread due to the sparse cover of fine fuels and extensive barren areas acting as firebreaks.

DISTRIBUTION

Range: This system is found only at the highest elevations, usually above 2800 m (8500 feet), throughout the Sierra Nevada and surrounding high mountain ranges.
Divisions: 204:C; 206:C
Nations: US
Subnations: CA, NV
Map Zones: 4:?, 6:C, 7:C, 12:C, 13:C
USFS Ecomap Regions: 322A:CC, 341D:CC, 341F:CP, 342B:CC, M261A:CP, M261D:CC, M261E:CC, M261G:CC
TNC Ecoregions: 4:C, 5:C, 12:C

SOURCES

References: Barbour and Major 1988, Comer et al. 2003, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722757#references
Description Author: P. Comer, T. Keeler-Wolf, mod. G. Kittel
Version: 12 Jan 2012 **Stakeholders:** West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

SONORA-MOJAVE CREOSOTEBUSH-WHITE BURSAGE DESERT SCRUB (CES302.756)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: North American Warm Desert (302)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland [Lowland]; Shrubland (Shrub-dominated); Tropical/Subtropical [Tropical Xeric]; Temperate [Temperate Xeric]; Aridic; Xeromorphic Shrub
Non-Diagnostic Classifiers: Toeslope/Valley Bottom; Alkaline Soil; W-Landscape/Medium Intensity
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Mixed evergreen-deciduous shrubland
National Mapping Codes: EVT 2087; ESLF 5264; ESP 1087

CONCEPT

Summary: This ecological system forms the vegetation matrix in broad valleys, lower bajadas, plains and low hills in the Mojave and lower Sonoran deserts. This desert scrub is characterized by a sparse to moderately dense layer (2-50% cover) of xeromorphic microphyllous and broad-leaved shrubs. *Larrea tridentata* and *Ambrosia dumosa* are typically dominants, but many different shrubs, dwarf-shrubs, and cacti may codominate or form typically sparse understories. Associated species may include *Atriplex canescens, Atriplex hymenelytra, Encelia farinosa, Ephedra nevadensis, Fouquieria splendens, Lycium andersonii*, and *Opuntia basilaris*. The herbaceous layer is typically sparse, but may be seasonally abundant with ephemerals. Herbaceous species such as *Chamaesyce* spp., *Eriogonum inflatum, Dasyochloa pulchella, Aristida* spp., *Cryptantha* spp., *Nama* spp., and *Phacelia* spp. are common. This system can often appear as very open sparse vegetation, with the mostly barren ground surface being the predominant feature.

Related Concepts:
- Creosote Bush Scrub (211) (Shiflet 1994) Finer
- Creosotebush - Bursage (506) (Shiflet 1994) Finer

Component Associations:
- *Ambrosia deltoidea / Simmondsia chinensis* Shrubland (CEGL000953, G4)
- *Ambrosia dumosa - Encelia farinosa* Dwarf-shrubland (CEGL005061, GNR)
- *Ambrosia dumosa - Ephedra (fasciculata, nevadensis)* Dwarf-shrubland (CEGL000954, GNR)
- *Ambrosia dumosa - Larrea tridentata var. tridentata* Dwarf-shrubland (CEGL000956, G4)
- *Ambrosia dumosa / Pleuraphis rigida* Dwarf-shrubland (CEGL000955, G2)
- *Ambrosia dumosa* Dwarf-shrubland (CEGL005074, GNR)
- *Ambrosia eriocentra - (Coleogyne ramosissima)* Dwarf-shrubland (CEGL005080, GNR)
- *Encelia farinosa - Ephedra (fasciculata, nevadensis)* Shrubland (CEGL001252, G3)
- *Encelia farinosa* Shrubland (CEGL001251, G5)
- *Encelia resinifera* Shrubland (CEGL005081, GNR)
- *Eriogonum fasciculatum - Purshia glandulosa* Shrubland (CEGL001259, G4)
- *Eriogonum fasciculatum* Rock Outcrop Shrubland (CEGL001260, G5?)
- *Eriogonum fasciculatum* Shrubland (CEGL001258, G5)
- *Fouquieria splendens / Encelia (farinosa, resinifera)* Shrubland (CEGL005118, GNR)
- *Fouquieria splendens* Shrubland (CEGL004452, GNR)
- *Grayia spinosa - Lycium andersonii* Shrubland (CEGL001347, G5)
- *Grayia spinosa - Lycium pallidum* Shrubland (CEGL001348, G5)
- *Grayia spinosa - Menodora spinescens* Shrubland (CEGL001349, G5)
- *Grayia spinosa - Prunus andersonii* Shrubland (CEGL001352, G4)
- *Grayia spinosa / Achnatherum thurberianum* Shrubland (CEGL002681, G2G3)
- *Grayia spinosa / Picrothamnus desertorum* Shrubland (CEGL001345, G5)
- *Larrea tridentata - Ambrosia dumosa - Fouquieria splendens* Shrubland (CEGL005136, GNR)
- *Larrea tridentata - Ambrosia dumosa - Krameria (erecta, grayi)* Shrubland (CEGL005137, GNR)
- *Larrea tridentata - Ambrosia dumosa* Shrubland (CEGL002954, G3G4)
- *Larrea tridentata - Atriplex confertifolia* Shrubland (CEGL001263, G5)
- *Larrea tridentata - Atriplex hymenelytra* Shrubland (CEGL001264, G5)
- *Larrea tridentata - Coleogyne ramosissima* Shrubland (CEGL002717, G4?)
- *Larrea tridentata - Encelia farinosa - Fouquieria splendens* Shrubland (CEGL005138, GNR)
- *Larrea tridentata - Encelia farinosa* Shrubland (CEGL002955, GNR)
- *Larrea tridentata - Ephedra nevadensis* Shrubland (CEGL001268, G5)
- *Larrea tridentata - Opuntia basilaris - Fouquieria splendens* Shrubland (CEGL001273, G4)
- *Larrea tridentata / Lycium andersonii - Grayia spinosa* Shrubland (CEGL001271, G5)
- *Larrea tridentata / Yucca* spp. Shrubland (CEGL001278, G5)

- *Larrea tridentata* Monotype Shrubland (CEGL001261, G5)
- *Larrea tridentata* Shrubland (CEGL005145, GNR)

DISTRIBUTION

Range: This system occupies broad valleys, lower bajadas, plains and low hills in the Mojave and lower Sonoran deserts.
Divisions: 302:C
Nations: MX, US
Subnations: AZ, CA, MXBC(MX), MXSO(MX), NV, UT
Map Zones: 4:C, 12:C, 13:C, 14:C, 15:C, 16:?, 17:P, 23:C, 24:?, 25:C
USFS Ecomap Regions: 313A:CC, 313C:CC, 321A:CC, 322A:CC, 322B:CC, 322C:CC, 341F:CC, M261E:PP, M341A:PP
TNC Ecoregions: 17:C, 23:C

SOURCES

References: Barbour and Major 1988, Brown 1982a, Comer et al. 2003, Holland and Keil 1995, MacMahon 1988, Thomas et al. 2004
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722916#references
Description Author: NatureServe Western Ecology Team
Version: 16 Jan 2009 **Stakeholders:** Latin America, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

SONORA-MOJAVE MIXED SALT DESERT SCRUB (CES302.749)

CLASSIFIERS

Conf.: 3 - Weak **Classification Status:** Standard
Primary Division: North American Warm Desert (302)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland [Lowland]; Shrubland (Shrub-dominated); Toeslope/Valley Bottom; Temperate [Temperate Xeric]; Alkaline Soil; Basin floor; Atriplex spp.
Non-Diagnostic Classifiers: Tropical/Subtropical [Tropical Xeric]; Saline Substrate Chemistry; Aridic
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Evergreen shrubland
National Mapping Codes: EVT 2088; ESLF 5265; ESP 1088

CONCEPT

Summary: This ecological system includes extensive open-canopied shrublands of typically saline basins in the Mojave and Sonoran deserts. Stands most often occur around playas and in valley bottoms or basins where evapotranspiration results in saline soils. Substrates are generally fine-textured, saline soils. Vegetation is typically composed of one or more *Atriplex* species, such as *Atriplex canescens* or *Atriplex polycarpa*, along with other species of *Atriplex*. Species of *Allenrolfea, Salicornia, Suaeda, Krascheninnikovia lanata*, or other halophytic plants are often present to codominant. In some locations, scattered *Yucca brevifolia* may occur, but other Mojavean taxa are typically not present. Graminoid species may include *Sporobolus airoides* or *Distichlis spicata* at varying densities.
Related Concepts:
- Salt Desert Shrub (414) (Shiflet 1994) Broader
- Saltbush - Greasewood (501) (Shiflet 1994) Intersecting

Component Associations:
- *Atriplex canescens - Artemisia tridentata* Shrubland (CEGL001282, G4)
- *Atriplex canescens - Ephedra viridis* Talus Shrubland (CEGL001287, G4)
- *Atriplex canescens - Krascheninnikovia lanata* Shrubland (CEGL001285, G5)
- *Atriplex canescens / Bouteloua gracilis* Shrubland (CEGL001283, G3)
- *Atriplex canescens / Calycoseris parryi* Shrubland (CEGL001284, G2)
- *Atriplex canescens / Pleuraphis jamesii* Shrubland (CEGL001288, G3G4)
- *Atriplex canescens* Shrubland (CEGL001281, G5)
- *Atriplex confertifolia - Atriplex polycarpa* Shrubland (CEGL001299, G5)
- *Atriplex confertifolia - Ephedra nevadensis* Shrubland (CEGL001303, G5)
- *Atriplex confertifolia - Lycium andersonii* Shrubland (CEGL001308, G3)
- *Atriplex confertifolia - Sarcobatus vermiculatus* Shrubland (CEGL001313, G5)
- *Atriplex hymenelytra* Shrubland (CEGL001317, G5)
- *Atriplex polycarpa* Shrubland (CEGL001318, G5)
- *Distichlis spicata* Herbaceous Vegetation (CEGL001770, G5)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- North American Warm Desert Playa (CES302.751)

DISTRIBUTION

Range: This system is found in saline basins of the Mojave and Sonoran deserts.
Divisions: 302:C
Nations: MX, US
Subnations: AZ, CA, MXBC(MX), MXSO(MX), NV, UT
Map Zones: 4:C, 5:P, 6:P, 12:C, 13:C, 14:C, 15:?, 17:P, 25:C
USFS Ecomap Regions: 261B:??, 262A:CC, 313A:PP, 313C:PP, 321A:PP, 322A:CC, 322B:CC, 322C:CC, 341D:C?, 341F:CC, M261E:CC, M341A:PP
TNC Ecoregions: 17:C, 22:C, 23:C

SOURCES

References: Barbour and Major 1988, Brown 1982a, Comer et al. 2003, Holland and Keil 1995, MacMahon 1988, Thomas et al. 2004
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722923#references
Description Author: NatureServe Western Ecology Team
Version: 16 Jan 2009 **Stakeholders:** Latin America, Southeast, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

SONORA-MOJAVE SEMI-DESERT CHAPARRAL (CES302.757)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: North American Warm Desert (302)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Lower Montane]; Lowland [Foothill]; Shrubland (Shrub-dominated); Tropical/Subtropical [Tropical Xeric]; Temperate [Temperate Xeric]; Intermediate Disturbance Interval; F-Patch/High Intensity; Evergreen Sclerophyllous Shrub
Non-Diagnostic Classifiers: Short (50-100 yrs) Persistence; Ridge/Summit/Upper Slope; Sideslope; Aridic; Broad-Leaved Deciduous Shrub; Broad-Leaved Evergreen Shrub
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Evergreen shrubland
National Mapping Codes: EVT 2108; ESLF 5314; ESP 1108

CONCEPT

Summary: This ecological system is composed of evergreen shrublands or dwarf-woodlands on sideslopes transitioning from low-elevation desert landscapes up into woodlands of the western Mojave and Sonoran deserts. It extends from northeast Kern County, California, into Baja Norte, Mexico. Associated species include *Quercus john-tuckeri, Quercus cornelius-mulleri, Quercus berberidifolia, Arctostaphylos patula, Arctostaphylos pungens, Arctostaphylos glauca, Rhus ovata, Cercocarpus montanus var. glaber (= Cercocarpus betuloides), Ceanothus greggii, Garrya flavescens, Juniperus californica,* and *Nolina parryi*. Sometimes *Juniperus californica* forms an open, shrubby tree layer over the evergreen oaks and other shrubs.
Related Concepts:
- Snowbush (420) (Shiflet 1994) Undetermined. uncertain if these are related in concept.

Component Associations:
- *Arctostaphylos pungens* Shrubland (CEGL000958, G4)
- *Mortonia utahensis* Shrubland (CEGL005153, GNR)
- *Quercus turbinella - (Rhus trilobata, Artemisia tridentata)* Shrubland (CEGL005168, GNR)
- *Quercus turbinella - Coleogyne ramosissima* Shrubland (CEGL000982, G4)
- *Quercus turbinella - Garrya flavescens - Arctostaphylos pungens* Shrubland (CEGL000977, G4)
- *Quercus turbinella - Juniperus osteosperma* Shrubland (CEGL000981, G4?)
- *Quercus turbinella - Ptelea trifoliata - Fraxinus anomala* Mesic Shrubland (CEGL005160, GNR)

DISTRIBUTION

Range: This system occurs in the western Mojave and Sonoran deserts, from northeast Kern County, California, into Baja Norte, Mexico.
Divisions: 302:C
Nations: MX, US
Subnations: AZ, CA, MXBC(MX), MXSO(MX), NV
Map Zones: 4:C, 6:P, 12:P, 13:C, 14:C, 17:P
USFS Ecomap Regions: 322A:CC, 322B:CC, 322C:CC, 341F:??, M261E:CC
TNC Ecoregions: 17:C, 23:C

SOURCES

References: Barbour and Major 1988, Brown 1982a, Comer et al. 2003, Holland and Keil 1995, MacMahon 1988, Thomas et al. 2004
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722915#references
Description Author: NatureServe Western Ecology Team
Version: 16 Jan 2009 **Stakeholders:** Latin America, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

SONORAN BRITTLEBUSH-IRONWOOD DESERT SCRUB (CES302.758)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: North American Warm Desert (302)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Shrubland (Shrub-dominated); Tropical/Subtropical [Tropical Xeric]; Temperate [Temperate Xeric]
Non-Diagnostic Classifiers: Lowland [Lowland]; Aridic
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Mixed evergreen-deciduous shrubland
National Mapping Codes: EVT 2089; ESLF 5266; ESP 1089

CONCEPT

Summary: This Sonoran Desert scrub ecological system is common in plains of Sonora, Mexico, between 100-800 m elevation, but may not occur in the U.S. Vegetation is a sparse to moderately dense layer of short trees and xeromorphic microphyllous and broad-leaved evergreen shrubs that is dominated by *Olneya tesota* and *Encelia farinosa*. *Parkinsonia microphylla* and *Prosopis* spp. can also be common in the short-tree canopy. The understory is typically sparse but may also include desert grasses and ephemerals.

Component Associations:
- *Encelia farinosa* Shrubland (CEGL001251, G5)

DISTRIBUTION

Range: Plains of Sonora, Mexico, between 100-800 m elevation, but may not occur in the U.S.
Divisions: 302:C
Nations: MX, US?
Subnations: AZ?, MXSO(MX)
Map Zones: 14:P
USFS Ecomap Regions: 322B:PP
TNC Ecoregions: 17:C, 23:C

SOURCES

References: Brown 1982a, Comer et al. 2003, MacMahon 1988
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722914#references
Description Author: NatureServe Western Ecology Team
Version: 20 Feb 2003 **Stakeholders:** Latin America, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

SONORAN GRANITE OUTCROP DESERT SCRUB (CES302.760)

CLASSIFIERS

Conf.: 3 - Weak **Classification Status:** Standard
Primary Division: North American Warm Desert (302)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Shrubland (Shrub-dominated); Granitic Rock; Tropical/Subtropical [Tropical Xeric]; Temperate [Temperate Xeric]; Aridic
Non-Diagnostic Classifiers: Montane [Upper Montane]; Montane [Montane]; Montane [Lower Montane]; Lowland [Foothill]; Ridge; Woody-Herbaceous; Ridge/Summit/Upper Slope; Sideslope; Sand Soil Texture; Canyon; Cliff (Landform)
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Mixed evergreen-deciduous shrubland
National Mapping Codes: EVT 2090; ESLF 5267; ESP 1090

CONCEPT

Summary: This ecological system occurs in foothills and mountains of Sonora, Mexico, and extends north across the border into southern Arizona. It is found on low- to mid-elevation granitic outcrops. Tropical genera of *Jatropha* and *Bursera* become codominants in dense to sparse vegetation transitioning upslope from Sonoran Paloverde-Mixed Cacti Desert Scrub (CES302.761). Diagnostic species are *Bursera microphylla, Jatropha cuneata, Nolina bigelovii, Parkinsonia microphylla,* or *Rhus kearneyi*.
Classification Comments: This ecological system is likely to be a northern expression of a more widely distributed desert scrub system of Sonora, Mexico, where it may not be restricted to rock outcrops or sites, such as in Arizona.

Component Associations:
- *Nolina bigelovii* Shrubland (CEGL003064, G3?)
- *Parkinsonia microphylla - Larrea tridentata* Shrubland (CEGL001375, G4)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Sonoran Paloverde-Mixed Cacti Desert Scrub (CES302.761)

Adjacent Ecological System Comments: This system transitions upslope from Sonoran Paloverde-Mixed Cacti Desert Scrub (CES302.761).

DISTRIBUTION

Range: Occurs in foothills and mountains of Sonora, Mexico, and extends north across the border into southern Arizona.
Divisions: 302:C
Nations: MX, US
Subnations: AZ, CA, MXBC(MX), MXSO(MX), NV
Map Zones: 14:C
USFS Ecomap Regions: 322B:CC, 322C:CC
TNC Ecoregions: 23:C

SOURCES

References: Barbour and Major 1988, Brown 1982a, Comer et al. 2003, MacMahon 1988, Thomas et al. 2004
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722912#references
Description Author: NatureServe Western Ecology Team
Version: 20 Feb 2003 **Stakeholders:** Latin America, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

SONORAN MID-ELEVATION DESERT SCRUB (CES302.035)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Warm Desert (302)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Lower Montane]; Shrubland (Shrub-dominated); Alkaline Soil
Non-Diagnostic Classifiers: Alluvial fan; Sideslope; Temperate [Temperate Xeric]
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Mixed evergreen-deciduous shrubland
National Mapping Codes: EVT 2091; ESLF 5268; ESP 1091

CONCEPT

Summary: This transitional desert scrub system occurs along the northern edge of the Sonoran Desert in an elevational band along the lower slopes of the Mogollon Rim/Central Highlands region between 750 and 1300 m. Stands occur in the Bradshaw, Hualapai, and Superstition mountains, among other desert ranges, and are found above Sonoran Paloverde-Mixed Cacti Desert Scrub (CES302.761) and below Mogollon Chaparral (CES302.741). Sites range from a narrow strip on steep slopes to very broad areas such as the Verde Valley. Climate is too dry for chaparral species to be abundant, and freezing temperatures during winter are too frequent and prolonged for many of the frost-sensitive species that are characteristic of Sonoran Paloverde-Mixed Cacti Desert Scrub (CES302.761), such as *Carnegiea gigantea*, *Parkinsonia microphylla*, *Prosopis* spp., *Olneya tesota*, *Ferocactus* sp., and *Opuntia bigelovii*. Substrates are generally rocky soils derived from parent materials such as limestone, granitic rocks or rhyolite. The vegetation is typically composed of an open shrub layer of *Larrea tridentata*, *Ericameria linearifolia*, or *Eriogonum fasciculatum* with taller shrub such as *Canotia holacantha* (limestone or granite) or *Simmondsia chinensis* (rhyolite). The herbaceous layer is generally sparse.
Classification Comments: Includes Brown's (1982) Jojoba-Mixed Scrub and Creosotebush-Crucifixion-thorn Series.

Component Associations:
- *Ambrosia deltoidea / Simmondsia chinensis* Shrubland (CEGL000953, G4)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Mogollon Chaparral (CES302.741)
- Sonoran Paloverde-Mixed Cacti Desert Scrub (CES302.761)

Adjacent Ecological System Comments: It is found above Sonoran Paloverde-Mixed Cacti Desert Scrub (CES302.761) and below Mogollon Chaparral (CES302.741).

DISTRIBUTION

Range: This system occurs along the northern edge of the Sonoran Desert in an elevational band along the lower slopes of the Mogollon Rim/Central Highlands region between 750 and 1300 m.
Divisions: 302:C; 306:P
Nations: MX, US
Subnations: AZ, MXSO(MX)
Map Zones: 13:C, 14:C, 15:C, 25:C
USFS Ecomap Regions: 313C:CC, 321A:CC, 322A:CC, 322B:CC, 322C:CP, M313A:CC
TNC Ecoregions: 22:P, 23:C

SOURCES

References: Brown 1982a, Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722672#references
Description Author: K. Pohs, K. Schulz, P. Comer
Version: 05 Oct 2004 **Stakeholders:** Latin America, West
Concept Author: K. Pohs, K. Schulz, P. Comer **ClassifResp:** West

SONORAN PALOVERDE-MIXED CACTI DESERT SCRUB (CES302.761)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: North American Warm Desert (302)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland [Foothill]; Lowland [Lowland]; Shrubland (Shrub-dominated); Tropical/Subtropical [Tropical Xeric]; Temperate [Temperate Xeric]; Aridic; Xeromorphic Shrub; Succulent Shrub; Cacti-dominated
Non-Diagnostic Classifiers: Sideslope; Toeslope/Valley Bottom; Alkaline Soil; Sand Soil Texture; Broad-Leaved Deciduous Shrub; Succulent Forb
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Mixed evergreen-deciduous shrubland
National Mapping Codes: EVT 2109; ESLF 5315; ESP 1109

CONCEPT

Summary: This ecological system occurs on hillsides, mesas and upper bajadas in southern Arizona and extreme southeastern California. The vegetation is characterized by a diagnostic sparse, emergent tree layer of *Carnegiea gigantea* (3-16 m tall) and/or a sparse to moderately dense canopy codominated by xeromorphic deciduous and evergreen tall shrubs *Parkinsonia microphylla* and *Larrea tridentata*, with *Prosopis* sp., *Olneya tesota*, and *Fouquieria splendens* less prominent. Other common shrubs and dwarf-shrubs include *Acacia greggii, Ambrosia deltoidea, Ambrosia dumosa* (in drier sites), *Calliandra eriophylla, Jatropha cardiophylla, Krameria erecta, Lycium* spp., *Menodora scabra, Simmondsia chinensis*, and many cacti, including *Ferocactus* spp., *Echinocereus* spp., and *Opuntia* spp. (both cholla and prickly-pear). The sparse herbaceous layer is composed of perennial grasses and forbs with annuals seasonally present and occasionally abundant. On slopes, plants are often distributed in patches around rock outcrops where suitable habitat is present. Outliers of this succulent-dominated ecological system occur as "Cholla Gardens" in transitional areas in the southern and eastern Mojave Desert ecoregion. In this area, the system is characterized by *Opuntia bigelovii, Senna armata*, and other succulents, but it lacks the *Carnegiea gigantea* and *Parkinsonia microphylla* which are typical farther east. *Fouquieria splendens* is present in increasingly diminishing amounts in as the system occurs further west and north
Related Concepts:
- Palo Verde - Cactus (507) (Shiflet 1994) Equivalent

DESCRIPTION

Environment: This succulent desert scrub system is typically found below 1200 m elevation, with rare occurrences up to 1400 m. Climate is arid to semi-arid, continental with mild winters and hot summers (Niering and Lowe 1984). Precipitation has a bimodal distribution generally occurring during in the winter (December-February) and a summer monsoon (July-September). Landforms range from steep, rocky slopes of desert mountains to upper and lower bajadas extending out on to alluvial flats. With decreasing elevation, the system typically occurs in xeroriparian habitats and on rock outcrops. In uplands, the system is found on coarse soils that may be associated with poorly developed geomorphic surfaces; at lower elevations, it is found on very stable geomorphic surfaces. The soils are often underlain by an impervious caliche layer.

Extended periods of drought or episodes of extreme cold limit this type. Specifically, establishment of dominant species is constrained by decadal or longer periods of below-average precipitation (Turner et al. 1995). Twenty-four hours of below-freezing temperature causes nearly total mortality of the dominant plants. At the southern end of the system's range, competition from more mesic species may constrain distribution of this system (Turner et al. 1995).
Dynamics: This system is not thought to have supported fuel loads to sustain large fires prior to European habitation of the region. Natural fires are associated with dry lightning coincident with monsoonal storms following years when previous winter precipitation was sufficient to create a thick fine-fuel bed of annual plants to carry fire. These fires tend to be patchy due to heavier fuel in microsites, or linear when high winds were associated with convection storms (Landfire 2007a). Replacement fires were very rare or absent (average FRI of 100-1000 years, and perhaps longer) (Landfire 2007b). If they occurred, they did so only during conditions of extreme fire behavior after consecutive years of above-average winter precipitation when necessary fine fuels accumulate. These rare fires - which may or may not have occurred - had tremendous influence on community structure because the dominant overstory plants are extremely susceptible to fires, even those of low intensity (McLaughlin and Bowers 1982, Esque et al. 2004).

Prolonged weather-related stress (drought or frost) thinned dominant overstory plants and, in rare cases, led to stand replacement. It is speculated that these events occurred with similar frequency as stand-replacing fires (Landfire 2007b). Cold stress is more common in stands at the northern extent and at higher elevations on desert mountain ranges. Large (presumably old) saguaro plants are also susceptible to windthrow, particularly after rainstorms saturate the soil (Landfire 2007b).

Component Associations:
- *Acacia greggii - Parkinsonia microphylla* Shrubland (CEGL001340, G4G5)
- *Ambrosia deltoidea / Simmondsia chinensis* Shrubland (CEGL000953, G4)
- *Carnegiea gigantea / Prosopis velutina* Wooded Shrubland (CEGL001389, GNR)
- *Fouquieria splendens / Bouteloua curtipendula* Shrubland (CEGL001376, GNR)

- *Fouquieria splendens / Bouteloua hirsuta* Shrubland (CEGL001377, G3?)
- *Opuntia bigelovii* Shrubland (CEGL003065, G4?)
- *Parkinsonia microphylla - Larrea tridentata* Shrubland (CEGL001375, G4)
- *Simmondsia chinensis - Parkinsonia microphylla* Shrubland (CEGL000983, G4)

Spatial Characteristics

Adjacent Ecological Systems:
- Sonoran Granite Outcrop Desert Scrub (CES302.760)
- Sonoran Mid-Elevation Desert Scrub (CES302.035)

Distribution

Range: This system is found primarily in southwestern Arizona and western Sonora, Mexico, extending east of the Colorado River in southeastern California where locally there is enough summer precipitation (Whipple Mountains).
Divisions: 302:C
Nations: MX, US
Subnations: AZ, CA, MXBC(MX), MXSO(MX), NV?
Map Zones: 13:C, 14:C, 15:C, 25:C
USFS Ecomap Regions: 313C:CC, 321A:CC, 322A:CC, 322B:CC, 322C:CC, M313A:??
TNC Ecoregions: 23:C

Sources

References: Bowers and McLaughlin 1987, Brown 1982a, Comer et al. 2003, Esque et al. 2004, IPCC 2013b, Landfire 2007a, Landfire 2007b, MacMahon 1988, McAuliffe 1993, McLaughlin and Bowers 1982, Niering and Lowe 1984, Pavek 1993b, Pavek 1994, Robichaux 1999, Shiflet 1994, Shreve and Wiggins 1964, Thomas 1991, Thomas et al. 2012, TNC 2013, Turner et al. 1995, USFS 2002b
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722911#references
Description Author: NatureServe Western Ecology Team, mod. K.A. Schulz
Version: 14 Jan 2014 **Stakeholders:** Latin America, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

SOUTHERN CALIFORNIA COASTAL SCRUB (CES206.933)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Non-Diagnostic Classifiers: Lowland [Foothill]; Lowland [Lowland]; Shrubland (Shrub-dominated); Sideslope; Mediterranean [Mediterranean Xeric-Oceanic]; Xeric; Intermediate Disturbance Interval; F-Landscape/High Intensity; Evergreen Sclerophyllous Shrub; Semi-Shrub; Artemisia californica, Salvia mellifera
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Evergreen shrubland
National Mapping Codes: EVT 2092; ESLF 5269; ESP 1092

CONCEPT

Summary: This ecological system includes mixed coastal shrublands from Monterey, California, south into Baja Norte, Mexico. It is dominated by drought-deciduous shrubs but at times can have characteristic (constant but not dominant) resprouting, deep-rooted sclerophyllous shrubs. It occurs below 1000 m (3000 feet) elevation and may extend inland from the maritime zone in hotter, drier conditions than northern (less fog-drenched) shrublands (e.g., areas with 10-60 cm of annual precipitation). Soils vary from coarse gravels to clays but typically only support plant-available moisture with winter and spring rain. Most predominant shrubs include *Artemisia californica, Salvia mellifera, Salvia apiana, Salvia leucophylla, Encelia californica, Eriogonum fasciculatum, Eriogonum cinereum, Opuntia littoralis, Diplacus aurantiacus (= Mimulus aurantiacus), Lotus scoparius* (early seral after fire), and *Baccharis pilularis* (in moister, disturbed sites). Characteristic (constant but not dominant) resprouting, deep-rooted sclerophyllous shrubs include *Malosma laurina, Rhus integrifolia*, and *Rhamnus crocea*. Fire frequency was historically low, but in recent years with adjacency to urban and suburban areas, the fire frequency has increased (a result of arson or cigarette ignition) resulting in type conversion to non-native and ruderal annual grasslands. *Malosma laurina* and *Rhus integrifolia* are also increasing in abundance because they can continually resprout after repeated fires. In places, *Opuntia littoralis* may proliferate and cover entire slopes in dry rocky areas with repeated fires that have killed the scrub taxa, while *Opuntia littoralis* can resprout and spread to cover large patches.
Similar Ecological Systems:
- Northern California Coastal Scrub (CES206.932)

Related Concepts:
- Coastal Sage Shrub (205) (Shiflet 1994) Equivalent

DESCRIPTION

Environment: The most important environmental factors are cool-season precipitation and minimum winter temperature (Rundel 2007, Sawyer et al. 2009). Mean minimum winter temperature is substantially more predictive of southern sage scrub distribution patterns than is mean maximum summer temperature. Southern scrub prefers warm winters and relatively low total precipitation. This means that this system is restricted to low-elevation areas that receive some marine climatic influence; generally it occurs below 1000 m (3000 feet) elevation and receives about 10-60 cm of annual precipitation. The coastal region where it occurs has a longer dry season than further north in California. Southern coastal scrub often responds sensitively to aspect on a local scale (for example, in San Diego County sometimes occurring on south-facing slopes where north-facing slopes are occupied by chaparral types), but occurs on all aspects when viewed at a regional scale (Sawyer et al. 2009). Species composition of stands varies both with distance from the coast and with latitude. Soils vary from coarse gravels to clays but typically only support plant-available moisture with winter and spring rain. Stands often form complex mosaics interdigitated with stands of chaparral and grassland types on scales of 10s-100s of meters.
Dynamics: This is not an ecosystem type that requires fire for regeneration of the major shrubs (Landfire 2007a, Rundel 2007). Coastal scrub often occupies sites denuded by landslides, slumps, debris flows, and other mass-wasting events. It sometimes occupies chaparral sites for a number of years after a burn, before the larger, woodier chaparral shrubs reestablish their dominance. The main sage scrub species have seeds that are wind-dispersed, and recovery of sage scrub communities post-disturbance may involve dispersal and germination from plants outside the disturbed area (Rundel 2007). Although *Lotus scoparius* can temporarily occupy chaparral sites, *Artemisia californica* could not have the seedbank necessary to be abundant in post-fire chaparral, except in a case where there were repeated burns over several to many years that opened up the chaparral. Southern coastal scrub can clearly persist on favorable sites for at least a hundred years and probably much longer in the absence of any fire (Rundel 2007).

Component Associations:
- *Opuntia littoralis* Shrubland (CEGL003066, G3G4)
- *Salvia mellifera - Artemisia californica* Shrubland (CEGL003012, G4)

DISTRIBUTION

Range: This system is found from Monterey, California, south into Baja Norte, Mexico. It occurs below 1000 m (3000 feet) elevation and may extend inland from the maritime zone.
Divisions: 206:C

Nations: MX, US
Subnations: CA, MXBC(MX)
Map Zones: 4:C, 5:?, 6:?
USFS Ecomap Regions: 261B:CC, 262A:CC
TNC Ecoregions: 15:C, 16:C

SOURCES

References: Barbour and Billings 2000, Barbour and Major 1988, Brooks and Minnich 2006, Comer et al. 2003, Holland and Keil 1995, Landfire 2007a, Minnich 1983, Minnich and Dezzani 1998, PRBO Conservation Science 2011, Rundel 2007, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Shiflet 1994, Taylor 2004

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722748#references

Description Author: P. Comer and T. Keeler-Wolf, mod. M. Reid
Version: 14 Jan 2014 **Stakeholders:** Latin America, West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

SOUTHERN CALIFORNIA DRY-MESIC CHAPARRAL (CES206.930)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland [Foothill]; Sideslope; Mediterranean [Mediterranean Desertic-Oceanic]; Ustic; F-Landscape/High Intensity; Broad-Leaved Shrub
Non-Diagnostic Classifiers: Lowland [Lowland]; Shrubland (Shrub-dominated); Deep Soil; Intermediate Disturbance Interval; Evergreen Sclerophyllous Shrub
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Evergreen shrubland
National Mapping Codes: EVT 2110; ESLF 5316; ESP 1110

CONCEPT

Summary: This ecological system includes chaparral from sea level up to 1500 m (4550 feet) elevation throughout central and southern California and inland portions of Baja Norte, Mexico. It is found in dry-mesic to mesic site conditions analogous to mesic chaparral. Santa Ana winds drive late-summer, stand-replacing fires in these systems. Characteristic species include *Ceanothus megacarpus, Ceanothus crassifolius, Ceanothus leucodermis, Ceanothus greggii, Adenostoma fasciculatum, Adenostoma sparsifolium, Arctostaphylos glauca, Cercocarpus montanus var. glaber (= Cercocarpus betuloides), Cercocarpus montanus var. minutiflorus (= Cercocarpus minutiflorus), Rhus ovata,* and *Xylococcus bicolor*.
Related Concepts:
- Ceanothus Mixed Chaparral (208) (Shiflet 1994) Broader
- Chamise Chaparral (206) (Shiflet 1994) Broader. SRM groups all Adenostoma-dominated communities into one range type; several ecological systems can have Adenostoma fasciculatum as a dominant.

Component Associations:
- *Ceanothus megacarpus - Cercocarpus montanus var. glaber* Shrubland (CEGL003029, G3?)

DISTRIBUTION

Range: This system includes chaparral from sea level up to 1500 m (4550 feet) elevation throughout central and southern California and inland portions of Baja Norte, Mexico.
Divisions: 206:C
Nations: MX, US
Subnations: CA, MXBC(MX)
Map Zones: 4:C, 5:C
USFS Ecomap Regions: 261B:CC, 262A:CC, 322A:PP, 322C:PP
TNC Ecoregions: 13:C, 15:P, 16:C

SOURCES

References: Barbour and Billings 2000, Barbour and Major 1988, Comer et al. 2003, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722751#references
Description Author: P. Comer, T. Keeler-Wolf
Version: 07 Oct 2005
Stakeholders: Latin America, West
Concept Author: P. Comer, T. Keeler-Wolf
ClassifResp: West

SOUTHERN COLORADO PLATEAU SAND SHRUBLAND (CES304.793)

CLASSIFIERS

Conf.: 3 - Weak **Classification Status:** Standard
Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland [Foothill]; Lowland [Lowland]; Woody-Herbaceous; Temperate [Temperate Xeric]; Alkaline Soil; Aridic; Very Short Disturbance Interval; G-Landscape/High Intensity
Non-Diagnostic Classifiers: Short (50-100 yrs) Persistence; Mechanical Disturbance; Xeromorphic Shrub
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Mixed evergreen-deciduous shrubland
National Mapping Codes: EVT 2093; ESLF 5270; ESP 1093

CONCEPT

Summary: This large-patch ecological system is found on the south-central Colorado Plateau in northeastern Arizona extending into southern and central Utah. It occurs on windswept mesas, broad basins and plains at low to moderate elevations (1300-1800 m). Substrates are stabilized sandsheets or shallow to moderately deep sandy soils that may form small hummocks or small coppice dunes. This semi-arid, open shrubland is typically dominated by short shrubs (10-30 % cover) with a sparse graminoid layer. The woody layer is often a mixture of shrubs and dwarf-shrubs. Characteristic species include *Ephedra cutleri, Ephedra torreyana, Ephedra viridis,* and *Artemisia filifolia*. *Coleogyne ramosissima* is typically not present. *Poliomintha incana, Parryella filifolia, Quercus havardii var. tuckeri*, or *Ericameria nauseosa* may be present to dominant locally. *Ephedra cutleri* and *Ephedra viridis* often assume a distinctive matty growth form. Characteristic grasses include *Achnatherum hymenoides*, *Bouteloua gracilis*, *Hesperostipa comata*, and *Pleuraphis jamesii*. The general aspect of occurrences is an open low shrubland but may include small blowouts and dunes. Occasionally grasses may be moderately abundant locally and form a distinct layer. Disturbance may be important in maintaining the woody component. Eolian processes are evident, such as pediceled plants, occasional blowouts or small dunes, but the generally higher vegetative cover and less prominent geomorphic features distinguish this system from Inter-Mountain Basins Active and Stabilized Dune (CES304.775).
Similar Ecological Systems:
- Inter-Mountain Basins Active and Stabilized Dune (CES304.775)

Component Associations:
- *Artemisia filifolia - Ephedra (torreyana, viridis)* Shrubland (CEGL002786, GNR)
- *Artemisia filifolia / Bouteloua eriopoda* Shrubland (CEGL001077, G4)
- *Ephedra torreyana - Achnatherum hymenoides* Hummock Shrubland (CEGL005802, GNR)
- *Ephedra torreyana / Bouteloua eriopoda* Shrub Herbaceous Vegetation (CEGL001731, G2)
- *Ephedra viridis / Achnatherum hymenoides - Bouteloua gracilis* Shrub Herbaceous Vegetation (CEGL001648, G2G4)
- *Ephedra viridis / Achnatherum hymenoides - Sporobolus cryptandrus* Shrub Herbaceous Vegetation (CEGL001649, G2G4)
- *Ephedra viridis / Pleuraphis rigida* Shrubland (CEGL001257, G3)
- *Ericameria nauseosa* Sand Deposit Sparse Shrubland (CEGL002980, GNR)
- *Poliomintha incana / (Pleuraphis jamesii)* Shrubland (CEGL002930, GNR)

DISTRIBUTION

Range: This system occurs in sandy plains and mesas on the south-central Colorado Plateau in northeastern Arizona extending into southern and central Utah.
Divisions: 304:C
Nations: US
Subnations: AZ, CO?, NM?, UT
Map Zones: 15:?, 16:?, 23:C, 24:C, 28:C
USFS Ecomap Regions: 313A:CC, 313B:CC, 313D:CC, 341B:CC, M313A:CC, M341B:PP
TNC Ecoregions: 19:C

SOURCES

References: AZGAP unpubl. data 2004, UTGAP unpubl. data 2004, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.740063#references
Description Author: K.A. Schulz
Version: 08 Sep 2004 **Stakeholders:** West
Concept Author: K. Pohs, K. Schulz, J. Kirby **ClassifResp:** West

TAMAULIPAN CALCAREOUS THORNSCRUB (CES301.986)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Madrean Semidesert (301)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Caliche Layer; Lowland [Lowland]; Ridge; Shrubland (Shrub-dominated); Ridge/Summit/Upper Slope; Tropical/Subtropical [Tropical Xeric]; Calcareous; Very Shallow Soil
Non-Diagnostic Classifiers: Oligotrophic Soil; Alkaline Soil
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Mixed evergreen-deciduous shrubland
National Mapping Codes: EVT 2392; ESLF 5323; ESP 1392

CONCEPT

Summary: This xeric thornscrub ecological system is restricted to limestone and calcareous sandstone hills and caliche substrates such as along the Bordas Scarp in southern Texas and northeastern Mexico. Soils are shallow, alkaline, strongly calcareous and underlain by bedrock or a caliche layer. It has a shorter, more open shrub canopy (usually less than 2 m) when compared to more typical thornscrub growing on more favorable sites. However, shrub cover is generally greater than 70% and often greater than 85%. Dominant species include *Leucophyllum frutescens*, *Acacia berlandieri*, and *Acacia farnesiana* with many other shrub species that may be locally dominant . The sparse to moderately dense herbaceous layer is dominated by perennial graminoids.

Similar Ecological Systems:
- Edwards Plateau Limestone Shrubland (CES303.041)
- Tamaulipan Mesquite Upland Scrub (CES301.984)
- Tamaulipan Mixed Deciduous Thornscrub (CES301.983)
- Tamaulipan Saline Thornscrub (CES301.711)

Related Concepts:
- Barretal (Jahrsdoerfer and Leslie 1988) Finer
- South Texas: Calcareous Dense Shrubland (7205) [CES301.986.5] (Elliott 2011) Finer
- South Texas: Calcareous Live Oak Motte and Woodland (7202) [CES301.986.2] (Elliott 2011) Finer
- South Texas: Calcareous Shrubland (7204) [CES301.986.4] (Elliott 2011) Finer
- South Texas: Calcareous Sparse Shrubland (7207) [CES301.986.7] (Elliott 2011) Finer
- Upland Thornscrub (Jahrsdoerfer and Leslie 1988) Broader

DESCRIPTION

Environment: This system is restricted to xeric, rocky hills, rolling or level plateaus, and ridges composed of limestone and calcareous sandstone, as well as caliche substrates such as of the Goliad Formation or Uvalde gravel along the Bordas Scarp in southern Texas and northeastern Mexico. Soils are thin, alkaline, strongly calcareous and underlain by bedrock or a caliche layer. These are Shallow, Shallow Ridge or Gravelly Ridge Ecological Sites.

Vegetation: Sites are most frequently dominated by shrubs between 0.5 and 2 m in height. Shrub canopy can be dense (to about 90% cover), or sparser where rocky exposures reduce substrate for rooting. A sparse overstory, usually <4 m in height, may be present and composed of species such as *Prosopis glandulosa* and, in the south, *Ebenopsis ebano, Cordia boissieri*, and/or *Helietta parvifolia*. *Quercus fusiformis* may form a relatively open canopy in areas in the northeastern part of the South Texas Plains. The shrub layer may be heavily dominated by *Leucophyllum frutescens, Acacia berlandieri*, and/or *Acacia rigidula*. More commonly, a diverse array of shrubs is present, including these three in addition to several of the following species: *Acacia schaffneri, Aloysia macrostachya, Amyris madrensis, Amyris texana, Bernardia myricifolia, Castela erecta ssp. texana, Celtis pallida (= Celtis ehrenbergiana), Condalia spathulata, Croton incanus, Diospyros texana, Ephedra antisyphilitica, Eysenhardtia texana, Forestiera angustifolia, Guajacum angustifolium, Helietta parvifolia, Jatropha dioica, Karwinskia humboldtiana, Koeberlinia spinosa, Krameria ramosissima, Mahonia trifoliolata, Opuntia leptocaulis (= Cylindropuntia leptocaulis), Parkinsonia texana var. macra, Salvia ballotiflora, Sideroxylon celastrinum, Sophora secundiflora, Yucca treculeana*, and others. More southerly occurrences may also contain *Lippia graveolens, Helietta parvifolia, Gochnatia hypoleuca, Croton humilis, Ebenopsis ebano*, and/or *Mortonia greggii*. The herbaceous layer may be somewhat well-developed, but often bare rock is easily visible through the layer. Many sites are now dominated by non-native grasses, particularly *Bothriochloa ischaemum var. songarica* and/or *Pennisetum ciliare*. Other grasses are often short grasses, with species such as *Bouteloua rigidiseta, Bouteloua hirsuta, Buchloe dactyloides (= Bouteloua dactyloides), Hilaria belangeri, Aristida purpurea, Bouteloua curtipendula*, and *Setaria leucopila* present. Forbs and subshrubs are conspicuous in the herbaceous layer and include species such as *Tiquilia canescens, Thamnosma texana, Galphimia angustifolia, Polygala alba, Cordia podocephala, Acourtia runcinata, Dalea aurea, Calliandra conferta, Chamaecrista greggii, Heliotropium torreyi, Melampodium cinereum, Hymenopappus scabiosaeus, Desmanthus velutinus, Calylophus hartwegii, Simsia calva, Hermannia texana, Macrosiphonia lanuginosa var. macrosiphon, Viguiera stenoloba, Hedyotis nigricans (= Stenaria nigricans), Thymophylla pentachaeta, Wedelia texana (= Wedelia hispida)*, and *Meximalva filipes* (Elliott 2011). Downslope from these sites, soil development increases, soils tend to be tight, a more well-developed overstory of *Prosopis glandulosa* becomes prominent, and species such as

Castela erecta and *Ziziphus obtusifolia* increase in cover relative to other species.
Dynamics: Erosion occurs on these sites, creating gullies, but not causing a shift in the community. Fire played little to no role in this system, though may have spread into the margins of stands during drought and high wind conditions (Landfire 2007a).

This system was modeled by Landfire (2007a) using a single class. Dense shrubland, generally 40-90% cover with sparse cover from emergent overstory species. Little natural disturbance affects this shrubland. Low fine fuel loadings make fire spread minimal except under extreme windy and dry conditions when fire may spread into it from surrounding sites. Species are drought-resistant. However, this system occurs in large patch to matrix scale and marginal fires likely spread little into the interior portions of occurrences.

Component Associations:
- *Acacia rigidula - Leucophyllum frutescens - Hechtia glomerata* Shrubland (CEGL007760, G2G3Q)
- *Helietta parvifolia - Acacia rigidula - Ebenopsis ebano - Leucophyllum frutescens* Shrubland (CEGL004923, G3)
- *Leucophyllum frutescens - Salvia ballotiflora - Lippia graveolens* Shrubland (CEGL007789, G2?)
- *Leucophyllum frutescens* Shrubland (CEGL002168, G4)

DISTRIBUTION

Range: Restricted to limestone and calcareous sandstone hills and caliche substrates such as along the Bordas Scarp in southern Texas and northeastern Mexico.
Divisions: 301:C; 303:P
Nations: MX, US
Subnations: MXCO(MX), MXNU(MX), MXTM(MX), TX
Map Zones: 26:C, 35:C, 36:C
USFS Ecomap Regions: 255E:CC, 315A:CC, 315C:C?, 315D:CC, 315G:C?, 321A:CC, 321B:CC
TNC Ecoregions: 24:C, 29:C, 30:C, 31:P

SOURCES

References: Comer et al. 2003, CONABIO 2003b, Elliott 2011, Jahrsdoerfer and Leslie 1988, Landfire 2007a, McLendon 1991, TNC 2013
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722719#references
Description Author: J. Teague and L. Elliott
Version: 14 Jan 2014 **Stakeholders:** Latin America, Southeast
Concept Author: NatureServe Western Ecology Team **ClassifResp:** Southeast

TAMAULIPAN LOMAS (CES301.462)

CLASSIFIERS

Classification Status: Standard

Primary Division: Madrean Semidesert (301)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Non-Diagnostic Classifiers: Herbaceous
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Mixed evergreen-deciduous shrubland
National Mapping Codes: EVT 2439; ESLF 7152; ESP 1439

CONCEPT

Summary: This system occurs on well-drained portions of clay dunes (lomas) rising above surrounding coastal tidal flats. It is a xeric, subtropical shrubland dominated by thorny evergreen shrubs, generally 2-4 m tall. Composition of this system is extremely variable, and there is usually no clear dominant, except locally. Local dominants may include *Citharexylum berlandieri, Leucophyllum frutescens, Havardia pallens (= Pithecellobium pallens),* and *Ebenopsis ebano*. While there is often no clear dominant, *Yucca treculeana* is a constant and conspicuous emergent in many occurrences. Some lomas may be flooded by the sea during severe storm events. Vegetation in this system is sometimes influenced by salt spray, high winds, limited rooting depth, saline water table, and extreme xeric conditions.

Related Concepts:
- Clay Lomas/Wind Tidal Flats (Jahrsdoerfer and Leslie 1988) Broader
- South Texas: Loma Deciduous Shrubland (7306) [CES301.462.6] (Elliott 2011) Finer
- South Texas: Loma Evergreen Shrubland (7305) [CES301.462.5] (Elliott 2011) Finer
- South Texas: Loma Grassland (7307) [CES301.462.7] (Elliott 2011) Finer

DESCRIPTION

Environment: This system occupies well-drained portions of clay dunes (lomas) along the lower Texas coast (and somewhat inland) and adjacent Mexico. These rise above surrounding coastal tidal flats and often develop from deposition of windblown fine sediments, resulting in elevated landforms within a matrix of tidal flats (Elliott 2011). At the time of formation, lomas were located on the leeward side of irregularly flooded lagoons and tidal flats that when dry provided the source for the windblown clayey sediments. The geology consists of Quaternary windblown deposits identified as clay dunes (Qcd). Landforms are round, elliptic, or crescent-shaped topographic highs, often within a matrix of low flats influenced by wind-driven tides. Soils include Point Isabel clay loam and Lalinda fine sandy loam, which are often associated with the Coastal Ridge Ecological Site. Lomas are characterized as wind-formed clay dunes on or near the coast, often surrounded by flats containing halophytic vegetation, coastal grasslands, or unvegetated wind-tidal flats. They usually occur as topographic highs in the surrounding level landscape, sometimes to 10 m above the surrounding plain and are a small-patch occurrence.

Vegetation: These are typically fairly dense to extremely dense shrublands, often 2-4 m in height. While there is often no clear dominant, *Yucca treculeana* is a constant and conspicuous emergent in many occurrences (Johnston 1952). Other dominants may include *Acacia rigidula, Castela erecta, Celtis pallida (= Celtis ehrenbergiana), Citharexylum berlandieri, Ebenopsis ebano, Forestiera angustifolia, Guajacum angustifolium, Jatropha dioica, Karwinskia humboldtiana, Leucophyllum frutescens, Opuntia engelmannii var. lindheimeri, Phaulothamnus spinescens, Prosopis glandulosa, Sideroxylon celastrinum, Zanthoxylum fagara,* and *Ziziphus obtusifolia*. There may be scattered emergent trees of *Ebenopsis ebano* and *Prosopis glandulosa* forming a sparse woodland. Within these shrublands, the herbaceous layer is typically not well-developed, however, the non-native *Urochloa maxima* may be conspicuous. A grassland, often dominated by *Sporobolus wrightii* occupies the margins of these clay dunes, as they grade downslope into the surrounding salty flats. These margins may also contain *Sporobolus coromandelianus (= Sporobolus pyramidatus), Monanthochloe littoralis,* and *Spartina spartinae*. Other somewhat halophytic species, such as *Maytenus phyllanthoides* and *Prosopis reptans,* may also occupy these dunes. The proximity of many of these dunes to active tidal fluctuations and salt spray also influences species composition at these sites.

Dynamics: From Landfire (2007a): Hurricanes and tropical storms can affect these sites through tidal surge causing influx of saline waters. Saltwater inundation would be restricted temporally to the period during storm surge and would not likely significantly affect shrub mortality. Also, high-intensity storms may completely eliminate these sites through erosion. Erosional processes would tend to completely eliminate sites rather than causing changes in the system structure. Fire is not a process important to this system and does not or rarely occurs. Tidal flat islands are important for wildlife such as migratory birds, mollusks and fish (USACE 2013).

This system occurs as small-patch sites ranging from 10s to a few 100 acres. Disturbances tend to have local effects or completely eliminate a site. This BpS occurs as a stable system.

Component Associations:
- *Citharexylum berlandieri - Yucca treculeana - Ebenopsis ebano - Phaulothamnus spinescens* Shrubland (CEGL002170, G1)
- *Maytenus phyllanthoides - Prosopis reptans / Spartina patens* Herbaceous Vegetation (CEGL007764, G2?)
- *Sporobolus wrightii* Herbaceous Vegetation (CEGL002232, G2?)

DISTRIBUTION

Range: This coastal system is known from Aransas County, Texas, south into Mexico.
Divisions: 301:C
Nations: US
Subnations: TX
Map Zones: 36:C
USFS Ecomap Regions: 255D:CC, 315E:??
TNC Ecoregions: 31:C

SOURCES

References: Comer et al. 2003, Crosswhite 1980, Elliott 2011, Jahrsdoerfer and Leslie 1988, Johnston 1952, Landfire 2007a, TNC 2013, USACE 2013
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723124#references
Description Author: J. Teague, mod. L. Elliott
Version: 14 Jan 2014
Concept Author: J. Teague
Stakeholders: Southeast
ClassifResp: Southeast

TAMAULIPAN MIXED DECIDUOUS THORNSCRUB (CES301.983)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Madrean Semidesert (301)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland [Lowland]; Shrubland (Shrub-dominated); Tropical/Subtropical [Tropical Xeric]
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Mixed evergreen-deciduous shrubland
National Mapping Codes: EVT 2390; ESLF 5321; ESP 1390

CONCEPT

Summary: This thornscrub ecological system occurs throughout much of northeastern Mexico and southern Texas. It occurs on a variety of substrates and landforms. Dominant species include *Acacia roemeriana, Leucophyllum frutescens,* and *Prosopis glandulosa*. Other species present to codominant include *Acacia berlandieri, Acacia farnesiana, Amyris madrensis, Amyris texana, Celtis pallida, Parkinsonia texana,* and cacti such as *Opuntia engelmannii var. lindheimeri*. The herbaceous layer is not well-developed but *Chloris pluriflora (= Trichloris pluriflora), Setaria* spp. and *Malpighia glabra* are present. This system generally occurs as a closed shrubland or low woodland, usually lacking a purely open herbaceous component. Soils are clays, clay loams, and clay flats and are often calcareous or alkaline to varying degrees. Some sites are highly saline, and these sites are occupied by Tamaulipan Saline Thornscrub (CES301.711), but transitions between the systems may be subtle.
Classification Comments: This shrubland is differentiated from Tamaulipan Savanna Grassland (CES301.985) as it occupies tighter soils, as opposed to the sandier soils of the savanna grassland. The sites are often lower in the landscape compared to nearby savanna grassland or Tamaulipan Calcareous Thornscrub (CES301.986), but would be considered uplands as they are distant from bottomland soils and drainages, and are not well-developed woodlands typical of the lowest landscape positions. To a large degree, all of these systems share numerous shrub species, but show subtle differences in relative dominance. However, this system generally occurs as a closed shrubland or low woodland, usually lacking a purely open herbaceous component.
Similar Ecological Systems:
- Tamaulipan Calcareous Thornscrub (CES301.986)
- Tamaulipan Mesquite Upland Scrub (CES301.984)
- Tamaulipan Saline Thornscrub (CES301.711)
- Tamaulipan Savanna Grassland (CES301.985)--occupies sandier soils.

Related Concepts:
- Chihuahuan Thorn Forest (Jahrsdoerfer and Leslie 1988) Intersecting
- South Texas: Clayey Blackbrush Mixed Shrubland (7005) [CES301.983.5] (Elliott 2011) Finer
- South Texas: Clayey Live Oak Motte and Woodland (7002) [CES301.983.2] (Elliott 2011) Finer
- South Texas: Clayey Mesquite Mixed Shrubland (7004) [CES301.983.4] (Elliott 2011) Finer
- Upland Thornscrub (Jahrsdoerfer and Leslie 1988) Broader

DESCRIPTION

Environment: This system is well-represented on the Eocene Claiborne and Jackson groups and the Pleistocene Beaumont Formation, but is also found on various other formations. Its landforms are gently rolling to nearly level sites, sometimes interdigitated with calcareous ridges and low-lying drainages and bottomlands. Found on upland sites on tight soils deposited through alluvial processes associated with the Rio Grande, also occurs on uplands away from the delta on deeper soils. Clay, Clay Flat, and Clay Loam Ecological Sites are the typical soils for this system.
Vegetation: *Prosopis glandulosa* is very often a conspicuous component of the canopy in stands of this system, sometimes reaching to 6 m in height. This canopy may be dense, but given the open nature of the canopy of individual *Prosopis glandulosa*, significant solar radiation reaches the lower strata. *Acacia farnesiana, Celtis pallida (= Celtis ehrenbergiana), Ebenopsis ebano*, and *Celtis laevigata* may also be components of the canopy, but *Prosopis glandulosa* usually dominates. The overstory canopy may be open with only scattered emergent trees over a dense shrub layer at 1 to 3 m in height. Depending on land-use history, the shrub understory may be limited to a few species such as *Opuntia engelmannii var. lindheimeri, Ziziphus obtusifolia*, or *Celtis pallida* on relatively recently cleared sites. On more mature sites, a diverse assemblage of species, such as *Acacia rigidula, Castela erecta, Malpighia glabra, Opuntia engelmannii var. lindheimeri, Opuntia leptocaulis (= Cylindropuntia leptocaulis), Ziziphus obtusifolia, Celtis pallida, Lycium berlandieri, Forestiera angustifolia, Guajacum angustifolium, Diospyros texana, Amyris texana, Karwinskia humboldtiana, Havardia pallens, Phaulothamnus spinescens, Schaefferia cuneifolia, Condalia hookeri*, and *Zanthoxylum fagara*, may occur. *Leucophyllum frutescens* and *Acacia berlandieri* may be present, but occur as scattered individuals as opposed to dominating the aspect of the community as they sometimes do on some shallow-soiled calcareous sites. However, like some shallow-soiled calcareous sites, *Acacia rigidula* is the aspect dominant of the shrub layer. The herbaceous layer is usually fairly sparse. Currently, the herbaceous layer may actually be dense with the non-native grass *Urochloa maxima*. Other non-native species, such as *Pennisetum ciliare, Cynodon dactylon, Bothriochloa ischaemum var. songarica*, and *Dichanthium annulatum*, may also be present to dominant. Native grasses, such as *Bothriochloa laguroides ssp. torreyana, Chloris* spp. (= *Trichloris* spp.), and *Pappophorum bicolor*, may be present.

Dynamics: Fire plays a role in this system, occurring in situations adjacent to grasslands during dry conditions when fire would jump to the canopy and carry during wind events. Drought would influence fire occurring in the woodland and shrubland classes (Landfire 2007a).

This system was modeled by Landfire (2007a) using three classes: early-, mid- and late-seral. The early-seral (0-5 years) class is dominated by perennial grasses. This class was maintained on higher topographic positions somewhat longer because of slower shrub growth in more xeric situations. Frequent replacement fire (MFRI = 7 years) is the dominant disturbance type in this class (Landfire 2007a). Mid-seral class is dominated by shrubs (40-70% cover). In this class, mesquite is a component of the shrub layer along with the other shrubs. Drought is incorporated into the MFRI in that dry conditions would be required for fire to be carried in the canopy. Replacement fire (MFRI = 20 years) is the dominant disturbance type in this class (Landfire 2007a). The late-seral class has a shrub layer at a height of 2-4 m and 70-100% cover. Mesquite canopy is well-developed in this class. Shrub layer development is extensive forming an almost continuous layer. Replacement fire (MFRI = 30 years) is the dominant disturbance type in this class (Landfire 2007a).

Component Associations:
- *Acacia berlandieri* South Texas Plains Shrubland (CEGL002181, G3G5)
- *Acacia rigidula - Leucophyllum frutescens - Acacia berlandieri* Shrubland (CEGL007759, G5)
- *Acacia rigidula* Shrubland (CEGL003874, G4G5)
- *Prosopis glandulosa / Acanthocereus tetragonus* Woodland (CEGL007832, G2?)
- *Prosopis glandulosa var. glandulosa - Acacia greggii - Celtis pallida / Paspalum setaceum - Urochloa ciliatissima* Woodland (CEGL007786, G5)
- *Prosopis glandulosa var. glandulosa - Celtis pallida / Opuntia* spp. - *Xylothamia palmeri* Woodland (CEGL007787, G4G5)
- *Prosopis glandulosa var. glandulosa - Opuntia engelmannii var. lindheimeri - Borrichia frutescens* Shrubland (CEGL007790, G3G4)
- *Prosopis glandulosa var. glandulosa - Parkinsonia texana var. macra - (Cordia boissieri, Koeberlinia spinosa)* Shrubland (CEGL007762, G4)
- *Prosopis glandulosa var. glandulosa / (Celtis pallida, Phaulothamnus spinescens, Ziziphus obtusifolia var. obtusifolia)* Woodland (CEGL002132, G5)
- *Varilla texana - Castela erecta ssp. texana - Isocoma coronopifolia / Hilaria belangeri* Shrubland (CEGL007763, G1?)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Tamaulipan Closed Depression Wetland (CES301.197)
- Tamaulipan Saline Thornscrub (CES301.711)

DISTRIBUTION

Range: Occurs throughout much of northeastern Mexico and southern Texas.
Divisions: 301:C
Nations: MX, US
Subnations: MXCO(MX), MXNU(MX), MXTM(MX), TX
Map Zones: 36:C
USFS Ecomap Regions: 315E:CC
TNC Ecoregions: 30:C, 31:C

SOURCES

References: Brown 1982a, Brown et al. 1998, Comer et al. 2003, CONABIO 2003a, Crosswhite 1980, Elliott 2011, Jahrsdoerfer and Leslie 1988, Landfire 2007a, TNC 2013, Webster 2001
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722722#references
Description Author: L. Elliott, mod. K.A. Schulz
Version: 14 Jan 2014 **Stakeholders:** Latin America, Southeast
Concept Author: NatureServe Western Ecology Team **ClassifResp:** Southeast

TAMAULIPAN SALINE THORNSCRUB (CES301.711)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Madrean Semidesert (301)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Shrubland (Shrub-dominated); Tropical/Subtropical [Tropical Xeric]; Saline Substrate Chemistry
National Mapping Codes: ESLF 9393

CONCEPT

Summary: This system is an open shrubland on gently rolling to level sites where soil salinity is particularly high on saline clays. It occurs in the Tamaulipan region of southern Texas and possibly ranges into Mexico. Scattered *Prosopis glandulosa* usually form an emergent canopy less than 5 m in height, creating an overstory canopy cover of around 10%. A variety of shrubs and subshrubs form the dominant layer with a cover of 20-70% interspersed in a mosaic with patchy grasses.

Similar Ecological Systems:
- Tamaulipan Calcareous Thornscrub (CES301.986)
- Tamaulipan Mesquite Upland Scrub (CES301.984)
- Tamaulipan Mixed Deciduous Thornscrub (CES301.983)--occurs on soils mapped as saline clay or saline clay loam, but where soil salinity is not extreme and is often found upslope of Tamaulipan Saline Thornscrub.
- Tamaulipan Savanna Grassland (CES301.985)--occupies sandier soils.

Related Concepts:
- South Texas: Salty Thornscrub (6806) (Elliott 2011) Equivalent

DESCRIPTION

Environment: This ecological system occurs on gently rolling to low flats, sometimes dissected by minor drainages. It is frequently associated with the Yegua Formation or the Jackson Group and within the Saline Clay and Saline Clay Loam Ecological Sites. Soils are typically saline clays such as Montell, Maverick, and Catarina soils and may have a veneer of gravel over the clay.
Vegetation: *Prosopis glandulosa* usually forms a scattered emergent canopy less than 5 m in height, creating an overstory canopy cover of around 10%. Shrubs and subshrubs, such as *Varilla texana, Castela erecta, Acacia rigidula, Atriplex canescens, Isocoma coronopifolia, Condalia spathulata, Jatropha dioica, Suaeda* spp., *Opuntia engelmannii var. lindheimeri, Opuntia leptocaulis (= Cylindropuntia leptocaulis), Xylothamia palmeri, Tiquilia canescens*, and *Prosopis reptans*, are conspicuous elements of the relatively open shrubland (20-70% canopy cover). Patchy grasses typify the herbaceous layer, with such species as *Hilaria belangeri, Sporobolus coromandelianus (= Sporobolus pyramidatus), Pappophorum bicolor, Buchloe dactyloides (= Bouteloua dactyloides), Bouteloua trifida*, and occasionally *Monanthochloe littoralis*. Forbs such as *Billieturnera helleri, Chamaesyce albomarginata, Heliotropium curassavicum*, and *Thymophylla pentachaeta* may be present and conspicuous. Cacti are sometimes well-represented in the ground layer, including species such as *Echinocereus reichenbachii var. fitchii, Escobaria emskoetteriana, Mammillaria heyderi, Sclerocactus scheeri, Echinocactus texensis*, and *Thelocactus setispinus*.
Dynamics: Regular fire plays a limited role in this system because of the relatively low cover of fine fuel. During dry conditions it may burn when fire would jump to the shrub layer and canopy and carry during wind events spreading from adjacent grasslands that have more frequent fires. Saline substrates are the driving environmental variable that limits plant growth and species diversity. Substrates are highly erodible saline clay and saline clay loam soils.

Component Associations:
- *Varilla texana - Castela erecta ssp. texana - Isocoma coronopifolia / Hilaria belangeri* Shrubland (CEGL007763, G1?)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Tamaulipan Floodplain (CES301.990)
- Tamaulipan Mixed Deciduous Thornscrub (CES301.983)

DISTRIBUTION

Range: This system occurs in the Tamaulipan region of southern Texas and possibly ranges into Mexico.
Divisions: 301:C
Nations: MX? , US
Subnations: MXCO?(MX), MXNU?(MX), MXTM?(MX), TX
Map Zones: 36:C
USFS Ecomap Regions: 315Eb:CCP, 315Ec:CCP, 315Ed:CCP
TNC Ecoregions: 30:C

SOURCES

References: Brown et al. 1998, CONABIO 2003a, Elliott 2011, Jahrsdoerfer and Leslie 1988, Southeastern Ecology Working Group

n.d., TNC 2013, Webster 2001

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.859564#references

Description Author: L. Elliott, mod. J. Teague and K.A. Schulz

Version: 14 Jan 2014 **Stakeholders:** Latin America, Southeast

Concept Author: L. Elliott, D. Diamond, A. Treuer-kuehn, D. German, J. Teague **ClassifResp:** Southeast

WESTERN GREAT PLAINS MESQUITE WOODLAND AND SHRUBLAND (CES303.668)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Western Great Plains (303)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Non-Diagnostic Classifiers: Shrubland (Shrub-dominated); F-Patch/Medium Intensity; G-Patch/Medium Intensity
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Mixed evergreen-deciduous shrubland
National Mapping Codes: EVT 2111; ESLF 5317; ESP 1111

CONCEPT

Summary: This system is found primarily in the southern portion of the Western Great Plains Division, primarily in Texas, Oklahoma and eastern New Mexico. It is dominated by *Prosopis glandulosa* with shortgrass species in the understory. *Ziziphus obtusifolia* and *Atriplex canescens* can codominate in some examples, as can *Opuntia* species in heavily grazed areas. Shortgrass species *Bouteloua gracilis* or *Buchloe dactyloides* are typically present. Other grasses may include *Aristida purpurea, Bouteloua curtipendula, Bouteloua eriopoda, Bouteloua hirsuta, Muhlenbergia torreyi, Pleuraphis jamesii, Sporobolus airoides*, and *Sporobolus cryptandrus*. Historically this system probably occurred as a natural component on more fertile soils and along drainages, but it has expanded its range into prairie uplands in recent decades.
Classification Comments: With fire suppression and grazing, *Prosopis glandulosa* has been able to extend its range and become dense in examples of Western Great Plains Shortgrass Prairie (CES303.672) or Central Mixedgrass Prairie (CES303.659). Those areas should still be considered part of the prairie system. In Landfire mapzone 26 BpS modeling workshops, this was modeled in its limited extent along drainages rather than as the pervasive EVT.
Similar Ecological Systems:
- Central Mixedgrass Prairie (CES303.659)
- Tamaulipan Mesquite Upland Scrub (CES301.984)
- Western Great Plains Shortgrass Prairie (CES303.672)

Related Concepts:
- Mesquite (729) (Shiflet 1994) Broader
- Mesquite (southern type): 68 (Eyre 1980) Finer
- Mesquite (western type): 242 (Eyre 1980) Broader
- Mesquite - Buffalograss (727) (Shiflet 1994) Finer
- Mesquite - Grama (718) (Shiflet 1994) Equivalent

DESCRIPTION

Environment: This system occurs naturally on deeper or more fertile soils and along drainages.
Vegetation: This system is dominated by *Prosopis glandulosa* with *Ziziphus obtusifolia*, and *Atriplex canescens* can codominate. *Opuntia* spp. can be prevalent in areas in heavily grazed examples of this system. The understory of this system is often dominated by shortgrass species.
Dynamics: Historically, fire controlled this system and limited the development of woody cover. Likewise, edaphic conditions and topographic factors limited this system to deep alluvial soils in relatively low topographic positions along broad valley floors.

Component Associations:
- *Acacia farnesiana - (Prosopis glandulosa)* Woodland (CEGL002131, G5)
- *Prosopis glandulosa - Ziziphus obtusifolia* Shrubland (CEGL004939, G2G3)
- *Prosopis glandulosa / Bouteloua curtipendula - Nassella leucotricha* Woodland (CEGL002133, G3?)
- *Prosopis glandulosa / Bouteloua curtipendula* Shrubland (CEGL002194, GNR)
- *Prosopis glandulosa var. glandulosa / Bouteloua gracilis - Buchloe dactyloides* Shrubland (CEGL003877, GNR)
- *Schizachyrium scoparium - (Sorghastrum nutans) - Sporobolus compositus var. compositus - Liatris mucronata* Herbaceous Vegetation (CEGL004211, GNR)
- *Schizachyrium scoparium - Bouteloua curtipendula - Nassella leucotricha* Herbaceous Vegetation (CEGL004070, GNR)

DISTRIBUTION

Range: This system is primarily found in the southern portion of the Western Great Plains division, particularly in Texas, Oklahoma and eastern New Mexico.
Divisions: 303:C
Nations: US
Subnations: NM, OK, TX
Map Zones: 26:C, 27:C, 34:C, 35:C, 38:P
USFS Ecomap Regions: 315A:CC, 315B:CC, 331B:CC, 331I:C?, M313B:??
TNC Ecoregions: 27:?, 28:C, 29:C, 33:C

SOURCES

References: Barbour and Billings 1988, Comer et al. 2003

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722990#references

Description Author: S. Menard and K. Kindscher, mod. K.A. Schulz

Version: 29 Jan 2007 **Stakeholders:** Midwest, Southeast, West

Concept Author: S. Menard and K. Kindscher **ClassifResp:** Midwest

WESTERN GREAT PLAINS SANDHILL STEPPE (CES303.671)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Western Great Plains (303)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Non-Diagnostic Classifiers: Shrubland (Shrub-dominated); Sand Soil Texture; Ustic; F-Landscape/Medium Intensity; G-Landscape/Medium Intensity
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Mixed evergreen-deciduous shrubland
National Mapping Codes: EVT 2094; ESLF 5271; ESP 1094

CONCEPT

Summary: This system is found mostly in south-central areas of the Western Great Plains Division ranging from southwestern Wyoming and southwestern Nebraska up into the Nebraska Sandhill region, south though eastern Colorado, and New Mexico to central Texas, although some examples may reach as far north as the Badlands of South Dakota. The climate is semi-arid to arid for much of the region in which this system occurs. This system is found on somewhat excessively to excessively well-drained, deep sandy soils that are often associated with dune systems and ancient floodplains. In some areas, this system may actually occur as a result of overgrazing in Western Great Plains Tallgrass Prairie (CES303.673) or Western Great Plains Sand Prairie (CES303.670). Typically, this system is characterized by a sparse to moderately dense woody layer dominated or codominated by *Artemisia filifolia*, but other characteristic species may be present, including *Amorpha canescens, Prosopis glandulosa* (southern stands), *Prunus angustifolia, Prunus pumila var. besseyi* (northern stands), *Rhus trilobata*, and *Yucca glauca*. Associated herbaceous species can vary with geography, amount and season of precipitation, disturbance, and soil texture. The herbaceous layer typically has a moderate to dense canopy but may include stands with sparse understory. Several mid- to tallgrass species characteristic of sand substrates are usually present to dominant, such as *Andropogon hallii, Calamovilfa gigantea, Calamovilfa longifolia, Schizachyrium scoparium, Sporobolus cryptandrus, Sporobolus giganteus*, or *Hesperostipa comata*.
Classification Comments: This system is minor in the sandhills region of western Nebraska which is dominated by sand prairie. It may overlap in concept with East-Central Texas Plains Xeric Sandyland (CES205.897). This system was modeled Monahans and Mescalero Sands of Texas and New Mexico during Landfire workshops, but probably needs significant review because of the complexity of the relationship among tallgrass, shin oak, and sandsage types. This type is probably best represented in mapzone 34.
Similar Ecological Systems:
- East-Central Texas Plains Xeric Sandyland (CES205.897)
- Western Great Plains Sand Prairie (CES303.670)
- Western Great Plains Tallgrass Prairie (CES303.673)

Related Concepts:
- Blue Grama - Sideoats Grama - Black Grama (707) (Shiflet 1994) Intersecting
- Bluestem -Dropseed (708) (Shiflet 1994) Broader
- High Plains: Shinnery Shrubland (2806) [CES303.671.8] (Elliott 2011) Equivalent
- Mesquite (southern type): 68 (Eyre 1980) Finer
- Mesquite (western type): 242 (Eyre 1980) Finer
- Mohrs (Shin) Oak: 67 (Eyre 1980) Finer
- Sand Bluestem - Little Bluestem Dunes (720) (Shiflet 1994) Finer
- Sand Sagebrush - Mixed Prairie (722) (Shiflet 1994) Equivalent
- Sand Shinnery Oak (730) (Shiflet 1994) Finer
- Sandsage Prairie (605) (Shiflet 1994) Broader

DESCRIPTION

Environment: This system is found primarily in semi-arid to arid areas of the Western Great Plains Division. It occurs on somewhat excessively to excessively well-drained and deep sandy soils. This system is often found associated with dune systems and/or ancient floodplains but may occur in soils derived from sandstone residuum. In parts of Texas, this system is apparently restricted to thick sandy deposits in the Seymour Formation (a Pleistocene formation formed from ancient channel deposits of the Clear Fork of the Brazos River), and is found on rolling to level uplands. In these areas, it is restricted to Deep Sand, Sand Hills or Sandy Ecological Sites (Elliott 2011).
Vegetation: This system is distinguished by a sparse to moderately dense shrub layer (15-90% canopy cover in Texas) dominated or codominated by *Artemisia filifolia* with *Quercus havardii* and *Prosopis glandulosa* to the south. In addition, *Rhus trilobata, Yucca glauca, Prunus angustifolia*, or *Prunus pumila var. besseyi* (northern stands) may also be conspicuous. Shrub cover may sometimes be sufficient to greatly reduce the cover of herbaceous species in the understory. At some sites, shrub cover may be low, and the herbaceous cover is typically dominated by grass species such as *Schizachyrium scoparium* and *Sporobolus cryptandrus*. Several mid- to tallgrass species characteristic of sand substrates are usually present to dominant within this system, including *Andropogon hallii, Calamovilfa gigantea, Calamovilfa longifolia, Sporobolus giganteus*, and/or *Hesperostipa comata*.

Dynamics: Fire and grazing constitute the most important processes impacting this system. Burning shrublands reduces cover of *Artemisia filifolia* for several years resulting in grassland patches that form a mosaic pattern with shrublands. Composition of grasslands depends on precipitation and management. Drought stress can also influence this system in some areas. In the southern range of this system, *Quercus havardii* may also be present to dominant and represents one succession pathway that develops over time following a disturbance. *Quercus havardii* is able to resprout following a fire and thus may persist for long periods of time once established, forming extensive clones. Edaphic and climatic factors are the most important dynamic processes for this type, with drought and extreme winds impacting this system significantly in some areas. Because *Quercus havardii* is able to resprout rapidly following fire, fire tends to cause structural changes in the vegetation, and compositional shifts are less significant in most cases. Overgrazing can lead to decreasing dominance of some of the grass species such as *Andropogon hallii*, *Calamovilfa gigantea*, and *Schizachyrium scoparium*. In the western extent of this system in the shortgrass prairie, more xeric mid- and shortgrass species such as *Hesperostipa comata*, *Sporobolus cryptandrus* and *Bouteloua gracilis* often dominate the herbaceous layer.

Component Associations:
- *Artemisia filifolia / Andropogon hallii* Shrubland (CEGL001459, G3?)
- *Artemisia filifolia / Bouteloua (curtipendula, gracilis)* Shrubland (CEGL002176, GNR)
- *Artemisia filifolia / Calamovilfa longifolia* Shrubland (CEGL002177, G2G3)
- *Artemisia filifolia / Schizachyrium scoparium - Andropogon hallii* Shrubland (CEGL002178, GNR)
- *Artemisia filifolia / Sporobolus cryptandrus* Shrubland (CEGL002179, GNR)
- *Quercus havardii / Sporobolus cryptandrus - Schizachyrium scoparium* Shrubland (CEGL002171, G3)

DISTRIBUTION

Range: This system is found primarily within the south-central areas of the Western Great Plains Division ranging from the Nebraska Sandhills south into central Texas. However, examples of this system can be found as far north as the Badlands in South Dakota.
Divisions: 303:C
Nations: US
Subnations: CO, KS, NE, NM, OK, SD?, TX
Map Zones: 25:?, 26:C, 27:C, 28:?, 31:C, 33:C, 34:C, 38:C
USFS Ecomap Regions: 315A:CC, 315B:CC, 315F:CC, 321A:CC, 331B:CC, 331C:CC, 331H:CC, 331I:CC, 332E:CC, 332F:CC, M313B:PP
TNC Ecoregions: 26:C, 27:C, 28:C, 33:C

SOURCES

References: Comer et al. 2003, Elliott 2011, Eyre 1980, Ramaley 1939b, Shiflet 1994, Sims et al. 1976, Tolstead 1942
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722987#references
Description Author: S. Menard and K. Kindscher, mod. K.A. Schulz and L. Elliott
Version: 24 Feb 2011 **Stakeholders:** Midwest, Southeast, West
Concept Author: S. Menard and K. Kindscher **ClassifResp:** Midwest

WESTERN NORTH AMERICAN BOREAL ALPINE DRYAS DWARF-SHRUBLAND (CES105.132)

CLASSIFIERS

Classification Status: Standard

Primary Division: Montane Boreal (105)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Alpine/AltiAndino [Alpine/AltiAndino]; Shrubland (Shrub-dominated); Ridge/Summit/Upper Slope; Boreal [Boreal Subcontinental]; Dwarf-Shrub; Dryas integrifolia and/or Dryas octopetala
Non-Diagnostic Classifiers: Sideslope
FGDC Crosswalk: Vegetated, Shrub-dominated, Dwarf-shrubland, Deciduous dwarf-shrubland
National Mapping Codes: EVT 2634; ESLF 5110; ESP 1634

CONCEPT

Summary: This alpine and subalpine system occurs commonly on mountain sideslopes, low summits and ridges, and in alpine valleys, throughout the boreal region and northern Alaska; it is uncommon throughout the boreal transition. Sites are well-drained and mesic to somewhat dry. *Dryas integrifolia* and/or *Dryas octopetala* dominate the shrub layer with at least 20% cover. Lichen cover is less than 25% and may include species of the genera *Cladina, Cetraria*, and *Stereocaulon*. Other dwarf-shrubs that may be common include *Cassiope tetragona, Salix arctica, Salix reticulata, Vaccinium uliginosum, Empetrum nigrum, Ledum palustre ssp. decumbens, Diapensia lapponica*, and *Oxytropis nigrescens*. Common herbaceous species include *Carex microchaeta, Senecio lugens, Minuartia arctica, Anemone parviflora, Podistera macounii (= Ligusticum mutellinoides ssp. alpinum), Castilleja elegans, Poa arctica, Trisetum spicatum, Silene acaulis, Saxifraga* spp., *Campanula lasiocarpa*, and *Polygonum bistorta*. Common mosses include *Hylocomium splendens, Polytrichum* spp., and *Racomitrium* spp. Lichen cover is less than 25% and may include species of the genera *Cladina, Cetraria*, and *Stereocaulon*.
Classification Comments: This system is known as Alpine Dryas Dwarf Shrub by the Alaska Natural Heritage Program.
Related Concepts:
- II.D.1.a - Dryas tundra (Viereck et al. 1992) Intersecting
- II.D.1.b - Dryas-sedge tundra (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: This alpine and subalpine system occurs commonly on mountain sideslopes, low summits and ridges, and in alpine valleys, throughout the boreal region and northern Alaska; it is uncommon throughout the boreal transition. Sites are well-drained and mesic to somewhat dry.
Vegetation: *Dryas integrifolia* and/or *Dryas octopetala* dominate the shrub layer with at least 20% cover. Lichen cover is less than 25% and may include species of the genera *Cladina, Cetraria*, and *Stereocaulon* (Boggs et al. 2001). Other dwarf-shrubs that may be common include *Cassiope tetragona, Salix arctica, Salix reticulata, Vaccinium uliginosum, Empetrum nigrum, Ledum palustre ssp. decumbens, Diapensia lapponica*, and *Oxytropis nigrescens* (Boggs and Sturdy 2005). Common herbaceous species include *Carex microchaeta, Senecio lugens, Minuartia arctica, Anemone parviflora, Podistera macounii (= Ligusticum mutellinoides ssp. alpinum), Castilleja elegans, Poa arctica, Trisetum spicatum, Silene acaulis, Saxifraga* spp., *Campanula lasiocarpa*, and *Polygonum bistorta*. Common mosses include *Hylocomium splendens, Polytrichum* spp., and *Racomitrium* spp. Lichen cover is less than 25% and may include species of the genera *Cladina, Cetraria*, and *Stereocaulon* (Boggs et al. 2001).

DISTRIBUTION

Range: This systems occurs on subalpine to alpine sites of the boreal and boreal transition (less frequently) regions of Alaska.
Divisions: 105:C
Nations: CA, US
Subnations: AK
Map Zones: 69:C, 70:C, 71:C, 73:C, 74:C, 75:C
TNC Ecoregions: 74:?, 75:C, 76:C, 77:C, 78:C, 79:C

SOURCES

References: Boggs and Sturdy 2005, Boggs et al. 2001, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817454#references
Description Author: T. Boucher
Version: 08 Aug 2008 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

WESTERN NORTH AMERICAN BOREAL ALPINE DWARF-SHRUB SUMMIT (CES105.129)

CLASSIFIERS

Classification Status: Standard

Primary Division: Montane Boreal (105)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Extreme Wind Exposure; Alpine/AltiAndino; Shrubland (Shrub-dominated); Ridge/Summit/Upper Slope; Boreal [Boreal Subcontinental]; W-Landscape/High Intensity; Dwarf-Shrub
FGDC Crosswalk: Vegetated, Shrub-dominated, Dwarf-shrubland, Deciduous dwarf-shrubland
National Mapping Codes: EVT 2631; ESLF 5111; ESP 1631

CONCEPT

Summary: This system occurs on windswept summits and ridges on alpine sites in the boreal and boreal transition regions of Alaska. Soils are thin, stony, and well-drained to excessively well-drained. Canopy cover is sparse, generally less than 25%, due to extreme exposure. Common species include *Dryas* spp., *Vaccinium uliginosum, Empetrum nigrum, Vaccinium vitis-idaea, Diapensia lapponica, Loiseleuria procumbens,* and dwarf *Salix* spp. Exposed rock and lichens are abundant.
Classification Comments: This system is known as Alpine Sparse Dwarf Shrub Summits by the Alaska Natural Heritage Program.
Similar Ecological Systems:
- Alaskan Pacific Maritime Alpine Sparse Shrub and Fell-Field (CES204.318)

Related Concepts:
- II.D.1.a - Dryas tundra (Viereck et al. 1992) Intersecting
- II.D.2.a - Bearberry tundra (Viereck et al. 1992) Intersecting
- II.D.2.b - Vaccinium tundra (Viereck et al. 1992) Intersecting
- II.D.2.c - Crowberry tundra (Viereck et al. 1992) Intersecting
- II.D.2.e - Cassiope tundra (Viereck et al. 1992) Intersecting

DISTRIBUTION

Range: This system occurs on alpine sites in the boreal and boreal transition regions of Alaska.
Divisions: 105:C; 204:C
Nations: CA, US
Subnations: AK
Map Zones: 68:?, 69:C, 70:C, 71:C, 72:?, 73:C, 74:C, 75:C
TNC Ecoregions: 70:C, 71:C, 72:C, 74:C, 75:C, 76:C, 77:C, 78:C, 79:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817445#references
Description Author: T. Boucher
Version: 08 Aug 2008 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

WESTERN NORTH AMERICAN BOREAL ALPINE DWARF-SHRUB-LICHEN SHRUBLAND (CES105.134)

CLASSIFIERS

Classification Status: Standard

Primary Division: Montane Boreal (105)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Alpine/AltiAndino; Shrubland (Shrub-dominated); Moss/Lichen (Nonvascular); Dwarf-Shrub; Dryas integrifolia and/or Dryas octopetala
Non-Diagnostic Classifiers: Ridge/Summit/Upper Slope; Boreal [Boreal Subcontinental]
FGDC Crosswalk: Vegetated, Shrub-dominated, Dwarf-shrubland, Deciduous dwarf-shrubland
National Mapping Codes: EVT 2636; ESLF 5112; ESP 1636

CONCEPT

Summary: This ecological system is common on summits and ridges throughout boreal, northern, and western Alaska. The shrub component is often mixed, with ericaceous shrubs, *Dryas*, and willows contributing to the layer. Lichen cover is at least 25%. Sites are generally exposed to the wind and do not accumulate much winter snow. Common shrub species include *Vaccinium uliginosum, Vaccinium vitis-idaea, Empetrum nigrum, Arctostaphylos rubra, Arctostaphylos alpina, Dryas integrifolia, Salix arctica, Salix rotundifolia*, and *Salix reticulata*. Fruticose lichens often codominate with the shrubs. Common lichens include *Cladina rangiferina, Cladina stellaris, Flavocetraria cucullata (= Cetraria cucullata), Stereocaulon* spp., *Alectoria nigricans*, and *Thamnolia vermicularis*. Herbaceous species include *Hierochloe alpina (= Anthoxanthum monticola ssp. alpinum), Polygonum bistorta, Anemone* spp., *Festuca* spp., and *Luzula* spp. Mosses may be present but do not contribute much cover.
Classification Comments: This system is known as Alpine Dwarf Shrub Lichen by the Alaska Natural Heritage Program.
Related Concepts:
- II.D.1.c - Dryas-lichen tundra (Viereck et al. 1992) Intersecting
- II.D.2.a - Bearberry tundra (Viereck et al. 1992) Intersecting
- II.D.2.b - Vaccinium tundra (Viereck et al. 1992) Intersecting
- II.D.2.c - Crowberry tundra (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: This ecological system is common on summits and ridges throughout boreal, northern, and western Alaska. The shrub component is often mixed, with ericaceous shrubs, *Dryas*, and willows contributing to the layer. Lichen cover is at least 25%. Sites are generally exposed to the wind and do not accumulate much winter snow (Viereck et al. 1992).
Vegetation: Common shrub species include *Vaccinium uliginosum, Vaccinium vitis-idaea, Empetrum nigrum, Arctostaphylos rubra, Arctostaphylos alpina, Dryas integrifolia, Salix arctica, Salix rotundifolia*, and *Salix reticulata*. Fruticose lichens often codominate with the shrubs. Common lichens include *Cladina rangiferina, Cladina stellaris, Flavocetraria cucullata (= Cetraria cucullata), Stereocaulon* spp., *Alectoria nigricans*, and *Thamnolia vermicularis*. Herbaceous species include *Hierochloe alpina (= Anthoxanthum monticola ssp. alpinum), Polygonum bistorta, Anemone* spp., *Festuca* spp., and *Luzula* spp. Mosses may be present but do not contribute much cover (Viereck et al. 1992).

DISTRIBUTION

Range: This system occurs on subalpine to alpine sites in the boreal and boreal transition regions of Alaska.
Divisions: 105:C; 204:?
Nations: CA, US
Subnations: AK
Map Zones: 69:C, 70:C, 71:C, 73:C, 74:C, 75:C
TNC Ecoregions: 74:?, 75:C, 76:C, 77:C, 78:C, 79:C

SOURCES

References: Viereck et al. 1992, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817460#references
Description Author: T. Boucher
Version: 08 Aug 2008 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

WESTERN NORTH AMERICAN BOREAL ALPINE ERICACEOUS DWARF-SHRUBLAND (CES105.133)

CLASSIFIERS

Classification Status: Standard

Primary Division: Montane Boreal (105)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Alpine/AltiAndino; Shrubland (Shrub-dominated); Ridge/Summit/Upper Slope; Boreal [Boreal Subcontinental]; Dwarf-Shrub; Ericaceous dwarf-shrubs
Non-Diagnostic Classifiers: Sideslope
FGDC Crosswalk: Vegetated, Shrub-dominated, Dwarf-shrubland, Deciduous dwarf-shrubland
National Mapping Codes: EVT 2635; ESLF 5113; ESP 1635

CONCEPT

Summary: This is a common alpine system throughout the boreal and boreal transition regions and in northern Alaska. Common slope positions include alpine valleys, sideslopes, and low summits and ridges. Ericaceous dwarf-shrubs typically dominate, but a wide range of species and plant communities are encompassed in this system. Total lichen cover is less than 25% and may include species of *Cetraria, Cladina*, and *Cladonia*. Common dwarf-shrub dominants include *Cassiope tetragona* (more common north of the Alaska Range), *Empetrum nigrum, Vaccinium uliginosum, Harrimanella stelleriana* (more common south of the Alaska Range), and *Arctostaphylos* spp. Other shrubs that may be common include *Betula nana, Diapensia lapponica, Dryas octopetala, Ledum palustre ssp. decumbens, Vaccinium vitis-idaea, Salix reticulata, Salix phlebophylla*, and *Salix rotundifolia*. Common herbaceous species include *Hierochloe alpina (= Anthoxanthum monticola ssp. alpinum), Arnica lessingii, Carex bigelowii*, and *Carex microchaeta*. Mosses such as *Aulacomnium palustre, Hylocomium splendens, Pleurozium schreberi*, and *Polytrichum* may be common. Sites are typically mesic. *Cassiope* and *Harrimanella* tundra sites occur on terrain that is well-protected by snow in the winter, and often remains snow-covered until the middle of the growing season.
Classification Comments: This system is known as Alpine Ericaceous Dwarf Shrub by the Alaska Natural Heritage Program.
Related Concepts:
- II.D.2.a - Bearberry tundra (Viereck et al. 1992) Intersecting
- II.D.2.b - Vaccinium tundra (Viereck et al. 1992) Intersecting
- II.D.2.c - Crowberry tundra (Viereck et al. 1992) Intersecting
- II.D.2.e - Cassiope tundra (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: This is a common alpine system throughout the boreal and boreal transition regions and in northern Alaska. Common slope positions include alpine valleys, sideslopes, and low summits and ridges.
Vegetation: Ericaceous dwarf-shrubs typically dominate, but a wide range of species and plant communities are encompassed in this system. Total lichen cover is less than 25% and may include species of *Cetraria, Cladina*, and *Cladonia*. Common dwarf-shrub dominants include *Cassiope tetragona* (more common north of the Alaska Range), *Empetrum nigrum, Vaccinium uliginosum, Harrimanella stelleriana* (more common south of the Alaska Range), and *Arctostaphylos* spp. Other shrubs that may be common include *Betula nana, Diapensia lapponica, Dryas octopetala, Ledum palustre ssp. decumbens, Vaccinium vitis-idaea, Salix reticulata, Salix phlebophylla*, and *Salix rotundifolia*. Common herbaceous species include *Hierochloe alpina (= Anthoxanthum monticola ssp. alpinum), Arnica lessingii, Carex bigelowii*, and *Carex microchaeta*. Mosses such as *Aulacomnium palustre, Hylocomium splendens, Pleurozium schreberi*, and *Polytrichum* may be common. Sites are typically mesic. *Cassiope* and *Harrimanella* tundra sites occur on terrain that is well-protected by snow in the winter, and often remains snow-covered until the middle of the growing season (Viereck et al. 1992).

DISTRIBUTION

Range: This system is found on subalpine to alpine sites in the boreal and boreal transition regions of Alaska.
Divisions: 105:C; 204:C
Nations: CA, US
Subnations: AK
Map Zones: 69:C, 70:C, 71:C, 73:C, 74:C, 75:C
TNC Ecoregions: 74:?, 75:C, 76:C, 77:C, 78:C, 79:C

SOURCES

References: Boggs and Sturdy 2005, Boggs et al. 2001, DeVelice et al. 1999, Viereck et al. 1992, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817457#references
Description Author: T. Boucher
Version: 08 Aug 2008 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

WESTERN NORTH AMERICAN BOREAL MESIC SCRUB BIRCH-WILLOW SHRUBLAND (CES105.113)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Upper Montane]; Shrubland (Shrub-dominated); Boreal [Boreal Subcontinental]; Feathermosses
Non-Diagnostic Classifiers: Lowland [Lowland]; Ridge/Summit/Upper Slope; Sideslope; Mineral: W/ A-Horizon >10 cm; Broad-Leaved Deciduous Shrub; Dwarf-Shrub
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Deciduous shrubland
National Mapping Codes: EVT 2610; ESLF 5281; ESP 1610

CONCEPT

Summary: This ecological system occurs throughout the boreal and boreal transition regions of Alaska on mesic sites on mid- to upper slopes, above treeline and on flats and sideslopes. *Betula nana* usually dominates the shrub layer, but *Vaccinium uliginosum, Ledum palustre ssp. decumbens, Salix pulchra, Salix barclayi*, or other *Salix* spp. may also be common. *Salix* spp. may occasionally be dominant. Dwarf-shrubs such as *Empetrum nigrum* and *Vaccinium vitis-idaea* may be common under the low-shrub layer. Herbaceous species are sparse, but feathermosses (*Hylocomium splendens* and *Pleurozium schreberi*) and lichens may be common. Sites with organic soils are not included in this type.
Classification Comments: This system is known as Boreal Shrub Birch by the Alaska Natural Heritage Program. Low-shrub types on peat deposits are included in wetland types. This type (formerly North Pacific Mesic Low Shrubland (CES204.855)) was originally defined for the south-central and southeast Alaska region, into Oregon and Washington. Review clarified this is not found in the lower 48 states. Nor is it found in the Pacific maritime regions of Alaska, except on the north of the Alaska Range. It is highly likely to occur in British Columbia.
Related Concepts:
- II.B.1.c - Shrub birch (closed) (Viereck et al. 1992) Intersecting
- II.B.1.e - Shrub birch-willow (closed) tall (Viereck et al. 1992) Intersecting
- II.B.2.c - Shrub birch (open) (Viereck et al. 1992) Intersecting
- II.B.2.e - Shrub birch-willow (open) tall (Viereck et al. 1992) Intersecting
- II.C.1.a - Shrub birch (Viereck et al. 1992) Intersecting
- II.C.1.c - Shrub birch-willow (closed) low (Viereck et al. 1992) Intersecting
- II.C.2.f - Shrub birch-willow (open) low (Viereck et al. 1992) Intersecting
- II.C.2.g - Willow low (open) (Viereck et al. 1992) Intersecting
- Low Scrub Shrub Birch - Ericaceous (912) (Shiflet 1994) Intersecting

DESCRIPTION

Environment: This system occurs on well-drained slopes and terraces often in the subalpine. Soils are mineral with a well-decomposed organic layer 5-30 cm thick (Viereck et al. 1992).
Vegetation: *Betula nana* usually dominates the shrub layer, but *Vaccinium uliginosum, Ledum palustre ssp. decumbens, Salix pulchra, Salix barclayi*, or other *Salix* spp. may also be common (Viereck 1979, Viereck et al. 1992). *Salix* spp. are occasionally dominant. Dwarf-shrubs such as *Empetrum nigrum* and *Vaccinium vitis-idaea* may be common under the low-shrub layer. Herbaceous species are sparse but may include *Festuca altaica* and *Hierochloe alpina (= Anthoxanthum monticola ssp. alpinum)*. Feathermosses (*Hylocomium splendens* and *Pleurozium schreberi*) and lichens are common, but peat-forming mosses and sedges are not (Viereck et al. 1992). *Betula nana* and *Betula glandulosa* are described as low-shrub species (Viereck and Little 1972); however, shrub height is variable, and sites with shrubs greater than 1.5 m are reported.
Dynamics: This system represents a topoedaphic climax in some areas; in other cases it may be seral to shrub-tussock over long time periods (Viereck et al. 1992). At treeline, this system occurs above Western North American Boreal Treeline White Spruce Woodland (CES105.137).

There is little information available about the fire history of shrub communities in Alaska. Birch and ericaceous shrub tundra tends to produce more severe burns than sedge-shrub tussock tundra (Racine 1979). After fire, shrubs resprout readily from underground propagules if they have not been burned, and a shrub community re-establishes on the site within 5 years. After severe fires that remove the organic layer and burn the propagules, herbaceous species that establish by seed may dominate the site for more than 5 years. Burned-over spruce woodlands near treeline may be converted to low shrub after fire (Pegau 1972) and may slowly regenerate a spruce overstory. The fire-return interval is longer in the boreal transition region than in boreal Alaska. Adjacent vegetation influences the fire frequency. If the adjacent vegetation is flammable, then this low-shrub type will have a more frequent fire return. Without adjacent flammable vegetation, fire-return intervals are probably more than 100+ years. Trees may also invade these shrublands but over long time frames.

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:

- Western North American Boreal Treeline White Spruce Woodland (CES105.137)

DISTRIBUTION

Range: This system occurs in the boreal and, less commonly, boreal transition regions of Alaska at low elevation through subalpine.
Divisions: 105:C; 204:C
Nations: CA? , US
Subnations: AK, BC?
Map Zones: 68:C, 69:C, 70:C, 71:C, 72:?, 73:C, 74:C, 75:C
TNC Ecoregions: 71:C, 72:C, 74:C, 75:C, 76:C, 77:C, 78:C

SOURCES

References: Anderson 1974, Batten 1977, Batten et al. 1979, Hanson 1951, Hanson 1953, Hettinger and Janz 1974, Hulten 1966, Jorgenson 1984, Kessel and Schaller 1960, Pegau 1968, Pegau 1972, Racine 1979, Shiflet 1994, Steigers et al. 1983, Viereck 1962, Viereck 1963, Viereck 1966, Viereck 1979, Viereck and Little 1972, Viereck et al. 1992, Webber et al. 1978, Western Ecology Working Group n.d., Young and Racine 1978
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817396#references
Description Author: T. Boucher
Version: 08 Aug 2008 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

WYOMING BASINS DWARF SAGEBRUSH SHRUBLAND AND STEPPE (CES304.794)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland [Foothill]; Lowland [Lowland]; Hill(s); Shrubland (Shrub-dominated); Ridge/Summit/Upper Slope; Sideslope; Shallow Soil; Silt Soil Texture; Clay Soil Texture; Aridic; W-Landscape/High Intensity; Low Artemisia spp.
Non-Diagnostic Classifiers: Temperate [Temperate Continental]; Alkaline Soil; Dwarf-Shrub
FGDC Crosswalk: Vegetated, Shrub-dominated, Dwarf-shrubland, Evergreen dwarf-shrubland
National Mapping Codes: EVT 2072; ESLF 5209; ESP 1072

CONCEPT

Summary: This windswept ecological system is composed of dwarf sagebrush shrubland and shrub-steppe that forms matrix vegetation and large patches on the margins of high-elevation basins in central and southern Wyoming. Typical sites are gently rolling hills and long, gently sloping pediments and fans. These sites are very windy and have shallow, often rocky soils. The distinguishing feature of this system is a short-shrub stratum in which dwarf-shrubs (≤30 cm tall) contribute at least two-thirds of the woody canopy. Four sagebrush taxa may dominate the shrub stratum: *Artemisia tripartita ssp. rupicola*, *Artemisia nova*, *Artemisia arbuscula ssp. longiloba*, and wind-dwarfed *Artemisia tridentata ssp. wyomingensis*. Two or more of these sagebrushes often codominate, but any of them may occur alone. Where graminoids are common and tall, the vegetation often has the appearance of grassland without shrubs; the shrubs are obvious only when the vegetation is viewed from up close. Where graminoids contribute less cover, the vegetation is a compact shrubland. The herbaceous component of the vegetation includes both rhizomatous and bunch-form graminoids, cushion plants, and other low-growing forbs. *Bouteloua gracilis*, a common species of Inter-Mountain Basins Big Sagebrush Steppe (CES304.778) in Wyoming, is absent.

Related Concepts:
- Black Sagebrush (405) (Shiflet 1994) Intersecting
- Black Sagebrush - Bluebunch Wheatgrass (320) (Shiflet 1994) Intersecting. Black sage communities in Montana need review for the best system placement.
- Black Sagebrush - Idaho Fescue (321) (Shiflet 1994) Intersecting. Black sage communities in Montana need review for the best system placement.
- Threetip Sagebrush (404) (Shiflet 1994) Intersecting. Artemisia tripartita ssp. rupicola shrublands are included in this ecological system in the Wyoming Basins.

Component Associations:
- *Artemisia arbuscula ssp. longiloba* / Cushion Plants Shrubland (CEGL005996, GNR)
- *Artemisia arbuscula ssp. longiloba / Elymus lanceolatus* Shrubland (CEGL002585, GNR)
- *Artemisia arbuscula ssp. longiloba / Poa fendleriana* Shrubland (CEGL005997, GNR)
- *Artemisia arbuscula ssp. longiloba / Poa secunda* Shrub Herbaceous Vegetation (CEGL001523, G3Q)
- *Artemisia arbuscula ssp. longiloba / Pseudoroegneria spicata* Shrub Herbaceous Vegetation (CEGL001416, GNR)
- *Artemisia nova / Pseudoroegneria spicata* Shrubland (CEGL001424, G4G5)
- *Artemisia tridentata ssp. wyomingensis / Carex filifolia* Shrubland (CEGL001042, G1Q)
- *Artemisia tridentata ssp. wyomingensis / Poa secunda* Shrubland (CEGL001049, G4)
- *Artemisia tripartita ssp. rupicola / Festuca idahoensis* Shrub Herbaceous Vegetation (CEGL001540, G3)

DISTRIBUTION

Range: This system occurs throughout the basins of central and southern Wyoming, extending south into adjacent portions of Colorado. It also occurs on the eastern side of the Continental Divide in Montana, where *Artemisia nova* shrublands are found on calcareous substrates.
Divisions: 304:C
Nations: US
Subnations: CO, MT, WY
Map Zones: 16:?, 21:C, 22:C, 23:C, 29:C
USFS Ecomap Regions: 331F:CC, 331G:CC, 331K:CP, 331L:C?, 331N:CP, 341C:??, 342F:CC, 342G:CC, M331A:C?, M331B:CC, M331D:C?, M331E:CC, M331H:CC, M331I:CC, M332D:CC, M341B:PP
TNC Ecoregions: 10:C, 26:C

SOURCES

References: Comer et al. 2003, Jones 1992b, Knight 1994, Knight et al. 1987
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722879#references

Description Author: Western Ecology Group, mod. M.S. Reid and G.P. Jones
Version: 01 Oct 2007
Concept Author: NatureServe Western Ecology Team

Stakeholders: West
ClassifResp: West

SAVANNA AND SHRUB-STEPPE

ALABAMA KETONA GLADE AND WOODLAND (CES202.338)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Woody-Herbaceous; Rock Outcrops/Barrens/Glades
FGDC Crosswalk: Vegetated, Tree-dominated, Sparse tree canopy, Mixed evergreen-deciduous sparse tree canopy
National Mapping Codes: EVT 2408; ESLF 5424; ESP 1408

CONCEPT

Summary: This system consists of open glades and related vegetation on Ketona dolomite slopes found in Bibb County, Alabama, in the vicinity of the Little Cahaba River. The vegetation includes herbaceous, shrubland, and open woodlands, which occur on thin soils or outcrops of Ketona dolomite. *Juniperus virginiana, Quercus muehlenbergii, Pinus palustris, Croton alabamensis, Sabal minor*, and *Leptopus phyllanthoides* are the dominant woody plants of the woodlands. The system supports eight endemic and numerous disjunct plant taxa and has very high conservation value based on rare plants.
Classification Comments: As TNC ecoregions are officially defined, examples of this system are found in the Cumberlands and Southern Ridge and Valley (Ecoregion 50), as well as in the Upper East Gulf Coastal Plain (Ecoregion 43). However, the occurrence in the latter ecoregion may be due to inaccurate boundaries; the system is fundamentally associated with the Cumberlands and Southern Ridge and Valley due to its fidelity to ancient dolomites not more recent sediments. It appears to be restricted to EPA level III Ecoregion 67 (Ridge and Valley) not 65 ("Southeastern Plains") (EPA 2004) and the corresponding MRLC mapzones (i.e., 48 not 46), and the attributions reflect this determination.
Similar Ecological Systems:
- Central Interior Highlands Calcareous Glade and Barrens (CES202.691)

Related Concepts:
- Eastern Redcedar: 46 (Eyre 1980) Finer
- Longleaf Pine: 70 (Eyre 1980) Finer

DESCRIPTION

Environment: This system consists of open glades and related vegetation on Ketona dolomite slopes found in Bibb County, Alabama, in the vicinity of the Little Cahaba River (Allison and Stevens 2001).
Vegetation: The vegetation of the system includes a mixture of herbaceous, shrubland, and open woodlands, which occur on thin soils surrounding outcrops of Ketona dolomite. *Juniperus virginiana, Quercus muehlenbergii, Pinus palustris, Croton alabamensis, Sabal minor*, and *Leptopus phyllanthoides* are the dominant woody plants of the woodlands. *Schizachyrium scoparium* is a frequent grass in this system and is commonly associated with *Andropogon gerardii* and other calcium-loving, drought-tolerant plant species. Stunted woodlands are primarily dominated by *Quercus muehlenbergii* interspersed with *Juniperus virginiana* and occur on variable-depth-to-bedrock soils. The trees may occur as islands in a wider herbaceous or rocky area. The islands are found in microenvironments where the soil depth and available water are sufficient to support trees (e.g., depressions or fissures in the bedrock). Small-scale stands of annual *Sporobolus* spp. may be prominent in some examples. More than 60 plant taxa of conservation concern occur on or near these glades, marking them as one of the most significant reservoirs of botanical diversity in the eastern United States. Eight endemic taxa were recently found and newly described: *Castilleja kraliana, Coreopsis grandiflora var. inclinata, Dalea cahaba, Erigeron strigosus var. dolomiticola, Liatris oligocephala, Onosmodium decipiens, Silphium glutinosum*, and *Spigelia gentianoides var. alabamensis*. Seven Alabama state records were discovered: *Solanum carolinense var. hirsutum (= Solanum pumilum)*, last collected in 1837 and presumed extinct; *Astrolepis integerrima*, disjunct from Texas; *Paronychia virginica*, bridging a gap between Arkansas and Virginia; *Baptisia australis var. australis, Rhynchospora capillacea, Rhynchospora thornei*, and *Spiranthes lucida*.
Dynamics: Fire and periodic drought both play a role in the natural dynamics of this system. Fires help manage this system by restricting woody growth and maintaining the more open glade structure. Historically, grazing by wild and domestic ungulate species represented a significant disturbance regime. Regionally significant drought cycles affect severity of other disturbance regimes. Some portions of sites for this system are so droughty and rocky that woody succession is severely retarded, and fuels are either sparse of composed of low annual grasses and scattered forbs (Landfire 2007a). Severe droughts kill tree saplings growing in cracks and potholes, helping to retain the open character of the glades (Quarterman et al. 1993).

Component Associations:
- *Juniperus virginiana var. virginiana - Croton alabamensis - Leptopus phyllanthoides / Carex eburnea* Shrubland (CEGL003937, G1)
- *Quercus muehlenbergii - Carya carolinae-septentrionalis / Acer (barbatum, leucoderme) - Juniperus virginiana var. virginiana /*

Croton alabamensis Woodland (CEGL003758, G1)

- *Schizachyrium scoparium - Sporobolus junceus - Rudbeckia triloba var. pinnatiloba - Onosmodium decipiens* Wooded Herbaceous Vegetation (CEGL004080, G1)

DISTRIBUTION

Range: This small-patch system is restricted to Ketona dolomite slopes found in Bibb County, Alabama, in the vicinity of the Little Cahaba River.
Divisions: 202:C
Nations: US
Subnations: AL
Map Zones: 48:C
USFS Ecomap Regions: 231D:CC
TNC Ecoregions: 43:C, 50:C

SOURCES

References: Allison and Stevens 2001, Comer et al. 2003, Delcourt et al. 1986, DeSelm 1993, DeSelm and Murdock 1993, Duffey et al. 1974, EPA 2004, Estes et al. 1979, Eyre 1980, Landfire 2007a, McKinney and Lockwood 1999, Murdock pers. comm., Noss 2013, Quarterman et al. 1993, Taft 1997, Taft 2009, Taft et al. 1995, TNC 1996c, Wiens and Dyer 1975
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723167#references
Description Author: M. Pyne, R. Evans, C. Nordman
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: M. Pyne, R. Evans, C. Nordman **ClassifResp:** Southeast

ALASKA ARCTIC MESIC SEDGE-DRYAS TUNDRA (CES102.199)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Arctic (102)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Large patch, Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Woody-Herbaceous; Polar [Polar Oceanic]; Dwarf-Shrub; Dryas integrifolia and/or Dryas octopetala
FGDC Crosswalk: Vegetated, Shrub-dominated, Herbaceous - shrub-steppe, Perennial graminoid steppe
National Mapping Codes: EVT 2684; ESLF 5466; ESP 1684

CONCEPT

Summary: This mesic sedge-*Dryas* tundra system is common on mountain slopes, hillslopes, drained lake basins, stabilized dunes, and snowbeds throughout arctic Alaska. Patch size is small to matrix-forming. pH ranges from circumneutral to non-acidic. Permafrost is present, and the soil surface is mesic but may be saturated below 15 cm. This system is codominated by sedges and dwarf- or low shrubs. *Dryas* spp. cover is >10%, and total low-shrub cover is <25%. *Dryas integrifolia* typically dominates or codominates with *Salix richardsonii (= Salix lanata ssp. richardsonii), Salix pulchra, Salix reticulata,* and *Rhododendron lapponicum*. The dominant sedges are *Carex bigelowii, Carex aquatilis,* and *Eriophorum angustifolium*. Other common species are *Eriophorum vaginatum* and *Equisetum arvense*. Nonvascular species include *Oncophorus wahlenbergii, Hylocomium splendens, Tomentypnum nitens,* and *Thamnolia vermicularis*.
Classification Comments: This system is known as Mesic Sedge-*Dryas* Tundra by the Alaska Natural Heritage Program.
Related Concepts:
- II.D.1.b - Dryas-sedge tundra (Viereck et al. 1992) Intersecting
- III.A.2.j - Sedge-dryas tundra (Viereck et al. 1992) Intersecting

DESCRIPTION

Dynamics: This system's disturbance processes and succession have not been described.

DISTRIBUTION

Range: This system occurs throughout arctic Alaska, from the Bristol Bay lowlands in southwestern Alaska to the North Slope on the Arctic Ocean.
Divisions: 102:C; 104:C
Nations: CA, US
Subnations: AK
Map Zones: 67:C, 68:C, 69:C, 72:C, 76:C
TNC Ecoregions: 73:C, 74:C, 75:C, 79:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818246#references
Description Author: K. Boggs
Version: 09 Oct 2008 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKA ARCTIC MESIC SEDGE-WILLOW TUNDRA (CES102.187)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Arctic (102)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Woody-Herbaceous; Sideslope; Polar [Polar Oceanic]; Salix pulchra, Salix richardsonii (= Salix lanata ssp. richardsonii)
FGDC Crosswalk: Vegetated, Shrub-dominated, Herbaceous - shrub-steppe, Perennial graminoid steppe
National Mapping Codes: EVT 2683; ESLF 5467; ESP 1683

CONCEPT

Summary: This ecological system is common on mountain slopes, hillslopes, drained lake basins, stabilized dunes, and snowbeds throughout arctic Alaska. Permafrost is present. Patch size is small to large. The mesic sedge-willow tundra system is codominated by sedges and dwarf- and low shrubs, although low-shrub cover is <25%; *Salix* cover is >20%. The dominant shrubs are *Betula nana, Salix pulchra, Salix richardsonii (= Salix lanata ssp. richardsonii),* and *Vaccinium uliginosum*. Other willows that may occur include *Salix bebbiana, Salix glauca,* and *Salix planifolia*. The dominant sedges are *Carex aquatilis, Eriophorum angustifolium*, and *Carex microchaeta*. Other species include *Petasites frigidus, Polemonium acutiflorum*, and *Sphagnum* spp.
Classification Comments: This system is known as Mesic Sedge-Willow Tundra by the Alaska Natural Heritage Program.
Related Concepts:
- II.C.2.h - Willow-sedge shrub tundra (Viereck et al. 1992) Intersecting
- III.A.2.h - Sedge-willow tundra (Viereck et al. 1992) Intersecting

DESCRIPTION

Dynamics: This system's disturbance processes and succession have not been described.

DISTRIBUTION

Range: This system occurs throughout arctic Alaska, from the Bristol Bay lowlands in southwestern Alaska to the North Slope on the Arctic Ocean.
Divisions: 102:C; 104:C
Nations: CA, US
Subnations: AK
Map Zones: 67:C, 68:C, 69:C, 72:C, 76:C
TNC Ecoregions: 73:C, 74:C, 75:C, 79:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818243#references
Description Author: K. Boggs
Version: 09 Oct 2008 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKAN PACIFIC MARITIME ALPINE DWARF-SHRUBLAND (CES204.310)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Alpine/AltiAndino [Alpine/AltiAndino]; Alpine Mosaic; Shrubland (Shrub-dominated); Temperate [Temperate Oceanic]; Dwarf-Shrub
Non-Diagnostic Classifiers: Ridge/Summit/Upper Slope; Sideslope; Forb; Graminoid
FGDC Crosswalk: Vegetated, Shrub-dominated, Herbaceous - shrub-steppe, Perennial graminoid steppe
National Mapping Codes: EVT 2643; ESLF 5468; ESP 1643

CONCEPT

Summary: This system occurs primarily on alpine and subalpine sites of southeastern, maritime Alaska, but it can also be found at lower elevations (e.g., Kenai Fjords and Prince William Sound). It occurs on sideslopes, shoulder slopes, and low summits, and the terrain varies from gently sloping to steep. The vegetation can be a mosaic of herbaceous meadow and alpine heath (dwarf-shrublands) or herbaceous meadow with a heath understory; however, in some areas dwarf-shrub cover is continuous. Dominant dwarf-shrub species include *Empetrum nigrum, Phyllodoce aleutica, Phyllodoce glanduliflora, Cassiope mertensiana, Cassiope tetragona, Harrimanella stelleriana*, and *Luetkea pectinata*. Other common species may include *Vaccinium uliginosum, Vaccinium vitis-idaea*, and *Loiseleuria procumbens*. Ericaceous species typically dominate this type, but sites dominated by *Salix arctica* and *Salix reticulata* are included in this system. Scattered tall shrubs and dwarf trees may be present. Common herbaceous species include *Carex macrochaeta, Lupinus nootkatensis, Valeriana sitchensis, Geranium erianthum, Aconitum delphiniifolium, Castilleja unalaschcensis, Sanguisorba canadensis, Anemone narcissiflora, Artemisia arctica*, and *Viola* spp. On slopes on the outer coast and also in Kenai Fjords and Prince William Sound *Nephrophyllidium crista-galli* is common in this system.
Classification Comments: This system includes the types known as Maritime Dwarf Shrubland and Herbaceous-Dwarf-Shrub by the Alaska Natural Heritage Program. If herbaceous cover is greater than 75%, then it will be mapped as herbaceous (shrub understory will not be mappable).
Related Concepts:
- *Artemisia arctica - Luetkea pectinata* (Boggs et al. 2008b) Finer
- *Cassiope mertensiana - Luetkea pectinata* (Boggs et al. 2008a) Finer
- *Cassiope mertensiana - Phyllodoce aleutica* (Boggs et al. 2008a) Finer
- *Cassiope mertensiana* (Boggs et al. 2008a) Finer
- *Dryas drummondii* (Boggs et al. 2008a) Finer. (upper GLBA) - include?
- *Empetrum nigrum* (Boggs et al. 2008a) Finer
- *Fauria crista-galli (Nephrophyllidium crista-galli)* (DeVelice et al. 1999) Finer
- *Harrimanella stelleriana - Luetkea pectinata / Nephrophyllidium crista-galli* (Boggs et al. 2008b) Finer
- *Harrimanella stelleriana - Luetkea pectinata / Nephrophyllidium crista-galli* (DeVelice et al. 1999) Finer
- *Harrimanella stelleriana* (Boggs et al. 2008a) Finer
- *Lupinus nootkatensis / Luetkea pectinata* (Boggs et al. 2008b) Finer
- *Phyllodoce aleutica - Luetkea pectinata* (Boggs et al. 2008a) Finer
- *Salix arctica* (Boggs et al. 2008a) Finer. include?
- *Salix reticulata* (Boggs et al. 2008a) Finer. include?
- *Vaccinium uliginosum* Alpine (Boggs et al. 2008a) Finer
- II.D.2.d - Mountain-heath tundra (Viereck et al. 1992) Intersecting
- II.D.2.e - Cassiope tundra (Viereck et al. 1992) Intersecting
- III.B.2.a - Mixed herbs (Viereck et al. 1992) Intersecting

DISTRIBUTION

Range: This system occurs from the Alaska Range south and east through southeastern Alaska.
Divisions: 204:C
Nations: US
Subnations: AK
Map Zones: 77:C, 78:C
TNC Ecoregions: 69:C, 70:C

SOURCES

References: Boggs et al. 2008b, DeVelice et al. 1999, Viereck et al. 1992, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818671#references
Description Author: K. Boggs

Version: 10 Dec 2008
Concept Author: Western Ecology Group and Alaska Natural Heritage Program

Stakeholders: West
ClassifResp: West

ALEUTIAN CROWBERRY-HERBACEOUS HEATH (CES105.230)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Large patch, Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Dune (Landform); Boreal [Boreal Oceanic]; Seabird Colony Nutrient Input; Empetrum nigrum
Non-Diagnostic Classifiers: Moraine; Slope; Terrace; Valley bottom
FGDC Crosswalk: Vegetated, Shrub-dominated, Herbaceous - shrub-steppe, Perennial graminoid steppe
National Mapping Codes: EVT 2719; ESLF 5469; ESP 1719

CONCEPT

Summary: This system is common in valley bottoms, sideslopes, stabilized dunes, terraces, moraines and fans. Patch size is small to matrix forming. It typically occupies lower elevation sites than Aleutian Mixed Dwarf-Shrub-Herbaceous Shrubland (CES105.231). Dwarf-shrub cover is >25% and dominated by *Empetrum nigrum*; herbaceous cover is variable, ranging from none to well over 50%. Other dwarf-shrub species include dwarf willows, *Harrimanella stelleriana, Phyllodoce aleutica, Vaccinium vitis-idaea,* and *Arctostaphylos alpina*. Herbaceous species include *Lupinus nootkatensis, Polemonium acutiflorum, Chamerion angustifolium, Solidago* spp., and grasses. A more abundant herbaceous component, particularly graminoids, may be due to nutrient inputs from seabird colonies; where seabirds have been impacted by introduced predators, the cover of herbaceous species appears to be lower (Croll et al. 2005). Fruticose lichens and *Racomitrium lanuginosum* may also be common. Heath hummocks may occur.
Classification Comments: This system combines those known as *Empetrum nigrum* Heaths and *Empetrum nigrum*-Herbaceous by the Alaska Natural Heritage Program.
Related Concepts:
- *Empetrum nigrum* (Boggs et al. 2003) Finer
- II.D.2.c - Crowberry tundra (Viereck et al. 1992) Broader

DESCRIPTION

Environment: This system is common in valley bottoms, sideslopes, stabilized dunes, terraces, moraines and fans. Patch size is small to matrix forming. It typically occupies lower elevation sites than Aleutian Mixed Dwarf-Shrub-Herbaceous Shrubland (CES105.231).
Vegetation: Dwarf-shrub cover is >25% and dominated by *Empetrum nigrum*; herbaceous cover is variable, ranging from none to well over 50%. Other dwarf-shrub species include dwarf willows, *Harrimanella stelleriana, Phyllodoce aleutica, Vaccinium vitis-idaea,* and *Arctostaphylos alpina*. Herbaceous species include *Lupinus nootkatensis, Polemonium acutiflorum, Chamerion angustifolium, Solidago* spp., and grasses. A more abundant herbaceous component, particularly graminoids, may be due to nutrient inputs from seabird colonies; where seabirds have been impacted by introduced predators, the cover of herbaceous species appears to be lower (Croll et al. 2005). Fruticose lichens and *Racomitrium lanuginosum* may also be common. Heath hummocks may occur.

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Aleutian Mesic Alder-Salmonberry Shrubland (CES105.147)

DISTRIBUTION

Range: This system occurs on the Alaska Peninsula, Aleutian Islands and Kodiak Island.
Divisions: 102:C; 105:C
Nations: US
Subnations: AK
Map Zones: 76:C
TNC Ecoregions: 70:C, 72:C, 73:C

SOURCES

References: Boggs et al. 2003, Croll et al. 2005, Daniels et al. 2004, Fleming and Spencer 2007, Shacklette et al. 1969, Talbot et al. 1984, Viereck et al. 1992, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818556#references
Description Author: K. Boggs
Version: 15 Oct 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALEUTIAN MIXED DWARF-SHRUB-HERBACEOUS SHRUBLAND (CES105.231)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Shrubland (Shrub-dominated); W-Patch/High Intensity; Dwarf-Shrub
Non-Diagnostic Classifiers: Ridge; Slope; Terrace; Valley
FGDC Crosswalk: Vegetated, Shrub-dominated, Herbaceous - shrub-steppe, Perennial graminoid steppe
National Mapping Codes: EVT 2720; ESLF 5470; ESP 1720

CONCEPT

Summary: This is a common system throughout the Alaska Peninsula and Aleutian Islands from low to high elevations. It occurs in valleys, terraces, sideslopes, and ridges. In the mountains, this system often grades upslope into the Aleutian sparse heath and fell-field system. The continuous dwarf-shrub heaths often fragment into strips that alternate with almost bare ground, possibly due to wind erosion and frost action. In this system, dwarf-shrub cover is >25%, not dominated by *Empetrum nigrum*, and herbaceous cover varies from none to 75%. Various dwarf-shrub species dominate or codominate, including *Harrimanella stelleriana, Phyllodoce aleutica, Salix arctica, Salix rotundifolia, Cassiope lycopodioides, Loiseleuria procumbens, Vaccinium vitis-idaea, Vaccinium uliginosum*, and *Arctostaphylos alpina*. While *Empetrum nigrum* may codominate, it is mixed with other dwarf-shrubs. Common herbaceous species include *Carex macrochaeta, Chamerion angustifolium, Deschampsia caespitosa, Lupinus nootkatensis, Leymus mollis, Geum calthifolium, Carex circinata, Polygonum viviparum*, and *Festuca rubra*. Bryophyte cover is often high.
Classification Comments: This system combines those known as Mixed Dwarf-Shrub and Mixed Dwarf-Shrub-Herbaceous by the Alaska Natural Heritage Program.
Related Concepts:
- *Arctostaphylos alpina* (Boggs et al. 2003) Finer
- *Phyllodoce aleutica - Luetkea pectinata* (Boggs et al. 2003) Finer
- *Vaccinium uliginosum* (Boggs et al. 2003) Finer
- Ericaceous shrubs/Unvegetated (Boggs et al. 2003) Finer
- II.D.2.a - Bearberry tundra (Viereck et al. 1992) Intersecting
- II.D.2.b - Vaccinium tundra (Viereck et al. 1992) Intersecting
- II.D.2.d - Mountain-heath tundra (Viereck et al. 1992) Intersecting
- II.D.2.e - Cassiope tundra (Viereck et al. 1992) Intersecting
- II.D.3.a - Willow tundra (Viereck et al. 1992) Intersecting
- Mixed dwarf-shrub (Boggs et al. 2003) Finer
- Mixed ericaceous (Boggs et al. 2003) Finer

DESCRIPTION

Environment: This is a common system throughout the Alaska Peninsula and Aleutian Islands from low to high elevations. It occurs in valleys, terraces, sideslopes, and ridges. In the mountains, this system often grades upslope into the Aleutian sparse heath and fell-field system. The continuous dwarf-shrub heaths often fragment into strips that alternate with almost bare ground, possibly due to wind erosion and frost action.
Vegetation: In this system, dwarf-shrub cover is >25%, not dominated by *Empetrum nigrum*, and herbaceous cover varies from none to 75%. Various dwarf-shrub species dominate or codominate, including *Harrimanella stelleriana, Phyllodoce aleutica, Salix arctica, Salix rotundifolia, Cassiope lycopodioides, Loiseleuria procumbens, Vaccinium vitis-idaea, Vaccinium uliginosum*, and *Arctostaphylos alpina*. While *Empetrum nigrum* may codominate, it is mixed with other dwarf-shrubs. Common herbaceous species include *Carex macrochaeta, Chamerion angustifolium, Deschampsia caespitosa, Lupinus nootkatensis, Leymus mollis, Geum calthifolium, Carex circinata, Polygonum viviparum*, and *Festuca rubra*. Bryophyte cover is often high.

DISTRIBUTION

Range: This system occurs throughout the Alaska Peninsula, Aleutian Islands and Kodiak Island.
Divisions: 102:C; 105:C
Nations: US
Subnations: AK
Map Zones: 76:C
TNC Ecoregions: 70:C, 72:C, 73:C

SOURCES

References: Boggs et al. 2003, Byrd 1984, Daniels et al. 2004, Fleming and Spencer 2007, Shacklette et al. 1969, Talbot et al. 2006, Viereck et al. 1992, Western Ecology Working Group n.d.
Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818559#references
Description Author: K. Boggs
Version: 15 Oct 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

APACHERIAN-CHIHUAHUAN SEMI-DESERT GRASSLAND AND STEPPE (CES302.735)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: North American Warm Desert (302)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland [Foothill]; Lowland [Lowland]; Herbaceous; Temperate [Temperate Xeric]; Short Disturbance Interval; F-Patch/High Intensity [Seasonality/Winter Fire]; Xeromorphic Tree; Thorn Shrub; Graminoid
Non-Diagnostic Classifiers: Tropical/Subtropical [Tropical Xeric]; Aridic; Broad-Leaved Evergreen Tree; Xeromorphic Shrub; Succulent Shrub
FGDC Crosswalk: Vegetated, Shrub-dominated, Herbaceous - shrub-steppe, Perennial graminoid steppe
National Mapping Codes: EVT 2121; ESLF 5450; ESP 1121

CONCEPT

Summary: This ecological system is a broadly defined desert grassland, mixed shrub-succulent or xeromorphic oak savanna that is typical of the Borderlands of Arizona, New Mexico and northern Mexico (Apacherian region) but extends west to the Sonoran Desert, north into the Mogollon Rim in Arizona and up the Rio Grande Valley into central New Mexico. It also likely occurs in the southern portions of the Chihuahuan Desert. It is found on gently sloping alluvial erosional fans and piedmonts (bajadas) that lie along mountain fronts of the isolated basin ranges throughout the Sky Island mountain archipelago and on to foothill slopes up to 1670 m elevation in the Chihuahuan Desert. The vegetation in this mixed semi-desert grassland ecosystem is variable. It is characterized by the dominance of a typically diverse layer of perennial grasses with scattered stem succulents and shrubs. Frequent species include the grasses *Aristida ternipes, Bouteloua chondrosioides, Bouteloua curtipendula, Bouteloua eriopoda, Bouteloua gracilis, Bouteloua hirsuta, Bouteloua ramosa, Bouteloua repens, Bouteloua rothrockii, Digitaria californica, Eragrostis intermedia, Heteropogon contortus, Hilaria belangeri, Leptochloa dubia, Muhlenbergia porteri*, with *Muhlenbergia emersleyi, Muhlenbergia setifolia* at upper foothill elevation, rosettophyllous, often succulent species of *Agave, Dasylirion, Nolina, Opuntia*, and *Yucca*, and short-shrub species of *Calliandra*, and *Parthenium*. Tall-shrub/short-tree species of *Acacia, Prosopis, Juniperus, Mimosa*, and various oaks (e.g., *Quercus grisea, Quercus emoryi, Quercus arizonica, Quercus oblongifolia*) may be present with low cover. *Pleuraphis mutica*-dominated semi-desert grasslands often with *Bouteloua eriopoda* or *Bouteloua gracilis* occurring on lowlands and loamy plains in the Chihuahuan Desert are classified as Chihuahuan Loamy Plains Desert Grassland (CES302.061). Many of the historical desert grassland and savanna areas have been converted through intensive grazing and other land uses, some to Apacherian-Chihuahuan Mesquite Upland Scrub (CES302.733) (*Prosopis* spp.-dominated).
Classification Comments: *Dasylirion leiophyllum*, *Dasylirion wheeleri*, and *Fouquieria splendens* foothill shrublands and oak savannas/open woodlands are included in the concept of the this grassland and steppe ecological system. Chihuahuan grassland types that are currently included in this system are: (1) Chino grasslands of mountain slopes on acidic igneous, limestone, or deeper gravelly soils at elevations less than 1070 m (3500 feet). These sites are dominated by *Bouteloua ramosa* with *Euphorbia antisyphilitica, Hechtia texensis (= Hechtia scariosa), Fouquieria splendens, Jatropha dioica*, and *Agave lechuguilla*. (2) Desert mountain grasslands on mountain slopes between 1070 and 1370 m (3500-4500 feet) elevation on acidic igneous substrates, but also sometimes on limestone. *Bouteloua eriopoda* and *Bouteloua curtipendula* are constituents of this system. (3) Gravelly piedmont slope grasslands between 1370 and 1670 m (4500-5500 feet) elevation on Perdiz conglomerate or Tascotal tuff. These grasslands have *Bouteloua eriopoda, Bouteloua gracilis*, and *Dasylirion* as common components. Input from fire ecologist at a Landfire modeling workshop in 2006 suggests a fire-return interval that is generally long (about 10 years), with pluvial periods providing conditions leading to more rapid fuel development.
Similar Ecological Systems:
- Apacherian-Chihuahuan Mesquite Upland Scrub (CES302.733)
- Madrean Encinal (CES305.795)
- Madrean Juniper Savanna (CES301.730)

Related Concepts:
- Alkali Sacaton - Tobosagrass (701) (Shiflet 1994) Intersecting
- Blue Grama - Sideoats Grama (706) (Shiflet 1994) Intersecting
- Grama - Tobosa Shrub (505) (Shiflet 1994) Finer
- Grama -Muhly - Threeawn (713) (Shiflet 1994) Finer
- MLRA 42 - Southern Desertic Basin (SD-1) R042XA058NM Hills (NRCS 2006a) Broader
- MLRA 42 - Southern Desertic Basin (SD-1) R042XA059NM Limestone Hills (NRCS 2006a) Broader
- MLRA 42 - Southern Desertic Basin (SD-2) Limy (NRCS 2006a) Broader
- MLRA 42 - Southern Desertic Basin (SD-2) R042XB021NM Limestone Hills (NRCS 2006a) Broader
- MLRA 42 - Southern Desertic Basin (SD-2) R042XB027NM Hills (NRCS 2006a) Broader
- MLRA 42 - Southern Desertic Basin (SD-4) Limy and Shallow Sandy (NRCS 2006a) Broader
- Oak - Juniper Woodland and Mahogany - Oak (509) (Shiflet 1994) Intersecting
- Sideoats Grama - Sumac - Juniper (735) (Shiflet 1994) Intersecting

- Western Live Oak: 241 (Eyre 1980) Intersecting

DESCRIPTION

Environment: It is found on gently sloping alluvial erosional fans and piedmonts (bajadas) that lie along mountain fronts of the isolated ranges throughout the Sky Island mountain archipelago and on to foothill slopes up to 1670 m and possibly to 1800 m elevation in the Chihuahuan Desert. Sites are typically gently sloping mesas and piedmonts (Landfire 2007a).
Dynamics: Semi-desert grasslands are complex with many stands having a shrub or stem succulent component (*Agave* and *Yucca* spp.) under natural conditions (Burgess 1995). This woody component increases in density over time in the absence of disturbance such as fire (Burgess 1995, Gori and Enquist 2003, Schussman 2006a). Under historic natural conditions (also called natural range of variability or NRV), this ecosystem ranges from open perennial grasslands with low cover of shrubs to grasslands with a moderately dense shrub layer and succulent layer (Burgess 1995, Gori and Enquist 2003). An exception is that some stands with deep argillic horizons appear resistant to shrub and tree invasion without disturbance (McAuliffe 1995).

It is well-documented that frequent stand-replacing fire (fire-return interval (FRI) of 2.5 to 10 years) was a key ecological attribute of this semi-desert grassland ecosystem historically before 1890 (Wright 1980, Bahre 1985, McPherson 1995, Kaib et al. 1996). Other evidence of the importance of fire in maintaining desert grasslands includes the widespread conversion of grasslands to shrublands during the century of fire suppression (McPherson 1995) and the results of prescribed burning on decreasing shrub cover and increasing grass cover (Bock and Bock 1992, Robinett 1994). Additional evidence that frequent fire is a key ecological attribute of this ecosystem is that many common invasive shrubs, subshrubs and cacti are fire-sensitive and individuals are killed when top-burned, at least when they are young (<10 years old) (McPherson 1995), while native perennial grasses generally quickly recover from burning (Wright 1980, Martin 1983, Bock and Bock 1992).

Herbivory by native herbivores in the system is varied and ranges from invertebrates and rodents to pronghorn (Parmenter and Van Devender 1995, Whitford et al. 1995, Finch 2004). Soil-dwelling invertebrates include tiny nematodes and larger termites and ants, are important in nutrient cycling and affect soil properties, such as bulk density (Whitford et al. 1995). Above-ground invertebrates such as grasshoppers can significantly impact herbaceous cover when populations are high. Herbivory by native mammals also impacts these grasslands. Historically, populations of large mammals such as pronghorn (*Antilocarpa americana*), mule deer (*Odocoileus hemionus*) and elk (*Cervus elaphus*) were once abundant in this ecosystem (Parmenter and Van Devender 1995). Populations were greatly reduced and, in the case of pronghorn, extirpated during the 1800s and early 1900s, but effective game management has restored many populations, although habitat changes will limit restoration in other areas (Parmenter and Van Devender 1995). The historic impact of large native ungulates on this ecosystem is not known; however, in the case of wintering elk, it may have been significant locally. The current impact is assumed to be relatively small in this ecosystem. Herbivory from native small mammals such as rodents is significant as they are the dominant mammals in the semi-desert grassland ecosystem. There is also high diversity of these rodents, especially ground-dwelling ones such as spotted ground squirrels (*Spermophilus spilosoma*), and bannertail and Ord kangaroo rats (*Dipodomys spectabilis* and *Dipodomys ordii*). These burrowing rodents have a substantial effect on vegetation composition, soil structure and nutrient cycling (Parmenter and Van Devender 1995, Finch 2004). Historically, black-tail prairie dogs (*Cynomys ludovicianus*) had extensive colonies but were greatly reduced or extirpated from semi-desert grasslands in Arizona by 1960s, and their numbers and impacts are still small (Parmenter and Van Devender 1995). Other rodents such as kangaroo rats are still abundant in semi-desert grasslands.

Component Associations:
- *Artemisia bigelovii / Bouteloua eriopoda* Dwarf-shrub Herbaceous Vegetation (CEGL001741, GNRQ)
- *Artemisia bigelovii / Bouteloua gracilis* Dwarf-shrub Herbaceous Vegetation (CEGL001742, GNR)
- *Artemisia bigelovii / Muhlenbergia setifolia* Shrub Herbaceous Vegetation (CEGL001544, GNR)
- *Ayenia microphylla / Bouteloua eriopoda* Shrub Herbaceous Vegetation (CEGL001729, G1G2)
- *Bothriochloa barbinodis* Herbaceous Vegetation (CEGL005323, GNR)
- *Bouteloua curtipendula - Bothriochloa barbinodis* Herbaceous Vegetation (CEGL001590, G4)
- *Bouteloua curtipendula - Hilaria belangeri - Bouteloua eriopoda* Herbaceous Vegetation (CEGL001591, G3)
- *Bouteloua curtipendula - Schizachyrium cirratum* Herbaceous Vegetation (CEGL001592, G4)
- *Bouteloua eriopoda - Bouteloua curtipendula* Herbaceous Vegetation (CEGL001747, G2)
- *Bouteloua eriopoda - Bouteloua gracilis* Herbaceous Vegetation (CEGL001748, G2)
- *Bouteloua eriopoda - Bouteloua hirsuta* Herbaceous Vegetation (CEGL001749, G2)
- *Bouteloua eriopoda - Bouteloua trifida* Herbaceous Vegetation (CEGL001750, GNRQ)
- *Bouteloua eriopoda - Hesperostipa neomexicana* Herbaceous Vegetation (CEGL001753, GNRQ)
- *Bouteloua eriopoda - Pleuraphis jamesii* Herbaceous Vegetation (CEGL001751, G3)
- *Bouteloua eriopoda* Semi-desert Herbaceous Vegetation (CEGL001752, G2Q)
- *Bouteloua gracilis - Bouteloua curtipendula* Herbaceous Vegetation (CEGL001754, G5)
- *Bouteloua gracilis - Bouteloua hirsuta* Herbaceous Vegetation (CEGL001755, G3G4)
- *Bouteloua gracilis - Eragrostis intermedia* Herbaceous Vegetation (CEGL001758, G3)
- *Bouteloua gracilis - Hesperostipa neomexicana* Herbaceous Vegetation (CEGL001763, GNRQ)
- *Bouteloua gracilis - Sporobolus cryptandrus* Herbaceous Vegetation (CEGL001761, GNRQ)
- *Bouteloua gracilis - Sporobolus flexuosus* Herbaceous Vegetation (CEGL001762, GNRQ)
- *Bouteloua hirsuta - Bouteloua curtipendula* Herbaceous Vegetation (CEGL001764, G4)
- *Bouteloua hirsuta - Bouteloua radicosa* Herbaceous Vegetation (CEGL001765, G2)

- *Bouteloua hirsuta - Digitaria californica* Herbaceous Vegetation (CEGL001767, GNRQ)
- *Bouteloua hirsuta - Hesperostipa neomexicana* Herbaceous Vegetation (CEGL001766, GNRQ)
- *Bouteloua ramosa* Herbaceous Vegetation (CEGL004522, GNR)
- *Dasylirion leiophyllum - Agave lechuguilla / Bouteloua hirsuta - Bouteloua gracilis - Bouteloua eriopoda* Shrubland (CEGL004245, GNR)
- *Dasylirion leiophyllum - Viguiera stenoloba - Agave lechuguilla / Bouteloua ramosa* Shrubland (CEGL004604, G3G4)
- *Dasylirion wheeleri / Bouteloua curtipendula* Shrub Herbaceous Vegetation (CEGL001593, GNR)
- *Dasylirion wheeleri / Bouteloua eriopoda* Shrub Herbaceous Vegetation (CEGL001730, GNRQ)
- *Dasylirion wheeleri / Muhlenbergia setifolia* Shrub Herbaceous Vegetation (CEGL001512, GNRQ)
- *Fouquieria splendens / Bouteloua curtipendula* Shrubland (CEGL001376, GNR)
- *Fouquieria splendens / Bouteloua hirsuta* Shrubland (CEGL001377, G3?)
- *Fouquieria splendens / Muhlenbergia setifolia* Shrub Herbaceous Vegetation (CEGL001513, GNRQ)
- *Hesperostipa neomexicana - Bouteloua curtipendula* Herbaceous Vegetation (CEGL001709, G3?)
- *Hesperostipa neomexicana - Dasylirion wheeleri* Herbaceous Vegetation (CEGL001710, GNR)
- *Larrea tridentata / Pleuraphis mutica* Shrub Herbaceous Vegetation (CEGL001542, G2)
- *Muhlenbergia emersleyi - Bouteloua curtipendula* Herbaceous Vegetation (CEGL001644, GNR)
- *Muhlenbergia emersleyi - Bouteloua hirsuta* Herbaceous Vegetation (CEGL001645, G2?)
- *Parthenium incanum / Bouteloua eriopoda* Shrub Herbaceous Vegetation (CEGL001734, G3)
- *Pleuraphis jamesii - Sporobolus airoides* Herbaceous Vegetation (CEGL001778, G2G3)
- *Prosopis glandulosa / Bouteloua eriopoda* Shrub Herbaceous Vegetation (CEGL001510, G3G4)
- *Prosopis glandulosa / Pleuraphis mutica* Shrub Herbaceous Vegetation (CEGL001641, G5)
- *Quercus arizonica / Bouteloua curtipendula* Woodland (CEGL000680, G3)
- *Quercus arizonica / Muhlenbergia emersleyi* Woodland (CEGL000681, G4)
- *Quercus emoryi / Bouteloua curtipendula* Woodland (CEGL000683, G3)
- *Quercus emoryi / Muhlenbergia emersleyi* Woodland (CEGL000685, G4)
- *Quercus emoryi / Schizachyrium cirratum* Woodland (CEGL000687, GNR)
- *Quercus grisea / Bouteloua curtipendula* Woodland (CEGL000689, G5)
- *Schizachyrium scoparium var. scoparium - Muhlenbergia pungens* Herbaceous Vegetation (CEGL001684, G2)
- *Yucca faxoniana / Bouteloua hirsuta - Bouteloua gracilis - Bouteloua eriopoda* Shrub Herbaceous Vegetation (CEGL004248, GNR)

DISTRIBUTION

Range: This system is found in the Borderlands of Arizona, New Mexico and northern Mexico (Apacherian region), extending to the Sonoran Desert and throughout much of the northern Chihuahuan Desert.
Divisions: 302:C
Nations: MX, US
Subnations: AZ, MXCH(MX), NM, TX
Map Zones: 13:C, 14:C, 15:C, 24:C, 25:C, 26:C, 27:C, 28:?, 34:?
USFS Ecomap Regions: 313B:CC, 313C:CC, 315A:CC, 315B:CC, 315H:CC, 321A:CC, 322A:CC, 322B:CC, M313A:CC, M313B:CC
TNC Ecoregions: 22:C, 24:C, 28:C

SOURCES

References: Anable et al. 1992, Bahre 1985, Bock and Bock 1992, Brown 1982a, Brown and Archer 1999, Burgess 1995, Cable 1971, Comer et al. 2003, Cooke and Reeves 1976, Dick-Peddie 1993, Eyre 1980, Finch 2004, Gori and Enquist 2003, Kaib et al. 1996, Landfire 2007a, Martin 1983, McAuliffe 1995, McPherson 1995, Muldavin et al. 2000b, Muldavin et al. 2002, NRCS 2006a, Parmenter and Van Devender 1995, Robinett 1994, Schussman 2006a, Shiflet 1994, TNC 2013, Whitford et al. 1995, Wright 1980
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722937#references
Description Author: K.A. Schulz and M.S. Reid
Version: 14 Jan 2014 **Stakeholders:** Latin America, Southeast, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

CALIFORNIA CENTRAL VALLEY MIXED OAK SAVANNA (CES206.935)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland [Lowland]; Woody-Herbaceous; Mediterranean [Mediterranean Xeric-Oceanic]; Deep Soil; Xeric; F-Landscape/Low Intensity; Quercus lobata, Quercus douglasii
Non-Diagnostic Classifiers: Herbaceous; Sideslope; Toeslope/Valley Bottom; Alluvial plain; Alluvial terrace; Eutrophic Soil; Mineral: W/ A-Horizon >10 cm
FGDC Crosswalk: Vegetated, Tree-dominated, Sparse tree canopy, Deciduous sparse tree canopy
National Mapping Codes: EVT 2112; ESLF 5401; ESP 1112

CONCEPT

Summary: Historically, these savannas occurred on alluvial terraces and flat plains, often with deep, fertile soils, throughout the California Central Valley from Lake Shasta south to Los Angeles County. This system is found from 10-1200 m (30-3600 feet) elevation; receiving on average 50 cm (range 25-100 cm) of precipitation per year, mainly as winter rain. Variable canopy densities in existing occurrences are likely due to variation in soil moisture regime, natural patch dynamics of fire, and land use (fire suppression, livestock grazing, herbivory, etc.). *Quercus lobata* was the characteristic oak species of these savannas, though other species were present, including *Quercus wislizeni, Quercus agrifolia, Quercus douglasii, Aesculus californica, Cercis canadensis var. texensis (= Cercis occidentalis), Juniperus californica*, and *Nassella pulchra*. There is some evidence that much of the understory prior to the invasion by non-native annual grasses and forbs was composed of native annual herbs such as *Hemizonia, Eriogonum, Trifolium, Gilia, Navarretia, Lupinus, Calycadenia, Lessingia, Lotus, Daucus*, and *Holocarpha* spp. There is considerable seasonal and annual variation in cover of understory species due to phenology and intra-annual precipitation and temperature variation.
Related Concepts:
- Blue Oak Woodland (201) (Shiflet 1994) Broader. Some *Q. lobata-Q. douglasii* Savannas are included in this SRM type.
- Coast Live Oak Woodland (202) (Shiflet 1994) Broader. Where *Q. agrifolia* mixes with *Q. lobata*.

DESCRIPTION

Environment: These savannas historically occurred on alluvial terraces and flat plains, often with deep, well-drained fertile soils, throughout the California Central Valley from Lake Shasta south to Los Angeles County. This system is found from 10-1200 m (30-3600 feet) elevation; receiving on average 50 cm (range 25-100 cm) of precipitation per year, mainly as winter rain. Summers are generally hot and dry. Variable canopy densities in existing occurrences are likely due to variation in soil moisture regime and natural patch dynamics of fire, also intra-annual precipitation and temperature variability result in variability in cover of plants.
Dynamics: Fire regime: frequent surface fires since good fuels of grasses, and carried from adjacent grasslands. Summer to early fall; FRI 5-100+ (Sawyer et al. 2009). Very productive and fire-prone landscape. From Sawyer et al. (2009): Literature describing post-fire natural regeneration and long-term fire recovery of *Quercus lobata* woodlands is minimal. Plants have the ability to survive fire, and stands probably burned frequently and hot with dry grasses and oak litter carrying surface fires. Larger mature trees are usually resistant to moderate-severity fire because of their thick bark. While seedlings and saplings are top-killed by such fire, juveniles sprout from root crowns. However, older mature trees that are top-killed do not have this same ability. Animals such as scrub jays also facilitate regeneration of *Quercus lobata*, because they prefer burned areas as acorn-caching sites, and buried acorns usually survive fire (Howard 1992, Wills 2006). Hot surface fires may kill large trees that have extensive internal rot, and usually kill small trees. Crown fires will kill a large number of valley oak of all size classes (Howard 1992). Herbivory from ungulates winter range; ground burrowers; oak regeneration is dependent upon bare soil and dispersal from birds/small mammals burial of seeds. Valley oak regeneration to replace mature trees is lower than in other deciduous oak species (Landfire 2007a). Some studies indicate that this is due to a rare occurrence of necessary climate conditions, such as a warm summer followed by several wet years.

Component Associations:
- *Quercus douglasii - Quercus wislizeni / Bromus* sp. - *Daucus pusillus* Woodland (CEGL008648, G4?)
- *Quercus douglasii / Bromus* sp. - *Daucus pusillus* Woodland (CEGL008645, G4?)
- *Quercus douglasii / Ceanothus cuneatus* / Poaceae Woodland (CEGL008646, G3G4)
- *Quercus lobata* Woodland (CEGL003096, G2?)

DISTRIBUTION

Range: Historically, this system was found throughout the California Central Valley from Lake Shasta south to Los Angeles County.
Divisions: 206:C
Nations: US
Subnations: CA
Map Zones: 3:C, 4:C, 5:C, 6:C
USFS Ecomap Regions: 262A:CC, 263A:??, 322A:??, M261A:CP, M261B:CC, M261C:CC, M261E:CC, M261F:CC

TNC Ecoregions: 13:C, 15:P, 16:P

SOURCES

References: Allen-Diaz 2007, Barbour and Billings 2000, Barbour and Major 1988, Barbour et al. 2007, Bolsinger 1988, Brooks and Minnich 2006, Comer et al. 2003, Griffin 1971, Holland and Keil 1995, Howard 1992, Landfire 2007a, Mahall et al. 2005, Mayer and Laudenslayer 1988, PRBO Conservation Science 2011, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Shiflet 1994, Wills 2006, WNHP 2011

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722746#references

Description Author: P. Comer and T. Keeler-Wolf, mod. M. Reid

Version: 14 Jan 2014 **Stakeholders:** West

Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

CALIFORNIA COASTAL LIVE OAK WOODLAND AND SAVANNA (CES206.937)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Woody-Herbaceous; Sideslope; Mediterranean [Mediterranean Xeric-Oceanic]; Xeric; F-Patch/Medium Intensity; Broad-Leaved Evergreen Tree; Quercus agrifolia
Non-Diagnostic Classifiers: Lowland [Foothill]; Lowland [Lowland]; Forest and Woodland (Treed); Ustic; Intermediate Disturbance Interval; Graminoid
FGDC Crosswalk: Vegetated, Tree-dominated, Sparse tree canopy, Mixed evergreen-deciduous sparse tree canopy
National Mapping Codes: EVT 2113; ESLF 5402; ESP 1113

CONCEPT

Summary: These *Quercus agrifolia*-dominated woodlands occur throughout the Pacific coastal areas from Sonoma County, California, south to Baja California. Occurrences vary in canopy cover from dense conditions that support sparse understory vegetation of *Rubus ursinus, Symphoricarpos mollis, Heteromeles arbutifolia*, and *Toxicodendron diversilobum*, to more open conditions with perennial bunchgrass understory. The latter typically occur on south-facing slopes with soils of variable depth. Variable canopy densities in existing occurrences are likely due to variation in soil moisture regime, natural patch dynamics of fire, and land use (fire suppression, livestock grazing, herbivory, etc.).
Related Concepts:
- California Coast Live Oak: 255 (Eyre 1980) Broader
- Coast Live Oak Woodland (202) (Shiflet 1994) Broader

DESCRIPTION

Environment: This system is found mainly below 500 m elevation in foothill environments (but up to 1200 m) on alluvial terraces, canyon bottoms, streambanks, slopes, and flats. It is typically found within 100 km of the coast, largely within the coastal fog belt (Allen-Diaz et al. 2007). Soils are moderately to well-drained, deep, sandy or loamy with high organic matter. More open occurrences with perennial bunchgrass undergrowth are typically on south-facing slopes with soils of variable depth. Annual precipitation is 40-80 cm, with January mean minimum daily temperatures of 5-10 degrees C and July mean maximum daily temperatures of 18-23 degrees C.
Dynamics: From Sawyer et al. (2009): Dominant tree root system contains both roots that tap groundwater and extensive surface-feeding ones (Callaway 1990, as cited in Sawyer et al. 2009). It is the most susceptible of the California oaks to soil drought.

Fire is the dominant disturbance mechanism. Fire severity can range from high in oak woodlands with a high shrub component to moderate or low in open woodlands and savannas with a grass understory. Historically, fire occurred frequently, and the dominant oaks are resistant to low-intensity surface fires (Allen-Diaz et al. 2007). Lightning-ignited fires are uncommon but human-ignited fires may have occurred frequently given the propensity of aboriginal cultures to burn foothill environments (Keeley 2002, Landfire 2007a). Fire history does exert some effect on fire mosaic turnover, although the effect appears to be short-lived. Also, productivity (e.g., high cover of flammable shrubs and grasses) does not seem to be as strong a control on fire occurrence as meteorology (i.e., hot, dry wind events) in these systems (Landfire 2007a).

From Sawyer et al. (2009): Large trees are exceptionally fire-resistant with the thickest bark of any California oak. They generally recover well from a fire, although severely burned crowns, trunks, and root crowns may require several years to sprout. Smaller trees are less resistant, but even low to moderately severe fires often kill seedlings and saplings. Stands may attain 80 to 100% of their pre-fire densities within 10 years after fire, though fire-return intervals in natural conditions vary widely (Steinberg 2002b, Sugihara et al. 2006).

Component Associations:
- *Quercus agrifolia / Toxicodendron diversilobum - (Corylus cornuta)* Woodland (CEGL003169, G4)

DISTRIBUTION

Range: Pacific coastal areas from Sonoma County, California, south to Baja California.
Divisions: 206:C
Nations: MX, US
Subnations: CA, MXBC(MX)
Map Zones: 3:C, 4:C, 5:?
USFS Ecomap Regions: 261B:CC, 262A:CC, 263A:CC, M261A:CC, M261B:CC
TNC Ecoregions: 15:C, 16:C

SOURCES

References: Allen-Diaz 2007, Barbour and Billings 2000, Barbour and Major 1988, Callaway and Davis 1993, Callaway and Davis

1998, Comer et al. 2003, Davis and Borchert 2006, Eyre 1980, Holland and Keil 1995, Keeley 2002, Landfire 2007a, Mensing 1998, PRBO Conservation Science 2011, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Shiflet 1994, Steinberg 2002b, Sugihara et al. 2006, Van Dyke et al. 2001, Wills 2006, WNHP 2011

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722744#references

Description Author: P. Comer and T. Keeler-Wolf, mod. M. Reid

Version: 14 Jan 2014 **Stakeholders:** Latin America, West

Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

CALIFORNIA LOWER MONTANE BLUE OAK-FOOTHILL PINE WOODLAND AND SAVANNA (CES206.936)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Savanna-Woodland Mosaic; Woody-Herbaceous; Mediterranean [Mediterranean Xeric-Oceanic]; Ustic; F-Patch/Low Intensity; Needle-Leaved Tree; Graminoid; Pinus sabiniana, Quercus douglasii
Non-Diagnostic Classifiers: Montane [Lower Montane]; Lowland [Foothill]; Forest and Woodland (Treed); Sideslope; Toeslope/Valley Bottom; Alluvial plain; Alluvial terrace; Sand Soil Texture; Short Disturbance Interval; Broad-Leaved Deciduous Tree; Broad-Leaved Evergreen Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Sparse tree canopy, Mixed evergreen-deciduous sparse tree canopy
National Mapping Codes: EVT 2114; ESLF 5403; ESP 1114

CONCEPT

Summary: This ecological system is primarily found in the valley margins and foothills of the Sierra Nevada and Coast Ranges of California from approximately 120-1200 m (360-3600 feet) in elevation on rolling plains or dry slopes. Over a century of anthropogenic changes (especially cutting of oak) have altered the density and distribution of woody vegetation. A high-quality occurrence often consists of open park-like stands of *Pinus sabiniana*, with oaks and other various broadleaf tree and shrub species, including *Quercus douglasii, Quercus wislizeni, Quercus agrifolia* (primarily central and southern Coast Ranges), *Quercus lobata, Aesculus californica, Arctostaphylos* spp., *Cercis canadensis var. texensis (= Cercis occidentalis), Ceanothus cuneatus, Frangula californica (= Rhamnus californica), Ribes quercetorum, Juniperus californica*, and *Pinus coulteri* (central and southern Coast Ranges). *Pinus sabiniana* tends to drop out all together in the driest and more southerly sites, which are often dominated by *Quercus douglasii*. The California central coast region may have open stands of just *Juniperus californica*, with a grassy understory. These stands belong here due to proximity to other blue oak and gray pine stands or chaparral, and due to the heavy native or non-native grass cover. This is distinguished from Great Basin pinyon-juniper stands, which have little herbaceous understory, and *Pinus monophylla* rather than *Pinus sabiniana*. These stands of only juniper are caused by repeated removal of the oaks by humans and feral pig populations. Northern extensions of this system include *Quercus garryana* as the dominant oak, where it becomes successional to Mediterranean California Lower Montane Black Oak-Conifer Forest and Woodland (CES206.923). *Pinus sabiniana* density also varies based on intensity or frequency of fire, being less abundant in areas of higher intensity or frequency, hence it is often more abundant on steep, rocky or more mesic north-facing slope exposures. Historically, understory vegetation included mixed chaparral to perennial bunchgrass. Currently, most occurrences have understories dominated by dense cover of annual species, both native and non-native. Variable canopy densities in existing occurrences are likely due to variation in soil moisture regime, natural patch dynamics of fire, and land use (fire suppression, livestock grazing, herbivory, etc.).
Similar Ecological Systems:
- Mediterranean California Lower Montane Black Oak-Conifer Forest and Woodland (CES206.923)

Related Concepts:
- Blue Oak - Digger Pine: 250 (Eyre 1980) Intersecting
- Blue Oak Woodland (201) (Shiflet 1994) Broader. This SRM type is close in concept to this system

Component Associations:
- *Pinus sabiniana - Quercus wislizeni / Arctostaphylos viscida* Woodland (CEGL008636, G3?)
- *Pinus sabiniana - Quercus wislizeni / Ceanothus cuneatus* Woodland (CEGL008635, G3?)
- *Quercus douglasii - Pinus sabiniana* / Grass Woodland (CEGL008647, G4?)
- *Quercus wislizeni - Quercus douglasii - Pinus sabiniana* Woodland (CEGL008642, G4?)

DISTRIBUTION

Range: This system occurs primarily in the valley margins and foothills of the Sierra Nevada and Coast Ranges from approximately 120-1200 m (360-3600 feet) elevation, from Shasta County to Kern and northern Los Angeles counties, California. It is unlikely to occur in the southern portion of zone 7 (Modoc Plateau), but this needs to be confirmed with California ecologists.
Divisions: 206:C
Nations: US
Subnations: CA
Map Zones: 2:P, 3:C, 4:C, 5:C, 6:C, 7:P
USFS Ecomap Regions: 261B:CC, 262A:CC, 263A:CC, 322A:PP, M242A:??, M242B:??, M261A:CC, M261B:CC, M261C:CC, M261D:CC, M261E:CC, M261F:CC
TNC Ecoregions: 5:C, 12:C, 13:C, 14:C, 15:C

SOURCES

References: Barbour and Billings 2000, Barbour and Major 1988, Comer et al. 2003, Eyre 1980, Holland and Keil 1995, Sawyer and

Keeler-Wolf 1995, Sawyer et al. 2009, Shiflet 1994

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722745#references

Description Author: P. Comer, T. Keeler-Wolf, mod. G. Kittel

Version: 13 Jan 2012 **Stakeholders:** West

Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

CENTRAL APPALACHIAN ALKALINE GLADE AND WOODLAND (CES202.602)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Woody-Herbaceous; Ridge/Summit/Upper Slope; Unglaciated; Alkaline Soil; Shallow Soil
Non-Diagnostic Classifiers: Lowland; Forest and Woodland (Treed); Temperate; Mesotrophic Soil; Circumneutral Soil; Ustic; Intermediate Disturbance Interval; F-Patch/Medium Intensity
FGDC Crosswalk: Vegetated, Tree-dominated, Sparse tree canopy, Mixed evergreen-deciduous sparse tree canopy
National Mapping Codes: EVT 2400; ESLF 5416; ESP 1400

CONCEPT

Summary: This system occurs at low to moderate elevations from the Central Appalachians (with a few northward incursions into southernmost New York and New England possible) south to the Ridge and Valley and Piedmont. It consists of woodlands and open glades on thin soils over limestone, dolostone or similar calcareous rock. *Juniperus virginiana* is a common tree, often increasing in the absence of fire, and *Quercus muehlenbergii* is indicative of the limestone substrate. *Rhus aromatica, Cercis canadensis*, and *Ostrya virginiana* may occur. Prairie grasses are the dominant herbs (*Andropogon gerardii, Schizachyrium scoparium, Bouteloua* spp.). Forb richness is often high; characteristic forbs include *Asclepias verticillata, Brickellia eupatorioides, Erigeron pulchellus, Monarda fistulosa, Packera obovata, Salvia lyrata*, and *Symphyotrichum oblongifolium*. Fire is sometimes an important natural disturbance factor, but open physiognomies may also be maintained by drought.

Similar Ecological Systems:

- Central Interior Highlands Calcareous Glade and Barrens (CES202.691)--is a related system to the south and west of CES202.602; ranges do not overlap.
- Laurentian-Acadian Calcareous Rocky Outcrop (CES201.572)--characterized by *Thuja occidentalis* rather than *Juniperus virginiana*.
- North-Central Appalachian Circumneutral Cliff and Talus (CES202.603)
- Southern Ridge and Valley / Cumberland Dry Calcareous Forest (CES202.457)--has a more closed canopy.
- Southern Ridge and Valley Calcareous Glade and Woodland (CES202.024)--occurs in the southern Ridge and Valley south of this system; they meet in southwestern Virginia.

Related Concepts:

- Eastern Redcedar: 46 (Eyre 1980) Finer
- Sugar Maple: 27 (Eyre 1980) Finer
- White Oak - Black Oak - Northern Red Oak: 52 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occupies mid-elevation rocky ridges, gentle to steep south- and southwest-facing slopes, and outcrops with thin soils and calcareous bedrock. Large amounts of exposed mineral soils and/or gravel are characteristic. Soils are high in pH and rich in calcium and magnesium. Although these areas are subject to prolonged droughts, local areas of ephemeral vernal seepage occur in microtopographic concavities, and they may have distinctive vegetation (e.g., colonies of Dodecatheon meadia). A series of glades in western Virginia is somewhat distinctive because of the dolostone, which contains a high magnesium content. These glades are located on low dolomite knobs and foothills of Elbrook dolomite that occupy middle to upper slopes and crests of south- or southwest-facing spur ridges at relatively low elevations. In the Allegheny Mountains and along the Allegheny Front of Pennsylvania, the surface geology is primarily sandstone and shale, but the Mauch Chunk formation includes several narrow bands of limestone that outcrop frequently on steep slopes (Berg et al. 1980).

Vegetation: In some cases, the woodlands grade into closed-canopy forests. *Juniperus virginiana* is a common tree, filling in in the absence of fire, and *Quercus muehlenbergii* is indicative of the limestone substrate. *Rhus aromatica, Cercis canadensis*, and *Ostrya virginiana* may occur. Prairie grasses are the dominant herbs (*Andropogon gerardii, Schizachyrium scoparium, Bouteloua* spp.); forb richness is often high. Characteristic forbs include *Asclepias verticillata, Monarda fistulosa, Salvia lyrata, Symphyotrichum oblongifolium*, and *Brickellia eupatorioides* (Braun 1950).

Dynamics: Drought stress appears to drive patch dynamics. Fire is likely to have a somewhat lesser impact due to thin soils and sparse vegetation, although fire scars on woody vegetation of barrens in Virginia suggest that fire may also play a role in maintaining the open character of this system (Ludwig 1999), and fire is also thought to contribute to arresting succession by woody species in Pennsylvania (Laughlin 2004, McPherson 2013). Where this system occurs on steep slopes, debris avalanches may cause periodic disturbance, but this process needs further study (Bartgis 1993); anthropogenic disturbance is thought to have played a role in establishment of some occurrences in Pennsylvania; quarrying has been noted to create habitat for the establishment of species characteristic of limestone prairies, but overall this activity poses a threat through outright destruction or habitat degradation (Laughlin 2004, McPherson 2013).

Component Associations:

- *Acer saccharum - Quercus muehlenbergii / Cercis canadensis* Forest (CEGL006017, G4?)
- *Juniperus virginiana / Bouteloua curtipendula - Carex eburnea* Wooded Herbaceous Vegetation (CEGL006047, G1G2)
- *Quercus muehlenbergii - Cercis canadensis / Packera obovata - Lithospermum canescens* Woodland (CEGL006231, G3G4)
- *Quercus muehlenbergii - Quercus (alba, rubra) - Carya cordiformis / Viburnum prunifolium* Forest (CEGL004793, G3G4)
- *Quercus muehlenbergii / Packera plattensis - Parthenium auriculatum - Schizachyrium scoparium* Woodland (CEGL006030, G2)
- *Quercus rubra - Carya (glabra, ovata) / Ostrya virginiana / Carex lucorum* Forest (CEGL006301, G4)

DISTRIBUTION

Range: This system is known from Pennsylvania and northwestern New Jersey south through the Ridge and Valley to western Virginia, possibly extending to southeasternmost New York and the marble valleys of northwestern Connecticut.
Divisions: 202:C
Nations: US
Subnations: CT?, MD, NJ, NY?, OH, PA, VA, WV
Map Zones: 57:C, 60:C, 61:C, 64:C, 65:P
USFS Ecomap Regions: 221B:CC, 221D:CC, M221A:CC, M221B:CC
TNC Ecoregions: 49:P, 51:C, 59:C, 61:C

SOURCES

References: Bartgis 1993, Berg et al. 1980, Braun 1950, Comer et al. 2003, Dreese 2010, Fike 1999, Fleming and Patterson 2013, Fleming et al. 2013, Laughlin 2004, Ludwig 1999, McPherson 2013
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723007#references
Description Author: S.C. Gawler, G. Fleming, R. Evans, mod. M. Pyne and L.A. Sneddon
Version: 14 Jan 2014 **Stakeholders:** East, Midwest, Southeast
Concept Author: S.C. Gawler, G. Fleming, R. Evans **ClassifResp:** East

CENTRAL INTERIOR HIGHLANDS CALCAREOUS GLADE AND BARRENS (CES202.691)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Woody-Herbaceous; Rock Outcrops/Barrens/Glades; Alkaline Soil
Non-Diagnostic Classifiers: Forest and Woodland (Treed); Sedimentary Rock; F-Patch/Medium Intensity
FGDC Crosswalk: Vegetated, Tree-dominated, Sparse tree canopy, Mixed evergreen-deciduous sparse tree canopy
National Mapping Codes: EVT 2401; ESLF 5417; ESP 1401

CONCEPT

Summary: This system is found primarily in the Interior Highlands of the Ozark, Ouachita, and Interior Low Plateau regions with scattered occurrences in northern Missouri. It occurs along moderate to steep slopes and steep valleys on primarily southerly to westerly facing slopes. Limestone and/or dolomite bedrock typify this system with shallow, moderately to well-drained soils interspersed with rocks. These soils often dry out during the summer and autumn, and then become saturated during the winter and spring. *Schizachyrium scoparium* dominates this system and is commonly associated with *Andropogon gerardii, Bouteloua curtipendula,* and calcium-loving plant species. Stunted woodlands primarily dominated by *Quercus muehlenbergii* interspersed with *Juniperus virginiana* occur on variable-depth-to-bedrock soils. Fire is the primary natural dynamic, and prescribed fires help manage this system by restricting woody growth and maintaining the more open glade structure.
Classification Comments: In Alabama, this system is found in the Moulton Valley region, which is technically part of TNC Ecoregion 50, but ambiguously placed there. This region is included in the Interior Plateau (71) of EPA (2004). The system is also found in the Western Valley of the Tennessee River (a very limited part of EPA 71f) in Decatur County, Tennessee. Also included here, somewhat uncomfortably, is an unusual series of flatrock glades on Silurian dolomite in Bullitt County, Kentucky (71d of Woods et al. (2002)).
Similar Ecological Systems:
- Alabama Ketona Glade and Woodland (CES202.338)--a similar concept on a very specialized substrate.
- Bluegrass Savanna and Woodland (CES202.888)
- Central Appalachian Alkaline Glade and Woodland (CES202.602)--of central Appalachians, mainly Virginia and north; need to clarify ranges.
- Nashville Basin Limestone Glade and Woodland (CES202.334)--restricted to the Nashville Basin of Tennessee, found on flat terrain instead of slopes.
- Ouachita Shale Glade and Barrens (CES202.343)
- Southern Ridge and Valley / Cumberland Dry Calcareous Forest (CES202.457)--has a more closed canopy.
- Southern Ridge and Valley Calcareous Glade and Woodland (CES202.024)--has a possible overlapping range.

Related Concepts:
- Ashe Juniper - Redberry (Pinchot) Juniper: 66 (Eyre 1980) Finer
- Dolomite Glade (Evans 1991) Finer
- Eastern Redcedar: 46 (Eyre 1980) Finer
- Limestone Glade (Evans 1991) Finer
- Post Oak - Blackjack Oak: 40 (Eyre 1980) Finer
- Xeric Calcareous Forest (Evans 1991) Finer

DESCRIPTION

Environment: This system is found primarily along moderate to steep slopes and steep valleys on primarily southerly to westerly facing slopes. Limestone and/or dolomite bedrock typify this system with shallow, moderately to well-drained soils interspersed with rocks. Soils are affected by the bedrock chemistry and tend to have high levels of calcium and potassium and a relatively high pH. Due to seasonal rainfall patterns and the extremely thin soils, these soils dry out during the summer and autumn and become saturated during the winter and spring. In northern Alabama (Moulton Valley), the stratum on which the system is found is a type of "marl." Seeps may occur where impervious rock strata meet relatively permeable limestone.
Vegetation: *Schizachyrium scoparium* dominates this system and is commonly associated with *Andropogon gerardii, Bouteloua curtipendula,* and calcium-loving plant species. Stunted woodlands primarily dominated by *Quercus muehlenbergii* interspersed with *Juniperus virginiana* occur on variable-depth-to-bedrock soils. The trees typically occur as islands in a wider herbaceous or rocky area. The islands are found in microenvironments where the soil depth and available water are sufficient to support trees (e.g., depressions in the bedrock). Other woody plants associated with this system (within their ranges) include *Quercus shumardii, Cercis canadensis, Ulmus alata, Fraxinus quadrangulata, Juniperus ashei, Acer saccharum,* and *Frangula caroliniana*. Other herbaceous taxa include *Silphium trifoliatum, Silphium terebinthinaceum, Liatris* spp., *Symphyotrichum oblongifolium, Castilleja coccinea, Hedyotis nigricans, Talinum* spp., *Sedum* spp., and *Panicum flexile*. Small-scale stands of annual *Sporobolus* spp. may be prominent in some examples. In some examples, small-scale seepage areas may contain *Eleocharis compressa, Nothoscordum bivalve, Isoetes*

butleri, and *Hypoxis hirsuta*.
Dynamics: The thin, dry soil characteristic of this system dries out during the growing season and much of the vegetation dries, as well. This allows fires to spread easily and these fires restrict the abundance of woody species. In high-quality examples where the natural fire regime operates, small trees and shrubs are limited to the edges of stands or small "islands" of deeper soil that retain more moisture while grasses are the dominant vegetation. Sparsely vegetated areas between the dominant grassy zones contain most of the rare species found in this system (Ware 2002). In the absence of fire, from active suppression or a lack of fuel due to excessive grazing, woody species can increase greatly.

Component Associations:
- *(Quercus stellata, Ulmus alata) / Schizachyrium scoparium - Symphyotrichum patens var. patentissimum* Wooded Herbaceous Vegetation (CEGL007824, G2?)
- *Eleocharis (bifida, compressa) - Nothoscordum bivalve* Herbaceous Vegetation (CEGL004669, G3Q)
- *Fraxinus quadrangulata - Juniperus virginiana var. virginiana / Schizachyrium scoparium - Lithospermum canescens* Woodland (CEGL007994, G2)
- *Juniperus ashei / Cotinus obovatus / Carex eburnea - Rudbeckia missouriensis* Woodland (CEGL007833, G2?)
- *Juniperus ashei* Dry Chalk Outcrop Woodland (CEGL007967, G1)
- *Juniperus ashei* Ozark Clifftop Woodland (CEGL004672, G2?)
- *Juniperus virginiana / Schizachyrium scoparium - (Andropogon gerardii, Sorghastrum nutans) - Silphium (trifoliatum, terebinthinaceum)* Wooded Herbaceous Vegetation (CEGL004738, G2)
- *Juniperus virginiana / Schizachyrium scoparium - Silphium terebinthinaceum var. luciae-brauniae - Carex juniperorum - Castilleja coccinea* Wooded Herbaceous Vegetation (CEGL004464, G1Q)
- *Juniperus virginiana* Alkaline Bluff Woodland (CEGL002426, G3)
- *Juniperus virginiana var. virginiana - Fraxinus quadrangulata / Symphyotrichum oblongifolium - Panicum flexile - Sedum pulchellum* Woodland (CEGL004271, G2)
- *Quercus marilandica - (Juniperus virginiana) / Schizachyrium scoparium - Danthonia spicata* Wooded Herbaceous Vegetation (CEGL002428, G2)
- *Quercus muehlenbergii - Fraxinus (quadrangulata, americana) / Schizachyrium scoparium* Woodland (CEGL002143, G3G4)
- *Quercus muehlenbergii - Juniperus virginiana / Schizachyrium scoparium - Manfreda virginica* Wooded Herbaceous Vegetation (CEGL005131, G2G3)
- *Quercus muehlenbergii / Schizachyrium scoparium - Bouteloua curtipendula* Wooded Herbaceous Vegetation (CEGL005284, G2G3)
- *Quercus stellata - Quercus alba - (Quercus falcata) / Schizachyrium scoparium* Woodland (CEGL004217, G1)
- *Rhus aromatica - Celtis tenuifolia / Carex eburnea* Shrubland (CEGL004393, G3)
- *Schizachyrium scoparium - Bouteloua curtipendula - Rudbeckia missouriensis - Mentzelia oligosperma* Wooded Herbaceous Vegetation (CEGL002251, G2)
- *Schizachyrium scoparium - Sorghastrum nutans - Bouteloua curtipendula - Rudbeckia missouriensis - Hedyotis nigricans* Wooded Herbaceous Vegetation (CEGL002398, G3G4)
- *Schizachyrium scoparium - Sorghastrum nutans - Tradescantia bracteata* Alkaline Bedrock Herbaceous Vegetation (CEGL005280, G1G2)
- *Schizachyrium scoparium - Sporobolus compositus var. compositus - Rudbeckia fulgida var. fulgida* Wooded Herbaceous Vegetation (CEGL004078, G2)
- *Sedum pulchellum - Talinum calcaricum - Leavenworthia* spp. / *Nostoc commune* Herbaceous Vegetation (CEGL004346, G3)
- *Sedum pulchellum - Talinum calycinum - Oenothera linifolia* Shale Herbaceous Vegetation (CEGL004347, G2G3)
- *Sporobolus (neglectus, vaginiflorus) - Leavenworthia exigua var. laciniata - Viola egglestonii* Herbaceous Vegetation (CEGL007772, G1Q)
- *Sporobolus vaginiflorus var. ozarkanus* Ozark Herbaceous Vegetation (CEGL008563, G3?)

DISTRIBUTION

Range: This system is found primarily in the Interior Highlands of the Ozark, Ouachita, and the Interior Low Plateau regions ranging east to southern Ohio and including the Knobs region and Cliff section of Kentucky, the Cumberland Plateau escarpment of Tennessee, the Western Valley of the Tennessee River, and the Moulton Valley of northern Alabama.
Divisions: 202:C; 203:C
Nations: US
Subnations: AL, AR, IL, IN, KY, MO, OH, OK, TN
Map Zones: 43:P, 44:C, 47:C, 48:C, 49:C, 53:C
USFS Ecomap Regions: 221E:CC, 221H:CC, 223B:CC, 223D:CC, 223E:CC, 223F:CC
TNC Ecoregions: 36:C, 38:C, 39:C, 43:C, 44:C, 50:C

SOURCES

References: Baskin and Baskin 2000, Baskin et al. 1995, Comer et al. 2003, Delcourt and Delcourt 1997, DeSelm and Murdock 1993, EPA 2004, Erickson et al. 1942, Evans 1991, Eyre 1980, Homoya 1994, Martin and Houf 1993, Nelson 1985, Nelson 2012, Taft 2009, Taft et al. 1995, USFWS 1974, Ware 2002, Webb et al. 1997, Woods et al. 2002
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722968#references

Description Author: S. Menard, T. Nigh, M. Pyne, mod. J. Drake
Version: 14 Jan 2014
Concept Author: S. Menard, T. Nigh, M. Pyne

Stakeholders: Midwest, Southeast
ClassifResp: Midwest

CHIHUAHUAN GYPSOPHILOUS GRASSLAND AND STEPPE (CES302.732)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: North American Warm Desert (302)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Herbaceous; Tropical/Subtropical [Tropical Xeric]; Temperate [Temperate Xeric]; Alkaline Soil; Gypsiferous; Dwarf-Shrub; Graminoid
Non-Diagnostic Classifiers: Lowland [Foothill]; Lowland [Lowland]; Oligotrophic Soil; Aridic
FGDC Crosswalk: Vegetated, Shrub-dominated, Herbaceous - shrub-steppe, Perennial graminoid steppe
National Mapping Codes: EVT 2122; ESLF 5451; ESP 1122

CONCEPT

Summary: This ecological system is restricted to gypsum outcrops or sandy gypsiferous and often alkaline soils that occur in basins and slopes in the Chihuahuan Desert. Elevation range is from 1100-2000 m. These typically sparse grasslands, steppes or dwarf-shrublands are dominated by a variety of gypsophilous plants, many of which are endemic to these habitats. Characteristic species include *Tiquilia hispidissima, Atriplex canescens, Calylophus hartwegii, Ephedra torreyana, Frankenia jamesii, Bouteloua breviseta, Mentzelia perennis, Nama carnosum, Calylophus hartwegii (= Oenothera hartwegii), Selinocarpus lanceolatus, Sporobolus nealleyi, Sporobolus airoides*, and *Sartwellia flaveriae* with gypsophilous species diagnostic of this system. This system does not include the sparsely vegetated gypsum dunes that are included in North American Warm Desert Active and Stabilized Dune (CES302.744).

Similar Ecological Systems:
- North American Warm Desert Active and Stabilized Dune (CES302.744)

Related Concepts:
- MLRA 42 - Southern Desertic Basin (SD-1) Gyp Uplands (NRCS 2006a) Broader
- MLRA 42 - Southern Desertic Basin (SD-2) Gyp Uplands (NRCS 2006a) Broader
- MLRA 42 - Southern Desertic Basin (SD-3) Gyp Uplands (NRCS 2006a) Broader

DESCRIPTION

Environment: This ecological system is restricted to gypsum outcrops and strongly gypseous soils (Powell and Turner 1974, Henrickson et al. 1985, Meyer 1986, Dick-Peddie 1993). Sites occur in warm, semi-desert and desert regions with hot summers, and occasionally cold winters from the Chihuahuan Desert to eastern Mojave Desert and may extend up into the southern Colorado Plateau (Powell and Turner 1974, Meyer 1986, Dick-Peddie 1993). Elevation range is from 1100-2000 m. Some occurrences may be windswept gypsum "pavement" where much of the gypsum sand has been removed by wind, but these are not open/moving dunes dominated by eolian processes. Substrates are typically fine-textured, alkaline clay soils but include some sandy gypsiferous soils that occur in closed basins in the Chihuahuan Desert, but not gypsum dunes at White Sands National Monument (Reid 1980, Dick-Peddie 1993, Muldavin et al. 2000b). Eolian processes drive the dune system so many of the same common sand scrub plants, e.g., *Atriplex canescens*, may characterize vegetation on both quartz and gypsum active dunes, although some gypsophiles will occur on gypsum dunes (Shields 1956, Reid 1980, 1980, Dick-Peddie 1993).

Vegetation: These typically sparse grasslands, steppes or dwarf-shrublands are dominated by a variety of gypsophilous plants, many of which are endemic to these habitats. Characteristic species include *Tiquilia hispidissima, Atriplex canescens, Calylophus hartwegii, Ephedra torreyana, Frankenia jamesii, Bouteloua breviseta, Mentzelia perennis, Nama carnosum, Calylophus hartwegii (= Oenothera hartwegii), Selinocarpus lanceolatus, Sporobolus nealleyi, Sporobolus airoides*, and *Sartwellia flaveriae*.

Dynamics: Gypsophile endemism is common in the North American deserts, especially the Chihuahuan Desert where much of the region is underlain by limestone, with occasional gypsum exposures. These gypsum deposits are distributed in a discontinuous, island-like fashion that facilitates endemism. Gypsum is a difficult substrate for plants to grow on because it typically forms a hard crust when dry, erodes quickly when wet, and is relatively low in available nutrients. However, a large and diverse group of gypsophilous plants only occur on this substrate, several of which are considered rare and at risk.

This is a substrate-driven ecosystem occurring in extreme environments on chemically harsh substrates. Fire plays little to no role in this ecosystem as vegetation is generally too sparse to carry fire. Normal climate conditions are warm and arid (6-10 inches annually) with drought not uncommon. Climatic fluctuations (precipitation cycles) have been speculated to affect plant vigor and recruitment (Landfire 2007a), but this is not likely significant considering the hardiness of these plants and the harshness of the environments (E. Muldavin pers. comm.). Variation in abundance of subshrubs and grasses is likely more related to fine-scale differences in the soil environment then climatic factors (E. Muldavin pers. comm.). Some occurrences may be windswept, but these are not open/moving dunes with eolian processes. Some occurrences may be gypsum "pavement" or outcrop where much of the gypsum sand has been removed by wind.

Component Associations:
- *Atriplex obovata / Tidestromia carnosa* Dwarf-shrubland (CEGL004575, G2?)
- *Fouquieria splendens / Sporobolus nealleyi* Shrub Herbaceous Vegetation (CEGL001517, GNRQ)

- *Schizachyrium scoparium var. scoparium - Muhlenbergia pungens* Herbaceous Vegetation (CEGL001684, G2)
- *Sporobolus airoides - Scleropogon brevifolius* Herbaceous Vegetation (CEGL001692, G5)
- *Sporobolus nealleyi - Bouteloua eriopoda* Herbaceous Vegetation (CEGL001697, GU)
- *Sporobolus nealleyi - Calylophus hartwegii* Herbaceous Vegetation (CEGL001698, G3)
- *Tidestromia carnosa - Kallstroemia grandiflora* Sparse Vegetation (CEGL004580, G2G3)
- *Tiquilia hispidissima - Yucca torreyi / Sporobolus nealleyi* Dwarf-shrubland (CEGL003959, G2G3)
- *Tiquilia hispidissima / Bouteloua breviseta - Mentzelia humilis* Dwarf-shrubland (CEGL004573, G2)
- *Tiquilia hispidissima / Sporobolus airoides* Dwarf-shrubland (CEGL004574, G2G3)
- *Tiquilia hispidissima / Sporobolus nealleyi* Dwarf-shrubland (CEGL001546, G2)

DISTRIBUTION

Range: This system is found on basins and slopes in the Chihuahuan Desert at elevations ranging from 1100-2000 m.
Divisions: 302:C
Nations: MX, US
Subnations: AZ, MXCH(MX), NM, TX
Map Zones: 25:C, 26:C, 27:P, 28:?
USFS Ecomap Regions: 315A:CC, 315B:CC, 315H:CP, 321A:CC, M313B:CC
TNC Ecoregions: 22:P, 24:C

SOURCES

References: Comer et al. 2003, Dick-Peddie 1993, Henrickson et al. 1985, Landfire 2007a, MacMahon 1988, Meyer 1986, Muldavin et al. 2000b, Muldavin et al. 2002, NRCS 2006a, Powell and Turner 1974, Reid 1980, Shields 1956, TNC 2013
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722940#references
Description Author: NatureServe Western Ecology Team, mod. K.A. Schulz
Version: 14 Jan 2014 **Stakeholders:** Latin America, Southeast, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

COLUMBIA PLATEAU LOW SAGEBRUSH STEPPE (CES304.080)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland [Foothill]; Lowland [Lowland]; Shrubland (Shrub-dominated); Ridge/Summit/Upper Slope; Sideslope; Shallow Soil; Silt Soil Texture; Clay Soil Texture; Aridic; W-Landscape/High Intensity; Low Artemisia spp.
Non-Diagnostic Classifiers: Temperate [Temperate Continental]; Alkaline Soil; Dwarf-Shrub
FGDC Crosswalk: Vegetated, Shrub-dominated, Herbaceous - shrub-steppe, Perennial graminoid steppe
National Mapping Codes: EVT 2124; ESLF 5453; ESP 1124

CONCEPT

Summary: This matrix ecological system is composed of sagebrush dwarf-shrub-steppe that occurs in a variety of shallow-soil habitats throughout eastern Oregon, northern Nevada and southern Idaho. *Artemisia arbuscula ssp. arbuscula* and close relatives (*Artemisia arbuscula ssp. longiloba* and occasionally *Artemisia nova*) form stands that typically occur on mountain ridges and flanks and broad terraces, ranging from 1000 to 3000 m in elevation. Substrates are shallow, fine-textured soils, poorly drained clays, shallow-soiled areas, almost always very stony, characterized by recent rhyolite or basalt. Other shrubs and dwarf-shrubs present may include *Purshia tridentata*, *Eriogonum* spp., and other species of *Artemisia*. Common graminoids include *Festuca idahoensis*, *Koeleria macrantha*, *Pseudoroegneria spicata*, and *Poa secunda*. Many forbs also occur and may dominate the herbaceous vegetation, especially at the higher elevations. Isolated individuals of *Juniperus occidentalis* (western juniper) and *Cercocarpus ledifolius* (mountain-mahogany) can often be found in this system.
Related Concepts:
- Antelope Bitterbrush - Bluebunch Wheatgrass (104) (Shiflet 1994) Intersecting. This system may have small inclusions of *Purshia tridentata* shrublands.
- Antelope Bitterbrush - Idaho Fescue (105) (Shiflet 1994) Intersecting. This system may have small inclusions of *Purshia tridentata* shrublands.
- Low Sagebrush (406) (Shiflet 1994) Intersecting

DESCRIPTION

Environment: This matrix ecological system is composed of sagebrush dwarf-shrub-steppe that occurs in a variety of shallow-soil habitats throughout eastern Oregon, northern Nevada and southern Idaho. Stands typically occur on mountain ridges and flanks and broad terraces, ranging from 1000 to 3000 m in elevation. Substrates are shallow, fine-textured soils, poorly drained clays, shallow-soiled areas, almost always very stony, characterized by recent rhyolite or basalt.
Vegetation: *Artemisia arbuscula ssp. arbuscula* and close relatives (*Artemisia arbuscula ssp. longiloba* and occasionally *Artemisia nova*) form stands. Other shrubs and dwarf-shrubs present may include *Purshia tridentata, Eriogonum* spp., and other species of *Artemisia*. Common graminoids include *Festuca idahoensis, Koeleria macrantha, Pseudoroegneria spicata*, and *Poa secunda*. Many forbs also occur and may dominate the herbaceous vegetation, especially at the higher elevations. Isolated individuals of *Juniperus occidentalis* (western juniper) and *Cercocarpus ledifolius* (mountain-mahogany) can often be found in this system.

Component Associations:
- *Artemisia arbuscula ssp. arbuscula - Purshia tridentata / Pseudoroegneria spicata - Festuca idahoensis* Shrub Herbaceous Vegetation (CEGL001518, G2G3)
- *Artemisia arbuscula ssp. arbuscula / Achnatherum thurberianum* Shrub Herbaceous Vegetation (CEGL001413, G4G5)
- *Artemisia arbuscula ssp. arbuscula / Festuca idahoensis* Shrub Herbaceous Vegetation (CEGL001409, G5)
- *Artemisia arbuscula ssp. arbuscula / Leymus salinus ssp. salmonis* Shrub Herbaceous Vegetation (CEGL001410, G1G2Q)
- *Artemisia arbuscula ssp. arbuscula / Poa secunda* Shrub Herbaceous Vegetation (CEGL001411, G5)
- *Artemisia arbuscula ssp. arbuscula / Pseudoroegneria spicata* Shrub Herbaceous Vegetation (CEGL001412, G5)
- *Artemisia arbuscula ssp. longiloba / Festuca idahoensis* Shrub Herbaceous Vegetation (CEGL001522, G2)
- *Artemisia arbuscula ssp. longiloba / Pascopyrum smithii* Shrub Herbaceous Vegetation (CEGL001415, GU)
- *Artemisia arbuscula ssp. longiloba / Poa secunda* Shrub Herbaceous Vegetation (CEGL001523, G3Q)
- *Artemisia arbuscula ssp. longiloba / Pseudoroegneria spicata* Shrub Herbaceous Vegetation (CEGL001416, GNR)
- *Artemisia arbuscula ssp. longiloba* Shrubland (CEGL001414, G4G5)

DISTRIBUTION

Range: This system is found throughout the basins of eastern Oregon and southern Idaho, south into northern Nevada and northeastern California.
Divisions: 304:C
Nations: US
Subnations: CA, ID, MT?, NV, OR, WY?

Map Zones: 1:?, 7:C, 8:C, 9:C, 10:C, 17:?, 18:C, 19:C, 21:P
USFS Ecomap Regions: 331A:CC, 341E:CP, 341G:CC, 342B:CC, 342C:CC, 342D:CC, 342E:CP, 342H:CC, 342I:CC, 342J:CC, M242C:CC, M242D:CC, M261D:CC, M261G:CC, M331D:CC, M332A:CC, M332E:CC, M332F:CC, M332G:CC, M333A:??, M341A:CC
TNC Ecoregions: 6:C, 11:C

SOURCES

References: West 1983a, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.740108#references
Description Author: J. Kagan
Version: 08 Sep 2004 **Stakeholders:** West
Concept Author: J. Kagan **ClassifResp:** West

COLUMBIA PLATEAU STEPPE AND GRASSLAND (CES304.083)

CLASSIFIERS

Conf.: 3 - Weak **Classification Status:** Standard
Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland [Foothill]; Lowland [Lowland]; Sideslope; Very Shallow Soil; Landslide; Xeromorphic Shrub; Graminoid
FGDC Crosswalk: Vegetated, Shrub-dominated, Herbaceous - shrub-steppe, Perennial graminoid steppe
National Mapping Codes: EVT 2123; ESLF 5452; ESP 1123

CONCEPT

Summary: These grasslands are similar floristically to Inter-Mountain Basins Big Sagebrush Steppe (CES304.778) but are defined by a more frequent fire regime and the absence or low cover of shrubs over large areas, occasionally entire landforms. These are extensive grasslands, not grass-dominated patches within the sagebrush shrub-steppe ecological system. This system occurs throughout much of the Columbia Plateau and is found at slightly higher elevations farther south. Soils are variable, ranging from relatively deep, fine-textured often with coarse fragments, and non-saline often with a microphytic crust, to stony volcanic-derived clays to alluvial sands. This grassland is dominated by perennial bunch grasses and forbs (>25% cover), sometimes with a sparse (<10% cover) shrub layer; *Chrysothamnus viscidiflorus, Ericameria nauseosa, Tetradymia* spp., or *Artemisia* spp. may be present in disturbed stands. Associated graminoids include *Achnatherum hymenoides, Elymus elymoides, Elymus lanceolatus ssp. lanceolatus, Hesperostipa comata, Festuca idahoensis, Koeleria macrantha, Poa secunda,* and *Pseudoroegneria spicata*. Common forbs are *Phlox hoodii, Arenaria* spp., and *Astragalus* spp. Areas with deeper soils are rare because of conversion to other land uses. The rapid fire-return regime of this ecological system maintains a grassland structure by retarding shrub invasion, and landscape isolation and fragmentation limit seed dispersal of native shrub species. Fire frequency is presumed to be less than 20 years. Through isolation from a seed source, combined with repeated burning, these are "permanently" (more than 50 years) converted to grassland.
Classification Comments: How this differs from Columbia Basin Palouse Prairie (CES304.792) is unclear.
Similar Ecological Systems:
- Inter-Mountain Basins Big Sagebrush Steppe (CES304.778)
- Inter-Mountain Basins Semi-Desert Grassland (CES304.787)

Related Concepts:
- Bluegrass Scabland (106) (Shiflet 1994) Intersecting
- Threetip Sagebrush (404) (Shiflet 1994) Intersecting

DESCRIPTION

Environment: These are extensive grasslands, not grass-dominated patches, within the sagebrush shrub-steppe ecological system. This system occurs throughout much of the Columbia Plateau and is found at slightly higher elevations farther south. Soil depth and soil texture within precipitation zones largely drive the distribution of shrub-steppe and grassland (WNHP 2011). Geographically (climatically), this steppe system is associated with Inter-Mountain Basins Big Sagebrush Steppe (CES304.778), rings the driest portion of the basin that supports the big sagebrush shrubland and the semi-desert shrub-steppe systems and is bounded by montane woodlands and the Palouse prairie. It is found in landscapes that favor frequent ignition sources and fuels that spread fire, and few natural firebreaks. Winter precipitation dominates and promotes cool-season grasses.

Biological soil crust is very important in this ecological system (WNHP 2011). Soils are variable, ranging from relatively deep, fine-textured often with coarse fragments, and non-saline often with a microphytic crust, to stony volcanic-derived clays to alluvial sands. Burrowing animals and their predators likely played important roles in creating small-scale patch patterns (WNHP 2011).
Vegetation: This grassland is dominated by perennial bunch grasses and forbs (>25% cover), sometimes with a sparse (<10% cover) shrub layer; *Chrysothamnus viscidiflorus, Ericameria nauseosa, Tetradymia* spp., or *Artemisia* spp. may be present in disturbed stands. Associated graminoids include *Achnatherum hymenoides, Elymus elymoides, Elymus lanceolatus ssp. lanceolatus, Hesperostipa comata, Festuca idahoensis, Koeleria macrantha, Poa secunda,* and *Pseudoroegneria spicata*. Common forbs are *Phlox hoodii, Arenaria* spp., and *Astragalus* spp.
Dynamics: These grasslands are defined by a more frequent fire regime and the absence or low cover of shrubs over large areas, occasionally entire landforms. The historic frequency was 30-100 years (Landfire 2007a). The natural fire regime of this ecological system likely maintains a patchy distribution of shrubs so the general aspect of the vegetation is a grassland. Post-fire shrub recruitment is limited and rate is estimated to be 25 acres in 50 years under ideal conditions for *Artemisia tridentata* (WNHP 2011). These shrubs produce large quantities of small seeds beginning at age 3-4 years of which 90% of the seed is dispersed within 9 m (30 feet) of the parent and few seeds are carried more than 30 m (100 feet) (Tirmenstein 1999c).

Ecosystems in the Columbia Basin are more sensitive to livestock grazing than grasslands in the Great Plains as they did not evolve with the same duration, seasonality, and severity of large native ungulate grazing (Mack and Thompson 1982, Burkhart 1996). In general, grazing was dispersed and during the winter and spring when forage was available. Shrubs may increase following heavy grazing and/or with fire suppression, particularly in moist portions in the northern Columbia Plateau where it forms a landscape

mosaic pattern with shallow-soil scabland shrublands. Microphytic crust is very important in this ecological system.

DISTRIBUTION

Range: This system occurs throughout the Columbia Plateau region, from north-central Idaho, south and west into Washington, Oregon, southern Idaho, and northern Nevada. Whether it also occurs in northeastern California, in the western ranges of Wyoming, or the central Wyoming Basins is unclear.
Divisions: 304:C; 306:C
Nations: US
Subnations: CA?, ID, MT?, NV, OR, UT?, WA, WY?
Map Zones: 7:?, 8:C, 9:C, 10:C, 12:P, 17:?, 18:C
USFS Ecomap Regions: 331A:CC, 341E:CP, 341G:CC, 342B:CC, 342C:CC, 342D:CC, 342H:CC, 342I:CC, 342J:CC, M242C:CC, M242D:CP, M261G:CC, M331A:??, M332A:CC, M332E:C?, M332F:C?, M332G:CC, M333A:PP
TNC Ecoregions: 4:C, 6:C, 8:C, 9:C, 10:P, 11:C

SOURCES

References: Burkhardt 1996, Daubenmire 1970, Johnson and Swanson 2005, Landfire 2007a, Mack and Thompson 1982, Pellant 1990, Pellant 1996, Quinn 2004, Shiflet 1994, Tirmenstein 1999c, TNC 2013, Vander Haegen et al. 2000, Vander Haegen et al. 2001, Western Ecology Working Group n.d., WNHP 2011
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.740175#references
Description Author: R. Crawford, mod. M.S. Reid and K.A. Schulz
Version: 14 Jan 2014 **Stakeholders:** West
Concept Author: R. Crawford **ClassifResp:** West

CUMBERLAND SANDSTONE GLADE AND BARRENS (CES202.337)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Woody-Herbaceous; Rock Outcrops/Barrens/Glades; Acidic Soil
FGDC Crosswalk: Vegetated, Tree-dominated, Sparse tree canopy, Mixed evergreen-deciduous sparse tree canopy
National Mapping Codes: EVT 2398; ESLF 5414; ESP 1398

CONCEPT

Summary: This system encompasses a complex of sparsely vegetated rock outcrops, perennial grasslands, and woodlands on shallow soils on the Cumberland Plateau of Kentucky, Tennessee, Alabama, and Georgia. Herbaceous plants, including *Diamorpha smallii* and *Minuartia glabra*, are typical of the outcrops in Tennessee. In Alabama, *Bigelowia nuttallii* and *Schizachyrium scoparium* are important. *Pinus virginiana* and *Acer rubrum* are typical of the current condition of many of the woodlands surrounding these outcrops on the Cumberland Plateau. This dominance pattern may be due to lack of disturbance. *Pinus rigida*, *Pinus echinata*, and/or *Quercus prinus* may also occur. Scattered shrubs, such as *Gaylussacia* spp., *Vaccinium arboreum*, and *Chionanthus virginicus*, occur on the margins in patches of deeper soil. Various mosses and fruticose lichens such as *Cladonia* spp. and *Cladina* spp. may be prominent in some examples. To the west, in the Interior Highlands (Ozark, Ouachita, and Interior Low Plateau regions), this system is replaced by Central Interior Highlands Dry Acidic Glade and Barrens (CES202.692) (both are found in Kentucky, with the latter in the Shawnee Hills of the Interior Low Plateau).

Similar Ecological Systems:
- Central Interior Highlands Dry Acidic Glade and Barrens (CES202.692)

Related Concepts:
- Cumberland Mountains xeric pine woodland (Evans 1991) Finer
- Virginia Pine: 79 (Eyre 1980) Finer

DESCRIPTION

Environment: This suite of glade, barren, and rock outcrop communities are found on flat to gently sloping expanses of sandstone and conglomerate (Edwards et al. 2013) on the surface of the Cumberland Plateau and related formations from Virginia south and west to Alabama. As the cement that holds the sand and conglomerate particles together dissolves and is transported away, sandy particles may collect in crevices and depressions to form sandy soil (Quarterman et al. 1993, Edwards et al. 2013). The sites of this system may be saturated for short times after rainfall, but also experience high temperatures in the summer, creating harsh conditions. Some examples of this system may occur adjacent to sandstone cliff faces.

Vegetation: These sandstone glades occur in a matrix of pine-oak forests. *Pinus virginiana* and *Acer rubrum* are typical of the woodlands surrounding these outcrops on the Cumberland Plateau (Perkins 1981). This dominance pattern may be due to lack of disturbance. Other trees may include *Pinus rigida, Pinus echinata*, and/or *Quercus prinus*. A perennial grass zone is typically present, which contains *Schizachyrium scoparium, Andropogon virginicus, Danthonia sericea*, and *Dichanthelium dichotomum*, in varying proportions. Herbaceous plants which are typical of the outcrops in Tennessee include *Diamorpha smallii* and *Minuartia glabra*. In Alabama, *Bigelowia nuttallii* is important, forming stands with other forbs (Perkins 1981, A. Schotz pers. comm.). Other herbaceous plants which may be found include *Liatris microcephala, Coreopsis pulchra, Eurybia surculosa (= Aster surculosus), Hypericum gentianoides, Talinum mengesii, Nuttallanthus canadensis (= Linaria canadensis), Opuntia humifusa var. humifusa, Sporobolus vaginiflorus*, and *Erigeron strigosus*. Nonvascular plants include *Aulacomnium palustre, Campylopus pilifer, Grimmia* spp., *Polytrichum commune, Polytrichum juniperinum*, and fruticose lichens such as *Cladonia* spp. and *Cladina* spp. Scattered shrubs, such as *Gaylussacia* spp., *Vaccinium arboreum*, and *Chionanthus virginicus*, along with oak and hickory regeneration, occur on the margins of more open areas, in patches of deeper soil.

Dynamics: Severe droughts kill tree saplings growing in cracks and potholes, helping to retain the open character of the glades (Quarterman et al. 1993). There is an apparent zonation or patchiness to glade/barren vegetation, with different zones that may be identified by their characteristic plant species (Quarterman et al. 1993). These zones are apparently relatively stable, with woody plant encroachment evident only in relation to the invasion of shrubs and trees into potholes or crevices where soil accumulates more rapidly.

Component Associations:
- *Bigelowia nuttallii - Coreopsis pulchra - Liatris microcephala* Herbaceous Vegetation (CEGL004622, G2)
- *Diamorpha smallii - Minuartia glabra* Sandstone Herbaceous Vegetation (CEGL004343, G2G3)
- *Kalmia latifolia - Gaylussacia (baccata, brachycera)* Cumberland Shrubland (CEGL008470, G3)
- *Pinus virginiana - Pinus (rigida, echinata) - (Quercus prinus) / Vaccinium pallidum* Forest (CEGL007119, G3)
- *Schizachyrium scoparium - Andropogon (gyrans, ternarius, virginicus)* Herbaceous Vegetation (CEGL007707, G3?)
- *Schizachyrium scoparium - Danthonia sericea - Liatris microcephala - (Eurybia surculosa)* Wooded Herbaceous Vegetation (CEGL004061, G3)

DISTRIBUTION

Range: This system is found in the Cumberland Plateau of Kentucky, Tennessee, Virginia, Alabama, and Georgia.
Divisions: 202:C
Nations: US
Subnations: AL, GA, KY, TN, VA
Map Zones: 48:C, 53:C
USFS Ecomap Regions: 221H:CC
TNC Ecoregions: 50:C

SOURCES

References: Comer et al. 2003, DeSelm and Murdock 1993, Duffey et al. 1974, Edwards et al. 2013, Estes et al. 1979, Evans 1991, Eyre 1980, McKinney and Lockwood 1999, Murdock pers. comm., Noss 2013, Perkins 1981, Quarterman et al. 1993, Schotz pers. comm., Taft 1997, Taft 2009, Taft et al. 1995, TNC 1996c, Wiens and Dyer 1975
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723168#references
Description Author: M. Pyne, R. Evans, C. Nordman
Version: 14 Jan 2014 **Stakeholders:** East, Midwest, Southeast
Concept Author: M. Pyne, R. Evans, C. Nordman **ClassifResp:** Southeast

EDWARDS PLATEAU CARBONATE GLADE AND BARRENS (CES303.655)

CLASSIFIERS

Classification Status: Standard

Primary Division: Western Great Plains (303)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland; Wetland
Diagnostic Classifiers: Herbaceous; Moss/Lichen (Nonvascular); Sedimentary Rock; Limestone; Very Shallow Soil
National Mapping Codes: ESLF 3141

CONCEPT

Summary: This system occurs on thin soils over massive hard-bedded limestone formations in the Edwards Plateau of Texas. This is a sparsely vegetated system, but species such as *Sedum* spp. can form bands of glades that alternate with areas of woodlands and forests. Some of the depressions hold moisture for longer periods than the surrounding landscape, providing for the establishment of a diversity of spring-blooming annuals. Some characteristic plants include *Lesquerella gordonii, Lesquerella ovalifolia, Schizachyrium scoparium, Sedum nuttallianum, Sporobolus vaginiflorus (var. ozarkanus* and *var. vaginiflorus)*, and *Sedum pulchellum*.
Classification Comments: Further field investigation is needed to better develop the association-level information for this system.

DESCRIPTION

Environment: These glades and barrens are found in xeric sites on limestone rock substrates. These include non-slope-forming members of the Glen Rose Formation or areas of massive limestones such as Edwards limestone. Landforms are usually level to gently sloping uplands on plateau tops or level benches between slopes in stairstep topography. Soils are very shallow; there is sometimes very little soil development over rocky substrates (Elliott 2011).
Vegetation: These are generally small-patch occurrences with very sparse herbaceous cover, sometimes with occasional scattered shrubs. These sites generally co-occur with savannas, representing the shallowest soils sites, often on exposed or near-exposed limestone. They may occur as bands with adjacent grasslands, shrublands, or open woodlands (Elliott 2011). The sparse cover of vegetation is usually limited to cracks or depressions in the limestone bedrock where soil has developed and accumulated. Some of the depressions hold moisture for longer periods than the surrounding landscape, providing for the establishment of a diversity of spring annuals. Herbaceous cover may include species such as *Chaetopappa bellidifolia, Evax prolifera, Croton monanthogynus, Sedum nuttallianum, Sedum pulchellum, Sporobolus vaginiflorus (var. ozarkanus* and *var. vaginiflorus), Centaurium texense, Spermolepis inermis, Chamaesyce serpens, Heliotropium tenellum, Lesquerella gordonii, Lesquerella ovalifolia*, and others (Elliott 2011).

A possible outlier (the system occurring well outside the ecoregion within which it is normally found) of this system consists of small-patch occurrences of very sparse herbaceous cover found on very shallow soils over chalk outcrops in isolated locales of northern Texas (Gober, Annona, Austin Chalk, and Pecan Gap formation). Species include *Bouteloua rigidiseta, Sedum pulchellum, Sporobolus vaginiflorus, Nostoc commune, Penstemon cobaea*, and *Lesquerella* spp. Adjacent woodlands or savannas on thin-soiled chalk ridges may contain *Quercus shumardii, Quercus muehlenbergii, Celtis* sp., *Cornus drummondii, Viburnum rufidulum, Fraxinus texensis*, and others (Elliott 2011).
Dynamics: Processes controlling this system are unclear; however, erosion likely plays a major role. Erosion may be exacerbated in some situations by removal of biomass through overgrazing. Erosion mediates the occurrence of this system through its effects on soil depth. As is true for all the systems, there is a gradient from moister representatives of this system in the east to drier representatives in the west.

Component Associations:
- *Lesquerella (gordonii, ovalifolia) - Schizachyrium scoparium* Herbaceous Vegetation (CEGL004917, G2G3)
- *Sedum nuttallianum - Sporobolus vaginiflorus (var. ozarkanus, var. vaginiflorus) - Sedum pulchellum* Herbaceous Vegetation (CEGL004729, G3)
- *Sedum pulchellum - Allium drummondii - Talinum parviflorum - Centaurium texense / Nostoc commune* Herbaceous Vegetation (CEGL004874, G1G2)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Edwards Plateau Cliff (CES303.653)
- Edwards Plateau Dry-Mesic Slope Forest and Woodland (CES303.656)
- Edwards Plateau Floodplain Terrace (CES303.651)
- Edwards Plateau Limestone Savanna and Woodland (CES303.660)
- Edwards Plateau Limestone Shrubland (CES303.041)
- Edwards Plateau Mesic Canyon (CES303.038)
- Edwards Plateau Riparian (CES303.652)

DISTRIBUTION

Range: This system occurs throughout the Edwards Plateau of Texas.

Divisions: 303:C
Nations: US
Subnations: TX
Map Zones: 35:C
USFS Ecomap Regions: 255E:CC, 315C:C?, 315D:CC, 315G:C?
TNC Ecoregions: 29:C

SOURCES

References: Elliott 2011, Southeastern Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.791381#references
Description Author: J. Teague, mod L. Elliott
Version: 24 Feb 2011 **Stakeholders:** Midwest, Southeast, West
Concept Author: L. Elliott and J. Teague **ClassifResp:** Southeast

GREAT LAKES ALVAR (CES201.721)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Laurentian-Acadian (201)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Non-Diagnostic Classifiers: Intermittent Flooding; Flat; Glaciated uplands; Rock Outcrops/Barrens/Glades; Limestone; Extensive Wet Flat [Lakeshore]; Isolated Wetland [Partially Isolated]; Very Shallow Soil
FGDC Crosswalk: Vegetated, Shrub-dominated, Herbaceous - shrub-steppe, Perennial graminoid steppe
National Mapping Codes: EVT 2409; ESLF 5458; ESP 1409

CONCEPT

Summary: Alvars are natural systems of humid and subhumid climates, centered around areas of glaciated horizontal limestone/dolomite (dolostone) bedrock pavement with a discontinuous thin soil mantle. These communities are characterized by distinctive flora and fauna with less than 60% tree cover that is maintained by associated geologic, hydrologic, and other landscape processes. In particular, all forms of alvar tend to flood each spring, then experience moderate to severe drought in summer months. They include open pavement, grassland, and shrubland/woodland types. Alvar communities occur in an ecological matrix with similar bedrock and hydrologically influenced communities. Almost all of North America's alvars occur within the Great Lakes basin, primarily in an arc along the Niagaran Escarpment from northern Lake Michigan across northern Lake Huron and eastern Ontario and northwestern New York state.

Related Concepts:
- Eastern Redcedar: 46 (Eyre 1980) Finer
- Northern White-Cedar: 37 (Eyre 1980) Finer

DESCRIPTION

Environment: Alvars are found near Great Lakes shores where flat limestone or dolostone bedrock pavement is exposed. Soils are shallow and discontinuous and tend to accumulate in cracks and shallow depressions in the bedrock. Where present, they are <25 cm deep. In the spring, soils are saturated or even flooded where shallow depressions occur. The thin soils dry quickly and are usually very dry by late summer.

Dynamics: The thin soils and large changes in soil moisture during the growing season shape the vegetation of alvars. These conditions favor herbaceous species over woody species. The composition of alvars varies largely with the soil moisture from seasonal herbaceous wetlands to dry grassy areas to sparsely vegetation bedrock. Small shrublands or stunted woodlands can be found where soil accumulates (Reschke et al. 1998). Fires do not carry well on alvars in most years but they did occur with low frequency (Landfire 2007a). Woody species grow slowly on alvars, so even low frequency fires limited their abundance.

Component Associations:
- *Acer saccharum - Ostrya virginiana - Carya ovata - Quercus rubra* Limestone Woodland (CEGL005059, G3G4)
- *Carya ovata / Zanthoxylum americanum / Panicum philadelphicum - Carex pensylvanica* Wooded Herbaceous Vegetation (CEGL005230, GNR)
- *Danthonia spicata - Poa compressa - (Schizachyrium scoparium)* Herbaceous Vegetation (CEGL005100, G2?)
- *Deschampsia caespitosa - (Sporobolus heterolepis, Schizachyrium scoparium) - Carex crawei - Packera paupercula* Herbaceous Vegetation (CEGL005110, G2)
- *Juniperus communis - (Juniperus virginiana) - Rhus aromatica - Viburnum rafinesquianum / Oligoneuron album* Shrubland (CEGL005212, G3)
- *Juniperus horizontalis - Dasiphora fruticosa ssp. floribunda / Schizachyrium scoparium - Carex richardsonii* Dwarf-shrubland (CEGL005236, G2)
- *Juniperus virginiana / Ranunculus fascicularis* Woodland (CEGL005122, G3?)
- *Picea glauca - Thuja occidentalis - Juniperus communis / Iris lacustris - Carex eburnea* Shrubland (CEGL005211, G1G2)
- *Pinus banksiana - Thuja occidentalis - Picea glauca / Juniperus communis* Woodland (CEGL005126, G2?)
- *Sporobolus heterolepis - Schizachyrium scoparium - (Carex scirpoidea) / (Juniperus horizontalis)* Herbaceous Vegetation (CEGL005234, G2)
- *Sporobolus neglectus - Sporobolus vaginiflorus - Isanthus brachiatus - Panicum philadelphicum - (Poa compressa)* Alvar Herbaceous Vegetation (CEGL005235, G2)
- *Thuja occidentalis - Pinus banksiana / Dasiphora fruticosa ssp. floribunda / Clinopodium arkansanum* Wooded Herbaceous Vegetation (CEGL005132, G1G2)
- *Tortella tortuosa - Cladonia pocillum - Placynthium* spp. Sparse Vegetation (CEGL005192, G2)

DISTRIBUTION

Range: Alvars occur within the Great Lakes basin.
Divisions: 201:C

Nations: CA, US
Subnations: MI, NY, OH, ON, WI
Map Zones: 41:C, 50:C, 51:C, 52:C, 63:P, 64:C
USFS Ecomap Regions: 211Ee:CCC, 212Hl:CCC, 212Rc:CCC, 212Re:CCC, 212Tb:CCC, 212Te:CCC, 222Ie:CCC, 222U:CC
TNC Ecoregions: 48:C, 64:C

SOURCES

References: Albert 1990, Comer et al. 2003, Eyre 1980, Kost et al. 2007, Landfire 2007a, Reschke et al. 1998
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722949#references
Description Author: C. Reschke, mod. S. Gawler and J. Drake
Version: 14 Jan 2014 **Stakeholders:** Canada, East, Midwest
Concept Author: C. Reschke **ClassifResp:** Midwest

INTER-MOUNTAIN BASINS BIG SAGEBRUSH STEPPE (CES304.778)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland [Lowland]; Deep Soil; Aridic; Xeromorphic Shrub; Bunch grasses; Artemisia tridentata ssp. tridentata
Non-Diagnostic Classifiers: Lowland [Foothill]; Plain; Plateau; Woody-Herbaceous; Sideslope; Temperate [Temperate Continental]; Alkaline Soil; Forb; Graminoid
FGDC Crosswalk: Vegetated, Shrub-dominated, Herbaceous - shrub-steppe, Perennial graminoid steppe
National Mapping Codes: EVT 2125; ESLF 5454; ESP 1125

CONCEPT

Summary: This widespread matrix-forming ecological system occurs throughout much of the Columbia Plateau and northern Great Basin, east into the Wyoming Basins, central Montana, and north and east onto the western fringe of the Great Plains in Montana and South Dakota. It is found at slightly higher elevations farther south. In central Montana, this system differs slightly, with more summer rain than winter precipitation, more precipitation annually, and it occurs on glaciated landscapes. Soils are typically deep and non-saline, often with a microphytic crust. This shrub-steppe is dominated by perennial grasses and forbs (>25% cover) with *Artemisia tridentata ssp. tridentata* (this is not at all important in Wyoming occurrences), *Artemisia tridentata ssp. xericensis*, *Artemisia tridentata ssp. wyomingensis*, *Artemisia tripartita ssp. tripartita* (Snake River valley in Wyoming), *Artemisia cana ssp. cana*, and/or *Purshia tridentata* dominating or codominating the open to moderately dense (10-40% cover) shrub layer. *Atriplex confertifolia*, *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, *Sarcobatus vermiculatus*, *Tetradymia* spp., or *Artemisia frigida* may be common especially in disturbed stands. In Montana and Wyoming, stands are more mesic, with more biomass of grass, have less shrub diversity than stands farther west, and 50 to 90% of the occurrences are dominated by *Artemisia tridentata ssp. wyomingensis* with *Pascopyrum smithii*. In addition, *Bromus japonicus* and *Bromus tectorum* are indicators of disturbance in the Intermountain West. Associated graminoids can include *Achnatherum hymenoides*, *Calamagrostis montanensis*, *Elymus lanceolatus ssp. lanceolatus*, *Koeleria macrantha*, *Poa secunda*, *Pascopyrum smithii*, *Hesperostipa comata*, *Nassella viridula*, *Bouteloua gracilis*, and *Pseudoroegneria spicata*. Important rhizomatous species include *Carex filifolia* and *Carex duriuscula*, which are very common and important in the eastern distribution of this system in both Wyoming and Montana. *Festuca idahoensis* is uncommon in this system, although it does occur in areas of higher elevations/precipitation; *Festuca campestris* is also uncommon. In Wyoming, both *Nassella viridula* and *Pseudoroegneria spicata* rarely occur, with the latter typically found in eastern Wyoming on ridgetops and rocky slopes outside of this system. In Montana, there is an absence of *Festuca* spp., except *Vulpia octoflora*. Common forbs are *Phlox hoodii*, *Arenaria* spp., *Opuntia* spp., *Sphaeralcea coccinea*, *Dalea purpurea*, *Liatris punctata*, and *Astragalus* spp. Areas with deeper soils more commonly support *Artemisia tridentata ssp. tridentata* but have largely been converted for other land uses. The natural fire regime of this ecological system likely maintains a patchy distribution of shrubs, so the general aspect of the vegetation is a grassland. Shrubs may increase following heavy grazing and/or with fire suppression, particularly in moist portions of the northern Columbia Plateau where it forms a landscape mosaic pattern with shallow-soil scabland shrublands. Where fire frequency has allowed for shifts to a native grassland condition, maintained without significant shrub invasion over a 50- to 70-year interval, the area would be considered Columbia Basin Foothill and Canyon Dry Grassland (CES304.993).
Classification Comments: *Artemisia cana ssp. cana* is listed as a component shrub of this system, but this statement needs a bit of review as to whether it is accurate. In addition, in Wyoming and Montana, *Artemisia tripartita ssp. tripartita* associations are not part of this system but occur at higher elevations as components of Inter-Mountain Basins Montane Sagebrush Steppe (CES304.785)%%. Farther west, they are included in this system (CES304.778), but perhaps this should be reviewed by ecologists familiar with the Columbia Basin region.
Similar Ecological Systems:
- Columbia Basin Foothill and Canyon Dry Grassland (CES304.993)
- Columbia Plateau Steppe and Grassland (CES304.083)
- Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland (CES306.040)

Related Concepts:
- AB Antelope-brush Shrub/Grassland (Ecosystems Working Group 1998) Broader
- Antelope Bitterbrush - Bluebunch Wheatgrass (104) (Shiflet 1994) Intersecting. *Purshia tridentata* shrublands are included in this ecological system.
- Antelope Bitterbrush - Idaho Fescue (105) (Shiflet 1994) Intersecting. *Purshia tridentata* shrublands are included in this ecological system.
- Basin Big Sagebrush (401) (Shiflet 1994) Broader. This is the primary ecological system crosswalking to this SRM type.
- Big Sagebrush - Bluebunch Wheatgrass (314) (Shiflet 1994) Intersecting
- Big Sagebrush - Idaho Fescue (315) (Shiflet 1994) Intersecting
- Bitterbrush (210) (Shiflet 1994) Intersecting. *Purshia tridentata* steppe is included in this ecological system.

- Bitterbrush - Bluebunch Wheatgrass (317) (Shiflet 1994) Finer. Bitterbrush-dominated communities are included in the big sage steppe and shrubland systems.
- Bitterbrush - Idaho Fescue (318) (Shiflet 1994) Finer. Bitterbrush-dominated communities are included in the big sage steppe and shrubland systems.
- Bitterbrush - Rough Fescue (319) (Shiflet 1994) Finer. Bitterbrush-dominated communities are included in the big sage steppe and shrubland systems.
- Sagebrush - Grass (612) (Shiflet 1994) Intersecting. *Artemisia tridentata ssp. tridentata* steppe communities are included in this ecological system.
- SS Big Sagebrush Shrub/Grassland (Ecosystems Working Group 1998) Broader. low-elevation sites; high elevation
- Threetip Sagebrush (404) (Shiflet 1994) Intersecting. *Artemisia tripartita ssp. tripartita* shrublands are included in this ecological system in the northern Great Basin, Columbia Plateau and northern Rockies regions.
- Threetip Sagebrush - Idaho Fescue (324) (Shiflet 1994) Broader. *Artemisia tripartita ssp. tripartita* communities are included in this ecological system.

DESCRIPTION

Environment: This widespread matrix-forming shrub-steppe occurs throughout much of the Columbia Plateau and northern Great Basin, east into the Wyoming Basins and central Montana. In central Montana, there is more summer rain than winter precipitation, more precipitation annually, and it occurs on glaciated landscapes. Soils are typically deep and non-saline, often with a microphytic crust.

Dynamics: The natural fire regime of this ecological system likely maintains patchy distribution of shrubs, so the general aspect of the vegetation is a grassland. Shrubs may increase following heavy grazing and/or with fire suppression, particularly in moist portions of the northern Columbia Plateau where it forms a landscape mosaic pattern with shallow-soil scabland shrublands. Where fire frequency has allowed for shifts to a native grassland condition, maintained without significant shrub invasion over a 50- to 70-year interval, the area would be considered Columbia Basin Foothill and Canyon Dry Grassland (CES304.993).

Response to grazing can be variable depending on the type of grazer and the season in which grazing occurs. *Hesperostipa comata* can decrease in abundance in response to either grazing or fire. In central and eastern Montana (and possibly elsewhere), complexes of prairie dog towns are common in this ecological system. Microphytic crust is very important in this ecological system.

Complex ecological interactions of fire regimes, grazing history, and climate patterns result in equally complex patterns of species structure and composition in *Artemisia tridentata* stands. Prolonged drought on the more xeric sites may reduce shrub cover. Flooding may also cause mortality if the soil remains saturated for an extended period of time. The Aroga moth is capable of defoliating large acreages (i.e., >1000 acres, but usually 10-100 acres). Heavy grazing by wildlife can remove the fine fuels that support mixed-severity fires and result in woody fuel buildup that leads to severe, stand-replacement fires (Landfire BpS 1210800) (Landfire 2007a).

Shrubs in big sagebrush steppe are reduced by fire as *Artemisia tridentata* does not sprout after burning (Tirmenstein 1999c). Excessive grazing may decrease fire frequency due to consumption of herbaceous forage (fine fuels) resulting in increased shrub density. Conversely, increasing fire frequency significantly will eliminate the shrubs from the stands (Daubenmire 1970, Tirmenstein 1999c). With a change in fire frequency, species composition will be altered as well (West 1983c). Locally in areas with a high fire frequency (every 2-5 years), perennial grasses and shrubs are eliminated and non-native annual grasses dominate. At fire-return intervals of 10-30 years, short-lived resprouting shrubs such as *Chrysothamnus* or *Tetradymia* spp. dominate. At fire-return intervals of 30-70 years, a mixture of perennial bunch grasses and non-sprouting shrubs is maintained (Johnson 2000b). Finally, in the complete absence of fire, deep-rooted shrubs such as *Artemisia tridentata* become dominant. At higher-elevation sites with absence of fire (>100 years), *Pinus monophylla* and *Juniperus* spp. trees may invade and eventually dominate sites (Tirmenstein 1999c). Alternatively, Bukowski and Baker (2013) concludes that *Artemisia tridentata* spp. *wyomingensis* steppe fire rotations are 171-342 years (fire regime V). *Artemisia tridentata ssp. wyomingensis* historical fire were longer than *Artemisia tridentata ssp. vaseyana*. Large, contiguous areas of sagebrush with large grass-dominated areas and small mosaics of grass and sagebrush composed the historical landscape. Sagebrush density was a common source of patchiness where "dense" sagebrush made up 24.5% of area and "scattered" sagebrush covered 16.3%. Modern fire rotations are shorter than historical fire rotations. Fire suppression may be advisable, as modern fire rotations are shorter than their historical counterparts (Bukowski and Baker 2013).

Component Associations:
- *Artemisia cana ssp. cana / Pascopyrum smithii* Shrub Herbaceous Vegetation (CEGL001556, G4)
- *Artemisia tridentata (ssp. tridentata, ssp. xericensis) / Pseudoroegneria spicata - Poa secunda* Shrub Herbaceous Vegetation (CEGL001019, G1)
- *Artemisia tridentata (ssp. tridentata, ssp. xericensis) / Pseudoroegneria spicata* Shrub Herbaceous Vegetation (CEGL001018, G1)
- *Artemisia tridentata / Festuca idahoensis* Shrub Herbaceous Vegetation (CEGL001530, G4Q)
- *Artemisia tridentata / Leymus cinereus* Shrub Herbaceous Vegetation (CEGL001458, G2G4)
- *Artemisia tridentata / Sporobolus cryptandrus - Achnatherum hymenoides* Shrub Herbaceous Vegetation (CEGL001545, G2?)
- *Artemisia tridentata ssp. tridentata - Grayia spinosa* Shrubland (CEGL001004, G5)
- *Artemisia tridentata ssp. tridentata / Distichlis spicata* Shrubland (CEGL001000, G5)
- *Artemisia tridentata ssp. tridentata / Festuca idahoensis* Shrubland (CEGL001014, G4?)
- *Artemisia tridentata ssp. tridentata / Hesperostipa comata* Shrubland (CEGL002966, G4?)
- *Artemisia tridentata ssp. tridentata / Leymus cinereus* Shrubland (CEGL001016, G2)
- *Artemisia tridentata ssp. tridentata / Pascopyrum smithii - (Elymus lanceolatus)* Shrubland (CEGL001017, G3?)

- *Artemisia tridentata ssp. tridentata / Pleuraphis jamesii* Shrubland (CEGL001015, G2G4)
- *Artemisia tridentata ssp. tridentata / Poa secunda* Shrubland (CEGL001008, G3G5)
- *Artemisia tridentata ssp. wyomingensis* / Mixed Grasses Shrub Herbaceous Vegetation (CEGL001534, G5)
- *Artemisia tridentata ssp. wyomingensis / Pascopyrum smithii* Shrub Herbaceous Vegetation (CEGL001047, G4)
- *Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata* Shrub Herbaceous Vegetation (CEGL001535, G4)
- *Artemisia tripartita ssp. tripartita / Festuca campestris* Shrub Herbaceous Vegetation (CEGL001537, G2?)
- *Artemisia tripartita ssp. tripartita / Festuca idahoensis* Shrub Herbaceous Vegetation (CEGL001536, G3)
- *Artemisia tripartita ssp. tripartita / Hesperostipa comata* Shrub Herbaceous Vegetation (CEGL001539, G1)
- *Artemisia tripartita ssp. tripartita / Leymus cinereus* Shrub Herbaceous Vegetation (CEGL002994, GU)
- *Artemisia tripartita ssp. tripartita / Pseudoroegneria spicata* Shrub Herbaceous Vegetation (CEGL001538, G2G3)
- *Purshia tridentata / Carex pensylvanica - Achnatherum occidentale* Shrub Herbaceous Vegetation (CEGL001492, G2)
- *Purshia tridentata / Festuca campestris* Shrub Herbaceous Vegetation (CEGL001494, G2?)
- *Purshia tridentata / Festuca idahoensis* Shrub Herbaceous Vegetation (CEGL002674, G3G5)
- *Purshia tridentata / Hesperostipa comata* Shrub Herbaceous Vegetation (CEGL001498, G2)
- *Purshia tridentata / Poa secunda* Shrubland (CEGL001059, G1?Q)
- *Purshia tridentata / Pseudoroegneria spicata* Shrub Herbaceous Vegetation (CEGL001495, G3)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Columbia Plateau Vernal Pool (CES304.057)
- Columbia Plateau Western Juniper Woodland and Savanna (CES304.082)

DISTRIBUTION

Range: This system occurs throughout much of the Columbia Plateau, the northern Great Basin, central and southeastern Montana, and Wyoming, and is found at slightly higher elevations farther south.
Divisions: 304:C; 306:C
Nations: CA, US
Subnations: BC, CA, CO, ID, MT, NV, OR, UT, WA, WY
Map Zones: 1:C, 4:C, 6:?, 7:C, 8:C, 9:C, 10:C, 12:C, 16:C, 17:C, 18:C, 19:C, 20:C, 21:C, 22:C, 28:P, 29:C, 30:?, 33:P
USFS Ecomap Regions: 331A:CC, 331D:CC, 331E:CP, 331F:CC, 331G:CC, 331H:CC, 331K:CC, 331L:CC, 331M:CC, 331N:CP, 341A:CP, 341D:CP, 341E:CC, 341F:CC, 341G:CC, 342A:CC, 342B:CC, 342C:CC, 342D:CC, 342E:CC, 342F:CC, 342G:CC, 342H:CC, 342I:CC, 342J:CC, M242C:CC, M242D:CC, M261A:C?, M261D:CC, M261E:CP, M261G:CC, M331A:CC, M331B:CC, M331D:CC, M331E:CC, M331H:CC, M331I:CC, M331J:CC, M332A:CC, M332B:CP, M332D:CC, M332E:CC, M332F:CC, M332G:CC, M333A:CC, M333C:CP, M333D:CP, M334A:CC, M341A:CC, M341B:CP, M341C:CP, M341D:CC
TNC Ecoregions: 4:C, 6:C, 8:C, 9:C, 10:C, 11:C, 20:C, 26:C

SOURCES

References: Barbour and Major 1977, Barbour and Major 1988, BLM 2004, Bukowski and Baker 2013, Bunting et al. 1987, Burkhardt 1996, Chambers et al. 2007, CNHP 2010b, Comer et al. 2003, Condon et al. 2011, Daubenmire 1970, Davies et al. 2009, Ecosystems Working Group 1998, Johnson 2000b, Johnson and Swanson 2005, Knick et al. 2003, Knight 1994, Landfire 2007a, Mack and Thompson 1982, Miller and Eddleman 2001, Miller et al. 2011, Mueggler and Stewart 1980, Pellant 1990, Pellant 1996, Quinn 2004, Rosentreter and Eldridge 2002, Shiflet 1994, Tirmenstein 1999c, TNC 2013, USDA-APHIS 2003, USDA-APHIS 2010, Vander Haegen et al. 2000, Vander Haegen et al. 2001, Veblen et al. 2011, West 1983c, WNHP 2011, Wright et al. 1979
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722894#references
Description Author: G. Kittel and M.S. Reid
Version: 14 Jan 2014 **Stakeholders:** Canada, Midwest, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

INTER-MOUNTAIN BASINS JUNIPER SAVANNA (CES304.782)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Temperate [Temperate Continental]; Intermediate Disturbance Interval; F-Landscape/Medium Intensity; Evergreen Sclerophyllous Tree; Graminoid
Non-Diagnostic Classifiers: Lowland [Foothill]; Lowland [Lowland]; Woody-Herbaceous; Ridge/Summit/Upper Slope; Sideslope; Toeslope/Valley Bottom; Calcareous
FGDC Crosswalk: Vegetated, Tree-dominated, Sparse tree canopy, Evergreen sparse tree canopy
National Mapping Codes: EVT 2115; ESLF 5404; ESP 1115

CONCEPT

Summary: This widespread ecological system occupies dry foothills and sandsheets of western Colorado, northwestern New Mexico, northern Arizona, Utah, and west into the Great Basin of Nevada and southern Idaho. It is typically found at lower elevations ranging from 1500-2300 m. This system is generally found at lower elevations and more xeric sites than Great Basin Pinyon-Juniper Woodland (CES304.773) or Colorado Plateau Pinyon-Juniper Woodland (CES304.767). These occurrences are found on lower mountain slopes, hills, plateaus, basins and flats often where juniper is expanding into semi-desert grasslands and steppe. The vegetation is typically open savanna, although there may be inclusions of more dense juniper woodlands. This savanna is typically dominated by *Juniperus osteosperma* trees with high cover of perennial bunch grasses and forbs, with *Bouteloua gracilis, Hesperostipa comata*, and *Pleuraphis jamesii* being most common. In the southern Colorado Plateau, *Juniperus monosperma* or juniper hybrids may dominate the tree layer. Pinyon trees are typically not present because sites are outside the ecological or geographic range of *Pinus edulis* and *Pinus monophylla*. It has been suggested that all *Juniperus osteosperma* stands in Wyoming be placed in Colorado Plateau Pinyon-Juniper Woodland (CES304.767). This savanna system does not occur in Wyoming.
Classification Comments: *Juniperus californica* savannas in the Central Valley of California and around the fringes of the Mojave Desert are not part of this ecological system. In many cases, they are the result of some disturbance removing an oak component from one of the several oak woodland and savanna systems of California.
Similar Ecological Systems:
- Colorado Plateau Pinyon-Juniper Woodland (CES304.767)
- Great Basin Pinyon-Juniper Woodland (CES304.773)

Related Concepts:
- Juniper - Pinyon Woodland (412) (Shiflet 1994) Intersecting
- Rocky Mountain Juniper: 220 (Eyre 1980) Intersecting

Component Associations:
- *Juniperus monosperma / Andropogon hallii* Woodland (CEGL000704, G3?)
- *Juniperus monosperma / Bouteloua curtipendula* Woodland (CEGL000708, G5)
- *Juniperus monosperma / Bouteloua eriopoda* Woodland (CEGL000709, GNR)
- *Juniperus monosperma / Bouteloua gracilis* Woodland (CEGL000710, G5)
- *Juniperus monosperma / Cercocarpus montanus - Ribes cereum* Woodland (CEGL000714, GU)
- *Juniperus monosperma / Cercocarpus montanus* Woodland (CEGL000713, GNR)
- *Juniperus monosperma / Hesperostipa neomexicana* Woodland (CEGL000722, G4)
- *Juniperus osteosperma / Hesperostipa comata* Wooded Herbaceous Vegetation (CEGL001489, G1Q)
- *Juniperus osteosperma / Hesperostipa comata* Woodland (CEGL002815, GNR)
- *Juniperus osteosperma / Hesperostipa neomexicana* Woodland (CEGL000740, GUQ)
- *Juniperus osteosperma / Leymus salinus ssp. salmonis* Wooded Herbaceous Vegetation (CEGL001488, G1Q)
- *Juniperus osteosperma / Pleuraphis mutica* Woodland (CEGL000736, G2)
- *Juniperus osteosperma / Pseudoroegneria spicata* Woodland (CEGL000738, G4)
- *Juniperus osteosperma / Symphoricarpos oreophilus* Woodland (CEGL000741, GU)
- *Juniperus scopulorum / Pseudoroegneria spicata* Woodland (CEGL000748, G4)
- *Juniperus scopulorum / Schizachyrium scoparium* Woodland (CEGL000750, G2)

DISTRIBUTION

Range: This juniper savanna occurs from northwestern New Mexico, northern Arizona, western Colorado, Utah, west into the Great Basin of Nevada and southern Idaho. Where it occurs in California, it is found only in the far eastern edges of the state adjacent to other Great Basin systems.
Divisions: 304:C; 306:C
Nations: US
Subnations: AZ, CA, CO, ID, NM, NV, OR, UT, WY

Map Zones: 7:?, 9:C, 12:P, 13:P, 14:P, 15:C, 16:P, 17:P, 18:C, 19:P, 21:?, 22:?, 23:C, 24:C, 25:C, 28:P
USFS Ecomap Regions: 313A:CC, 313B:CC, 313C:CC, 313D:CC, 315H:CC, 321A:CC, 322A:CC, 341A:C?, 341D:C?, 341E:C?, 341F:C?, 341G:CC, 342B:CC, 342C:CC, 342D:CC, 342E:CP, 342G:CC, 342J:CC, M313A:CC, M331D:CC, M331E:C?, M331G:CP, M331H:CC, M331I:CP, M331J:CP, M332E:CC, M341A:CC, M341D:CP
TNC Ecoregions: 6:C, 9:C, 10:C, 11:C, 18:C, 19:C, 20:C, 21:C

SOURCES

References: Bassett et al. 1987, Blackburn and Tueller 1970, Comer et al. 2003, Fitzhugh et al. 1987, Francis 1986, Knight 1994, Larson and Moir 1986, Larson and Moir 1987, Tuhy et al. 2002
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722890#references
Description Author: NatureServe Western Ecology Team
Version: 16 Jan 2009 **Stakeholders:** West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

INTER-MOUNTAIN BASINS MONTANE SAGEBRUSH STEPPE (CES304.785)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Upper Montane]; Montane [Montane]; Montane [Lower Montane]; Woody-Herbaceous
Non-Diagnostic Classifiers: Mountainside; Mountain valley; Plateau; Sideslope; Toeslope/Valley Bottom; Temperate [Temperate Continental]; Long Disturbance Interval; F-Patch/Medium Intensity; Broad-Leaved Evergreen Shrub; Graminoid; Bunch grasses; Artemisia tridentata ssp. vaseyana
FGDC Crosswalk: Vegetated, Shrub-dominated, Herbaceous - shrub-steppe, Perennial graminoid steppe
National Mapping Codes: EVT 2126; ESLF 5455; ESP 1126

CONCEPT

Summary: This ecological system includes sagebrush communities occurring at foothills (in Wyoming) to montane and subalpine elevations across the western U.S. from 1000 m in eastern Oregon and Washington to over 3000 m in the southern Rockies. In Montana, it occurs on mountain "islands" in the north-central portion of the state and possibly along the Boulder River south of Absarokee and at higher elevations. In British Columbia, it occurs between 450 and 1650 m in the southern Fraser Plateau and the Thompson and Okanagan basins. Climate is cool, semi-arid to subhumid. This system primarily occurs on deep-soiled to stony flats, ridges, nearly flat ridgetops, and mountain slopes. In general, this system shows an affinity for mild topography, fine soils, some source of subsurface moisture or more mesic sites, zones of higher precipitation and areas of snow accumulation. Across its range of distribution, this is a compositionally diverse system. It is composed primarily of *Artemisia tridentata ssp. vaseyana, Artemisia cana ssp. viscidula*, and related taxa such as *Artemisia tridentata ssp. spiciformis (= Artemisia spiciformis)*. *Purshia tridentata* may codominate or even dominate some stands. *Artemisia arbuscula ssp. arbuscula*-dominated shrublands commonly occur within this system on rocky or windblown sites. Other common shrubs include *Symphoricarpos* spp., *Amelanchier* spp., *Ericameria nauseosa, Peraphyllum ramosissimum, Ribes cereum*, and *Chrysothamnus viscidiflorus*. *Artemisia tridentata ssp. wyomingensis* may be present to codominant if the stand is clearly montane as indicated by montane indicator species such as *Festuca idahoensis, Leucopoa kingii*, or *Danthonia intermedia*. Most stands have an abundant perennial herbaceous layer (over 25% cover, in many cases over 50% cover), but this system also includes *Artemisia tridentata ssp. vaseyana* shrublands. Common graminoids include *Danthonia intermedia, Festuca arizonica, Festuca idahoensis, Hesperostipa comata, Poa fendleriana, Elymus trachycaulus, Bromus carinatus, Poa secunda, Leucopoa kingii, Deschampsia caespitosa, Calamagrostis rubescens*, and *Pseudoroegneria spicata*. Species of *Achnatherum* are common, including *Achnatherum nelsonii ssp. dorei, Achnatherum nelsonii ssp. nelsonii, Achnatherum hymenoides*, and others. In many areas, wildfires can maintain an open herbaceous-rich steppe condition, although at most sites, shrub cover can be unusually high for a steppe system (>40%), with the moisture providing equally high grass and forb cover.
Classification Comments: In Wyoming and Montana, *Artemisia tripartita ssp. tripartita* associations are part of this system, occurring at higher elevations than Inter-Mountain Basins Big Sagebrush Steppe (CES304.778). Farther west, they are included in that system, but perhaps this should be reviewed by ecologists familiar with the Columbia Basin region.
Related Concepts:

- Big Sagebrush - Bluebunch Wheatgrass (314) (Shiflet 1994) Intersecting
- Big Sagebrush - Idaho Fescue (315) (Shiflet 1994) Intersecting
- Big Sagebrush - Rough Fescue (316) (Shiflet 1994) Finer
- Chokecherry - Serviceberry - Rose (421) (Shiflet 1994) Intersecting. Montane sagebrush has inclusions of choke cherry-, serviceberry- and rose-dominated shrublands.
- Low Sagebrush (406) (Shiflet 1994) Intersecting. This system includes *Artemisia arbuscula ssp. arbuscula* shrublands.
- Mountain Big Sagebrush (402) (Shiflet 1994) Equivalent
- Other Sagebrush Types (408) (Shiflet 1994) Intersecting. *Artemisia tridentata ssp. spiciformis* shrublands are included in this ecological system.
- SS Big Sagebrush Shrub/Grassland, high elevation (Ecosystems Working Group 1998) Broader

DESCRIPTION

Environment: This ecological system occurs in many of the western United States, usually at middle elevations (1000-2500 m). The climate regime is cool, semi-arid to subhumid, with yearly precipitation ranging from 25 to 90 cm/year. Much of this precipitation falls as snow. Temperatures are continental with large annual and diurnal variation. In general this system shows an affinity for mild topography, fine soils, and some source of subsurface moisture. Soils generally are moderately deep to deep, well-drained, and of loam, sandy loam, clay loam, or gravelly loam textural classes; soils often have a substantial volume of coarse fragments, and are derived from a variety of parent materials. This system primarily occurs on deep-soiled to stony flats, ridges, nearly flat ridgetops, and mountain slopes. All aspects are represented, but the higher elevation occurrences may be restricted to south- or west-facing slopes.
Vegetation: Vegetation types within this ecological system are usually less than 1.5 m tall and dominated by *Artemisia tridentata ssp. vaseyana, Artemisia cana ssp. viscidula*, or *Artemisia tridentata ssp. spiciformis*. A variety of other shrubs can be found in some

occurrences, but these are seldom dominant. They include *Artemisia rigida, Artemisia arbuscula, Ericameria nauseosa, Chrysothamnus viscidiflorus, Symphoricarpos oreophilus, Purshia tridentata, Peraphyllum ramosissimum, Ribes cereum, Rosa woodsii, Ceanothus velutinus*, and *Amelanchier alnifolia*. *Artemisia tridentata ssp. wyomingensis* may be present to codominant if the stand is clearly montane to subalpine as indicated by montane indicator species such as *Festuca idahoensis, Leucopoa kingii*, or *Danthonia intermedia*. The canopy cover is usually between 20-80%. The herbaceous layer is usually well represented, but bare ground may be common in particularly arid or disturbed occurrences. Graminoids that can be abundant include *Festuca idahoensis, Festuca thurberi, Festuca ovina, Elymus elymoides, Deschampsia caespitosa, Danthonia intermedia, Danthonia parryi, Stipa* spp., *Pascopyrum smithii, Bromus carinatus, Elymus trachycaulus, Koeleria macrantha, Pseudoroegneria spicata, Poa fendleriana*, or *Poa secunda*, and *Carex* spp. Forbs are often numerous and an important indicator of health. Forb species may include *Castilleja, Potentilla, Erigeron, Phlox, Astragalus, Geum, Lupinus*, and *Eriogonum, Balsamorhiza sagittata, Achillea millefolium, Antennaria rosea*, and *Eriogonum umbellatum, Fragaria virginiana, Artemisia ludoviciana, Hymenoxys hoopesii (= Helenium hoopesii)*, etc.
Dynamics: Healthy sagebrush shrublands are very productive, are often grazed by domestic livestock, and are strongly preferred during the growing season (Padgett et al. 1989). Prolonged livestock use can cause a decrease in the abundance of native bunch grasses and increase in the cover of shrubs and non-native grass species, such as *Poa pratensis*. *Artemisia cana* resprouts vigorously following spring fire, and prescribed burning may increase shrub cover. Conversely, fire in the fall may decrease shrub abundance (Hansen et al. 1995). *Artemisia tridentata* is generally killed by fires and may take over ten years to form occurrences of some 20% cover or more. The condition of most sagebrush steppe has been degraded due to fire suppression and heavy livestock grazing. It is unclear how long restoration will take to restore degraded occurrences.

Component Associations:
- *Amelanchier utahensis - Artemisia tridentata (ssp. vaseyana, ssp. wyomingensis)* Shrubland (CEGL002820, GNR)
- *Arctostaphylos patula - Artemisia tridentata (ssp. vaseyana, ssp. wyomingensis)* Shrubland (CEGL002694, GNR)
- *Artemisia arbuscula ssp. arbuscula - Purshia tridentata / Pseudoroegneria spicata - Festuca idahoensis* Shrub Herbaceous Vegetation (CEGL001518, G2G3)
- *Artemisia arbuscula ssp. arbuscula / Achnatherum thurberianum* Shrub Herbaceous Vegetation (CEGL001413, G4G5)
- *Artemisia arbuscula ssp. arbuscula / Eriogonum microthecum* Shrubland (CEGL003483, G2G3)
- *Artemisia arbuscula ssp. arbuscula / Festuca idahoensis* Shrub Herbaceous Vegetation (CEGL001409, G5)
- *Artemisia arbuscula ssp. arbuscula / Leptodactylon pungens* Shrubland (CEGL003482, G4?)
- *Artemisia arbuscula ssp. arbuscula / Leymus salinus ssp. salmonis* Shrub Herbaceous Vegetation (CEGL001410, G1G2Q)
- *Artemisia arbuscula ssp. arbuscula / Poa secunda* Shrub Herbaceous Vegetation (CEGL001411, G5)
- *Artemisia arbuscula ssp. arbuscula / Pseudoroegneria spicata* Shrub Herbaceous Vegetation (CEGL001412, G5)
- *Artemisia arbuscula ssp. thermopola / Festuca idahoensis* Shrub Herbaceous Vegetation (CEGL001519, G2)
- *Artemisia nova / Poa fendleriana* Shrubland (CEGL002698, GNR)
- *Artemisia nova / Poa secunda* Shrubland (CEGL001423, G3)
- *Artemisia nova / Pseudoroegneria spicata* Shrubland (CEGL001424, G4G5)
- *Artemisia rothrockii / Monardella odoratissima* Shrubland (CEGL008652, G3?)
- *Artemisia tridentata / Festuca idahoensis* Shrub Herbaceous Vegetation (CEGL001530, G4Q)
- *Artemisia tridentata ssp. spiciformis / Bromus carinatus* Shrubland (CEGL002989, GNR)
- *Artemisia tridentata ssp. spiciformis / Carex geyeri* Shrubland (CEGL002990, GNR)
- *Artemisia tridentata ssp. vaseyana - Purshia tridentata / Pseudoroegneria spicata* Shrubland (CEGL001032, G5?)
- *Artemisia tridentata ssp. vaseyana - Symphoricarpos oreophilus / Bromus carinatus* Shrubland (CEGL001035, G4Q)
- *Artemisia tridentata ssp. vaseyana - Symphoricarpos oreophilus / Elymus trachycaulus ssp. trachycaulus* Shrubland (CEGL001034, G3G4)
- *Artemisia tridentata ssp. vaseyana - Symphoricarpos oreophilus / Festuca idahoensis* Shrubland (CEGL001036, G4)
- *Artemisia tridentata ssp. vaseyana - Symphoricarpos oreophilus / Hesperostipa comata* Shrubland (CEGL001039, G3?)
- *Artemisia tridentata ssp. vaseyana - Symphoricarpos oreophilus / Poa secunda* Shrubland (CEGL001037, G5?)
- *Artemisia tridentata ssp. vaseyana - Symphoricarpos oreophilus / Pseudoroegneria spicata* Shrubland (CEGL001038, G5?)
- *Artemisia tridentata ssp. vaseyana / Achnatherum lettermanii* Shrubland (CEGL002811, GNR)
- *Artemisia tridentata ssp. vaseyana / Achnatherum occidentale* Shrubland (CEGL001033, G2)
- *Artemisia tridentata ssp. vaseyana / Achnatherum pinetorum* Shrubland (CEGL002806, GNR)
- *Artemisia tridentata ssp. vaseyana / Balsamorhiza sagittata* Shrubland (CEGL001020, GNR)
- *Artemisia tridentata ssp. vaseyana / Bromus carinatus* Shrubland (CEGL001021, G4?)
- *Artemisia tridentata ssp. vaseyana / Carex exserta* Shrubland (CEGL008651, GNR)
- *Artemisia tridentata ssp. vaseyana / Carex geyeri* Shrub Herbaceous Vegetation (CEGL001532, G3)
- *Artemisia tridentata ssp. vaseyana / Festuca campestris* Shrub Herbaceous Vegetation (CEGL001531, G3Q)
- *Artemisia tridentata ssp. vaseyana / Festuca idahoensis - Bromus carinatus* Shrubland (CEGL001023, G4Q)
- *Artemisia tridentata ssp. vaseyana / Festuca idahoensis* Shrub Herbaceous Vegetation (CEGL001533, G5)
- *Artemisia tridentata ssp. vaseyana / Festuca thurberi* Shrubland (CEGL001024, G3G4)
- *Artemisia tridentata ssp. vaseyana / Hesperostipa comata* Shrubland (CEGL002931, GNR)
- *Artemisia tridentata ssp. vaseyana / Leucopoa kingii - Koeleria macrantha* Shrubland (CEGL001026, G4)
- *Artemisia tridentata ssp. vaseyana / Leucopoa kingii* Shrubland (CEGL001025, G3)
- *Artemisia tridentata ssp. vaseyana / Leymus cinereus* Shrubland (CEGL001027, G4?)
- *Artemisia tridentata ssp. vaseyana / Monardella odoratissima* Shrubland (CEGL003476, GNR)

- *Artemisia tridentata ssp. vaseyana / Pascopyrum smithii* Shrubland (CEGL001028, G3?)
- *Artemisia tridentata ssp. vaseyana / Phlox condensata* Shrubland (CEGL002770, GNR)
- *Artemisia tridentata ssp. vaseyana / Poa fendleriana* Shrubland (CEGL002812, GNR)
- *Artemisia tridentata ssp. vaseyana / Poa pratensis* Sagebrush Shrubland (CEGL002528, GNR)
- *Artemisia tridentata ssp. vaseyana / Poa secunda* Shrubland (CEGL001029, G3)
- *Artemisia tridentata ssp. vaseyana / Pseudoroegneria spicata - Poa fendleriana* Shrubland (CEGL001031, G5)
- *Artemisia tridentata ssp. vaseyana / Pseudoroegneria spicata* Shrubland (CEGL001030, G5)
- *Artemisia tridentata ssp. wyomingensis - Peraphyllum ramosissimum / Festuca idahoensis* Shrubland (CEGL001048, G2)
- *Artemisia tridentata ssp. wyomingensis / Pascopyrum smithii* Shrub Herbaceous Vegetation (CEGL001047, G4)
- *Artemisia tridentata* Upperzone Community Shrubland (CEGL001013, G5?)

DISTRIBUTION

Range: This system is found at montane and subalpine elevations across the western U.S. from 1000 m in eastern Oregon and Washington to over 3000 m in the southern Rockies. In British Columbia, it occurs in the southern Fraser Plateau and the Thompson and Okanagan basins. This system occurs in mapzone 20 on the Rocky Mountain island ranges and on the western edge with mapzone 19.
Divisions: 304:C; 306:C
Nations: CA, US
Subnations: AZ?, BC, CA, CO, ID, MT, NM, NV, OR, UT, WA, WY
Map Zones: 1:C, 3:?, 4:P, 6:C, 7:C, 8:C, 9:C, 10:C, 12:C, 13:P, 16:C, 17:C, 18:C, 19:C, 20:C, 21:C, 22:C, 23:C, 24:?, 25:C, 27:?, 28:C, 29:C
USFS Ecomap Regions: 313A:CC, 313B:CP, 315A:CC, 315H:CC, 321A:??, 322A:CC, 331B:C?, 331F:CC, 331G:CC, 331J:CC, 331M:C?, 331N:CP, 341A:CC, 341B:CC, 341C:CC, 341D:CC, 341E:CC, 341F:CC, 341G:CC, 342A:CC, 342B:CC, 342C:CC, 342D:CC, 342E:CC, 342F:CC, 342G:CC, 342H:CC, 342I:CC, 342J:CC, M242C:CC, M242D:CC, M261A:CC, M261D:CC, M261E:CC, M261F:C?, M261G:CC, M313A:CP, M313B:CC, M331A:CC, M331B:CC, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M331J:CC, M332A:CC, M332B:CC, M332D:CC, M332E:CC, M332F:CC, M332G:CC, M341A:CC, M341B:CC, M341C:CC, M341D:CC
TNC Ecoregions: 6:C, 7:C, 8:C, 9:C, 12:C, 18:C, 19:C, 20:C, 26:C, 68:C

SOURCES

References: Comer et al. 2003, Ecosystems Working Group 1998, Hansen et al. 1995, Hironaka et al. 1983, Johnston 2001, Mueggler and Stewart 1980, Neely et al. 2001, Padgett et al. 1989, West 1983c
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722887#references
Description Author: R. Crawford, mod. M.S. Reid and K.A. Schulz
Version: 01 Oct 2007 **Stakeholders:** Canada, Midwest, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

INTER-MOUNTAIN BASINS SEMI-DESERT SHRUB-STEPPE (CES304.788)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland [Foothill]; Lowland [Lowland]; Woody-Herbaceous; Temperate [Temperate Xeric]; Alkaline Soil; Aridic; Very Short Disturbance Interval; G-Landscape/High Intensity; Graminoid
Non-Diagnostic Classifiers: Short (50-100 yrs) Persistence; Mechanical Disturbance; Broad-Leaved Evergreen Shrub; Xeromorphic Shrub; Thorn Shrub; Evergreen Sclerophyllous Shrub; Succulent Shrub; Dwarf-Shrub; Forb
FGDC Crosswalk: Vegetated, Shrub-dominated, Herbaceous - shrub-steppe, Perennial graminoid steppe
National Mapping Codes: EVT 2127; ESLF 5456; ESP 1127

CONCEPT

Summary: This ecological system occurs throughout the intermountain western U.S., typically at lower elevations on alluvial fans and flats with moderate to deep soils, and extends into south-central Montana between the Pryor and Beartooth ranges where a distinct rainshadow effect occurs. This semi-arid shrub-steppe is typically dominated by graminoids (>25% cover) with an open shrub to moderately dense woody layer with a typically strong graminoid layer. The most widespread (but not dominant) species is *Pseudoroegneria spicata*, which occurs from the Columbia Basin to the northern Rockies. Characteristic grasses include *Achnatherum hymenoides, Bouteloua gracilis, Distichlis spicata, Poa secunda, Poa fendleriana, Sporobolus airoides , Hesperostipa comata, Pleuraphis jamesii*, and *Leymus salinus*. The woody layer is often a mixture of shrubs and dwarf-shrubs, although it may be dominated by a single species. Characteristic species include *Atriplex canescens, Artemisia tridentata, Chrysothamnus greenei, Chrysothamnus viscidiflorus, Ephedra* spp., *Ericameria nauseosa, Gutierrezia sarothrae*, and *Krascheninnikovia lanata*. *Artemisia tridentata* or *Atriplex canescens* may be present but does not dominate. Annual grasses, especially the exotics *Bromus japonicus* and *Bromus tectorum*, may be present to abundant. Forbs are generally of low importance and are highly variable across the range but may be diverse in some occurrences. The general aspect of occurrences may be either open shrubland with patchy grasses or patchy open herbaceous layers. Disturbance may be important in maintaining the woody component. Microphytic crust is very important in some stands.
Related Concepts:
- Sagebrush - Grass (612) (Shiflet 1994) Intersecting. In southwestern Montana.

DESCRIPTION

Environment: This ecological system occurs throughout the Intermountain West from the western Great Basin to the northern Rocky Mountains and Colorado Plateau at elevations ranging from 300 m up to 2500 m. The climate where this system occurs is generally hot in summers and cold in winters with low annual precipitation, ranging from 18-40 cm and high inter-annual variation. Much of the precipitation falls as snow, and growing-season drought is characteristic. Temperatures are continental with large annual and diurnal variations. Sites are generally alluvial fans and flats with moderate to deep soils. Some sites can be flat, poorly drained and intermittently flooded with a shallow or perched water table often within 1 m depth (West 1983). Substrates are generally shallow, calcareous, fine-textured soils (clays to silt-loams), derived from alluvium; or deep, fine to medium-textured alluvial soils with some source of subirrigation during the summer season. Soils may be alkaline and typically moderately saline (West 1983). Some occurrences occur on deep, sandy loam soils, or soils that are highly calcareous, but not deep sand with active dune fields (Hironaka et al. 1983).
Vegetation: The plant associations in this broadly defined system are characterized by a somewhat sparse to moderately dense (10-70% cover) shrub layer usually with a strong graminoid layer. The typically open woody layer is often a mixture of shrubs and dwarf-shrubs, although it may be dominated by a single species. Characteristic woody species include *Artemisia filifolia, Artemisia tridentata, Atriplex canescens, Ephedra cutleri, Ephedra nevadensis, Ephedra torreyana, Ephedra viridis, Ericameria nauseosa, Chrysothamnus viscidiflorus, Gutierrezia sarothrae, Krascheninnikovia lanata*, and *Sarcobatus vermiculatus*. Other shrubs occasionally present include *Purshia tridentata* and *Tetradymia canescens*. *Artemisia filifolia, Artemisia tridentata, Atriplex canescens*, or *Sarcobatus vermiculatus* may be present but does not dominate as it does in big sagebrush shrublands and steppes, or mixed salt-desert scrub systems. Trees are very rarely present in this system, but some individuals of *Pinus ponderosa, Juniperus scopulorum, Juniperus occidentalis*, or *Cercocarpus ledifolius* may occur. The herbaceous layer is dominated by bunch grasses which occupy patches in the shrub matrix. The most widespread species is *Pseudoroegneria spicata*, which occurs from the Columbia Basin to the northern Rockies. Other locally dominant or important species include *Sporobolus airoides, Leymus cinereus, Festuca idahoensis, Pascopyrum smithii, Bouteloua gracilis, Distichlis spicata, Pleuraphis jamesii, Elymus lanceolatus, Elymus elymoides, Koeleria macrantha, Muhlenbergia richardsonis, Hesperostipa comata*, and *Poa secunda*. Annual grasses, especially the exotics *Bromus japonicus* and *Bromus tectorum*, may be present to abundant. Forbs are generally of low importance and are highly variable across the range, but may be diverse in some occurrences. Species that often occur are *Symphyotrichum ascendens (= Aster adscendens), Collinsia parviflora, Penstemon caespitosus, Achillea millefolium, Erigeron compositus, Senecio* spp., and *Taraxacum officinale*. Other important genera include *Astragalus, Oenothera, Eriogonum*, and *Balsamorhiza*. Mosses and lichens may be

important ground cover. Forbs are common on disturbed weedy sites. Weedy annual forbs may include the exotics *Descurainia* spp., *Helianthus annuus*, *Halogeton glomeratus*, *Lactuca serriola*, and *Lepidium perfoliatum*.

Component Associations:
- *Achnatherum speciosum* Shrub Herbaceous Vegetation (CEGL003113, G1Q)
- *Artemisia bigelovii / Bouteloua gracilis* Dwarf-shrub Herbaceous Vegetation (CEGL001742, GNR)
- *Artemisia tridentata - Atriplex confertifolia* Shrubland (CEGL000993, G4)
- *Artemisia tridentata ssp. wyomingensis / Leymus salinus* Shrubland (CEGL002813, GNR)
- *Atriplex canescens / Pleuraphis jamesii* Shrubland (CEGL001288, G3G4)
- *Atriplex obovata / Sporobolus airoides - Pleuraphis jamesii* Shrub Herbaceous Vegetation (CEGL001775, GU)
- *Bouteloua eriopoda* Coconino Plateau Shrub Herbaceous Vegetation (CEGL002787, GNR)
- *Chrysothamnus viscidiflorus / Hesperostipa comata* Shrubland (CEGL002799, GNR)
- *Chrysothamnus viscidiflorus / Leymus salinus ssp. salinus* Shrub Herbaceous Vegetation (CEGL001501, G2G4)
- *Chrysothamnus viscidiflorus* Shrub Herbaceous Vegetation (CEGL002530, GNR)
- *Ephedra torreyana - Artemisia bigelovii* Sparse Vegetation (CEGL002350, GNR)
- *Ephedra torreyana / Achnatherum hymenoides - Pleuraphis jamesii* Shrubland (CEGL002352, GNR)
- *Ephedra viridis / Achnatherum hymenoides - Bouteloua gracilis* Shrub Herbaceous Vegetation (CEGL001648, G2G4)
- *Ephedra viridis / Achnatherum hymenoides - Sporobolus cryptandrus* Shrub Herbaceous Vegetation (CEGL001649, G2G4)
- *Ericameria nauseosa / Bouteloua gracilis* Shrub Herbaceous Vegetation (CEGL003495, GNR)
- *Ericameria nauseosa / Muhlenbergia pungens - Achnatherum hymenoides* Shrub Herbaceous Vegetation (CEGL002921, GNR)
- *Ericameria nauseosa / Pleuraphis jamesii - (Hesperostipa comata)* Shrub Herbaceous Vegetation (CEGL002996, GNR)
- *Ericameria parryi / Achnatherum hymenoides* Shrubland (CEGL003751, GNR)
- *Ericameria parryi / Pleuraphis jamesii - Bouteloua gracilis* Shrubland (CEGL001331, GUQ)
- *Gutierrezia sarothrae* - (*Opuntia* spp.) / *Pleuraphis jamesii* Dwarf-shrubland (CEGL002690, GNR)
- *Gutierrezia sarothrae - Krascheninnikovia lanata - Atriplex canescens / Bouteloua eriopoda* Shrub Herbaceous Vegetation (CEGL001733, G2)
- *Gutierrezia sarothrae / Pleuraphis rigida* Shrub Herbaceous Vegetation (CEGL001543, G2Q)
- *Gutierrezia sarothrae / Sporobolus airoides - Pleuraphis jamesii* Shrub Herbaceous Vegetation (CEGL001776, GU)
- *Krascheninnikovia lanata / Bouteloua gracilis* Dwarf-shrub Herbaceous Vegetation (CEGL001321, G4)
- *Krascheninnikovia lanata / Pascopyrum smithii - Bouteloua gracilis* Dwarf-shrub Herbaceous Vegetation (CEGL001324, G4)
- *Krascheninnikovia lanata / Pleuraphis jamesii* Dwarf-shrubland (CEGL001322, G3G4)
- *Krascheninnikovia lanata / Poa secunda* Dwarf-shrubland (CEGL001326, G3)
- *Krascheninnikovia lanata* Dwarf-shrubland (CEGL001320, G5?)
- *Opuntia polyacantha / Pleuraphis jamesii* Shrubland (CEGL002299, GNR)
- *Poliomintha incana / (Pleuraphis jamesii)* Shrubland (CEGL002930, GNR)

DISTRIBUTION

Range: This system occurs throughout the intermountain western U.S., typically at lower elevations, and extends into Wyoming and Montana across the Great Divide Basin. It barely gets as far north into north-central Montana (mapzone 20) but is unlikely to be mapped.
Divisions: 304:C
Nations: US
Subnations: AZ, CA, CO, ID, MT, NM, NV, OR, UT, WY
Map Zones: 6:P, 7:P, 8:C, 9:C, 12:C, 13:C, 14:C, 15:C, 16:C, 17:C, 18:C, 19:?, 22:C, 23:C, 24:C, 25:C, 27:C, 28:C
USFS Ecomap Regions: 313A:CC, 313B:CC, 313C:CC, 313D:CC, 315A:CC, 315B:CC, 315H:CC, 321A:CC, 322A:CC, 331B:CC, 331H:CC, 331I:CC, 331J:CC, 341A:CC, 341B:CC, 341C:CC, 341D:CC, 341E:CC, 341F:CC, 341G:CC, 342B:CC, 342C:CC, 342D:CC, 342E:CC, 342F:CC, 342G:CC, 342H:CC, 342I:CP, 342J:CC, M242C:CC, M261E:CC, M261G:CC, M313A:CC, M313B:CC, M331A:CC, M331B:CC, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M331J:CC, M332A:CC, M332E:CP, M332G:CC, M333A:??, M341A:CC, M341B:CC, M341C:CC, M341D:CC
TNC Ecoregions: 4:C, 6:C, 8:C, 9:C, 10:C, 11:C, 18:C, 19:C, 20:C, 21:C

SOURCES

References: Branson et al. 1976, Comer et al. 2003, Hanson 1929, Hironaka et al. 1983, Tuhy et al. 2002, West 1983e
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722884#references
Description Author: G. Kittel and M.S. Reid, mod. K.A. Schulz
Version: 01 Oct 2007 **Stakeholders:** West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

KLAMATH-SISKIYOU XEROMORPHIC SERPENTINE SAVANNA AND CHAPARRAL (CES206.150)

CLASSIFIERS

Classification Status: Standard

Primary Division: Mediterranean California (206)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Serpentine; Mediterranean [Mediterranean Pluviseasonal-Oceanic]; Ultramafic with low Ca:Mg ratio
FGDC Crosswalk: Vegetated, Tree-dominated, Sparse tree canopy, Mixed evergreen-deciduous sparse tree canopy
National Mapping Codes: EVT 2170; ESLF 5425; ESP 1170

CONCEPT

Summary: This ecological system occurs throughout the Klamath-Siskiyou region below 1500 m (4550 feet) on thin rocky soils below winter snow accumulations and typically experiences hot and dry summers. These savannas and shrublands are almost always found on ultramafic soils (gabbro, peridotite, serpentinite), especially on the Josephine Peridotite Formation in the western Klamaths, with very low Ca:Mg ratio. These systems are highly variable and spotty in distribution. This system represents the most xeromorphic of these environments, generally supporting savannas or shrublands in areas with high rainfall amounts (over 130 cm/year) that would usually support closed-canopy forests. Landforms can include rocky ridges and ridgetops, south-facing slopes and river terraces, or gravelly valley bottomlands. These contain mosaics or patches of open-canopy tree-savannas with chaparral understories or shrub-dominated chaparral. Shrubs will often have higher densities than the trees which are more limited due to the rocky/thin soils and are often stunted in growth-form. These can also be short-duration chaparrals in previously forested areas that have experienced crownfires. When present, trees tend to have a scattered, open canopy or can be clustered, over a usually continuous, dense shrub layer, but sometimes with a grassy understory. *Pinus jeffreyi* or occasionally *Pinus attenuata* can form a scattered tree layer over bunch grasses. Dense shrub layers can also be present in some stands, or form their own patches without trees, especially on ridges. *Quercus vacciniifolia, Quercus sadleriana* (coastal and wetter climate but found on xeric sties), *Lithocarpus densiflorus var. echinoides, Quercus garryana var. breweri* (drier, inland), *Ceanothus cuneatus, Ceanothus pumilus, Arctostaphylos viscida, Arctostaphylos X cinerea, Arctostaphylos canescens, Arctostaphylos nevadensis, Frangula californica (= Rhamnus californica),* and *Garrya buxifolia* represent some of the many chaparral shrubs that can be found in these habitats. Perennial grasses such as *Festuca roemeri, Achnatherum lemmonii, Melica,* and *Danthonia californica* may also be characteristic, although a diverse and often endemic forb component (including rare serpentine endemics) is usually present. This system tends to have lower diversity within stands than in the other serpentine woodland and shrubland systems. Locally occurring, stunted and open stands of *Pinus contorta* and *Pinus monticola* on serpentine at low elevation are included in this system. The grassy understory savannas tend to have understory burns, while shrub-dense stands will suffer intense, stand-replacing fires.

Classification Comments: While generally occurring on serpentine soils, these also can be found on rocky or shallow, non-serpentine soils. They are identified by their very dry, open appearance, and hence are distinguished from the similar Klamath-Siskiyou Lower Montane Serpentine Mixed Conifer Woodland (CES206.917) which occurs on less xeric sties and has a woodland physiognomy.

Similar Ecological Systems:
- Klamath-Siskiyou Lower Montane Serpentine Mixed Conifer Woodland (CES206.917)

Related Concepts:
- *Arctostaphylos canescens - Arctostaphylos viscida - Ceanothus cuneatus* chaparral (Kagan et al. 2004b) Finer. in OR Classification, not in NVC.
- *Ceanothus cuneatus - Garrya fremontii - Toxicodendron diversilobum* chaparral (Kagan et al. 2004b) Finer. in OR Classification, not in NVC.
- Knobcone Pine: 248 (Eyre 1980) Intersecting

Component Associations:
- *Pinus attenuata / Arctostaphylos viscida* Woodland (CEGL008623, G3)
- *Pinus jeffreyi / Ceanothus pumilus* Wooded Herbaceous Vegetation (CEGL000816, G4)
- *Pinus jeffreyi / Festuca roemeri* Wooded Herbaceous Vegetation (CEGL000817, G3)

DISTRIBUTION

Range: This system occurs throughout the Klamath - Siskiyou region below 1500 m (4550 feet), but mostly in the western Klamaths on the Josephine peridotite body.
Divisions: 206:C
Nations: US
Subnations: CA, OR
Map Zones: 2:C, 3:C, 7:?
USFS Ecomap Regions: 263A:??, M242A:??, M242B:??, M261A:CC, M261D:C?
TNC Ecoregions: 5:P

SOURCES

References: Atzet et al. 1996, Barbour and Major 1988, Holland and Keil 1995, Jimerson 1993, Jimerson 1994, Jimerson and Daniel 1999, Jimerson et al. 1995, Sawyer and Keeler-Wolf 1995, Western Ecology Working Group n.d.

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.791117#references

Description Author: M.S. Reid

Version: 23 Jan 2006

Concept Author: J. Kagan, T. Keeler-Wolf

Stakeholders: West

ClassifResp: West

LAURENTIAN ACIDIC ROCKY OUTCROP (CES201.019)

CLASSIFIERS

Classification Status: Standard

Primary Division: Laurentian-Acadian (201)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland; Ridge/Summit/Upper Slope; Rock Outcrops/Barrens/Glades; Glaciated; Acidic Soil
Non-Diagnostic Classifiers: Forest and Woodland (Treed)
National Mapping Codes: ESLF 5463

CONCEPT

Summary: This Laurentian and near-boreal outcrop system is found across central southern Canada and the upper Midwest of the United States. It is found on ridges or summits of resistant acidic bedrock at low to mid elevations. The vegetation is patchy, often a mosaic of woodlands and open glades. The system is typically dominated by various conifers, including *Pinus banksiana* and *Picea mariana*, with occasional *Picea glauca* or *Populus tremuloides*. Hardwoods include *Quercus rubra, Quercus ellipsoidalis*, and *Populus tremuloides*. Structure can vary from treed to low heath shrubs to open lichen woodland. Exposure and occasional fire are the major factors in keeping the vegetation relatively open.
Classification Comments: See also Northern Appalachian-Acadian Rocky Heath Outcrop (CES201.571), which occurs to the east of this system's primary range and is characterized by granitic bedrock.
Similar Ecological Systems:
- Northern Appalachian-Acadian Rocky Heath Outcrop (CES201.571)--is similar but occurs east of the Great Lakes. *Picea rubens* is often present and *Quercus ellipsoidalis* is absent; *Pinus banksiana* is only rarely present.

Related Concepts:
- Aspen: 217 (Eyre 1980) Finer
- Jack Pine: 1 (Eyre 1980) Finer

Component Associations:
- (*Pinus strobus, Quercus rubra*) / *Danthonia spicata* Acidic Bedrock Wooded Herbaceous Vegetation (CEGL005101, G3G4)
- Boreal Glaciere Talus Sparse Vegetation (CEGL005243, G2G3)
- *Corylus cornuta - Amelanchier* spp. - *Prunus virginiana* Rocky Shrubland (CEGL005197, GNR)
- *Danthonia spicata - Poa compressa* Granite Herbaceous Vegetation (CEGL005157, GNR)
- *Juniperus communis - (Quercus rubra) / Juniperus horizontalis - Arctostaphylos uva-ursi* Shrubland (CEGL005065, G3G4)
- *Picea glauca - (Betula papyrifera) / Danthonia spicata* Woodland (CEGL005196, GNR)
- *Pinus banksiana - (Picea mariana, Pinus strobus) / Vaccinium* spp. Rocky Woodland (CEGL002483, G4?)
- *Pinus banksiana / Cladina* spp. Rock Outcrop Vegetation (CEGL002491, G3G5)
- *Pinus banksiana / Photinia melanocarpa / Xanthoparmelia* spp. Woodland (CEGL005045, G4G5)
- *Pinus resinosa - Pinus strobus / Vaccinium* spp. Rocky Woodland (CEGL005492, G4?)
- *Populus tremuloides - (Populus grandidentata)* Rocky Woodland (CEGL002487, GNR)
- *Quercus ellipsoidalis - Quercus macrocarpa - (Pinus banksiana)* Rocky Woodland (CEGL005246, GNR)

DISTRIBUTION

Range: This system is found in central Canada south to the Great Lakes and northern Minnesota, eastward in Canada to Quebec and a small portion of extreme northeastern New York.
Divisions: 103:C; 201:C
Nations: CA, US
Subnations: MB, MI, MN, NY, ON, QC, WI
Map Zones: 41:C, 50:C, 51:C, 64:C
USFS Ecomap Regions: 211E:CC, 212Jb:CCC, 212Jc:CCC, 212Jo:CCP, 212K:CC, 212Lb:CCP, 212M:CC, 212Q:CC, 212Sb:CCC, 212Sc:CCP, 212Sn:CCP, 212Sq:CCC, 212Tc:CCC, 212X:CC, 212Ya:CCC
TNC Ecoregions: 47:C, 48:C, 64:C

SOURCES

References: Comer et al. 2003, Edinger et al. 2002
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722686#references
Description Author: D. Faber-Langendoen, mod. S.C. Gawler
Version: 03 Oct 2007 **Stakeholders:** Canada, East, Midwest
Concept Author: D. Faber-Langendoen **ClassifResp:** Midwest

LAURENTIAN PINE-OAK BARRENS (CES201.718)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Laurentian-Acadian (201)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Woody-Herbaceous
FGDC Crosswalk: Vegetated, Tree-dominated, Sparse tree canopy, Mixed evergreen-deciduous sparse tree canopy
National Mapping Codes: EVT 2407; ESLF 5423; ESP 1407

CONCEPT

Summary: These pine-oak barrens occur in the northern and western Great Lakes region. They occur on sandplains/outwash habitats, with droughty, infertile sand or loamy sands and frequent fires (every 5-30 years). *Pinus banksiana, Pinus resinosa, Quercus ellipsoidalis*, and *Pinus strobus* are common overstory dominants. Prairie species are common throughout much of the range of the type. Common shrub and ground cover species include *Andropogon gerardii, Carex pensylvanica, Corylus americana, Schizachyrium scoparium*, and *Vaccinium angustifolium*. Oak grubs may be common under frequent burning. Catastrophic burns may create open bracken grasslands.
Classification Comments: his system covers the Great Lakes barrens. The eastern U.S. pine barrens fall into Northeastern Interior Pine Barrens (CES202.590) described under the Central Interior-Appalachian Division (202). The more southern North-Central Oak Barrens (CES202.727) overlaps this type along the "tension zone" of Minnesota and Wisconsin. Northward, this system is differentiated from more boreal systems with *Pinus banksiana* by absence of *Picea mariana* and the presence of many prairie species. Within the pine barrens landscape this system overlaps with Laurentian-Acadian Northern Pine-(Oak) Forest (CES201.719), which may occupy pine barrens sites that have not burned for more than 50 years.
Similar Ecological Systems:
- Laurentian-Acadian Northern Pine-(Oak) Forest (CES201.719)
- North-Central Oak Barrens (CES202.727)
- Northeastern Interior Pine Barrens (CES202.590)

Related Concepts:
- Jack Pine: 1 (Eyre 1980) Finer
- Northern Pin Oak: 14 (Eyre 1980) Finer

DESCRIPTION

Environment: These barrens occur on sandy outwash plains, glacial lakeplains, and broad riverine terraces. Soils are generally infertile, coarse-textured, and acidic sands and loamy sands. The landscape is flat to gently rolling.
Dynamics: Fire and droughty soil conditions maintain the characteristic open tree/shrub canopy and prairie-like understory of this system. The dry, relatively infertile soil limits the rate of tree growth, while periodic fires remove most tree regeneration and, less commonly, canopy trees. Fires are also necessary for regeneration of *Pinus banksiana*. Sites with finer-textured and more fertile soils need greater fire frequency, while sites with coarser-textured, less fertile soils need less frequent fires to maintain this system. The historical fire-return interval is 5-20 years (Landfire 2007a). Fire-return intervals of 20-30 years result in abundant woody cover. Occasional frost during the growing season, sustained drought, and catastrophic winds can kill canopy trees (*Quercus* spp. would be more affected by frost) (Kost et al. 2007).

Component Associations:
- *Pinus banksiana - (Pinus resinosa) - Quercus ellipsoidalis / Carex pensylvanica* Forest (CEGL002478, G4G5)
- *Pinus banksiana - (Quercus ellipsoidalis) / Schizachyrium scoparium* - Prairie Forbs Barrens Woodland (CEGL002490, G2)
- *Pinus banksiana - Pinus resinosa - (Quercus ellipsoidalis) / Carex pensylvanica* Wooded Herbaceous Vegetation (CEGL005124, G3G4)
- *Pinus banksiana / Vaccinium* spp. / *Pleurozium schreberi* Woodland (CEGL002441, G4G5)
- *Pinus strobus - Quercus alba - (Quercus velutina) / Andropogon gerardii* Wooded Herbaceous Vegetation (CEGL005127, G2?)
- *Populus tremuloides - Quercus (ellipsoidalis, macrocarpa) / Andropogon gerardii* Shrubland (CEGL002197, GNR)
- *Pteridium aquilinum - Bromus kalmii* Herbaceous Vegetation (CEGL005142, GNR)
- *Quercus ellipsoidalis - (Quercus macrocarpa)* Forest (CEGL002077, G4?)

DISTRIBUTION

Range: Occurs in the northern and western Great Lakes region.
Divisions: 201:C
Nations: CA, US
Subnations: MI, MN, ON, WI
Map Zones: 41:C, 50:C, 51:C
USFS Ecomap Regions: 212Ha:CCC, 212Hb:CCC, 212Hc:CCC, 212He:CCC, 212Hg:CCC, 212Hj:CCC, 212Hk:CCC, 212Hl:CCP,

212J:CP, 212K:CC, 212L:CP, 212N:CC, 212Ra:CCC, 212Rb:CCP, 212Rc:CCP, 212Re:CCP, 212Sc:CCP, 212Sn:CCC, 212Sq:CCP, 212Tb:CCC, 212Tc:CCC, 212Te:CCC, 212X:CP, 222Ja:CCC, 222Jb:CCC, 222R:CC, 222Ud:CCC
TNC Ecoregions: 45:P, 47:C, 48:C

SOURCES

References: Comer et al. 1995a, Comer et al. 1998, Comer et al. 2003, Curtis 1959, Eyre 1980, Kost et al. 2007, Landfire 2007a, Vogl 1964, WNHI 2012

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722951#references

Description Author: D. Faber-Langendoen, mod. J. Drake

Version: 14 Jan 2014 **Stakeholders:** Canada, Midwest

Concept Author: D. Faber-Langendoen **ClassifResp:** Midwest

LAURENTIAN-ACADIAN CALCAREOUS ROCKY OUTCROP (CES201.572)

CLASSIFIERS

Classification Status: Standard

Primary Division: Laurentian-Acadian (201)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Rock Outcrops/Barrens/Glades; Glaciated; Alkaline Soil; Circumneutral Soil
Non-Diagnostic Classifiers: Lowland; Forest and Woodland (Treed); Ridge/Summit/Upper Slope; Mesotrophic Soil; Very Shallow Soil; Udic; Consolidated; Intermediate Disturbance Interval; F-Patch/Medium Intensity
National Mapping Codes: ESLF 5461

CONCEPT

Summary: This outcrop system occurs in scattered locations from New England west to the Great Lakes. It occurs on ridges or summits of circumneutral to calcareous bedrock. Sites are often exposed and dry; however, there may be local areas of more moist conditions. The vegetation is often a mosaic of woodlands and open glades. This system may also occur on rocks that are primarily acidic but with a local influence of calcium through weathering.

Similar Ecological Systems:
- Central Appalachian Alkaline Glade and Woodland (CES202.602)

Related Concepts:
- Boreal Circumneutral Open Outcrop (Gawler and Cutko 2010) Finer
- Northern White-Cedar: 37 (Eyre 1980) Undetermined

Component Associations:
- *Acer saccharum - Ostrya virginiana - Carya ovata - Quercus rubra* Limestone Woodland (CEGL005059, G3G4)
- *Adiantum aleuticum - Asplenium* spp. *- Cerastium arvense* Sparse Vegetation (CEGL006104, G1G2)
- *Juniperus virginiana - Ostrya virginiana / Carex eburnea* Woodland (CEGL006180, G2G3)
- *Quercus macrocarpa / Danthonia spicata - (Geum triflorum)* Limestone Wooded Herbaceous Vegetation (CEGL005237, G1?)
- *Thuja occidentalis - Fraxinus pennsylvanica / Acer pensylvanicum* Woodland (CEGL006508, GNR)
- *Thuja occidentalis / Carex eburnea* Forest (CEGL006021, GNR)
- *Thuja occidentalis / Gaylussacia baccata - Vaccinium angustifolium* Woodland (CEGL006411, GNR)
- *Thuja occidentalis / Oligoneuron album* Woodland (CEGL006093, GNR)

DISTRIBUTION

Range: Scattered locations from New England and adjacent Canada west to the eastern Great Lakes.
Divisions: 201:C
Nations: US
Subnations: ME, NH, NY, VT
Map Zones: 63:C, 64:C, 66:C
TNC Ecoregions: 48:C, 63:C

SOURCES

References: Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723033#references
Description Author: S.C. Gawler
Version: 09 Jan 2003
Concept Author: S.C. Gawler
Stakeholders: East, Midwest
ClassifResp: East

LLANO ESTACADO CAPROCK ESCARPMENT AND BREAKS SHRUBLAND AND STEPPE (CES303.725)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Primary Division: Western Great Plains (303)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Canyon
Non-Diagnostic Classifiers: Very Shallow Soil; Flood Scouring
National Mapping Codes: ESLF 3205

CONCEPT

Summary: This ecological system occurs on various surfaces that are sufficiently resistant to erosion to form breaks or escarpments along the eastern edge of the Llano Estacado in Texas. This includes sedimentary deposits such as sandstones, limestones, or shales, or less frequently, igneous formations such as basalt. It is sometimes associated with canyons or drainages, but not always. The system occupies slopes, but may continue over transitions to more level sites upslope and downslope. Soils are variable and this system can occur where there is little soil development. Rough Breaks Ecological Sites are characteristic of this system, but other sites such as Rocky Hill and Gravelly Ecological Sites may also be occupied by this system. The physiognomic character of occurrences ranges from sparsely vegetated to shrubland, to sparse woodland. Bare ground is often conspicuous, and herbaceous cover is usually dominated by mid- to short grasses such as *Aristida purpurea, Bouteloua curtipendula, Bouteloua gracilis, Bouteloua hirsuta,* and *Schizachyrium scoparium*. Forbs, including species such as *Artemisia ludoviciana, Calylophus* sp., *Chaetopappa ericoides, Krameria lanceolata*, and *Melampodium leucanthum*, may also be present. Shrub canopy may be dense, with some species reaching tree stature, and on some sites forming sparse woodland. Shrub and tree species include *Juniperus pinchotii, Juniperus ashei, Quercus mohriana, Rhus trilobata, Dalea formosa, Cercocarpus montanus, Prosopis glandulosa*, and *Gutierrezia sarothrae*.
Classification Comments: This system is differentiated from Southwestern Great Plains Canyon (CES303.664) by its location along the caprock escarpment along the eastern edge of the Llano Estacado in Texas.
Similar Ecological Systems:
- Southwestern Great Plains Canyon (CES303.664)

Related Concepts:
- Mohrs (Shin) Oak: 67 (Eyre 1980) Intersecting
- Rolling Plains: Breaks and Canyon Deciduous Shrubland (2106) (Elliott 2011) Finer
- Rolling Plains: Breaks and Canyon Evergreen Shrubland (2105) (Elliott 2011) Finer

DESCRIPTION

Environment: This system may occur on various surfaces that are sufficiently resistant to erosion to form breaks or escarpments. This includes sedimentary deposits such as sandstones, limestones, or shales, or less frequently, igneous formations such as basalt. Landforms include breaks and escarpments with slopes less than 20% as defined here, sometimes associated with canyons or drainages, but not necessarily. The system occupies slopes but may continue over transitions to more level sites upslope and downslope. The system may occur on various soils, as well as on sites where little soil development has occurred. Rough Breaks Ecological Sites are characteristic of this system, but other sites such as Rocky Hill and Gravelly Ecological Sites may also be occupied (Elliott 2011).
Vegetation: This system is closely related to, and may overlap with, Southwestern Great Plains Canyon (CES303.664), although the currently considered system is not confined strictly to canyons. The physiognomic character of occurrences ranges from sparsely vegetated to shrubland to sparse woodland. Bare ground is often conspicuous, and herbaceous cover is usually dominated by mid- to short grasses such as *Aristida purpurea, Bouteloua curtipendula, Bouteloua gracilis, Bouteloua hirsuta,* and *Schizachyrium scoparium*. Forbs, including species such as *Artemisia ludoviciana, Calylophus* sp., *Chaetopappa ericoides, Krameria lanceolata*, and *Melampodium leucanthum*, may also be present. Shrub canopy may be dense, with some species reaching tree stature and on some sites forming sparse woodland. Shrub and tree species include *Juniperus pinchotii, Juniperus ashei, Quercus mohriana, Rhus trilobata, Dalea formosa, Cercocarpus montanus, Prosopis glandulosa*, and *Gutierrezia sarothrae* (Elliott 2011).

DISTRIBUTION

Range: This system occurs along the escarpment breaks on the east side of the Llano Estacado in Texas.
Divisions: 303:C
Nations: US
Subnations: OK?, TX
Map Zones: 26:C, 34:C, 35:C
USFS Ecomap Regions: 315B:CC, 315C:CC, 315F:CC, 321B:CC
TNC Ecoregions: 24:C, 28:C, 29:C

SOURCES

References: Elliott 2011, Eyre 1980, Southeastern Ecology Working Group n.d.

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.821221#references
Description Author: L. Elliott
Version: 24 Feb 2011 **Stakeholders:** Midwest, Southeast, West
Concept Author: L. Elliott **ClassifResp:** Southeast

MADREAN JUNIPER SAVANNA (CES301.730)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Madrean Semidesert (301)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Lower Montane]; Woody-Herbaceous; Tropical/Subtropical [Tropical Xeric]; Evergreen Sclerophyllous Tree; Succulent Shrub; Juniperus coahuilensis, J. deppeana, J. pinchotii
Non-Diagnostic Classifiers: Alluvial flat; Sideslope; Toeslope/Valley Bottom; Alluvial plain; Alluvial terrace; Sand Soil Texture; F-Patch/Low Intensity; Graminoid
FGDC Crosswalk: Vegetated, Tree-dominated, Sparse tree canopy, Evergreen sparse tree canopy
National Mapping Codes: EVT 2116; ESLF 5405; ESP 1116

CONCEPT

Summary: This Madrean ecological system occurs in lower foothills and plains of southeastern Arizona, southern New Mexico extending into west Texas and Mexico. These savannas have widely spaced mature juniper trees and moderate to high cover of graminoids (>25% cover). The presence of Madrean *Juniperus* spp. such as *Juniperus coahuilensis*, *Juniperus pinchotii*, and/or *Juniperus deppeana* is diagnostic. *Juniperus monosperma* may be present in some stands; *Juniperus deppeana* has a broader range than this Madrean system and extends north into southern stands of Southern Rocky Mountain Juniper Woodland and Savanna (CES306.834). Stands of *Juniperus pinchotii* may be short and resemble a shrubland. Graminoid species are a mix of those found in Western Great Plains Shortgrass Prairie (CES303.672) and Apacherian-Chihuahuan Semi-Desert Grassland and Steppe (CES302.735), with *Bouteloua gracilis* and *Pleuraphis jamesii* being most common. In addition, these areas include succulents such as species of *Yucca*, *Opuntia*, and *Agave*. Juniper savanna expansion into grasslands has been documented in the last century.
Similar Ecological Systems:
- Apacherian-Chihuahuan Semi-Desert Grassland and Steppe (CES302.735)
- Western Great Plains Shortgrass Prairie (CES303.672)

Related Concepts:
- Sideoats Grama - Sumac - Juniper (735) (Shiflet 1994) Intersecting

Component Associations:
- *Juniperus deppeana / Bouteloua gracilis* Woodland (CEGL000693, G5)
- *Juniperus deppeana / Bouteloua hirsuta* Woodland (CEGL000694, G3)
- *Juniperus deppeana / Muhlenbergia emersleyi* Woodland (CEGL000697, G4)
- *Juniperus deppeana / Panicum obtusum* Woodland (CEGL000698, GNR)
- *Juniperus deppeana / Schizachyrium cirratum* Woodland (CEGL000699, G4)
- *Juniperus monosperma / Bouteloua eriopoda* Woodland (CEGL000709, GNR)
- *Quercus mohriana - Juniperus pinchotii / Bouteloua curtipendula* Scrub (CEGL002173, G4)

DISTRIBUTION

Range: This system is found in southeastern Arizona, southern New Mexico, and extending into west Texas and Mexico. It likely occurs on the west side of the Sacramento and Guadalupe mountains.
Divisions: 301:C
Nations: MX, US
Subnations: AZ, NM, TX
Map Zones: 14:P, 15:C, 24:C, 25:C, 26:C, 27:C, 28:?
USFS Ecomap Regions: 313B:CC, 313C:CC, 313D:CC, 315A:CC, 315B:CC, 315H:CC, 321A:CC, 322A:CC, 322B:CC, M313A:CC, M313B:CC, M331F:??
TNC Ecoregions: 22:C, 24:C, 30:P

SOURCES

References: Barbour and Billings 2000, Brown et al. 1979, Brown et al. 1998, Comer et al. 2003, Dick-Peddie 1993
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722942#references
Description Author: NatureServe Western Ecology Team
Version: 10 Nov 2003 **Stakeholders:** Latin America, Southeast, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

MEDITERRANEAN CALIFORNIA MESIC SERPENTINE WOODLAND AND CHAPARRAL (CES206.928)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Mediterranean [Mediterranean Xeric-Oceanic]; Ultramafic with low Ca:Mg ratio; Shallow Soil; Udic; Broad-Leaved Evergreen Shrub; Cupressus sargentii
Non-Diagnostic Classifiers: Montane [Lower Montane]; Lowland [Foothill]; Forest and Woodland (Treed); Shrubland (Shrub-dominated); Sideslope; Toeslope/Valley Bottom; Serpentine
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2034; ESLF 4221; ESP 1034

CONCEPT

Summary: This ecological system occurs in Mediterranean California in the north and south Coast Ranges and the northern Sierra Nevada, on cool northerly and concave slopes and toeslopes with thin, rocky, ultramafic (gabbro, peridotite, serpentinite) soils. Not all ultramafic outcrops support distinct vegetation; only those with very low Ca:Mg ratios impact biotic composition. These systems are highly variable and spotty in distribution, and the composition of individual stands can be very diverse, especially the shrubs (often individual species have low cover). *Cupressus sargentii, Pinus sabiniana, Garrya congdonii, Quercus durata, Umbellularia californica*, and *Frangula californica ssp. tomentella (= Rhamnus tomentella ssp. tomentella)* are characteristic. Common associates include *Heteromeles arbutifolia, Adenostoma fasciculatum*, and the California endemics *Arctostaphylos viscida ssp. pulchella* and *Ceanothus jepsonii*. In some settings *Arctostaphylos glauca, Styrax rediviva (= Styrax officinalis)*, or *Cercocarpus montanus var. glaber (= Cercocarpus betuloides)* can be common. Occasionally, *Chamaecyparis lawsoniana* may be present. Common grasses and forbs can include *Melica torreyana, Festuca idahoensis, Iris* spp., and locally endemic serpentine forbs (*Senecio* spp. and others). Structurally, this system is sometimes woodland in character, but it can also be an arborescent chaparral, depending on fire history. Herbaceous-dominated serpentine fens (and bogs) are treated in Mediterranean California Serpentine Fen (CES206.953).
Related Concepts:
- Knobcone Pine: 248 (Eyre 1980) Intersecting
- Pacific Ponderosa Pine: 245 (Eyre 1980) Broader

DESCRIPTION

Environment: This ecological system occurs in Mediterranean California in the northern and southern Coast Ranges and the northern Sierra Nevada, on cool northerly and concave slopes and toeslopes with thin, rocky, ultramafic (gabbro, peridotite, serpentinite) soils. Not all ultramafic outcrops support distinct vegetation; only those with very low Ca:Mg ratios impact biotic composition. Soils on ultramafics are usually shallow and skeletal, with little profile development (Kruckeberg 1984). Ultramafic soils impose the following stresses on plants: imbalance of calcium and magnesium, magnesium toxicity, low availability of molybdenum, toxic levels of heavy metals, sometime high alkalinity, low concentrations of some essential nutrients, and low soil water storage capacity (Kruckeberg 1984, Sanchez-Mata 2007). In some cases, the steepness of the slopes and general sparseness of the vegetation result in continual erosion.
Dynamics: Structurally, this system is sometimes woodland in character, but it can also be an arborescent chaparral, depending on fire history. Landfire (2007)a: Stand-replacing fires occur mostly in the shrub-dominated stages. In the conifer-dominated late-seral closed stage, surface fire is also important. Mean FRI is generally greater than that of the surrounding forested landscape (including the lower elevation California Mesic Chaparral (CES206.926) - perhaps double (Nagel and Taylor 2005) - due to the lack of flammability of many young shrub fields without a long history of fuel accumulation.

Within this system, *Cupressus sargentii* dominates some occurrences as woodlands or as dense shrubby thickets (Griffin and Critchfield 1976). This tree begins bearing cones by 3-7 years of age, and abundant cone crops are produced that require 2 years to mature. The serotinous cones remain closed on the tree until opened by the heat of a fire or from desiccation due to age. Seeds establish best on bare mineral soil. Seedling mortality is high on shaded sites with abundant litter because of damping-off fungi (Esser 1994b, Barbour 2007). *Cupressus sargentii (= Callitropsis sargentii)* has serotinous cones. Burned trees usually release large quantities of seed after fire, and seedlings establish as dense thickets. No information was available on fire-return intervals. To maintain a stand, fire-return intervals of greater than 7 years will allow new cone crops to develop (Esser 1994b).

The mesic chaparral stage of this system generally burns in high-intensity, stand-replacing crown fires that may burn thousands of acres in a single event (Landfire 2007a). However, there is a considerable range in the flammability of shrub species (e.g., *Adenostoma fasciculatum* is "flashier" than *Arctostaphylos* spp.). Large, stand-replacement events can interact with seed availability and, hence, influence post-fire successional pathways differently than for smaller, less severe fires. Mean fire-return intervals are highly variable across the range of this system depending on species composition and other factors. Sediment cores taken from the Santa Barbara Channel in central California dating from the 16th and 17th centuries indicate that large fires burned the Santa Ynez and Santa Lucia mountains every 40-60 years. Season of burning plays a large part in species composition. Occasionally, frost affects mortality and increases fuel buildup.

Quercus durata is an important shrub in this system. Plants sprout from swollen root crowns and root suckers after damage to their trunks; they sprout rapidly following fire (Sawyer et al. 2009). Small mammals and jays cache acorns, which other wildlife also eat.

Component Associations:
- *Cupressus sargentii* Woodland (CEGL003044, G2)
- *Quercus durata - Arctostaphylos glandulosa* Shrubland (CEGL003351, G3)
- *Umbellularia californica - Quercus agrifolia / Toxicodendron diversilobum* Forest (CEGL003175, G4)
- *Umbellularia californica / Polystichum munitum* Forest (CEGL003174, G4)

DISTRIBUTION

Range: This system occurs throughout Mediterranean California except in the Klamath Mountains and possibly into Oregon.
Divisions: 206:C
Nations: US
Subnations: CA, OR?
Map Zones: 2:C, 3:C, 4:C, 6:C, 7:P
USFS Ecomap Regions: M261A:CC, M261B:CC, M261C:CC, M261D:CC, M261E:CC
TNC Ecoregions: 5:C, 12:P, 14:C, 15:P

SOURCES

References: Barbour 2007, Barbour and Major 1988, Barbour et al. 2007, Batten et al. 2006, Brooks and Minnich 2006, Comer et al. 2003, Esser 1994b, Eyre 1980, Griffin and Critchfield 1976, Holland and Keil 1995, Kruckberg 1984, Landfire 2007a, Nagel and Taylor 2005, PRBO Conservation Science 2011, Safford and Harrison 2004, Sanchez-Mata 2007, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722753#references
Description Author: P. Comer and T. Keeler-Wolf, mod. G. Kittel and M. Reid
Version: 14 Jan 2014 **Stakeholders:** West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

NASHVILLE BASIN LIMESTONE GLADE AND WOODLAND (CES202.334)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Woody-Herbaceous; Rock Outcrops/Barrens/Glades; Alkaline Soil; Graminoid
FGDC Crosswalk: Vegetated, Tree-dominated, Sparse tree canopy, Mixed evergreen-deciduous sparse tree canopy
National Mapping Codes: EVT 2397; ESLF 5413; ESP 1397

CONCEPT

Summary: This system encompasses a range of plant communities associated with thin soils on flat areas of Ordovician limestone in the Inner Nashville Basin of Tennessee, with a few disjunct occurrences in Kentucky. The vegetation of this system includes sparsely vegetated rock outcrops, annual *Sporobolus* spp.-dominated grasslands, *Schizachyrium scoparium*-dominated perennial grasslands, seasonally wet herbaceous washes and seeps, shrublands, as well as woodlands dominated by *Juniperus virginiana* and oaks. *Echinacea tennesseensis* and *Astragalus bibullatus* are completely endemic to this system. There are numerous other disjunct and near-endemic plants.

Classification Comments: This system occupies a small portion of the landscape but many associations are only found in this system. The most closely related system is Central Interior Highlands Calcareous Glade and Barrens (CES202.691). Also included here are related disjunct examples in Kentucky on Mississippian limestones (EPA ecoregions 71a, 71e of Woods et al. (2002)).

Similar Ecological Systems:

- Central Interior Highlands Calcareous Glade and Barrens (CES202.691)--is typically found on sloping surfaces, not flatrocks, and has a broader distribution.

Related Concepts:

- Eastern Redcedar: 46 (Eyre 1980) Finer
- Limestone Flat-Rock Glade (Evans 1991) Finer
- Post Oak - Blackjack Oak: 40 (Eyre 1980) Finer

DESCRIPTION

Environment: This system is associated with thin soils on flat areas of Ordovician limestone in the Inner Nashville Basin of Tennessee (Ecoregion 71i of Griffith et al. 1998 and EPA 2004; Subsection 222Ed of Keys et al. 1995), with a few disjunct occurrences in Kentucky.

Vegetation: The vegetation of this system includes sparsely vegetated rock outcrops, annual *Sporobolus* spp.-dominated grasslands, *Schizachyrium scoparium*-dominated perennial grasslands, seasonally wet herbaceous washes and seeps, shrublands, as well as woodlands dominated by *Juniperus virginiana* and oaks. Other woody plants associated with this system include *Quercus shumardii, Cercis canadensis, Ulmus alata, Fraxinus quadrangulata,* and *Acer saccharum.* Characteristic shrubs include *Forestiera ligustrina, Rhus aromatica, Hypericum frondosum,* and *Frangula caroliniana*. Other herbaceous taxa include *Andropogon gerardii, Bouteloua curtipendula, Silphium trifoliatum, Silphium terebinthinaceum, Helianthus mollis, Grindelia lanceolata, Liatris* spp., *Hedyotis nigricans, Croton capitatus, Heliotropium tenellum, Isanthus brachiatus, Manfreda virginica, Ruellia humilis, Talinum calcaricum, Sedum pulchellum,* and *Panicum flexile*. *Echinacea tennesseensis* and *Astragalus bibullatus* are completely endemic to this system. There are numerous other disjunct and near-endemic plants, including *Astragalus tennesseensis, Dalea gattingeri,* and *Pediomelum subacaule* (Somers et al. 1986). Small-scale seepage areas and washes may contain *Eleocharis compressa, Nothoscordum bivalve, Isoetes butleri,* and *Hypoxis hirsuta*.

Dynamics: There is an apparent zonation or patchiness to glade/barren vegetation, with different zones that may be identified by their characteristic plant species (Quarterman et al. 1993). These zones are apparently relatively stable, with woody plant encroachment evident only in relation to the invasion of shrubs and trees into potholes or crevices where soil accumulates more rapidly.

Periodic droughts, fire, historic grazing, and ice storms all play a role in the dynamics of the system by restricting woody growth and maintaining the more open glade structure. Historic grazing by wild and domestic ungulate species represented a significant disturbance regime in the past. Regionally significant drought cycles lead to death or decline of *Juniperus virginiana*, as well as affecting the severity of other disturbance regimes. Severe droughts kill tree saplings growing in cracks and potholes, helping to retain the open character of the glades (Quarterman et al. 1993). Fire carries best in zones or areas dominated by perennial grasses, which provide the most abundant and consistent fuel. This zone is also the most vulnerable to succession, with *Juniperus virginiana* and various native (and exotic) shrubs occupying these areas in periods without disturbance (Landfire 2007a).

The ecological processes that maintain these open grasslands and glades within a forested matrix are not completely understood. Clearly periodic drought cycles of varying lengths play a role, along with fire and free-ranging grazing livestock, at least until the 1940s, when open range laws were changed (DeSelm 1994). Livestock confinement, habitat fragmentation, and the ingrowth of exotic shrubs have caused many examples of these communities to become more densely covered by woody plants, including the native but weedy *Juniperus virginiana var. virginiana*.

Open range laws and the use of fire to clear native grass pastures worked to keep large parts of the rural Nashville Basin in an open, grass-dominated condition, either as open, prairie-like areas, or as oak woodlands with a native grass and forb understory. This combination of conditions persisted until about 1945 (DeSelm 1994). In a Missouri study of presettlement fire using composite fire scar chronologies, Guyette and McGinnes (1982 as cited in Frost 1998) reconstructed a presettlement fire frequency of 3.2 years in Missouri cedar glade vegetation.

Component Associations:
- *Dalea foliosa - Mecardonia acuminata - Mitreola petiolata* Herbaceous Vegetation (CEGL004292, G2?)
- *Eleocharis (bifida, compressa) - Schoenolirion croceum - Carex crawei - Allium cernuum* Herbaceous Vegetation (CEGL004169, G2?)
- *Juniperus virginiana var. virginiana - Forestiera ligustrina - Rhus aromatica - Hypericum frondosum* Shrubland (CEGL003938, G3G4)
- *Juniperus virginiana var. virginiana - Fraxinus quadrangulata / Polymnia canadensis - (Astranthium integrifolium)* Woodland (CEGL003754, G3)
- *Quercus muehlenbergii - Juniperus virginiana / Schizachyrium scoparium - Manfreda virginica* Wooded Herbaceous Vegetation (CEGL005131, G2G3)
- *Quercus stellata / Viburnum rufidulum - Forestiera ligustrina / Andropogon gerardii* Woodland (CEGL003712, G2?)
- *Sedum pulchellum - Talinum calcaricum - Leavenworthia* spp. / *Nostoc commune* Herbaceous Vegetation (CEGL004346, G3)
- *Sporobolus (neglectus, vaginiflorus) - Aristida longispica - Panicum flexile - Panicum capillare* Herbaceous Vegetation (CEGL004340, G3)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Southern Interior Low Plateau Dry-Mesic Oak Forest (CES202.898)

DISTRIBUTION

Range: This system is restricted to flat areas of Ordovician limestone in the Inner Nashville Basin of Tennessee (Ecoregion 71i of Griffith et al. (1998); Subsection 222Ed of Keys et al. (1995)), as well as limited and disjunct examples on flat Mississippian limestones in Kentucky.
Divisions: 202:C
Nations: US
Subnations: KY, TN
Map Zones: 47:C, 48:C
USFS Ecomap Regions: 223D:CC, 223E:CC
TNC Ecoregions: 44:C

SOURCES

References: Comer et al. 2003, DeSelm 1994, DeSelm and Murdock 1993, Duffey et al. 1974, EPA 2004, Estes et al. 1979, Evans 1991, Eyre 1980, Frost 1998, Griffith et al. 1998, Guyette and McGinnes 1982, Keys et al. 1995, Landfire 2007a, McKinney and Lockwood 1999, Murdock pers. comm., Noss 2013, Quarterman et al. 1993, Somers et al. 1986, Sutter et al. 2011, Taft 1997, Taft 2009, Taft et al. 1995, TNC 1996c, Wiens and Dyer 1975, Woods et al. 2002
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723170#references
Description Author: M. Pyne, R. Evans, C. Nordman
Version: 14 Jan 2014
Concept Author: M. Pyne, R. Evans, C. Nordman
Stakeholders: Southeast
ClassifResp: Southeast

NORTH-CENTRAL INTERIOR OAK SAVANNA (CES202.698)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Non-Diagnostic Classifiers: Woody-Herbaceous
FGDC Crosswalk: Vegetated, Tree-dominated, Sparse tree canopy, Deciduous sparse tree canopy
National Mapping Codes: EVT 2394; ESLF 5410; ESP 1394

CONCEPT

Summary: This system is found primarily in the northern glaciated regions of the Midwest with the largest concentration in the prairie-forest border ecoregion. It is typically found on rolling outwash plains, hills and ridges. Soils are typically moderately well- to well-drained deep loams. This system is typified by scattered trees over a continual understory of prairie and woodland grasses and forbs. *Quercus macrocarpa* is the most common tree species and can range from 10-60% cover. The understory is dominated by tallgrass prairie species such as *Andropogon gerardii* and *Schizachyrium scoparium* associated with several forb species. Historically, frequent fires maintained this savanna system within its range and would have restricted tree canopies to 10-30%. Fire suppression in the region has allowed trees to establish more dense canopies. Periodic, strong wind disturbances and browsing also impact this system. Much of this system has also been converted to urban use or agriculture, and thus its range has decreased considerably.

DESCRIPTION

Environment: This system is typically found on rolling tillplains, hills, and ridges in the glaciated Midwest. Soils are typically moderately well- to well-drained deep loams and fertile. Because fire is critical to maintaining this system, it is not found in fire-protected portions of the landscape.
Vegetation: *Quercus macrocarpa* is the most common tree species and can range from 10-60% cover. The understory is dominated by tallgrass prairie species such as *Andropogon gerardii*, *Calamagrostis canadensis*, and *Schizachyrium scoparium* associated with several forb species.
Dynamics: Historically, frequent fires maintained this savanna system within its range and would have restricted tree canopies to 10-30% cover with some portions having up to 60% tree canopy. On average, surface fires were very frequent (1- to 5-year return intervals) and maintained the open, herbaceous understory. Canopy trees were replaced when periodic longer fire-return intervals, due to chance, multi-year wet climatic cycles, or lack of burning by Native Americans, allowed oak seedlings to grow large enough to survive surface fires when they returned. If fire is absent for more than about 20-40 years, a site will transition to oak woodland/forest (Cottam 1949, Curtis 1959, Grimm 1981). Fire suppression in the region has allowed trees to establish more consistent dense canopies. Periodic, strong wind disturbances and browsing/grazing also impact this system through modification to the herbaceous layer and tree seedlings.

Component Associations:
- *Quercus alba - Quercus macrocarpa - Quercus rubra / Corylus americana* Woodland (CEGL002142, G3G4)
- *Quercus alba - Quercus macrocarpa / Andropogon gerardii* Wooded Herbaceous Vegetation (CEGL005121, G1)
- *Quercus macrocarpa - (Quercus alba, Quercus stellata) / Andropogon gerardii* Wooded Herbaceous Vegetation (CEGL002159, G1)
- *Quercus macrocarpa - (Quercus alba, Quercus velutina) / Andropogon gerardii* Wooded Herbaceous Vegetation (CEGL002020, G1)
- *Quercus macrocarpa - Quercus palustris - Quercus bicolor / Calamagrostis canadensis* Wooded Herbaceous Vegetation (CEGL005120, G1)
- *Quercus macrocarpa* Northern Tallgrass Wooded Herbaceous Vegetation (CEGL002158, G1G2)

DISTRIBUTION

Range: This system is found throughout the northern glaciated regions of the Midwest. Its main concentration, where it was likely the matrix type, is within the Prairie Forest Border of Minnesota, Wisconsin, Iowa, and Illinois. Conversion to urban uses and agriculture and fire suppression have significantly impacted the range of this system.
Divisions: 201:?; 202:C; 205:C
Nations: US
Subnations: IA, IL, IN, MI, MN, MO, OH, WI
Map Zones: 39:P, 40:C, 41:C, 42:C, 43:P, 44:P, 49:C, 50:C, 51:P, 52:C
USFS Ecomap Regions: 212K:CP, 212Q:CP, 222Jb:CCP, 222Jc:CCC, 222Je:CCC, 222Jf:CCC, 222Jg:CCC, 222Jh:CCC, 222Ji:CCC, 222K:CC, 222L:CC, 222M:CC, 222N:CC, 222Ua:CCC, 222Ud:CCC, 222Ue:CCC, 251A:CC, 251B:CC
TNC Ecoregions: 35:C, 36:C, 45:P, 46:C, 47:P

SOURCES

References: Abella et al. 2001, Albert 1995b, Anderson and Bowles 1999, Apfelbaum and Haney 1991, Bowles and McBride 1994,

Cohen 2004, Comer et al. 1995a, Comer et al. 1998, Comer et al. 2003, Cottam 1949, Curtis 1959, Grimm 1981, Landfire 2007a, MNNHP 1993, Nuzzo 1986

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722962#references

Description Author: S. Menard, mod. J. Drake

Version: 14 Jan 2014 **Stakeholders:** Midwest, Southeast

Concept Author: S. Menard **ClassifResp:** Midwest

NORTH-CENTRAL INTERIOR QUARTZITE GLADE (CES202.699)

CLASSIFIERS

Conf.: 3 - Weak **Classification Status:** Standard
Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Non-Diagnostic Classifiers: Forest and Woodland (Treed); Woody-Herbaceous; Ridge/Summit/Upper Slope; Metamorphic Rock [Quartzite]; Very Shallow Soil; Cliff (Landform)
National Mapping Codes: ESLF 5459

CONCEPT

Summary: This quartzite woodland is found on rocky, hilly regions in the upper midwestern United States in the Baraboo Hills of Wisconsin. Stands occur on the brow of steep slopes that overlay quartzite or rhyolite bedrock that contains some fractures. Soils are thin (10-30 cm deep) silt loams, acidic (pH of 4.5-5.0), fertile, and rich in organic matter (10-15% organic matter). These glades represent forest openings dominated by relatively even-spaced, small-statured trees and a sparse shrub and sapling layer. The tree canopy is variable. These glades are dominated by *Quercus alba*, *Quercus macrocarpa*, or *Carya ovata* with an understory of herbaceous species such as *Carex pensylvanica*, *Antennaria plantaginifolia*, *Solidago ulmifolia*, and others. Lichens and mosses are common on the exposed bedrock. Drought strongly influences this system, although deer browsing and fire, at least historically, may also play a role in keeping the glade structure.
Classification Comments: This system was originally included with the Minnesota/South Dakota quartzite glades, but further discussion determined that those examples found within the Driftless Area are distinct from those farther west.

DESCRIPTION

Environment: Stands occur on the brow of steep slopes that overlay quartzite or rhyolite bedrock that contains some fractures. Exposed bedrock may average about 15%. The stands themselves have gentle slopes (2-11%), mostly with a southwestern aspect, but range from due east to due west. Glade soils are thin (10-30 cm deep) silt loams, acidic (pH of 4.5-5.0), fertile, and rich in organic matter (10-15% organic matter). The high organic matter content could be a function of low pH and droughtiness that inhibit decomposition of organic matter (West and Welsh 1998).
Vegetation: These glades represent forest openings dominated by relatively even-spaced, small-statured trees and a sparse shrub and sapling layer. The tree canopy is fairly closed, averaging about 75% (range of 57-82%). Either *Quercus alba* or *Carya ovata* dominate the canopy. *Quercus velutina* and *Quercus rubra* are much less common. Shrubs are nearly absent from all glades. Herbaceous species include *Carex pensylvanica*, *Antennaria plantaginifolia*, *Solidago ulmifolia*, and others. The flora is complicated by the fact that the glades likely served as refugia for prairie plants historically and now serve as refugia for woodland and savanna plants (P. West pers. comm. 2000).
Dynamics: Droughts and deer browse may currently interact to keep these glades open. Historically, the surrounding matrix of dry oak forests may have been more likely to burn, and those fires could have spread into the glades (West and Welsh 1998). These glades are thought to be more environmentally controlled, by shallow soils, which suggest that soil depth and the historic extent of the glade community may be positively correlated (P. West pers. comm. 2000). *Juniperus virginiana* was present on some of the glades but in low abundance (P. West pers. comm. 2000).

Component Associations:
- *Quercus alba - Carya ovata / Carex pensylvanica - Heuchera richardsonii* Quartzite Glade Woodland (CEGL005276, G2?)

DISTRIBUTION

Range: This system is known from a very restricted area on quartzite or rhyolite outcrops in the Baraboo Hills region of Wisconsin. Glades, including partially wooded glades, also occur on basalt in northwestern Wisconsin, on rhyolite in central Wisconsin, and at a few sites on various bedrock substrates, including quartzite, in northwestern Wisconsin, e.g., within the Nicolet portion of the Chequamegon-Nicolet National Forest.
Divisions: 202:C
Nations: US
Subnations: WI
Map Zones: 42:C, 50:C
USFS Ecomap Regions: 222L:CC
TNC Ecoregions: 46:C

SOURCES

References: Comer et al. 2003, West and Welsh 1998, WNHI 2012
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722961#references
Description Author: S. Menard and D. Faber-Langendoen, mod. J. Drake
Version: 14 Jan 2014 **Stakeholders:** Midwest

Concept Author: S. Menard and D. Faber-Langendoen **ClassifResp:** Midwest

NORTH-CENTRAL OAK BARRENS (CES202.727)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Woody-Herbaceous
FGDC Crosswalk: Vegetated, Tree-dominated, Sparse tree canopy, Deciduous sparse tree canopy
National Mapping Codes: EVT 2395; ESLF 5411; ESP 1395

CONCEPT

Summary: This system occurs on well-drained, coarse-textured sandy soils derived from glacial outwash, end moraine formations, lakeplain dune systems, and broad sandy river terraces in the north-central U.S. into Ontario, Canada. Soils range from almost pure sand, to loamy sand, to sandy loam. The soils have low fertility, organic matter, and moisture-retention capacity. Factors which affect seasonal soil moisture are strongly related to variation in this type. This oak barrens system is a scrubby, open-treed system dominated by graminoids and shrubs. Canopy structure varies from a dominant herbaceous ground layer with sparse, scattered "savanna" canopy (5-30%), through oak-dominated scrub, to a more closed woodland canopy (30-80%). The canopy layer is dominated by *Quercus velutina*, with some *Quercus ellipsoidalis, Quercus macrocarpa*, and *Quercus alba* (the latter more common eastward and in woodland conditions). Occasional *Pinus banksiana* can occur in the northern parts of the range. Species found in the herb layer include *Ambrosia psilostachya, Amphicarpaea bracteata, Artemisia ludoviciana, Andropogon gerardii, Calamovilfa longifolia, Carex pensylvanica, Carex* spp., *Comandra umbellata, Dichanthelium* spp., *Hesperostipa spartea (= Stipa spartea), Koeleria macrantha, Lupinus perennis, Schizachyrium scoparium, Sorghastrum nutans*, and *Tephrosia virginiana*. Fire was an important factor in maintaining this system. Oak wilt, droughts and, in some northern sites, frosts during the growing season also reduce tree cover.
Classification Comments: Black oak woodland variants may occur in this system, but because *Quercus velutina* and *Quercus ellipsoidalis* can sprout after stems have been killed by fires, stands generally have a somewhat scrubby structure that can vary from 10-60% cover over time. Some stands may occur on fairly mesic sands. In New England and (most of) New York, similar settings are occupied by pitch pine - oak barrens (Northeastern Interior Pine Barrens (CES202.590)) which are characterized by *Quercus ilicifolia*, not *Quercus ellipsoidalis*.
Similar Ecological Systems:
- Laurentian Pine-Oak Barrens (CES201.718)--is a pine-dominated system and lacks *Quercus velutina*.

Related Concepts:
- White Oak - Black Oak - Northern Red Oak: 52 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs on well-drained, coarse-textured sandy soils derived from glacial outwash, end moraine formations, lakeplain dune systems, broad sandy river terraces, and sometimes on colluvium below sandstone bluffs. Soils range from almost pure sand, to loamy sand, to sandy loam. The soils have low fertility, organic matter, and moisture-retention capacity. Factors which affect seasonal soil moisture are strongly related to variation in this type.
Vegetation: This oak barrens system is a scrubby, open-treed system dominated by graminoids and shrubs. Canopy structure varies from a dominant herbaceous ground layer with sparse, scattered "savanna" canopy (5-30%), through oak-dominated scrub, to a more closed woodland canopy (30-80%). The canopy layer is dominated by *Quercus velutina*, with some *Quercus ellipsoidalis, Quercus macrocarpa*, and *Quercus alba* (the latter more common eastward and in woodland conditions). Occasional *Pinus banksiana* can occur in the northern parts of the range. Species found in the herb layer include *Ambrosia psilostachya, Amphicarpaea bracteata, Artemisia ludoviciana, Andropogon gerardii, Calamovilfa longifolia, Carex pensylvanica, Carex* spp., *Comandra umbellata, Sorghastrum nutans, Hesperostipa spartea (= Stipa spartea)*, and *Schizachyrium scoparium*.
Dynamics: Fire was an important factor in maintaining this system. Oak wilt and droughts also reduce tree cover. For more fertile sites, surface fires were very frequent (1- to 5-year return intervals) and important for maintaining the open canopy and herbaceous understory. This system was not as fire-dependent as more mesic savannas and woodlands, due to the relatively infertile and often droughty soils on which it occurred. Some examples retained an open canopy without frequent fires (Whitford and Whitford 1971). Canopy trees were replaced when periodic longer fire-return intervals, due to chance, multi-year wet climatic cycles, or lack of burning by Native Americans, allowed oak seedlings to grow large enough to survive surface fires when they returned. If fire is absent for more than about 20-40 years, a site will transition to oak woodland/forest (Curtis 1959).

Component Associations:
- *Quercus alba - (Quercus velutina) / Lespedeza virginica - Eupatorium hyssopifolium* Woodland (CEGL006433, GNR)
- *Quercus macrocarpa - (Quercus ellipsoidalis) / Schizachyrium scoparium - Koeleria macrantha* Wooded Herbaceous Vegetation (CEGL002160, G2)
- *Quercus velutina - (Quercus alba) - Quercus ellipsoidalis / Schizachyrium scoparium - Lupinus perennis* Wooded Herbaceous Vegetation (CEGL002492, G3)
- *Quercus velutina - (Quercus ellipsoidalis) - Quercus alba / Deschampsia flexuosa* Woodland (CEGL005029, GNR)

DISTRIBUTION

Range: This system is found in the north-central U.S. from North Dakota to western New York and westernmost Pennsylvania (mostly historic there) and into Ontario, Canada.
Divisions: 202:C
Nations: CA, US
Subnations: IL, IN, MI, MN, ND, NY, OH, ON, PA, WI
Map Zones: 39:C, 40:C, 41:C, 42:C, 43:C, 49:C, 50:C, 51:C, 52:C, 63:C
USFS Ecomap Regions: 212Ha:CCP, 212Hb:CCC, 222I:CC, 222Ja:CCC, 222Jb:CCC, 222Jc:CCC, 222Je:CCC, 222Jf:CCC, 222Jg:CCC, 222Jh:CCC, 222Ji:CCP, 222K:CC, 222L:CC, 222M:CP, 222R:CC, 222Ua:CCC, 222Ud:CCC, 222Ue:CCC
TNC Ecoregions: 35:C, 36:C, 45:C, 46:C, 47:C, 48:C, 49:C

SOURCES

References: Chapman et al. 1994, Comer and Albert 1997, Comer et al. 1995a, Comer et al. 1998, Comer et al. 2003, Curtis 1959, Eyre 1980, Landfire 2007a, Nuzzo 1986, Whitford and Whitford 1971
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722945#references
Description Author: D. Faber-Langendoen, mod. J. Drake
Version: 14 Jan 2014 **Stakeholders:** Canada, East, Midwest
Concept Author: D. Faber-Langendoen **ClassifResp:** Midwest

NORTHERN APPALACHIAN-ACADIAN ROCKY HEATH OUTCROP (CES201.571)

CLASSIFIERS

Classification Status: Standard

Primary Division: Laurentian-Acadian (201)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland; Ridge/Summit/Upper Slope; Rock Outcrops/Barrens/Glades; Glaciated; Acidic Soil
Non-Diagnostic Classifiers: Forest and Woodland (Treed); Oligotrophic Soil; Very Shallow Soil; Mineral: W/ A-Horizon >10 cm; Mineral: W/ A-Horizon <10 cm; Loam Soil Texture; Sand Soil Texture; Udic; Consolidated; Long Disturbance Interval; F-Patch/Low Intensity; W-Landscape/Medium Intensity; Needle-Leaved Tree; Broad-Leaved Deciduous Tree; Broad-Leaved Shrub; Dwarf-Shrub; Graminoid; Nonvascular
National Mapping Codes: ESLF 5462

CONCEPT

Summary: This outcrop ecological system ranges across New England and adjacent Canada, and southward at higher elevations to northern Pennsylvania, on ridges or summits of resistant acidic bedrock. Throughout most of its range, it occurs at low to mid elevations (600-1000 m, lower on the coast of eastern Maine and the Maritimes). The vegetation is patchy, often a mosaic of woodlands and open glades. *Quercus rubra* and various conifers, including *Pinus strobus* and *Picea rubens*, or (especially near the coast) *Picea mariana*, are characteristic trees. Low heath shrubs, including *Kalmia angustifolia, Vaccinium angustifolium, Gaylussacia baccata*, and *Photinia melanocarpa*, are typically present. Exposure and occasional fire are the major factors in keeping the vegetation relatively open.
Classification Comments: This system transitions westward and northward into Laurentian Acidic Rocky Outcrop (CES201.019) and southward into Central Appalachian Pine-Oak Rocky Woodland (CES202.600). Where their ranges overlap or abut, this system is distinguished from the latter by the presence of more northern elements such as *Picea, Sorbus, Pinus banksiana*, etc., and lack of *Pinus rigida* and *Quercus ilicifolia* which may be found in the Central Appalachian system. This system overlaps with Laurentian Acidic Rocky Outcrop (CES201.019) only in New York state, where the latter occurs in the St. Lawrence - Champlain ecoregion (an extension of its Great Lakes affinities), and the present type occurs primarily in the Northern Appalachian ecoregion. Northward or at higher elevations, this system is replaced by Acadian-Appalachian Subalpine Woodland and Heath-Krummholz (CES201.568).
Similar Ecological Systems:
- Acadian-Appalachian Subalpine Woodland and Heath-Krummholz (CES201.568)--occurs at higher elevations.
- Central Appalachian Pine-Oak Rocky Woodland (CES202.600)
- Laurentian Acidic Rocky Outcrop (CES201.019)

Related Concepts:
- Black Spruce Woodland (Gawler and Cutko 2010) Finer
- Jack Pine Woodland (Gawler and Cutko 2010) Finer
- Northern Red Oak: 55 (Eyre 1980) Finer
- Oak - Pine Woodland (Gawler and Cutko 2010) Finer
- Pitch Pine Rocky Woodland (Gawler and Cutko 2010) Finer
- Red Pine Woodland (Gawler and Cutko 2010) Finer
- Red Spruce - Mixed Conifer Woodland (Gawler and Cutko 2010) Finer
- Red Spruce: 32 (Eyre 1980) Finer
- Three-Toothed Cinquefoil - Blueberry Low Summit Bald (Gawler and Cutko 2010) Finer
- White Pine - Northern Red Oak - Red Maple: 20 (Eyre 1980) Finer

Component Associations:
- *Picea mariana / Kalmia angustifolia* Woodland (CEGL006292, G4?)
- *Picea rubens / Vaccinium angustifolium / Sibbaldiopsis tridentata* Woodland (CEGL006053, G4)
- *Pinus banksiana / Kalmia angustifolia - Vaccinium* spp. Woodland (CEGL006041, G3G5)
- *Pinus resinosa / Gaylussacia baccata - Vaccinium angustifolium* Woodland (CEGL006010, G3G5)
- *Quercus rubra - (Quercus prinus) / Vaccinium* spp. / *Deschampsia flexuosa* Woodland (CEGL006134, G4)
- *Vaccinium angustifolium - Sorbus americana / Sibbaldiopsis tridentata* Dwarf-shrubland (CEGL005094, GNR)

DISTRIBUTION

Range: This system is found in New England and adjacent Canada west to the Adirondacks and south to northern Pennsylvania.
Divisions: 201:C
Nations: CA, US
Subnations: MA, ME, NB, NH, NS, NY, PA, QC, VT
Map Zones: 63:C, 64:C, 65:C, 66:C
USFS Ecomap Regions: 211A:CC, 211B:CC, 211C:CC, 211D:CC, 211F:CC, 211I:CC, M211A:CC, M211B:CC, M211C:CC, M211D:CC

TNC Ecoregions: 48:P, 60:C, 61:C, 63:C, 64:P

SOURCES

References: Comer et al. 2003

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723034#references

Description Author: S.C. Gawler

Version: 05 Oct 2004

Concept Author: S.C. Gawler and D. Faber-Langendoen

Stakeholders: Canada, East

ClassifResp: East

NORTHERN ROCKY MOUNTAIN FOOTHILL CONIFER WOODED STEPPE (CES306.958)

CLASSIFIERS

Classification Status: Standard

Primary Division: Rocky Mountain (306)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Woody-Herbaceous; Shallow Soil; Aridic; Short Disturbance Interval; F-Patch/Low Intensity; F-Landscape/Low Intensity; Needle-Leaved Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Sparse tree canopy, Evergreen sparse tree canopy
National Mapping Codes: EVT 2165; ESLF 5426; ESP 1165

CONCEPT

Summary: This inland Pacific Northwest ecological system occurs in the foothills of the northern Rocky Mountains in the Columbia Plateau region and west along the foothills of the Modoc Plateau and eastern Cascades into southern interior British Columbia. It also occurs east across Idaho into the eastern foothills of the Montana Rockies. The system may also occur on the lower treeline slopes of the Wyoming Rockies. These wooded steppes occur at the lower treeline/ecotone between grasslands or shrublands and forests and woodlands, typically on warm, dry, exposed sites too droughty to support a closed tree canopy. This is not a fire-maintained system. The "savanna" character results from a climate-edaphic interaction that results in widely scattered trees over shrubs or grasses, and even in the absence of fire, a "woodland" or "forest" structure will not be obtained. Elevations range from less than 500 m in British Columbia to 1600 m in the central Idaho mountains. Occurrences are found on all slopes and aspects; however, moderately steep to very steep slopes or ridgetops are most common. This system can occur in association with cliff and canyon systems. It generally occurs on glacial till, glacio-fluvial sand and gravel, dune, basaltic rubble, colluvium, to deep loess or volcanic ash-derived soils, with characteristic features of good aeration and drainage, coarse textures, circumneutral to slightly acidic pH, an abundance of mineral material, rockiness, and periods of drought during the growing season. These can also occur on areas of sand dunes, scablands, and pumice where the edaphic conditions limit tree abundance. *Pinus ponderosa* (vars. *ponderosa* and *scopulorum*) and *Pseudotsuga menziesii* are the predominant conifers (not always together); *Pinus flexilis* may be present or common in the tree canopy. In interior British Columbia, *Pseudotsuga menziesii* is the characteristic canopy dominant. In transition areas with big sagebrush steppe systems, *Purshia tridentata, Artemisia tridentata ssp. wyomingensis, Artemisia tridentata ssp. tridentata*, and *Artemisia tripartita* may be common in fire-protected sites such as rocky areas. Deciduous shrubs, such as *Physocarpus malvaceus, Symphoricarpos albus*, or *Spiraea betulifolia*, can be abundant in more northerly sites or more moist climates. Important grass species include *Pseudoroegneria spicata, Poa secunda, Hesperostipa* spp., *Achnatherum* spp., and *Elymus elymoides*.
Classification Comments: This is not a fire-maintained system; it occurs on sites too droughty to support a closed tree canopy. It does burn with a high-frequency / low-intensity regime, but fire is not carried because of the sparse vegetation of the edaphically constrained sites (rock outcrops, dunes, super-dry, sparse trees over shrubs and sometimes grasses but widely spaced). True "savannas" with grassy understories and high-frequency / low-intensity fires are now placed into Northern Rocky Mountain Ponderosa Pine Woodland and Savanna (CES306.030). Ponderosa woodlands and "steppes" in eastern Wyoming, eastern and central Montana, including the Missouri River Breaks, are now included in Northwestern Great Plains-Black Hills Ponderosa Pine Woodland and Savanna (CES303.650). Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648) and Southern Rocky Mountain Ponderosa Pine Savanna (CES306.649) mostly contain *Pinus ponderosa var. scopulorum, Pinus ponderosa var. ponderosa (= var. brachyptera),* and *Pinus arizonica var. arizonica (= Pinus ponderosa var. arizonica)*. The FRIS site describes different varieties of *Pinus ponderosa* and associated species. This ecological system of the northern Rockies is primarily *Pinus ponderosa var. ponderosa*. Johansen and Latta (2003) have mapped the distribution of two varieties (*Pinus ponderosa var. scopulorum* and *Pinus ponderosa var. ponderosa*) using mitochondrial DNA. They hybridize along the Continental Divide in Montana backing up the FRIS information.
Similar Ecological Systems:
- Northwestern Great Plains-Black Hills Ponderosa Pine Woodland and Savanna (CES303.650)

Related Concepts:
- Interior Ponderosa Pine: 237 (Eyre 1980) Intersecting
- Limber Pine: 219 (Eyre 1980) Intersecting
- Ponderosa Pine - Grassland (110) (Shiflet 1994) Intersecting. This SRM type includes edaphically-controlled open ponderosa over sparse grasses, corresponding to this system.
- Ponderosa Pine - Shrubland (109) (Shiflet 1994) Intersecting. This SRM type includes edaphically-controlled open ponderosa over shrubs, corresponding to this system.

DESCRIPTION

Environment: These wooded steppes occur at the lower treeline/ecotone between grasslands or shrublands and forests and woodlands, typically on warm, dry, exposed sites too droughty to support a closed tree canopy. The "savanna" character results from a climate-edaphic interaction that results in widely scattered trees over shrubs or grasses, and even in the absence of fire, a "woodland" or "forest" structure will not be obtained. Elevations range from less than 500 m in British Columbia to 1600 m in the central Idaho mountains. Occurrences are found on all slopes and aspects; however, moderately steep to very steep slopes or ridgetops are most

common. This system can occur in association with cliff and canyon systems. It generally occurs on glacial till, glacio-fluvial sand and gravel, dune, basaltic rubble, colluvium, to deep loess or volcanic ash-derived soils, with characteristic features of good aeration and drainage, coarse textures, circumneutral to slightly acidic pH, an abundance of mineral material, rockiness, and periods of drought during the growing season. These can also occur on areas of sand dunes, scablands, and pumice where the edaphic conditions limit tree abundance.

Dynamics: This is not a fire-maintained system. Periodic drought that limits tree establishment is the driving factor in this system. The concept is that of the climate-edaphic interaction that results in widely scattered trees over "shrub-steppe" of sage, bitterbrush, or sparsely distributed grasses. Tree growth is likely episodic, with regeneration episodes in years with available moisture. Tree density is limited in some areas by available growing space due to rocky conditions of the site. The tree canopy in this system will never reach woodland density or close due to the interaction of climate and edaphic factors, even in the absence of fire. This system burns occasionally, but the vegetation is sparse enough that fires are typically not carried through the stand. Fire frequency is speculated to be 30-50 years. This type usually has little surface fuel and replacement fires would be a function of extreme conditions, such as very high winds (Landfire 2007a). Western pine beetle is a significant disturbance and especially affects larger trees, while parasitic mistletoe can cause tree mortality in young and small trees.

Component Associations:

- *Pinus ponderosa - Pseudotsuga menziesii / Purshia tridentata* Woodland (CEGL000214, G3)
- *Pinus ponderosa / Artemisia tridentata - Purshia tridentata* Woodland (CEGL000178, G3)
- *Pinus ponderosa / Artemisia tridentata ssp. wyomingensis / Hesperostipa comata* Woodland (CEGL000179, G1)
- *Pinus ponderosa / Hesperostipa comata* Woodland (CEGL000879, G1)
- *Pinus ponderosa / Pseudoroegneria spicata* Woodland (CEGL000865, G4)
- *Pinus ponderosa / Purshia tridentata / Achnatherum hymenoides* Woodland (CEGL000196, G1)
- *Pinus ponderosa / Purshia tridentata / Achnatherum occidentale* Woodland (CEGL000198, G2)
- *Pinus ponderosa / Purshia tridentata* Woodland (CEGL000867, G3G5)
- *Pinus ponderosa* Scree Woodland (CEGL000878, G4)
- *Pseudotsuga menziesii / Purshia tridentata* Woodland (CEGL000909, G3Q)

DISTRIBUTION

Range: This system is found in the Fraser River drainage of southern British Columbia south along the Cascades into the Modoc Plateau of California, and the northern Rocky Mountains of Washington and Oregon. In the northeastern part of its range, it extends across the northern Rocky Mountains west of the Continental Divide into northwestern Montana and south to the Snake River Plain in Idaho. In Oregon, it is most common in south-central Oregon, in lands managed by the Lakeview District of the BLM, and by the adjacent Fremont and Deschutes national forests. It also occurs on the marginal lands coming south out of the Blue Mountains, on the edge of the northern Basin and Range.

Divisions: 204:C; 304:C; 306:C

Nations: CA, US

Subnations: BC, ID, MT, OR, WA, WY

Map Zones: 1:C, 7:C, 8:C, 9:C, 10:C, 12:?, 18:P, 19:C, 20:?, 21:C

USFS Ecomap Regions: 331A:CP, 342B:CC, 342C:CC, 342D:CC, 342H:CP, 342I:CC, 342J:C?, M331A:PP, M332A:PP, M332B:PP, M332D:PP, M332E:PP, M332F:PP, M332G:PP, M333A:PP

TNC Ecoregions: 4:C, 6:C, 7:C, 8:C, 9:C, 10:C, 26:C, 68:C

SOURCES

References: Camp et al. 1997, Comer et al. 2002, Cooper et al. 1987, Daubenmire and Daubenmire 1968, Everett et al. 2000, Eyre 1980, Franklin and Dyrness 1973, Johansen and Latta 2003, Landfire 2007a, Littell et al. 2009, Mauk and Henderson 1984, Mehl 1992, Meidinger and Pojar 1991, Pfister et al. 1977, Reid et al. 1999, Rice et al. 2012, Shiflet 1994, USFS 1993, Western Ecology Working Group n.d., WNHP 2011, Youngblood and Mauk 1985

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.786411#references

Description Author: M.S. Reid and R. Crawford

Version: 14 Jan 2014 **Stakeholders:** Canada, West

Concept Author: Western Ecology Group **ClassifResp:** West

OUACHITA NOVACULITE GLADE AND WOODLAND (CES202.314)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Woody-Herbaceous; Ozark/Ouachita; Rock Outcrops/Barrens/Glades
FGDC Crosswalk: Vegetated, Tree-dominated, Sparse tree canopy, Mixed evergreen-deciduous sparse tree canopy
National Mapping Codes: EVT 2505; ESLF 5427; ESP 1505

CONCEPT

Summary: This system represents a mosaic of glades and woodlands found on novaculite geology in the central Ouachita Mountains of western Arkansas and adjacent Oklahoma. Novaculite is a weakly metamorphosed rock of sedimentary origin that is primarily composed of microcrystalline quartz and chalcedony. Examples of this system generally occupy ridgetops at 450-640 m (1476-2100 feet) elevation. They are a mosaic of small woodlands scattered on ridges and upper slopes with outcrops and patches of talus scattered throughout. Some woodland or forest patches may appear as almost linear strips interspersed with grassy openings. Wooded patches have a variable, often patchy, structure with some areas of dense canopy interspersed with more open canopies and open grassy patches. In general, the grassy openings occur on shallow soils with exposed bedrock, while the woodlands occur on somewhat deeper soils. In all cases, these are fairly extreme growing conditions due to droughty, rocky soils.

Similar Ecological Systems:
- Ozark-Ouachita Dry Oak Woodland (CES202.707)
- Ozark-Ouachita Dry-Mesic Oak Forest (CES202.708)
- Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland (CES202.313)

Related Concepts:
- Eastern Redcedar: 46 (Eyre 1980) Finer
- Post Oak - Blackjack Oak: 40 (Eyre 1980) Finer
- White Oak - Black Oak - Northern Red Oak: 52 (Eyre 1980) Finer

DESCRIPTION

Environment: The novaculite formation is of Devonian and Mississippian age and consists of novaculite interbedded with some shale, ranging in thickness from about 76 to 275 m (250-900 feet) (Arkansas Geological Commission 2001, Babcock et al. 2001). Examples of this system are found on ridgetops and south-facing sideslopes over fractured outcrops of novaculite, a hard, siliceous, weakly metamorphosed rock of sedimentary origin as a bedded, virtually pure silica chert deposited under geosynclinal conditions. It is primarily composed of microcrystalline quartz and chalcedony. The Arkansas Novaculite formation is of Devonian and Mississippian age and consists of novaculite interbedded with some shale. These glade openings can range in size from small (less than one hectare) to larger, often linear formations covering as much as 40 hectares.

Vegetation: Several distinct communities may be recognized at a local scale within this system. Open habitats may be characterized by sparse tree cover of dwarfed (1-3 m) *Quercus marilandica var. ashei*, which can sometimes occur in clumps. Herbaceous cover is 100%, except where bare rock is exposed or on talus. Lichens cover 40-70% of the exposed rock surface. Open community components of this system grade into more densely wooded types, with a variable structure, dominated by *Quercus stellata, Ulmus alata, Quercus marilandica, Juniperus virginiana var. virginiana, Pinus echinata*, and *Carya texana*. More submesic areas have *Quercus rubra*-dominated woodlands with *Carya texana* that may approach a forest physiognomy.

Dynamics: The structure of this system is thought to be controlled by edaphic factors, along with a combination of periodic fire and severe drought. Many existing overstory trees have multiple stems indicating past die-back due to severe drought of decades-long intervals. Summer leaf loss is common and snags extant. Minor droughts cause extensive die-backs in smaller stems and appear to maintain shrubby conditions in places and limit the abundance and distribution of shortleaf pine. Historically, fire is thought to have played a more important role than today in maintaining the open canopy. A lack of fire presumably decreases the extent of the glade openings and allows a change in structure through increased coverage by shrubs and trees. The trees, when present, are dwarfed and often multi-stemmed from drought die-back. Summer leaf loss is common.

Component Associations:
- *Quercus marilandica var. ashei / Schizachyrium scoparium - Andropogon gerardii - Monarda fistulosa var. stipitatoglandulosa - Streptanthus maculatus* / Lichens Novaculite Glade Wooded Herbaceous Vegetation (CEGL007825, G3)
- *Quercus rubra / Ostrya virginiana / Ptelea trifoliata - Ribes curvatum / Helianthus divaricatus* Woodland (CEGL007828, G3)
- *Quercus stellata - Ulmus alata - (Juniperus virginiana var. virginiana) / Sporobolus clandestinus - Monarda fistulosa var. stipitatoglandulosa* Woodland (CEGL003756, G2)
- *Toxicodendron radicans / (Polymnia cossatotensis)* Sparse Vegetation (CEGL003889, G1)

DISTRIBUTION

Range: This system is endemic to the central Ouachita Mountains in Arkansas and adjacent Oklahoma.

Divisions: 202:C
Nations: US
Subnations: AR, OK
Map Zones: 44:C
USFS Ecomap Regions: M231A:CC
TNC Ecoregions: 39:C

SOURCES

References: Arkansas Geological Commission 2001, Babcock et al. 2001, Comer et al. 2003, DeSelm and Murdock 1993, Duffey et al. 1974, Estes et al. 1979, Eyre 1980, Fountain and Sweeney 1985, McKinney and Lockwood 1999, Murdock pers. comm., Noss 2013, Quarterman et al. 1993, Taft 1997, Taft 2009, Taft et al. 1995, TNC 1996c, Wiens and Dyer 1975

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723182#references

Description Author: T. Foti and R. Evans, mod. M. Pyne

Version: 14 Jan 2014

Concept Author: T. Foti and R. Evans

Stakeholders: Southeast

ClassifResp: Southeast

OUACHITA SHALE GLADE AND BARRENS (CES202.343)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Woody-Herbaceous; Rock Outcrops/Barrens/Glades
National Mapping Codes: ESLF 5432

CONCEPT

Summary: This ecological system is found in scattered locations in the Ouachita Mountains of Arkansas. It occurs on gently sloping to steep south- and west-facing slopes and in broad, flat and gently sloping drainages where shale bedrock outcrops comes near to the surface of the ground. It is characterized by treeless, open glades which grade into open woodlands along gradients of soil depth and moisture. Both glades and woodlands may support exceptionally diverse plant communities and appear to have been maintained in an open condition by a combination of fire and edaphic factors. Vegetation in these barrens is highly heterogeneous and ranges from xeric patches of exposed bedrock with sparse vascular plant cover, to rich mucky seepage meadows, to prairie-like grasslands, to shrub thickets, to open woodlands over a small area. Much of the non-bedrock ground in these barrens lacks organic soil but consists of a soft, friable, dark gray or tan shale residuum that retains moisture in the wet season but becomes very dry in the summer and early fall. Depressions in flat areas may contain thin layers of dark, seasonally-wet, organic-rich soil over bedrock. This system supports more than 600 species of vascular plants including 36 species of state conservation concern in Arkansas and more than 20 globally critically imperiled, imperiled, or vulnerable species (G1-G3).

Similar Ecological Systems:

- Central Interior Highlands Calcareous Glade and Barrens (CES202.691)
- Central Interior Highlands Dry Acidic Glade and Barrens (CES202.692)

DESCRIPTION

Environment: This system can be divided into two subtypes based on slope and hydrology: (1) steep, xeric barrens occurring on slopes above small stream drainages which are exceedingly well-drained, and (2) gently sloping to flat barrens occurring in small erosional valleys, often along intermittent streams. The valley-bottom barrens often have a wet component, at least during the spring. Several of the shale formations that outcrop in these barrens in Arkansas also contain thin interbedded limestones and provide habitat for several species typically associated with calcareous habitat and which are uncommon or rare in the Ouachita Mountains. Examples of these include *Ophioglossum engelmannii, Ratibida pinnata, Pellaea atropurpurea, Sporobolus compositus var. compositus, Nemastylis nuttallii, Carex meadii, Scleria verticillata*, and *Hypericum sphaerocarpum*. In addition, these glades and woodlands provide habitat for a number of plant taxa of conservation concern and are of significant conservation importance. One species, *Sabatia arkansana* Pringle & Witsell, was recently described new-to-science from this habitat and is known only from Saline County, where it is apparently restricted to shale barrens and igneous glades (Pringle and Witsell 2005).

Vegetation: The most extreme areas, with very shallow soils adjacent to bare rock outcrops, are dominated by annual forbs and grasses with a very few extremely drought-tolerant perennials. Characteristic species include *Ptilimnium nuttallii, Ambrosia bidentata, Astranthium integrifolium ssp. ciliatum (= Astranthium ciliatum), Krigia virginica, Hypericum drummondii, Hypericum gentianoides, Croton willdenowii, Phacelia hirsuta, Clinopodium arkansanum (= Calamintha arkansana), Isanthus brachiatus (= Trichostema brachiatum), Oenothera linifolia, Plantago virginica, Polygonum tenue, Diodia teres, Valerianella longiflora, Valerianella nuttallii, Aristida dichotoma var. curtissii, Panicum flexile, Sporobolus vaginiflorus*, and *Vulpia octoflora*.

Seasonally wet microhabitats occur along drainages within flat, open shale glades. These areas include thin, seasonally saturated organic soils in the floodplains of small streams and scattered areas over bedrock where water stands in shallow pools during the wet season. Small seepage zones also occur where water continues to seep out along the bedrock surface into the summer, keeping the thin soil moist. These microhabitats support a distinctive assemblage of species characterized by *Isoetes butleri, Isoetes melanopoda, Selaginella apoda, Selenia aurea, Minuartia patula, Sedum pulchellum, Sabatia arkansana, Clinopodium arkansanum, Talinum calycinum (= Phemeranthus calycinus), Houstonia pusilla (= Hedyotis crassifolia), Allium canadense var. mobilense, Bulbostylis capillaris, Cyperus squarrosus, Fimbristylis autumnalis, Isolepis molesta (= Isolepis pseudosetacea),* and *Agrostis elliottiana*. Wet spots on deeper soils along ephemeral streams and drains within glades support a variety of shrubs, including *Symphoricarpos orbiculatus, Hypericum lobocarpum, Hypericum prolificum, Cornus obliqua, Amorpha nitens, Amorpha ouachitensis*, and *Salix caroliniana*. Herbaceous-dominated areas in drains support *Amsonia hubrichtii, Arnoglossum plantagineum, Mitreola petiolata, Spigelia marilandica, Cuphea viscosissima, Eleocharis wolfii, Juncus secundus*, and *Steinchisma hians*.

Adjacent woodlands are dominated by stunted, open-grown *Pinus echinata, Quercus stellata, Quercus muehlenbergii, Juniperus virginiana, Nyssa sylvatica*, and *Carya texana*, with *Quercus alba, Fraxinus americana, Sideroxylon lanuginosum*, and *Ulmus alata* as locally important species. Shrubs include *Rhus aromatica, Rhus copallinum, Symphoricarpos orbiculatus, Celtis tenuifolia, Hypericum prolificum*, and *Vaccinium arboreum*. The herbaceous layer is diverse and well-developed and is dominated by *Chasmanthium sessiliflorum, Piptochaetium avenaceum, Schizachyrium scoparium, Sporobolus* spp., and *Danthonia spicata*. There is typically a diverse herbaceous layer similar to that of the deeper soil areas of the glades. Without fire, extreme drought, or some other

vegetation management, these sites become encroached by woody vegetation, especially *Juniperus virginiana*.
Dynamics: Fire is the primary natural dynamic and prescribed fires help manage this system by restricting woody growth and maintaining the more open glade structure.

Component Associations:
- *Schizachyrium scoparium - Sporobolus clandestinus - Grindelia lanceolata - Opuntia humifusa - (Eriogonum longifolium)* Dry Shale Glade Herbaceous Vegetation (CEGL007117, G3?)

DISTRIBUTION

Range: This system is endemic to the central Ouachita Mountains in Arkansas and adjacent Oklahoma.
Divisions: 202:C
Nations: US
Subnations: AR, OK
TNC Ecoregions: 39:C

SOURCES

References: Pringle and Witsell 2005, Southeastern Ecology Working Group n.d., Witsell 2007
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.874293#references
Description Author: T. Witsell
Version: 31 May 2012
Concept Author: T. Witsell (ANHC)
Stakeholders: Southeast
ClassifResp: Southeast

PALEOZOIC PLATEAU BLUFF AND TALUS (CES202.704)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Non-Diagnostic Classifiers: Forest and Woodland (Treed); Woody-Herbaceous; Herbaceous; Unglaciated; Bluff
FGDC Crosswalk: Vegetated, Tree-dominated, Sparse tree canopy, Mixed evergreen-deciduous sparse tree canopy
National Mapping Codes: EVT 2517; ESLF 5430; ESP 1517

CONCEPT

Summary: This system is found in the driftless regions of southeastern Minnesota, southwestern Wisconsin, and northern Iowa and Illinois. This region was not glaciated like the surrounding areas and thus is predominated by rolling hills and bluff outcrops. This system is found primarily on blufftops and dry upper slopes along the Upper Mississippi River, although it can range into bordering regions such as the Baraboo Hills in Wisconsin. This system contains a mosaic of woodlands, savannas, prairies and sparsely vegetated limestone, dolomite, and/or sandstone outcrops, with occasional talus, especially algific talus. Soils range from thin to moderately deep and are moderately to excessively well-drained with a high mineral content. Woodlands consist of primarily a mixture of oak species such as *Quercus macrocarpa, Quercus rubra, Quercus muehlenbergii*, and *Quercus alba*. *Acer saccharum, Betula alleghaniensis*, and conifer species such as *Pinus* spp. and *Tsuga canadensis* may occur on more mesic and protected areas within this system. Prairie openings (also called "goat prairies") contain *Schizachyrium scoparium* and *Bouteloua curtipendula* with scattered *Juniperus virginiana*. Historically, fire was the most important dynamic maintaining these systems, however, fire suppression within the region has allowed more canopy cover and thus very few prairie openings remain. Algific talus harbors a number of unusual Pleistocene relict species, including plants and snails.
Classification Comments: This system will need review from Minnesota, Wisconsin and Iowa to make sure it is correctly characterized.
Similar Ecological Systems:
- Central Interior Calcareous Cliff and Talus (CES202.690)

Related Concepts:
- Eastern Redcedar: 46 (Eyre 1980) Finer
- Eastern White Pine: 21 (Eyre 1980) Finer
- Hemlock - Yellow Birch: 24 (Eyre 1980) Finer
- Red Pine: 15 (Eyre 1980) Finer

DESCRIPTION

Environment: This system is found on an unglaciated landscape that is predominated by rolling hills and bluff outcrops. This system is found primarily on blufftops and dry upper slopes along the Upper Mississippi River, although it can range into bordering regions such as the Baraboo Hills in Wisconsin. This system contains limestone, dolomite, and/or sandstone outcrops, with occasional talus, especially algific talus. Soils are primarily loess and range from thin to moderately deep and are moderately to excessively well-drained with a high mineral content.
Dynamics: This is a diverse system with different ecological processes necessary for different aspects. Fire is important for maintaining the prairie and dry oak aspects of the system, but the steep slope and thin soil reduce the suitability for many other species, so fire frequency does not need to be as high as in more fertile prairies and oak woodlands. The prolonged absence of fire will favor shrub and tree invasion of the prairie and an increase in mesophytic trees and shrubs in the oak forests and woodlands (Nowacki and Abrams 2008). The cooler, more mesic aspects of the system with significant conifers (*Pinus strobus, Pinus resinosa,* and *Tsuga canadensis*) occur in protected ravines or on steep slopes with little soil development, and fire is not important in establishing or maintaining these communities (McIntosh 1950, Kline and Cottam 1979). These communities occur where there are cooler summer soil and air temperatures and on this soiled sites over acidic bedrock (McIntosh 1950, Adams and Loucks 1971).

Component Associations:
- *Impatiens pallida - Cystopteris bulbifera - Adoxa moschatellina - (Chrysosplenium iowense, Aconitum noveboracense)* Algific Talus Herb Vegetation (CEGL002387, G2)
- Midwest Maderate Cliff Vegetation (CEGL002293, G3?)
- *Pinus strobus - (Pinus resinosa)* Driftless Bluff Forest (CEGL002378, G2G3)
- *Pinus strobus - Abies balsamea - Betula alleghaniensis* Driftless Forest (CEGL002111, G2?)
- *Quercus muehlenbergii - Quercus (alba, velutina) - (Juniperus virginiana var. virginiana)* Bluff Woodland (CEGL002144, G2G3)
- *Schizachyrium scoparium - Bouteloua curtipendula - Muhlenbergia cuspidata - Symphyotrichum sericeum* Alkaline Herbaceous Vegetation (CEGL002403, G2)
- *Schizachyrium scoparium - Bouteloua curtipendula* Bedrock Bluff Herbaceous Vegetation (CEGL002245, G3G4)
- *Tsuga canadensis - Acer saccharum / (Hepatica nobilis var. acuta)* Driftless Forest (CEGL002597, G2)

DISTRIBUTION

Range: This system is found within the Paleozoic Plateau (aka Driftless Region) of southeastern Minnesota, southwestern Wisconsin and northern Iowa and Illinois.
Divisions: 202:C
Nations: US
Subnations: IA, IL, MN, WI
Map Zones: 42:C, 49:C, 50:C
USFS Ecomap Regions: 222L:CC
TNC Ecoregions: 46:C

SOURCES

References: Adams and Loucks 1971, Albert 1995b, Comer et al. 2003, Dunevitz pers. comm., Eyre 1980, Kline and Cottam 1979, McIntosh 1950, Nowacki and Abrams 2008
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722956#references
Description Author: S. Menard, mod. J. Drake
Version: 14 Jan 2014 **Stakeholders:** Midwest
Concept Author: S. Menard **ClassifResp:** Midwest

PANHANDLE FLORIDA LIMESTONE GLADE (CES203.534)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Woody-Herbaceous; Rock Outcrops/Barrens/Glades
FGDC Crosswalk: Vegetated, Tree-dominated, Sparse tree canopy, Mixed evergreen-deciduous sparse tree canopy
National Mapping Codes: ESLF 5422

CONCEPT

Summary: This small-patch limestone glade and outcrop system is nearly endemic to the Panhandle of Florida (primarily Gadsden and Jackson counties), and is also found in adjacent Decatur County, Georgia. It includes a range of open limestone outcrops on hillsides and hill crests where soils are either shallow or absent, as well as shaded mesic lower slopes near the floodplain of the Chipola River.

Related Concepts:
- Upland Glade (FNAI 1990) Equivalent
- Upland Glade, Chalky Limestone Glade subtype (FNAI 1992b) Undetermined

DESCRIPTION

Environment: These calcareous glades of the warm temperate Southeastern Coastal Plain are found in rather soft, chalky limestone, in Gadsden and Jackson counties, Florida, and Decatur County, Georgia (Ward and Gholson 1987, FNAI 1990). In Gadsden County, these matrix soils are Binnsville soils or Cuthbert, Boswell, and Susquehanna soils on moderate to steep slopes (Thomas et al. 1961b). In Jackson County, the matrix soils are the Oktibbeha variant rock outcrop complex (Duffee et al. 1979).

Vegetation: On the open calcareous glades, the dominant herbaceous species are *Schoenus nigricans, Hedyotis nigricans var. nigricans, Muhlenbergia capillaris var. capillaris, Andropogon* sp., *Setaria* sp., *Helianthus radula*, and *Dichanthelium* sp. Some additional forbs are *Callirhoe papaver, Rudbeckia fulgida, Aristida* spp., *Delphinium carolinianum ssp. carolinianum, Stachys crenata, Lepuropetalon spathulatum, Solidago discoidea, Liatris squarrosa, Symphyotrichum pratense (= Aster sericeus var. microphyllus), Asclepias viridis, Asclepias viridiflora, Ponthieva racemosa, Carex cherokeensis, Rhynchospora* spp., and *Selaginella ludoviciana*. *Nostoc commune* is abundant on the exposed limestone. Woody species occurring in soil islands and borders of the limestone outcrops are *Berchemia scandens, Cercis canadensis var. canadensis, Sideroxylon* sp., *Morella cerifera (= Myrica cerifera), Diospyros virginiana, Fraxinus americana, Ulmus alata, Acer leucoderme, Rhus copallinum, Crataegus spathulata, Yucca filamentosa (= Yucca flaccida)*, and *Viburnum* sp. Also included here are shaded limestone outcrops with herbaceous vegetation found near the Chipola River; these outcrops are dominated by *Aquilegia canadensis, Polymnia laevigata, Thelypteris kunthii, Asplenium heterochroum, Oxalis* sp., *Pilea pumila, Laportea canadensis, Pachysandra procumbens, Urtica chamaedryoides, Melica mutica, Arenaria lanuginosa, Chaerophyllum tainturieri*, and *Carex willdenowii*. Bryophytes are locally abundant and include *Anomodon attenuatus, Conocephalum conicum*, and *Marchantia* sp. Shrubs and woody vines, such as *Decumaria barbara, Hydrangea quercifolia, Ptelea trifoliata*, and *Acer barbatum*, are sometimes rooted in solution pockets in the tops and sides of the outcrops and can be locally abundant. The alien *Lonicera japonica* may also be rooted in these solution pockets and may dominate parts of lower quality examples.

Dynamics: Although the ecology of the upland glade community has not been studied, it seems a reasonable working hypothesis that soil depth prevents woody colonization on the rockier portions of the glades, such as those areas dominated by *Hedyotis nigricans (= Stenaria nigricans)* and *Sporobolus vaginiflorus*, as has been proposed for herbaceous portions of limestone glades in Tennessee and Alabama (Quarterman 1950, Quarterman et al. 1993, Baskin and Baskin 1999). A small study measuring soil depth and pH on transects across three of the Gadsden County glades (Coultas 1983) lends support to this hypothesis for the Florida upland glades (FNAI 2010c). Portions of the glades supporting taller grasses such as *Muhlenbergia capillaris* and *Schizachyrium scoparium* may be more susceptible to woody encroachment, since increases in cover of *Juniperus virginiana* have been observed at some glades over the course of several decades. Fire may have swept through upland glades at irregular intervals, especially those that were bordered by longleaf pine-dominated upland or sandhill communities that would have naturally tended to burn frequently. These fires would play a role in preventing woody species from shading out the characteristic graminoid dominants (FNAI 2010c). Casual observation of one burn on a glade indicated that the herbaceous species recovered to pre-burn levels of cover within a year or two, but the question of natural fire interval for this community needs more research. Growing season burns on experimental plots on a glade in Georgia also showed little effect on 14 herbaceous species of conservation concern two years later, but did result in a dramatic decline in populations of young trees on the glade (Duncan et al. 2008). Occasional droughts may also play a similar role in retarding woody growth on the glade. An additional environmental factor in glades is the alternation between wet and dry soils. Soils on the herbaceous portion of the glades are often wet and "mushy" in early spring and become nearly completely dry by fall.

Component Associations:
- *Aquilegia canadensis - Asplenium heterochroum - Polymnia laevigata - Urtica chamaedryoides* Herbaceous Vegetation (CEGL004268, G1?)

- *Schoenus nigricans - Hedyotis nigricans* Wooded Herbaceous Vegetation (CEGL004081, G1)

SPATIAL CHARACTERISTICS

Size: Glades occur in very small areas, <1.0 hectare.

DISTRIBUTION

Range: This system is nearly endemic to the Panhandle of Florida (primarily Gadsden and Jackson counties), and is also found in adjacent Decatur County, Georgia.
Divisions: 203:C
Nations: US
Subnations: FL, GA
Map Zones: 55:C, 99:C
USFS Ecomap Regions: 232B:CC
TNC Ecoregions: 53:C

SOURCES

References: Baskin and Baskin 1999, Comer et al. 2003, Coultas 1983, Duffee et al. 1979, Duffey et al. 1974, Duncan et al. 2008, FNAI 1990, FNAI 1992b, FNAI 2010c, Hardin pers. comm., Leonard and Baker 1982, McKinney and Lockwood 1999, Murdock pers. comm., Quarterman 1950, Quarterman et al. 1993, Taft 2009, Taft et al. 1995, Thomas et al. 1961b, TNC 1996c, Ward and Gholson 1987
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723068#references
Description Author: R. Evans, mod. C.W. Nordman and M. Pyne
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: R. Evans **ClassifResp:** Southeast

SOUTH-CENTRAL SALINE GLADE (CES203.291)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Woody-Herbaceous; Rock Outcrops/Barrens/Glades; Very Shallow Soil
FGDC Crosswalk: Vegetated, Tree-dominated, Sparse tree canopy, Mixed evergreen-deciduous sparse tree canopy
National Mapping Codes: ESLF 5418

CONCEPT

Summary: This system occurs in portions of the Gulf Coastal Plain west of the Mississippi River on soils with high saline content, which in the most extreme examples are generally not conducive to woody plant growth. Thus, the vegetation forms a mosaic primarily consisting of open herbaceous or shrubby plant communities. This type is most common and best documented in Arkansas and western Louisiana, but also occurs in eastern Texas. At least one high-ranked plant species, *Geocarpon minimum*, occurs in this system. In some cases, this system may be associated with inland salt domes when the proximity of such a structure to the surface produces high salinity in the surface soils. Otherwise, surface geology of various formations may contain sufficient alkalinity such that leaching from particular members of these formations gives rise to such conditions.
Classification Comments: In Arkansas, the forested examples of this system are called "Alkali Post Oak Flat," and the herbaceous examples are called "Alkali Wet Prairie" (Arkansas Multi-Agency Wetland Planning Team 2001).
Related Concepts:
- Eastern Redcedar: 46 (Eyre 1980) Finer
- Pineywoods: Saline Glade (4207) [CES203.291] (Elliott 2011) Equivalent
- Post Oak - Blackjack Oak: 40 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs on soils with high saline content, including Glossic Natraqualfs, which in the most extreme examples are generally not conducive to woody plant growth. The soils on which this system is found have high pH and high levels of sodium or magnesium salts in or near the surface layer. They typically have very poor drainage and a shallow hardpan. The combination of impeded drainage and unusual soil chemistry restricts the potential plant communities and provides habitat for certain rare species. The forested community apparently occurs on soils with deeper hardpans than the prairie communities. These sites are often associated with streams or drainages, sometimes occurring on terraces (Elliott 2011). Most sites with alkali soils are believed to be former (Pleistocene) lakebeds (Arkansas Multi-Agency Wetland Planning Team 2001). In some cases, this system may be associated with inland salt domes when the proximity of such a structure to the surface produces high salinity in the surface soils. Otherwise, surface geology of various formations may contain sufficient alkalinity such that leaching from particular members of these formations gives rise to such conditions (Elliott 2011).
Vegetation: Some characteristic plants in examples of this system include (in stands with trees) *Quercus stellata, Quercus marilandica, Quercus similis*, as well as shrubs *Baccharis halimifolia, Crataegus berberifolia, Iva angustifolia*; grasses and graminoids include *Aristida dichotoma, Aristida longispica, Aristida oligantha, Aristida purpurascens, Distichlis spicata, Eleocharis* spp., *Fimbristylis* spp., *Juncus* spp., *Muhlenbergia capillaris, Schoenoplectus* spp., *Schizachyrium scoparium, Tridens strictus*, and forbs *Krigia occidentalis, Houstonia rosea, Ambrosia artemisiifolia, Diodia teres, Euthamia leptocephala,* and *Bigelowia nuttallii*.
Dynamics: Edaphic factors are the most important in maintaining and limiting this system. The influence of fire is variable depending on the density of the vegetation, with a greater influence where the fuels are adequate to carry a fire. Some areas may support relatively frequent fire, and others are too thinly vegetated to carry one. The topsoil is thin silt with toxic levels of sodium and/or magnesium salts in the subsoil, and in some areas is often exposed as "slick spots," which are denuded of vegetation, except for a "cryptogamic lip" dominated by lichens, algae and very small flowering plants (Pittman 1988, Baker and Witsell 2013, T. Foti pers. comm.). Although the subsoil is silt, it is essentially cemented into an impervious hardpan by calcium or other minerals. Sites therefore alternate between extremely dry and extremely wet, a condition that has been described as xerohydric. The genesis of the slicks is uncertain, but salts may be "wicked" to the surface through evaporation. The "slicks" appear to be somewhat ephemeral features, appearing, disappearing, and migrating around a site over time. This migration has been observed in the process of collecting transect data in an effort to monitor *Geocarpon minimum*. It was reported that "experimental transects [to monitor *Geocarpon* populations over time] were set up in saline prairie areas. The project was a miserable failure because the plants disappeared from the transects. Then someone noticed that there were unrecorded, apparently new, slicks nearby that had *Geocarpon*" (T. Foti pers. comm.). It was observed that "Â…not only did the *Geocarpon* disappear from the transects, but many of the slicks themselves disappeared. First they were encroached by lichens, then by *Aristida, Ambrosia bidentata*, and mosses, some of them [being] no longer even discernible as having been slicks in the past" (T. Witsell pers. comm.).

Component Associations:
- *Aristida longispica - Schizachyrium scoparium - Diodia teres* Saline Herbaceous Vegetation (CEGL008419, G1G2)
- *Baccharis halimifolia - Crataegus berberifolia / Eleocharis* sp. *- Tridens strictus - Euthamia leptocephala* Shrubland

(CEGL003904, G1)
- *Bigelowia nuttallii - Aristida dichotoma - Houstonia rosea / Cladonia* spp. Herbaceous Vegetation (CEGL004274, G1)
- *Eleocharis* sp. - *Iva angustifolia - Distichlis spicata* Herbaceous Vegetation (CEGL004171, G1)
- *Eleocharis* spp. - *Schoenoplectus* spp. - *Fimbristylis* spp. - *Juncus* spp. Southeastern Coastal Plain Inland Salt Flat Sparse Vegetation (CEGL007803, G1?)
- *Quercus stellata - Quercus similis - Quercus marilandica* Saline Woodland (CEGL008418, G2G3)

DISTRIBUTION

Range: This system is found in isolated areas of the Upper West and West Gulf Coastal Plain ecoregions, and along the boundary of the Gulf Coast Prairies and Marshes. It is also known from the Mississippi River Alluvial Plain (T. Foti pers. comm. 2005). It does not occur in Oklahoma.
Divisions: 203:C
Nations: US
Subnations: AR, LA, TX
Map Zones: 36:?, 37:C, 44:C, 45:C
USFS Ecomap Regions: 231E:CC, 231G:CC, 234D:CC, 234E:CC
TNC Ecoregions: 31:C, 39:C, 40:C, 41:C, 42:C

SOURCES

References: Arkansas Multi-Agency Wetland Planning Team 2001, Baker and Witsell 2013, Comer et al. 2003, Elliott 2011, Eyre 1980, Foti pers. comm., Pittman 1988, Quarterman et al. 1993, Taft et al. 1995, Witsell pers. comm., Zollner pers. comm.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723197#references
Description Author: R. Evans, mod. M. Pyne
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: R. Evans **ClassifResp:** Southeast

SOUTHERN AND CENTRAL APPALACHIAN MAFIC GLADE AND BARRENS (CES202.348)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Woody-Herbaceous; Rock Outcrops/Barrens/Glades; Shallow Soil
FGDC Crosswalk: Vegetated, Tree-dominated, Sparse tree canopy, Mixed evergreen-deciduous sparse tree canopy
National Mapping Codes: ESLF 5415

CONCEPT

Summary: This Southern and Central Appalachian system consists of vegetation associated with shallow soils over predominantly mafic bedrock, usually with significant areas of rock outcrop. Bedrock includes a variety of igneous and metamorphic rock types such as greenstone and amphibolite. These areas support a patchy mosaic of open woodland and grassy herbaceous vegetation sometimes with a predominant woody short-shrub community present.
Classification Comments: These glades and barrens are intermediate between other rock outcrop and forest systems, with less dense vegetation than the closed forests supported by the region's climate but with more vegetation than bare rock cover. They may grade very gradually into both kinds of systems. Systems of similar physiognomy and setting but on acidic substrates are generally included in Central Appalachian Pine-Oak Rocky Woodland (CES202.600).
Similar Ecological Systems:
- Appalachian Shale Barrens (CES202.598)
- Southern Appalachian Granitic Dome (CES202.297)
- Southern Appalachian Montane Cliff and Talus (CES202.330)
- Southern Appalachian Rocky Summit (CES202.327)
- Southern Piedmont Glade and Barrens (CES202.328)

DESCRIPTION

Environment: Occurs on upper to mid slopes, usually on gentle to moderate slopes but occasionally steeper. The ground is mostly shallow soil over bedrock, usually with significant areas of rock outcrop. The rock usually has few fractures but may have a pitted or irregular surface. This rock structure supports more extensive and deeper soil development than in Southern Appalachian Granitic Dome (CES202.297), but has few of the crevices and deeper rooting sites available in Southern Appalachian Rocky Summit (CES202.327). Micro-scale soil depth and presence of seepage are important factors in determining the vegetation patterns. Shallow soil, unable to support a closed tree canopy, separates this system from forest systems. Bedrock includes a variety of igneous and metamorphic rock types. Some examples are on mafic substrates such as amphibolite, some are on felsic rock such as granitic gneiss but have flora that suggests a basic influence, and a few occur on felsic rocks and are clearly acidic. Rock or soil chemistry appears to be the most important factor affecting different associations on sites that have the physical structure to belong to this system. Elevation may also be an important factor causing variation.
Vegetation: Vegetation is a fine mosaic of different physiognomies, with open woodland and grassy herbaceous vegetation or short shrubs predominating. Some instances may have closed canopies of small trees or large shrubs, but no examples have large canopy trees with a closed canopy. Bare rock outcrops are usually present in a minority of the area. The canopy species are species tolerant of dry, shallow soils, most commonly *Quercus prinus, Pinus* spp., and *Juniperus virginiana*. Basic examples may also have *Carya glabra, Fraxinus americana,* and other species abundant. Shrubs may be dense, with species determined by soil chemistry. The herb layer is usually fairly dense and dominated by grasses, both in treeless areas and beneath open canopy. An abundant forb component is also usually present, especially in the more basic examples. The forbs include species characteristic of other rock outcrops and grassland species, with a smaller number of forest species present.
Dynamics: The dynamics of this system are not well known. The occurrence of the system appears to be primarily determined by site physical properties, with physical and chemical properties determining vegetational variation. Fire may be an important influence on vegetation, and may in the long run be important for keeping the vegetation structure open, though the patchy distribution of vegetation might limit fire intensity. Periodic drought and windstorms may also be important factors limiting canopy density and stature. These sites, with their shallow soil, would likely be affected by fire, drought, and windstorms. Severe droughts kill tree saplings growing in cracks and potholes, helping to retain the open character of the glades (Quarterman et al. 1993). These glades do not appear to be undergoing the kind of cyclic succession that has been described for granitic domes, but some balance of soil accumulation and destruction may be occurring on a longer term or coarser scale. There may be a zonation or patchiness to glade/barren vegetation, with different zones that may be identified by their characteristic plant species (Quarterman et al. 1993). These zones are apparently relatively stable, with woody plant encroachment evident only in relation to the invasion of shrubs and trees into potholes or crevices where soil accumulates more rapidly. It is possible that the slightly irregular curved surface of some examples represents a late stage in the weathering of old exfoliation surfaces that once supported granitic domes, but most known examples are not spatially associated with existing granitic domes.

Component Associations:

- (*Kalmia latifolia, Physocarpus opulifolius) / Schizachyrium scoparium - Thalictrum revolutum - Sibbaldiopsis tridentata* Shrub Herbaceous Vegetation (CEGL004238, G1)
- *(Pinus palustris) / Prunus umbellata - Rhus aromatica / Piptochaetium avenaceum - Schizachyrium scoparium* Herbaceous Vegetation (CEGL007014, G1)
- *Carya (glabra, alba) - Fraxinus americana - (Juniperus virginiana var. virginiana)* Woodland (CEGL003752, G2)
- *Diervilla lonicera - Solidago simplex var. randii - Deschampsia flexuosa - Hylotelephium telephioides - Saxifraga michauxii* Herbaceous Vegetation (CEGL008536, G1)
- *Fraxinus americana - Carya glabra / Muhlenbergia sobolifera - Helianthus divaricatus - Solidago ulmifolia* Woodland (CEGL003683, G2)
- *Fraxinus americana / Physocarpus opulifolius / Carex pensylvanica - Allium cernuum - (Phacelia dubia)* Wooded Herbaceous Vegetation (CEGL008529, G2)
- *Juniperus virginiana - Fraxinus americana / Carex pensylvanica - Cheilanthes lanosa* Wooded Herbaceous Vegetation (CEGL006037, G2)
- *Photinia melanocarpa - Gaylussacia baccata / Carex pensylvanica* Shrubland (CEGL008508, G1?)
- *Quercus stellata / Schizachyrium scoparium - Sorghastrum nutans - Pycnanthemum tenuifolium - Packera paupercula* Wooded Herbaceous Vegetation (CEGL006215, G1)
- *Schizachyrium scoparium - Sorghastrum nutans - Aletris farinosa - Packera paupercula* Herbaceous Vegetation (CEGL004999, G1)
- *Selaginella rupestris - Croton willdenowii - Cheilanthes tomentosa - (Allium cuthbertii)* Herbaceous Vegetation (CEGL004992, G1)
- *Selaginella rupestris - Schizachyrium scoparium - Hylotelephium telephioides - Allium cernuum* Herbaceous Vegetation (CEGL004991, G2)

SPATIAL CHARACTERISTICS

Spatial Summary: Small-patch system, most examples covering a few acres.
Size: Most examples naturally cover a few acres, with a few examples up to 10 or more acres.
Adjacent Ecological Systems:
- Southern Appalachian Granitic Dome (CES202.297)
- Southern Appalachian Oak Forest (CES202.886)
- Southern Appalachian Rocky Summit (CES202.327)

Adjacent Ecological System Comments: This system is surrounded by forest systems on deeper soils less influenced by bedrock, most typically Southern Appalachian Oak Forest (CES202.886). It is rarely associated with Southern Appalachian Granitic Dome (CES202.297) or Southern Appalachian Rocky Summit (CES202.327).

DISTRIBUTION

Range: This system occurs in scattered clusters in the Southern Blue Ridge and adjacent portions of the upper Piedmont and Central Appalachians.
Divisions: 202:C
Nations: US
Subnations: GA?, MD, NC, PA?, SC?, TN, VA
Map Zones: 54:C, 57:C, 59:C, 61:C
USFS Ecomap Regions: 221D:CC, M221D:CC
TNC Ecoregions: 51:C, 52:C, 59:C

SOURCES

References: Comer et al. 2003, DeSelm and Murdock 1993, Duffey et al. 1974, Estes et al. 1979, McKinney and Lockwood 1999, Murdock pers. comm., Noss 2013, Quarterman et al. 1993, Taft 1997, Taft 2009, Taft et al. 1995, TNC 1996c, Wiens and Dyer 1975
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723162#references
Description Author: M. Schafale, R. Evans, M. Pyne, S.C. Gawler
Version: 14 Jan 2014 **Stakeholders:** East, Southeast
Concept Author: M. Schafale, R. Evans, M. Pyne, S.C. Gawler **ClassifResp:** Southeast

SOUTHERN CALIFORNIA OAK WOODLAND AND SAVANNA (CES206.938)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Woody-Herbaceous; Mediterranean [Mediterranean Desertic-Oceanic]; Broad-Leaved Evergreen Tree; Evergreen Sclerophyllous Shrub; Quercus agrifolia, Q. wislizeni, Q. engelmannii
Non-Diagnostic Classifiers: Lowland [Foothill]; Lowland [Lowland]; Sideslope; F-Patch/Medium Intensity
FGDC Crosswalk: Vegetated, Tree-dominated, Sparse tree canopy, Mixed evergreen-deciduous sparse tree canopy
National Mapping Codes: EVT 2118; ESLF 5407; ESP 1118

CONCEPT

Summary: These oak woodlands and savannas occur in coastal plains, intermountain valleys, and low mountains (such as the San Jacinto Mountains) from Ventura County, California, south into Baja California, Mexico. *Quercus agrifolia, Quercus wislizeni, Quercus engelmannii, Quercus kelloggii*, and/or *Juglans californica* dominate a mixed closed or open canopy. Southern chaparral species such as *Adenostoma fasciculatum, Artemisia californica, Rhus integrifolia, Rhus ovata, Rhus trilobata, Ceanothus* spp., *Ribes* spp., and *Arctostaphylos* spp. are also characteristic. These woodlands may occur as remnant patches on offshore islands, where they include endemic species such as *Quercus tomentella* and *Lyonothamnus floribundus*. The California central coast region may have open stands of just *Juniperus californica*, with a grassy understory. These stands belong here due to proximity to other oak stands or chaparral, and due to the heavy native or non-native grass cover. This is distinguished from Great Basin pinyon-juniper stands, which have little herbaceous understory, and *Pinus monophylla* mixed with *Juniperus californica*. These stands of only juniper are caused by repeated removal of the oaks by humans and feral pig populations. Variable canopy densities in existing occurrences are likely due to variation in soil moisture regime, natural patch dynamics of fire, and land use (fire suppression, livestock grazing, herbivory, etc.). Most of these woodlands and savannas have been heavily altered through urban and agricultural development throughout southern California.

Related Concepts:
- California Coast Live Oak: 255 (Eyre 1980) Intersecting
- Coast Live Oak Woodland (202) (Shiflet 1994) Intersecting

DESCRIPTION

Environment: This system occurs in coastal plains, intermountain valleys, and low mountains (such as the San Jacinto Mountains). Soils are moderately to well-drained, deep, sandy or loamy with high organic matter. Elevation ranges from sea level to 2200 m, but generally at less than 1500 m elevation. It is found on variable aspects and topography with rainfall between 13-102 cm (5-40 inches).
Dynamics: Variable canopy densities in existing occurrences are likely due to variation in soil moisture regime and natural patch dynamics of fire. Fire reduces the survivorship and growth of juvenile *Quercus engelmannii*, with seedlings especially sensitive. Stands with grassy understories tend to suffer minimal damage, but those with shrubby understories tend to top-kill the trees, which may sprout and survive (Sawyer et al. 2009). Natural fire-return intervals are 30-100 years, and occur primarily in summer to early fall. From Landfire (2007a): Typical regime is frequent, low-severity fire that likely exert positive influences on overstory productivity and canopy resilience to fire damage. Infrequent isolated areas of stand-replacement fire create gaps of grasslands that require patch-gap recruitment and edge recolonization over time. Grass fuels allow very frequent fire, up to annually. A high proportion of seedlings and saplings are top-killed in low- to moderate-severity fires. Mortality rates of different size trees decrease with increasing height and dbh. Mortality may be as much as 50-60% for trees less than 40 cm (15.7 inches) dbh. In plants that survive fires, there is a significant amount of resprouting (Lathrop and Osborne 1991, Lawson 1993, Steinberg 2002b).

Component Associations:
- *Quercus tomentella* Forest (CEGL003098, G2?)

DISTRIBUTION

Range: This system occurs in coastal plains and intermountain valleys from Ventura County, California, south into Baja California, Mexico.
Divisions: 206:C
Nations: MX, US
Subnations: CA, MXBC(MX)
Map Zones: 4:C, 5:C
USFS Ecomap Regions: 261B:CC, 262A:CC, 322A:PP, 322C:P?
TNC Ecoregions: 15:C, 16:C

SOURCES

References: Allen-Diaz 2007, Barbour and Billings 2000, Barbour and Major 1988, Brooks and Minnich 2006, Comer et al. 2003, Eyre 1980, Holland and Keil 1995, Howard 1992, Landfire 2007a, Lathrop and Osborne 1991, Lawson 1993, Osborne 1989, PRBO

Conservation Science 2011, Principe 2002, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Shiflet 1994, Steinberg 2002b, WNHP 2011

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722743#references

Description Author: P. Comer and T. Keeler-Wolf, mod. G. Kittel, M.S. Reid

Version: 14 Jan 2014 **Stakeholders:** Latin America, West

Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

SOUTHERN PIEDMONT GLADE AND BARRENS (CES202.328)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Woody-Herbaceous; Rock Outcrops/Barrens/Glades
FGDC Crosswalk: Vegetated, Tree-dominated, Sparse tree canopy, Mixed evergreen-deciduous sparse tree canopy
National Mapping Codes: ESLF 5412

CONCEPT

Summary: This glade and barrens system of the southern Piedmont consists of gently to moderately sloping areas with mostly shallow soil over bedrock. Examples usually have significant areas of exposed rock evident. The bedrock potentially includes a variety of igneous and metamorphic rock types, including diabase, mudstone, and shale. Examples support open vegetation of patchy, mixed physiognomy with a significant woody component. Trees may be stunted and/or more widely spaced than in the more typical forests of the region. The shallow soils which impede tree growth help distinguish this system from forest systems of the Piedmont. This system is structurally intermediate between other rock outcrop systems and the more common and typical forest systems. The canopy species are those tolerant of dry, shallow soils, most commonly *Juniperus virginiana* and various oaks and pines, but also including *Fraxinus americana, Ulmus alata*, and *Cercis canadensis* on basic examples. Shrubs may be dense, with species determined by soil chemistry. The herb layer is usually fairly dense and may be dominated by grasses or by a mix of grasses and forbs, both in treeless areas and beneath open canopy. The forbs include species characteristic of other rock outcrops and grassland species, with a smaller number of forest species present. Plant species richness may be fairly high in communities of this system.
Classification Comments: The southern Piedmont as defined here consists of TNC Ecoregion 52 (ECOMAP 231A, EPA 45), but within this region, this system is not expected to occur north of about the James River in Virginia. This system is intermediate between other rock outcrops and forest systems, with less dense vegetation than the closed forests supported by the region's climate but with more vegetation than bare rock cover. They may grade very gradually into both kinds of systems. They are analogous to Southern and Central Appalachian Mafic Glade and Barrens (CES202.348), but are distinguished by their climate, flora, and landscape setting. Southern and Central Appalachian Mafic Glade and Barrens (CES202.348) occurs in the hilly upper Piedmont, whereas this system is confined to the eastern and central Piedmont.

This system represents a collection of several different kinds of communities related primarily by structure, and could be further subdivided. The rare diabase glades are flat and have a very distinctive flora. The examples on meta-mudstone are less well known. Other kinds may occur.

Similar Ecological Systems:
- Southern and Central Appalachian Mafic Glade and Barrens (CES202.348)
- Southern Appalachian Rocky Summit (CES202.327)
- Southern Piedmont Cliff (CES202.386)
- Southern Piedmont Granite Flatrock and Outcrop (CES202.329)

Related Concepts:
- Eastern Redcedar: 46 (Eyre 1980) Finer
- Shortleaf Pine - Oak: 76 (Eyre 1980) Finer
- Shortleaf Pine: 75 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs on upper to midslopes, usually on moderate slopes but occasionally flat. The ground is mostly shallow soil over bedrock, usually with significant areas of rock outcrop. The rock usually has few fractures but may have a pitted or irregular surface. This rock structure supports more extensive and deeper soil development than in Southern Piedmont Granite Flatrock and Outcrop (CES202.329) or Southern Piedmont Cliff (CES202.386), but has few of the crevices and deeper rooting sites available in Southern Appalachian Rocky Summit (CES202.327). Micro-scale soil depth and presence of seepage are important factors in determining the vegetation patterns. Shallow soil, unable to support a closed tree canopy, separates this system from forest systems. Bedrock potentially includes a variety of igneous and metamorphic rock types, including diabase, mudstone, and shale. Rock or soil chemistry appears to be the most important factor affecting different associations on sites that have the physical structure to belong to this system.
Vegetation: Vegetation is a fine mosaic of different physiognomies, with open woodland and grassy herbaceous vegetation or short shrubs predominating. Bare rock outcrops are usually present in a minority of the area. The canopy species are species tolerant of dry, shallow soils, most commonly *Juniperus virginiana* and various oaks and pines, but also including *Fraxinus americana, Ulmus alata*, and *Cercis canadensis* on basic examples. Shrubs may be dense, with species determined by soil chemistry. The herb layer is usually fairly dense and may be dominated by grasses or by a mix of grasses and forbs, both in treeless areas and beneath open canopy. The forbs include species characteristic of other rock outcrops and grassland species, with a smaller number of forest species present. Plant species richness may be fairly high in communities of this system.

Dynamics: The dynamics of this system are not well known. The occurrence of the system appears to be primarily determined by site physical properties, with physical and chemical properties determining vegetational variation. Fire may be an important influence on vegetation, and may in the long run be important for keeping the vegetation structure open, though the patchy distribution of vegetation might limit fire intensity. It is possible that fire would have allowed glade structure and vegetation to extend onto slightly deeper soils and therefore allowed for more extensive glades. Periodic drought and wind storms may also be an important factor limiting canopy density and stature. The shallow soil would make these sites particularly prone to all three. These glades do not appear to be undergoing the kind of cyclic succession that has been described for granitic flatrocks, but some balance of soil accumulation and destruction may be occurring on a longer term or coarser scale.

Component Associations:
- *(Pinus palustris) / Prunus umbellata - Rhus aromatica / Piptochaetium avenaceum - Schizachyrium scoparium* Herbaceous Vegetation (CEGL007014, G1)
- *Fraxinus americana - Carya glabra / Symphoricarpos orbiculatus - Rhus aromatica / Piptochaetium avenaceum* Woodland (CEGL003684, G2)
- *Fraxinus americana - Juniperus virginiana / Talinum teretifolium - Polygonum tenue - Opuntia humifusa* Wooded Herbaceous Vegetation (CEGL006294, G1)
- *Juniperus virginiana - Celtis tenuifolia - Quercus (prinus, stellata) / Sporobolus compositus - Talinum teretifolium - Tragia urticifolia* Wooded Herbaceous Vegetation (CEGL008485, G1)
- *Juniperus virginiana var. virginiana - Celtis tenuifolia - Cercis canadensis / Sporobolus clandestinus - Danthonia sericea* Woodland (CEGL008499, G2G3Q)
- *Juniperus virginiana var. virginiana - Ulmus alata / Schizachyrium scoparium* Woodland (CEGL004443, G2)
- *Philadelphus hirsutus - Ptelea trifoliata var. mollis / Schizachyrium scoparium - Pycnanthemum curvipes / Thuidium delicatulum* Shrubland (CEGL004243, G2)
- *Pinus echinata - Quercus stellata - Quercus marilandica / Andropogon gyrans - Chrysopsis mariana* Woodland (CEGL004447, G1?)

SPATIAL CHARACTERISTICS

Spatial Summary: Small-patch system, most examples covering no more than a couple of acres.
Size: Most examples naturally cover a few acres at most, with some less than one acre.
Adjacent Ecological Systems:
- Southern Piedmont Dry Oak-(Pine) Forest (CES202.339)
- Southern Piedmont Mesic Forest (CES202.342)

Adjacent Ecological System Comments: Surrounded by forest systems on deeper soils less influenced by bedrock, most typically Southern Piedmont Dry Oak-(Pine) Forest (CES202.339).

DISTRIBUTION

Range: This system is found in scattered clusters in the southern Piedmont, possibly extending north to about the James River in Virginia. However, the overall distribution in this region is not well-known.
Divisions: 202:C
Nations: US
Subnations: AL, GA, NC, SC, VA
Map Zones: 54:C, 59:C, 61:P
USFS Ecomap Regions: 231A:CC, 231I:CC
TNC Ecoregions: 52:C

SOURCES

References: Comer et al. 2003, DeSelm and Murdock 1993, Duffey et al. 1974, Estes et al. 1979, Eyre 1980, LeGrand 1988, McKinney and Lockwood 1999, Murdock pers. comm., Noss 2013, Oakley et al. 1995, Quarterman et al. 1993, Slapcinsky 1994, Taft 1997, Taft 2009, Taft et al. 1995, TNC 1996c, Wiens and Dyer 1975
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723175#references
Description Author: M. Schafale and R. Evans, mod. M. Pyne
Version: 14 Jan 2014 **Stakeholders:** East, Southeast
Concept Author: M. Schafale and R. Evans **ClassifResp:** Southeast

SOUTHERN RIDGE AND VALLEY CALCAREOUS GLADE AND WOODLAND (CES202.024)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Woody-Herbaceous; Rock Outcrops/Barrens/Glades
National Mapping Codes: ESLF 5464

CONCEPT

Summary: This ecological system consists of open glades and surrounding woodlands on shallow, high pH soils of the Ridge and Valley region from southwestern Virginia southward. These glades occur in broad valley bottoms, rolling basins, and adjacent slopes where soils are shallow over flat-lying limestone strata. The flat to rolling terrain and locally xeric soils may have been especially conducive to periodic fires that helped maintain the prairielike openings and savannalike woodlands. Today, much of the system is currently somewhat more closed and brushy, suggesting fire suppression. *Quercus muehlenbergii* and *Quercus stellata* are typical where the canopy is present. Dominant or abundant *Juniperus virginiana var. virginiana* is probably a result of the lack of fire.
Classification Comments: This system formerly embodied a narrower concept, being restricted to glades of "valley bottoms," and thereby, at least by implication, not those of slopes. The current concept includes glades in the southern Ridge and Valley on a variety of landforms and slope positions, as they are all sufficiently similar in floristic components and ecological processes to be grouped together. These processes and factors include erosional processes, zonal vegetation patterns, and general ecological dynamics.
Similar Ecological Systems:
- Central Appalachian Alkaline Glade and Woodland (CES202.602)--of central Appalachians, Virginia and north.
- Central Interior Highlands Calcareous Glade and Barrens (CES202.691)--is related, generally to the west in the Interior Low Plateau.
- Southern Ridge and Valley / Cumberland Dry Calcareous Forest (CES202.457)--is a more closed-canopy system with a similar range.

Related Concepts:
- Eastern Redcedar: 46 (Eyre 1980) Finer
- Limestone and Dolomite Barrens (Fleming et al. 2005) Undetermined
- Sugar Maple: 27 (Eyre 1980) Finer

DESCRIPTION

Environment: Examples occur on shallow, high pH soils, in broad valley bottoms, rolling basins, and adjacent slopes over limestone strata.
Vegetation: The vegetation of typical examples could range from open woodlands of *Quercus muehlenbergii* and *Juniperus virginiana*, with interspersed grasslands dominated by perennial *Schizachyrium scoparium*, to patches dominated by annual grasses such as varieties of *Sporobolus vaginiflorus* (e.g., var. *ozarkanus*, var. *vaginiflorus*). Some other trees that may occur in stands include *Quercus falcata, Quercus shumardii, Quercus stellata*, as well as the understory woody plants *Cercis canadensis, Salix humilis*, and *Viburnum rufidulum*. Some characteristic herbs include *Eryngium yuccifolium, Manfreda virginica*, and *Hypericum dolabriforme*. Dominant or abundant *Juniperus virginiana var. virginiana* is probably a result of the lack of fire.
Dynamics: The flat to rolling terrain and locally xeric soils may have been especially conducive to periodic fires that helped maintain the grass-dominated openings and open woodlands. In addition to occasional fire, periodic drought may also be important in regulating woody plant encroachment into native grasslands. It is believed that these native glade-grassland systems have evolved under a combined system of grazing, drought, and periodic fire (Duffey et al. 1974, Estes et al. 1979, Noss 2013).

Component Associations:
- *Andropogon gerardii - Bouteloua curtipendula - Echinacea simulata* Coosa Valley Barren Herbaceous Vegetation (CEGL004045, G1)
- *Fraxinus americana - Carya ovata / Frangula caroliniana / Helianthus hirsutus* Woodland (CEGL008458, G1?)
- *Quercus muehlenbergii - Juniperus virginiana / Schizachyrium scoparium - Manfreda virginica* Wooded Herbaceous Vegetation (CEGL005131, G2G3)
- *Quercus muehlenbergii - Quercus (falcata, shumardii, stellata) / Cercis canadensis / Viburnum rufidulum* Forest (CEGL007699, G3)
- *Rhus aromatica - Celtis tenuifolia / Carex eburnea* Shrubland (CEGL004393, G3)
- *Sporobolus vaginiflorus (var. ozarkanus, var. vaginiflorus) - Hypericum dolabriforme* Herbaceous Vegetation (CEGL004339, G2G3)

DISTRIBUTION

Range: This system occurs from southwestern Virginia (roughly Roanoke) south through the southern Ridge and Valley into Georgia.

Divisions: 202:C
Nations: US
Subnations: GA, TN, VA
Map Zones: 48:C, 53:C, 57:C, 61:?
USFS Ecomap Regions: 221A:CC, 221B:CC, 221J:CC, 231C:CC, 231D:CC, M221A:CC
TNC Ecoregions: 50:C, 59:?

SOURCES

References: Comer et al. 2003, DeSelm and Murdock 1993, Duffey et al. 1974, Estes et al. 1979, Eyre 1980, Fleming et al. 2005, Keys et al. 1995, Landfire 2007a, McKinney and Lockwood 1999, Murdock pers. comm., Noss 2013, Quarterman et al. 1993, Sutter et al. 2011, Taft 1997, Taft 2009, Taft et al. 1995, TNC 1996c, Wiens and Dyer 1975
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722681#references
Description Author: M. Pyne, G. Fleming, R. Evans, mod. S.C. Gawler
Version: 14 Jan 2014 **Stakeholders:** East, Southeast
Concept Author: M. Pyne, G. Fleming, R. Evans **ClassifResp:** Southeast

SOUTHERN ROCKY MOUNTAIN JUNIPER WOODLAND AND SAVANNA (CES306.834)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland [Foothill]; Woody-Herbaceous; Shallow Soil; Mineral: W/ A-Horizon <10 cm; Aridic; Needle-Leaved Tree; Graminoid; Juniperus monosperma and grasses
Non-Diagnostic Classifiers: Moderate (100-500 yrs) Persistence; Lowland [Lowland]; Temperate [Temperate Continental]; Unglaciated; Intermediate Disturbance Interval
FGDC Crosswalk: Vegetated, Tree-dominated, Sparse tree canopy, Evergreen sparse tree canopy
National Mapping Codes: EVT 2119; ESLF 5408; ESP 1119

CONCEPT

Summary: This ecological system occupies the lower and warmest elevations, growing from 1370 to 1830 m in a semi-arid climate, primarily along the east and south slopes of the southern Rockies and Arizona-New Mexico mountains. It is best represented just below the lower elevational range of ponderosa pine and often intermingles with grasslands and shrublands. This system is best described as a savanna that has widely spaced, mature (>150 years old) juniper trees and occasionally *Pinus edulis*. *Juniperus monosperma* and *Juniperus scopulorum* (at higher elevations) are the dominant tall shrubs or short trees. These savannas may have inclusions of more dense juniper woodlands and have expanded into adjacent grasslands during the last century. Graminoid species are similar to those found in Western Great Plains Shortgrass Prairie (CES303.672), with *Bouteloua gracilis* and *Pleuraphis jamesii* being most common. In addition, succulents such as species of *Yucca* and *Opuntia* are typically present.
Similar Ecological Systems:
- Western Great Plains Shortgrass Prairie (CES303.672)

Related Concepts:
- Pinyon - Juniper: 239 (Eyre 1980) Intersecting
- Sideoats Grama - Sumac - Juniper (735) (Shiflet 1994) Intersecting

Component Associations:
- *Juniperus monosperma / Andropogon hallii* Woodland (CEGL000704, G3?)
- *Juniperus monosperma / Bouteloua curtipendula* Woodland (CEGL000708, G5)
- *Juniperus monosperma / Bouteloua eriopoda* Woodland (CEGL000709, GNR)
- *Juniperus monosperma / Bouteloua gracilis* Woodland (CEGL000710, G5)
- *Juniperus monosperma / Cercocarpus montanus - Ribes cereum* Woodland (CEGL000714, GU)
- *Juniperus monosperma / Cercocarpus montanus* Woodland (CEGL000713, GNR)
- *Juniperus monosperma / Forestiera pubescens* Woodland (CEGL005371, GNR)
- *Juniperus monosperma / Hesperostipa neomexicana* Woodland (CEGL000722, G4)
- *Juniperus monosperma* / Rockland Woodland (CEGL005369, GNR)
- *Juniperus monosperma* / Sparse Understory Woodland (CEGL005368, GNR)

DISTRIBUTION

Range: This system occupies the lower and warmest elevations, growing from 1370 to 1830 m elevation in a semi-arid climate, primarily along the east and south slopes of the southern Rockies and Arizona-New Mexico mountains. This includes the Sacramento Mountains. especially the east side; the west side has Madrean elements but is mostly southern Rocky Mountains.
Divisions: 303:C; 304:C; 306:C
Nations: US
Subnations: CO, NM
Map Zones: 24:P, 25:C, 26:?, 27:C, 28:C, 34:P
USFS Ecomap Regions: 315A:CC, 315B:CC, 315H:CC, 321A:PP, 331B:CC, 331C:C?, 331I:CC, 331J:CC, M313B:CC, M331F:CC, M331G:CC
TNC Ecoregions: 20:C, 21:C, 27:C

SOURCES

References: Anderson et al. 1985, Barnes 1987, Bassett et al. 1987, Blackburn and Tueller 1970, Comer et al. 2003, Commons et al. 1999, Dick-Peddie 1993, Dwyer and Pieper 1967, Eager 1999, Fitzhugh et al. 1987, Francis 1986, Gehlbach 1967, Ladyman and Muldavin 1996, Larson and Moir 1986, Larson and Moir 1987, Mehl 1992, Neely et al. 2001, Rogers 1950, West 1999b, West and Young 2000, Wright and Bailey 1982a
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722839#references
Description Author: NatureServe Western Ecology Team

Version: 05 Oct 2004
Concept Author: NatureServe Western Ecology Team

Stakeholders: West
ClassifResp: West

SOUTHERN ROCKY MOUNTAIN PONDEROSA PINE SAVANNA (CES306.649)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Woody-Herbaceous; Shallow Soil; Aridic; Short Disturbance Interval; F-Patch/Low Intensity; F-Landscape/Low Intensity; Needle-Leaved Tree; Graminoid; Pinus ponderosa with grassy understory
FGDC Crosswalk: Vegetated, Tree-dominated, Sparse tree canopy, Evergreen sparse tree canopy
National Mapping Codes: EVT 2117; ESLF 5406; ESP 1117

CONCEPT

Summary: This ecological system is found predominantly in the Colorado Plateau region, west into scattered locations in the Great Basin, and north along the eastern front of the southern Rocky Mountains into southeastern Wyoming. These savannas occur at the lower treeline/ecotone between grassland/or shrubland and more mesic coniferous forests typically in warm, dry, exposed sites. Elevations range from less than 1900 m in central and northern Wyoming to 2800 m in the New Mexico mountains to well over 2700 m on the higher plateaus of the Southwest. It is found on rolling plains, plateaus, or dry slopes usually on more southerly aspects. This system is best described as a savanna that has widely spaced (<25% tree canopy cover) (>150 years old) *Pinus ponderosa* (primarily *var. scopulorum* and *var. ponderosa (= <i>var. brachyptera)*) as the predominant conifer. It is maintained by a fire regime of frequent, low-intensity surface fires. A healthy occurrence often consists of open and park-like stands dominated by *Pinus ponderosa*. Understory vegetation in the true savanna occurrences is predominantly fire-resistant grasses and forbs that resprout following surface fires; shrubs, understory trees and downed logs are uncommon. Important and often dominant species include *Festuca arizonica, Koeleria macrantha, Muhlenbergia montana, Muhlenbergia virescens,* and *Pseudoroegneria spicata*. Other important grasses, such as *Andropogon gerardii, Bouteloua gracilis, Elymus elymoides, Festuca idahoensis, Piptatherum micranthum,* and *Schizachyrium scoparium,* dominate less frequently. A century of anthropogenic disturbance and fire suppression has resulted in a higher density of *Pinus ponderosa* trees, altering the fire regime and species composition. Presently, many stands contain understories of more shade-tolerant species, such as *Pseudotsuga menziesii* and/or *Abies* spp., as well as younger cohorts of *Pinus ponderosa*. Northern Rocky Mountain Ponderosa Pine Woodland and Savanna (CES306.030) in the eastern Cascades, Okanogan, and northern Rockies regions receives winter and spring rains, and thus has a greater spring "green-up" than the drier woodlands in the Central Rockies.
Classification Comments: The Pine Escarpment regions of northwestern and central Nebraska are no longer included within this system; they have been lumped into Northwestern Great Plains-Black Hills Ponderosa Pine Woodland and Savanna (CES303.650). Because this ecological system has undergone some important changes in its concept, the original system (CES306.826) was archived, and this new system was created to account for the new concept of ponderosa pine savannas in the southern Rocky Mountains.

The FRIS site describes different varieties of *Pinus ponderosa* and associated species. This system is mostly *Pinus ponderosa var. scopulorum* and *Pinus ponderosa (= var. brachyptera)*. Johansen and Latta (2003) have mapped the distribution of two varieties (vars. *scopulorum* and *ponderosa*) using mitochondrial DNA. Hybridization along the Continental Divide in Montana backs up the FRIS information.

Similar Ecological Systems:
- Northern Rocky Mountain Ponderosa Pine Woodland and Savanna (CES306.030)
- Northwestern Great Plains-Black Hills Ponderosa Pine Woodland and Savanna (CES303.650)
- Southern Rocky Mountain Ponderosa Pine Woodland (CES306.648)

Related Concepts:
- Interior Ponderosa Pine: 237 (Eyre 1980) Broader

DESCRIPTION

Environment: These savannas occur at the lower elevation ecotone between pinyon conifer woodlands, grassland/or shrubland and upper elevation, more mesic coniferous forests typically in warm, dry, exposed sites. Elevations range from less than 1900 m in central and northern Wyoming to 2800 m in the New Mexico mountains to well over 2700 m on the higher plateaus of the Southwest. It is found on rolling plains, plateaus, or dry slopes usually on more southerly aspects; however, it can occur on all slopes and aspects. Stands occur on soils derived from igneous, metamorphic, and sedimentary material, including basalt, andesite, intrusive granitoids and porphyrites, and tuffs (Youngblood and Mauk 1985). Characteristic soil features include good aeration and drainage, coarse textures, circumneutral to slightly acidic pH, an abundance of mineral material, and periods of drought during the growing season. Surface textures are highly variable in this ecological system ranging from sand to loam and silt loam. Exposed rock and bare soil consistently occur to some degree in all the associations. Annual precipitation is 25-60 cm (8-24 inches), mostly through winter storms and some monsoonal summer rains. Typically a seasonal drought period occurs throughout this system as well.
Dynamics: *Pinus ponderosa* is a drought-resistant, typically open-grown conifer, which usually occurs at lower treeline in the major ranges of the western United States. Mature trees have thick bark that protects the cambium layer from fire. Historically, fires and drought were influential in maintaining open-canopy conditions in these woodlands. Low-intensity surface fire would burn through these stands every 5-15 year, killing young trees, but not the fire-resistant mature ponderosa pine trees or grass understory maintaining

an open park-like stand (Harrington and Sackett 1992, Mehl 1992, Swetnam and Baisan 1996). Infrequent stand-replacement fire on the order of a few hundred years (300-500 years) is possible (Landfire 2007a). Drought and other weather events (e.g., blowdown), parasites and disease may play a minor role, and have very long rotations (Landfire 2007a). Impacts from insects such as mountain pine beetles (*Dendroctonus ponderosae*) may be significant during outbreaks, but infrequent in occurrence (Landfire 2007a). Beetles attack less vigorously growing trees, e.g., old, crowded, diseased, damaged, or growing on poor sites) especially during droughts (Leatherman et al. 2013). Winter mortality of beetles is a significant factor; however, a severe freeze of at least -30 degrees F is necessary for at least five days during midwinter (Leatherman et al. 2013).

Component Associations:
- *Pinus ponderosa / Bouteloua gracilis* Woodland (CEGL000848, G4)
- *Pinus ponderosa / Cercocarpus montanus / Andropogon gerardii* Wooded Herbaceous Vegetation (CEGL000852, G2)
- *Pinus ponderosa / Cornus sericea* Woodland (CEGL000853, G3)
- *Pinus ponderosa / Crataegus douglasii* Woodland (CEGL000855, G1)
- *Pinus ponderosa / Festuca arizonica* Woodland (CEGL000856, G4)
- *Pinus ponderosa / Festuca idahoensis* Woodland (CEGL000857, G4)
- *Pinus ponderosa / Poa fendleriana* Woodland (CEGL005507, GNR)
- *Pinus ponderosa / Purshia stansburiana* Woodland (CEGL000854, G3)
- *Pinus ponderosa* / Sparse Understory Woodland (CEGL002384, GNR)

DISTRIBUTION

Range: This ecological system is found predominantly in the Colorado Plateau region, west into scattered locations of the Great Basin, and north along the eastern front of the Rocky Mountains of Colorado and Wyoming. Pine woodlands and savannas of the Black Hills and central Montana are now included in Northwestern Great Plains-Black Hills Ponderosa Pine Woodland and Savanna (CES303.650), as are woodlands and savannas in Nebraska and northeastern Colorado.
Divisions: 303:C; 304:C; 306:C
Nations: US
Subnations: AZ, CO, NM, NV, UT, WY
Map Zones: 15:C, 16:?, 22:C, 23:C, 24:C, 25:C, 26:C, 27:C, 28:P, 29:C, 33:P
USFS Ecomap Regions: 315A:CC, 315B:CC, 315H:CP, 321A:PP, 331B:CC, 331G:C?, 331H:CC, 331I:CC, 331J:CP, 342F:CC, M313B:PP, M331B:CC, M331F:CC, M331G:CP, M331I:CC
TNC Ecoregions: 18:C, 19:C, 20:C, 21:C, 26:P

SOURCES

References: CNHP 2010b, Comer et al. 2003, Eyre 1980, Harrington and Sackett 1992, Johansen and Latta 2003, Landfire 2007a, Leatherman et al. 2013, Mehl 1992, Reid et al. 1999, Smith 2006, Swetnam and Baisan 1996, TNC 2013, Western Ecology Working Group n.d., Youngblood and Mauk 1985
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.797989#references
Description Author: M.S. Reid, mod. K.A. Schulz
Version: 14 Jan 2014 **Stakeholders:** Midwest, West
Concept Author: M.S. Reid **ClassifResp:** West

WEST GULF COASTAL PLAIN CATAHOULA BARRENS (CES203.364)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Woody-Herbaceous; Rock Outcrops/Barrens/Glades; Very Shallow Soil
FGDC Crosswalk: Vegetated, Tree-dominated, Sparse tree canopy, Mixed evergreen-deciduous sparse tree canopy
National Mapping Codes: EVT 2403; ESLF 5419; ESP 1403

CONCEPT

Summary: This system is confined to the Catahoula geologic formation of eastern Texas and western Louisiana. It includes a vegetational mosaic ranging from herbaceous-dominated areas on shallow soil and exposed sandstone to deeper soils with open woodland vegetation. Woodlands include a post oak-dominated overstory grading into longleaf pine-dominated areas. Seasonal droughtiness, shallow soils, aluminum toxicity, and periodic fires are important factors that influence the composition and structure of this system. Vegetation associated with thin soils over the tuffaceous sandstone of the Catahoula Formation is primarily herbaceous. But where the soil is deeper, or fire is excluded for long periods, it can display significant woody cover, with usually stunted representatives of species such as *Pinus palustris, Pinus taeda, Pinus echinata, Quercus stellata, Quercus marilandica*, and *Carya texana* dominating the canopy. Shrubs may form a patchy, discontinuous layer. Open sites may have significant herbaceous cover, usually dominated by graminoid species.
Classification Comments: The western boundary of this system is unclear. The Catahoula Formation extends into the Crosstimbers region as well as the Pineywoods, but it is not clear whether these areas should be considered the same system.
Related Concepts:
- Catahoula Barrens (Bridges and Orzell 1989a) Equivalent
- Eastern Redcedar: 46 (Eyre 1980) Finer
- Pineywoods: Catahoula Herbaceous Barrens (4307) [CES203.365.7] (Elliott 2011) Finer
- Pineywoods: Catahoula Woodland or Shrubland Barrens (4308) [CES203.365.5] (Elliott 2011) Finer
- Post Oak - Blackjack Oak: 40 (Eyre 1980) Finer

DESCRIPTION

Environment: The habitat of this system includes shallow soil and exposed sandstone, which tend to an herbaceous-dominated vegetation expression, as well as zones of deeper soils with open woodland vegetation. Examples of this system are restricted to surface outcrops of the Oligocene Catahoula geologic formation, an often tuffaceous sandstone. Sites are generally level to gently undulating (but sometimes steep), with surface or near-surface exposure of the underlying sandstone bedrock. Soils are shallow loams, such as Browndell-Rock outcrop. Soils may contain montmorillonitic clays. These thin soils can be extremely xeric during dry periods, but can also be saturated during wetter months (Elliott 2011).
Vegetation: Vegetation associated with thin soils over the tuffaceous sandstone of the Catahoula Formation is primarily herbaceous. But where the soil is deeper, or fire is excluded for long periods, it can display significant woody cover, with usually stunted representatives of species such as *Pinus palustris, Pinus taeda, Pinus echinata, Quercus stellata, Quercus marilandica*, and *Carya texana* dominating the canopy. Shrubs may form a patchy, discontinuous layer with species such as *Ilex vomitoria, Morella cerifera, Vaccinium arboreum, Forestiera ligustrina, Gelsemium sempervirens*, and *Crataegus* spp. commonly encountered. Maintenance of fire in the landscape will reduce woody cover in these sites, with herbaceous-dominated sites displaying increased species richness. On open sites, there may be exposed patches of bedrock or mineral soils, or areas of patchy cover of foliose and/or fruticose lichens. Open sites may have significant herbaceous cover, usually dominated by graminoid species such as *Schizachyrium scoparium, Sporobolus clandestinus, Sporobolus silveanus, Schizachyrium tenerum, Tridens strictus, Scleria* spp., and/or *Aristida* spp. Forbs, including *Bigelowia nuttallii, Plantago* spp., *Minuartia drummondii, Chaetopappa asteroides, Lechea san-sabeana, Sabatia campestris, Croton michauxii, Croton monanthogynus, Krameria lanceolata, Selaginella arenicola ssp. riddellii, Talinum parviflorum (= Phemeranthus parviflorus)*, and a variety of other herbaceous species, may also be present. Lack of fire tends to lead to closing of the woody canopy and a reduction in diversity in the herbaceous layer. More wooded sites may have an herbaceous cover that contains species such as *Chasmanthium sessiliflorum, Ranunculus fascicularis*, and *Piptochaetium avenaceum* (Elliott 2011). Undisturbed examples are dominated by *Bigelowia nuttallii, Aristida longispica, Schizachyrium scoparium, Croton michauxii (= Crotonopsis linaris)*, and *Sporobolus silveanus* (Marietta and Nixon 1984). Woodlands include a *Quercus stellata*-dominated overstory grading into *Pinus palustris*-dominated areas.
Dynamics: Seasonal droughtiness, shallow soils, aluminum toxicity, and periodic fires are important factors that influence the maintenance of this system as one with primarily herbaceous composition and structure. This ecological system is maintained by a combination of edaphic factors and natural disturbances including severe drought and fire. The outcrops themselves are relatively extreme environments for plant growth due to mild alkalinity, exfoliation of rock surfaces, and surface moisture and temperature fluctuations. Severe droughts kill tree saplings growing in cracks and potholes, helping to retain the open character of the glades (Quarterman et al. 1993). There is an apparent zonation or patchiness to glade/barren vegetation, with different zones that may be

identified by their characteristic plant species (Quarterman et al. 1993). These zones are apparently relatively stable, with woody plant encroachment evident only in relation to the invasion of shrubs and trees into potholes or crevices where soil accumulates more rapidly.

Component Associations:
- *(Pinus palustris) / Schizachyrium scoparium - Bigelowia nuttallii / Cladonia* spp. Herbaceous Vegetation (CEGL003600, G1G2)
- *Bigelowia nuttallii - Krameria lanceolata - Aristida dichotoma - Sporobolus silveanus* Herbaceous Vegetation (CEGL002276, G1)
- *Quercus stellata - Carya texana - (Pinus palustris) / Chasmanthium sessiliflorum - Ranunculus fascicularis* Woodland (CEGL007868, G1)

DISTRIBUTION

Range: This system is endemic to areas where sandstones of the Catahoula Formation occur near and at the surface in western Louisiana and eastern Texas. Sandstone glades are estimated to have historically covered less than 2000 acres in Louisiana and today 50-75% of that historic distribution is thought to remain (Smith 1993).
Divisions: 203:C
Nations: US
Subnations: LA, TX
Map Zones: 37:C
USFS Ecomap Regions: 231E:CC, 232F:CC
TNC Ecoregions: 40:C, 41:C

SOURCES

References: Bridges and Orzell 1989a, Comer et al. 2003, Duffey et al. 1974, Elliott 2011, Estes et al. 1979, Eyre 1980, LDWF 2005, LNHP 2009, MacRoberts and MacRoberts 1993a, MacRoberts and MacRoberts 1993b, Marietta and Nixon 1984, McKinney and Lockwood 1999, Noss 2013, Quarterman et al. 1993, Smith 1993, Taft 1997, Taft 2009, Taft et al. 1995
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723152#references
Description Author: R. Evans, mod. M. Pyne, L. Elliott, J. Teague
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: R. Evans **ClassifResp:** Southeast

WEST GULF COASTAL PLAIN NEPHELINE SYENITE GLADE (CES203.371)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Woody-Herbaceous; Rock Outcrops/Barrens/Glades; Very Shallow Soil
FGDC Crosswalk: Vegetated, Tree-dominated, Sparse tree canopy, Mixed evergreen-deciduous sparse tree canopy
National Mapping Codes: EVT 2405; ESLF 5421; ESP 1405

CONCEPT

Summary: This glade system is present only in Saline and Pulaski counties, Arkansas, on distinctive, massive outcrops of igneous substrate ("nepheline syenite"). Zonal vegetation communities are present around the outcrops. Interior herbaceous-dominated zones can be mesic to wet as springs and small ephemeral streams flow across the rock outcrops and water pools in flat areas. Deeper, more heavily wooded vegetation develops along the flat or slightly sloping outcrop edges.

DESCRIPTION

Environment: This ecological system is found where the igneous rock nepheline syenite occurs at or near the surface in the Upper West Gulf Coastal Plain of Arkansas. This glade system is characterized by patches of bare rock interspersed with areas of shallow soil imbedded within a matrix of deeper soil supporting forested ecosystems. Slope varies from gentle to flat. Gently sloping areas are often extremely xeric whereas flatter areas can accumulate moisture, creating seasonally wet microhabitats. Exposed bedrock may have abundant lichen and moss cover and limited vascular plants. At the edges of the rock outcrops, areas with shallow soils support grasslands with scattered stunted trees. As soils become deeper, grasslands grade into open woodlands (Witsell 2007).
Vegetation: Some examples will have open stands of *Quercus stellata*, but trees may be absent. Some typical dominant grasses include *Schizachyrium scoparium, Piptochaetium avenaceum, Aristida purpurascens*, and *Sporobolus clandestinus*. Other herbs may include *Delphinium carolinianum, Clinopodium arkansanum, Camassia scilloides, Sabatia campestris*, and *Talinum calycinum.* Lichens are common on the rocky substrate of some examples.
Dynamics: This ecological system is maintained by a combination of edaphic factors and natural disturbances, including severe drought and fire (Witsell 2007). The outcrops themselves are relatively extreme environments for plant growth due to mild alkalinity, exfoliation of rock surfaces, and surface moisture and temperature fluctuations. Severe droughts kill tree saplings growing in cracks and potholes, helping to retain the open character of the glades (Quarterman et al. 1993). There is an apparent zonation or patchiness to glade/barren vegetation, with different zones that may be identified by their characteristic plant species (Quarterman et al. 1993). These zones are apparently relatively stable, with woody plant encroachment evident only in relation to the invasion of shrubs and trees into potholes or crevices where soil accumulates more rapidly.

Component Associations:
- *(Quercus stellata) / Schizachyrium scoparium - Piptochaetium avenaceum - Aristida purpurascens - Delphinium carolinianum* Nepheline Syenite Wooded Herbaceous Vegetation (CEGL008422, G1)
- *Sporobolus clandestinus - Clinopodium arkansanum - Camassia scilloides - Sabatia campestris - Talinum calycinum* - Lichens Nepheline Syenite Herbaceous Vegetation (CEGL008421, G1)

DISTRIBUTION

Range: This system is present only in the Upper West Gulf Coastal Plain of Saline and Pulaski counties, Arkansas. It may have existed historically in Garland and Hot Spring counties (and thereby at least partly in the Ouachita region). Less than 10 occurrences of this ecological system are known to persist.
Divisions: 203:C
Nations: US
Subnations: AR
Map Zones: 37:C, 44:?
USFS Ecomap Regions: 231E:CC
TNC Ecoregions: 39:?, 40:C

SOURCES

References: Arkansas Geological Commission 2006, Comer et al. 2003, Duffey et al. 1974, Estes et al. 1979, McKinney and Lockwood 1999, Noss 2013, Quarterman et al. 1993, Taft 1997, Taft 2009, Taft et al. 1995, Witsell 2007
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723145#references
Description Author: R. Evans, mod. M. Pyne and J. Teague
Version: 14 Jan 2014
Concept Author: R. Evans
Stakeholders: Southeast
ClassifResp: Southeast

WEST GULF COASTAL PLAIN WECHES GLADE (CES203.277)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Woody-Herbaceous; Rock Outcrops/Barrens/Glades; Alkaline Soil
FGDC Crosswalk: Vegetated, Tree-dominated, Sparse tree canopy, Mixed evergreen-deciduous sparse tree canopy
National Mapping Codes: EVT 2404; ESLF 5420; ESP 1404

CONCEPT

Summary: This small-patch system is endemic to outcrops of marine sediment and glauconitic clays of the Weches Formation in central eastern Texas, where it occurs primarily in San Augustine, Nacogdoches, and Sabine counties. These outcrops are exposed by natural erosion of hillsides. Soils are shallow, rocky and basic, factors which tend to inhibit growth of woody vegetation, although as soil depth increases, so does woody plant development. Outcrops are seepy and saturated during winter and early spring but become hard and dry in the summer. Enormous seasonal variations in species dominance can occur, but a number of herbaceous species are characteristic of this system, including the narrowly endemic annuals *Lesquerella pallida (= Physaria pallida)* and *Leavenworthia aurea var. texana (= Leavenworthia texana)*. Characteristic species include *Sedum pulchellum, Clinopodium arkansanum,* and *Sporobolus vaginiflorus*. A scattered shrub layer, including *Cercis canadensis, Cornus drummondii, Juniperus virginiana,* and *Sideroxylon lanuginosum*, may be present on some sites.
Classification Comments: There is probably a woodland association from this geology that should also be described.
Related Concepts:
- Pineywoods: Weches Herbaceous Glade (4107) [CES203.277.7] (Elliott 2011) Finer
- Pineywoods: Weches Shrub Glade (4106) [CES203.277.6] (Elliott 2011) Finer

DESCRIPTION

Environment: This system is associated with outcrops of glauconitic (green-stone) clays, marls, mudstone, and ironstone of the Eocene Weches Formation. Outcrops of the Weches Formation are often found on slopes as a result of erosion, therefore this ecological system typically occupies slopes within rolling to relatively steep uplands, and sometimes on minor scarp slopes of ironstone outcrops. Surficial outcrops of the Weches Formation form the core of this ecological system but it extends to areas where the Weches is near the surface supporting shallow soils. Soils in this ecological system have high levels of calcium, magnesium, and potassium as a result of the marine-based parent material, and are mapped as the Trawick-Bub complex or the Trawick series (Mollic Hapludalfs). It is known from Texas and may extend into Louisiana and Arkansas (T. Witsell pers. comm. 2012, USFWS 2013b). Soils are often shallow but have been measured as deep as 50 cm (20 inches) (George and Nixon 1990). Outcrops of the Weches are generally 5-20 m wide and <100 m long and occur within a band averaging 8 km (5 miles) wide paralleling Texas State Highway 21 (George and Nixon 1990, USFWS 2013a, 2013b).The Weches Formation forms an impermeable layer that transports shallow groundwater to surface seeps and springs occurring on outcrop ledges along slopes. This moisture forms small pools and saturates shallow soils during the winter and spring, but the system can quickly become parched and droughty in the summer. The seasonal wet-dry pattern and alkaline soils are important characteristics to the maintenance of this system. In addition, the lack of woody canopy and corresponding leaf litter is important for the heliophytic flora (George and Nixon 1990, USFWS 2012a, 2013b). Calciphilic woody species may occur along the margins of outcrops where deeper soils have formed. The naturally fragmented distribution of this small-patch ecosystem over rock outcrops and thin alkaline soils in a region dominated by acidic sandy soils has become more isolated as areas are converted to other uses and encroachment by invasive species and off-site natives degrades the system (USFWS 2013b).
Vegetation: Characteristic species include *Sedum pulchellum, Clinopodium arkansanum,* and *Sporobolus vaginiflorus*. Other species include *Valerianella radiata, Galium virgatum, Minuartia patula (= Arenaria patula), Allium drummondii, Anemone caroliniana, Opuntia* spp., *Croton monanthogynus, Chamaesyce nutans (= Euphorbia nutans), Arnoglossum plantagineum (= Cacalia plantaginea),* and *Ipomopsis rubra*. A scattered shrub layer, including *Cercis canadensis, Cornus drummondii, Juniperus virginiana,* and *Sideroxylon lanuginosum*, may be present on some sites.
Dynamics: This ecological system is maintained by a combination of edaphic factors and natural disturbances, including severe drought and fire (Geroge and Nixon 1990, TNC 2003a, USFWS 2013a, 2013b). The outcrops themselves are relatively extreme environments for plant growth due to shallow soils, high levels of calcium, magnesium, and potassium, and extreme fluctuations in moisture and temperature. Severe droughts and a suggested fire frequency of 5-10 years can kill tree saplings, helping to retain the open character of glades (Quarterman et al. 1993, TNC 2003a). There is an apparent zonation or patchiness to glade/barren vegetation, with different zones that may be identified by their characteristic plant species (Quarterman et al. 1993). These zones are apparently relatively stable, with woody plant encroachment evident only in relation to the invasion of shrubs and trees into potholes or crevices where soil accumulates more rapidly. The open physiognomy and wet-dry hydrology play important roles in the dynamics of this system which supports heliophytic herbaceous species, some of which depend on the seasonal pattern of saturated and droughty soils (Baskin and Baskin 1988, USFWS 2013a, 2013b). This system supports two federally endangered endemic species, *Leavenworthia*

aurea var. texana (= Leavenworthia texana) and *Lesquerella pallida (= Physaria pallida)*.

Component Associations:
- *Sedum pulchellum - Clinopodium arkansanum - Sporobolus vaginiflorus* Herbaceous Vegetation (CEGL007797, G1)

DISTRIBUTION

Range: This system is endemic to a localized region of eastern Texas, primarily in San Augustine, Nacogdoches, and Sabine counties. More information is needed on possible extension into Arkansas and Louisiana.
Divisions: 203:C
Nations: US
Subnations: AR?, LA?, TX
Map Zones: 37:C
USFS Ecomap Regions: 232F:CC
TNC Ecoregions: 40:C, 41:C

SOURCES

References: Baskin and Baskin 1988, Comer et al. 2003, Duffey et al. 1974, Elliott 2011, Estes et al. 1979, George and Nixon 1990, Ledger and Judy 2003, Noss 2013, Quarterman et al. 1993, Singhurst pers. comm., Taft 2009, Taft et al. 1995, TNC 2003a, USFWS 2013a, USFWS 2013b, Witsell pers. comm.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723209#references
Description Author: R. Evans, mod. M. Pyne, L. Elliott, J. Teague
Version: 14 Jan 2014
Concept Author: R. Evans
Stakeholders: Southeast
ClassifResp: Southeast

WESTERN NORTH AMERICAN BOREAL DRY ASPEN-STEPPE BLUFF (CES105.109)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Linear, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Slope; Sideslope; Boreal [Boreal Subcontinental]; Shallow Soil; Xeric; Bluff; Low Artemisia spp.
Non-Diagnostic Classifiers: Montane; Montane [Upper Montane]; Slump and topple prone slope; Soil creep slope; Ridge/Summit/Upper Slope; Populus tremuloides
FGDC Crosswalk: Vegetated, Tree-dominated, Sparse tree canopy, Deciduous sparse tree canopy
National Mapping Codes: EVT 2606; ESLF 5431; ESP 1606

CONCEPT

Summary: This ecological system occurs commonly on moderately steep to very steep, south-facing slopes and windswept bluffs throughout the boreal and boreal transition regions of Alaska. Generally, the substrate is steep, unstable, dry mineral soil. This system is common above major rivers and is often associated with river bluffs above treeline. Soils are typically well-drained to excessively well-drained and develop on glacial, loess, or fluvial deposits or residual material. Soils are often unstable and rocky; outcrops are common. The system is a mosaic of open forests or woodlands, low shrub-dominated patches, or dry meadows. At increasing elevation, trees become less important, and at subalpine or low alpine locations, shrubs are the dominant lifeform. Tree patches are dominated by *Populus tremuloides*, but *Picea glauca* may also be present. Patches of low-shrub and dry herbaceous communities are interspersed within the aspen forest, where it occurs. Common shrubs include *Artemisia frigida, Artemisia alaskana, Juniperus communis*, and *Arctostaphylos uva-ursi*. Important grasses include *Pseudoroegneria spicata (= Agropyron spicatum), Bromus inermis var. pumpellianus (= Bromus pumpellianus), Calamagrostis purpurascens, Festuca altaica*, and *Poa* spp.
Classification Comments: This system combines those known as Boreal Dry Aspen and Steppe Bluff and Boreal Subalpine Steppe Bluff by the Alaska Natural Heritage Program.
Similar Ecological Systems:
- Western North American Boreal Dry Grassland (CES105.115)

Related Concepts:
- I.B.2.b - Quaking aspen (open) (Viereck et al. 1992) Intersecting
- II.C.2.m - Sagebrush-juniper (Viereck et al. 1992) Finer
- II.C.2.n - Sagebrush-grass (Viereck et al. 1992) Finer
- III.A.1.c - Midgrass-shrub (Viereck et al. 1992) Intersecting
- III.A.1.d - Midgrass-herb (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: This system occurs from the low alpine down through low elevations on south-facing slopes and windswept bluffs and ridges. Substrates are steep, unstable, dry mineral soils that are typically excessively well- to well-drained and develop on glacial, loess, or fluvial deposits or residual material. Rocky outcrops are common.
Vegetation: This system is a mosaic of *Populus tremuloides* forest, low-shrub and dry herbaceous communities. The vegetation cover in this system is typically open and discontinuous with much exposed mineral soil. Where trees dominate, *Populus tremuloides* is typically the dominant species, and *Picea glauca* may also be present at low cover values. The *Populus tremuloides* understory is typically open, and common species include *Vaccinium vitis-idaea, Rosa acicularis, Shepherdia canadensis*, and *Chamerion angustifolium* (Boggs and Sturdy 2005). The unforested portion features steppe vegetation, including species such as *Juniperus communis, Arctostaphylos uva-ursi, Artemisia frigida, Artemisia alaskana, Calamagrostis purpurascens, Pseudoroegneria spicata (= Agropyron spicatum), Bromus inermis var. pumpellianus (= Bromus pumpellianus), Festuca altaica*, and *Poa* spp. (Viereck et al. 1992, Chapin et al. 2006).
Dynamics: The aspen component can be self-replacing. Stages in model represent the mosaic within the system (sagebrush-juniper, aspen, spruce, grass-dominated).

DISTRIBUTION

Range: This system is found in the boreal and boreal transition (low elevation through alpine) regions of Alaska. It probably occurs further east into the Yukon Territories of Canada.
Divisions: 105:C
Nations: CA? , US
Subnations: AK, YT?
Map Zones: 69:C, 70:C, 71:C, 73:C, 74:C, 75:C
TNC Ecoregions: 71:C, 76:C, 77:C, 78:C

SOURCES

References: Batten et al. 1979, Boggs and Sturdy 2005, Chapin et al. 2006, Hanson 1951, Viereck et al. 1992, Western Ecology

Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817384#references
Description Author: T. Boucher, mod. M.S. Reid
Version: 10 Dec 2008 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

WILLAMETTE VALLEY UPLAND PRAIRIE AND SAVANNA (CES204.858)

CLASSIFIERS

Conf.: 1 - Strong
Classification Status: Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Steppe/Savanna
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Woody-Herbaceous; Short Disturbance Interval; F-Landscape/Low Intensity
Non-Diagnostic Classifiers: Lowland [Lowland]; Temperate [Temperate Oceanic]
FGDC Crosswalk: Vegetated, Tree-dominated, Sparse tree canopy, Mixed evergreen-deciduous sparse tree canopy
National Mapping Codes: EVT 2120; ESLF 5409; ESP 1120

CONCEPT

Summary: This grassland system is endemic to the Puget Trough and Willamette Valley. It formed a complex mosaic of varying patch sizes with wet prairies and riparian forests over much of the Willamette Valley during the pre-European settlement era. In parts of the Puget Trough, it occurred as large patches in more forested landscapes, usually associated with deep, coarse outwash deposits. Historically, it also occurred as large patches on glacially associated soils of variable texture in localized portions of the Georgia Basin in both Washington and British Columbia. It occurs on well-drained deep soils and was maintained historically by frequent anthropogenic burning. Landforms are usually flat, rolling, or gently sloping, and often part of extensive plains. Dominant vegetation is perennial bunch grasses, especially *Festuca roemeri (= Festuca idahoensis var. roemeri)* and, to a lesser degree, *Danthonia californica*, with abundant and diverse forbs. Scattered deciduous (*Quercus garryana*) and/or coniferous (*Pseudotsuga menziesii*, *Pinus ponderosa*) trees are rarely found now, but such savannas historically covered about one-third of the total acreage. In the absence of disturbance, many of them have succeeded to forest and others continue to do so.

DESCRIPTION

Environment: This ecosystem occurs on well-drained deep soils and was maintained historically by frequent anthropogenic burning. Landforms are usually flat, rolling, or gently sloping, and often part of extensive plains.
Dynamics: Fires are thought to have occurred every few years (Chappell and Kagan 2001, as cited in WNHP 2011). Annual soil drought during the summer made it difficult for woody species (especially trees) to establish in these grasslands. However, occasionally *Quercus garryana* and *Pseudotsuga menziesii* would establish and survive long enough to be resistant to frequent fires thereby creating savanna conditions (Chappell and Kagan 2001, as cited in WNHP 2011). Following European settlement of the region, anthropogenic fire became less frequent resulting in widespread encroachment of the prairies and savannas by woody vegetation, especially conifers (WNHP 2011).

Component Associations:
- *Danthonia californica* Valley Grassland Herbaceous Vegetation (CEGL001598, G1Q)
- *Elymus caninus - Festuca roemeri - (Koeleria macrantha)* Herbaceous Vegetation (CEGL001744, G1)
- *Festuca roemeri - Sericocarpus rigidus* Herbaceous Vegetation (CEGL001608, G1)
- *Pinus ponderosa / Carex inops - Festuca roemeri* Woodland (CEGL003348, G1)
- *Quercus garryana / Festuca (roemeri, rubra)* Wooded Herbaceous Vegetation (CEGL001714, G1)

DISTRIBUTION

Range: This system is endemic to the Puget Trough and Willamette Valley.
Divisions: 204:C
Nations: US
Subnations: OR, WA
Map Zones: 1:C, 2:C, 3:?, 7:C
USFS Ecomap Regions: 242A:CC, 242B:CC, M242A:??, M242B:??, M261A:CC, M261D:CC
TNC Ecoregions: 2:C

SOURCES

References: Chappell and Christy 2004, Chappell and Kagan 2001, Comer et al. 2003, Littell et al. 2009, PRBO Conservation Science 2011, WNHP 2011
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722817#references
Description Author: C. Chappell, mod. G. Kittel
Version: 14 Jan 2014
Stakeholders: West
Concept Author: C. Chappell
ClassifResp: West

UPLAND GRASSLAND AND HERBACEOUS

ALASKA ARCTIC LICHEN TUNDRA (CES104.178)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Arctic (104)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Montane]; Moss/Lichen (Nonvascular); Polar [Polar Oceanic]; Acidic Soil; Lichen
Non-Diagnostic Classifiers: Ridge; Slope; Summit
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Nonvascular, Lichen
National Mapping Codes: EVT 2687; ESLF 7166; ESP 1687

CONCEPT

Summary: This is a common ecological system in the hills and mountains of arctic Alaska. Common slope positions include sideslopes, summits and ridges. Sites are typically acidic and dry to mesic. It is especially common on recent volcanic deposits with little soil development. Patch size is small to large. Lichen cover is >25%, and vascular plant species cover is <25%. Foliose and fruticose lichens dominate and include *Umbilicaria* spp., *Rhizocarpon geographicum, Cladina stellaris (= Cladonia stellaris), Racomitrium lanuginosum, Flavocetraria* spp., and *Alectoria ochroleuca*. Common dwarf-shrubs include *Loiseleuria procumbens, Betula nana, Ledum palustre ssp. decumbens, Empetrum nigrum*, and *Vaccinium uliginosum*.
Classification Comments: This system is known as Lichen by the Alaska Natural Heritage Program.
Related Concepts:
- III.C.1.b - Dry bryophyte (Viereck et al. 1992) Finer
- III.C.2.a - Crustose lichen (Viereck et al. 1992) Finer
- III.C.2.b - Foliose and fruticose lichen (Viereck et al. 1992) Finer

DISTRIBUTION

Range: This system occurs throughout arctic Alaska, from the Bristol Bay lowlands in southwestern Alaska to the North Slope on the Arctic Ocean.
Divisions: 102:C; 104:C
Nations: CA, US
Subnations: AK
Map Zones: 67:C, 68:C, 69:C, 72:C, 76:C
TNC Ecoregions: 73:C, 74:C, 75:C, 79:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818202#references
Description Author: K. Boggs
Version: 09 Oct 2008 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKA ARCTIC MARINE BEACH AND BEACH MEADOW (CES102.207)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Arctic (102)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Linear, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Coastal Grass/Shrub/Barren Mosaic; Lowland; Herbaceous; Dune (Substrate); Beach (Substrate); Polar [Polar Hyperoceanic]; Salt Spray; Salt-tolerant Forbs
Non-Diagnostic Classifiers: Dune (Landform); Sand Soil Texture; Beach (Landform)
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2709; ESLF 7167; ESP 1709

CONCEPT

Summary: This system consists of coastal beaches, beach dunes, and vegetation that has stabilized sand or cobble deposits. Soils are dry to mesic and typically sandy. Patch size is small to moderate and often linear. Two different physiognomic structures are found in the system: *Leymus mollis* grasslands and dwarf-shrublands; bare sand or cobble are also common. Salt-tolerant forb communities occur just above mean high tide and are dominated or codominated by *Cochlearia groenlandica*, *Achillea millefolium var. borealis*, *Honckenya peploides*, and/or *Mertensia maritima*. As dune height and distance from the ocean increase, sites are dominated by *Leymus mollis* communities that may include near-monocultures of *Leymus mollis* to more species-rich associations including *Leymus mollis*, *Lathyrus japonicus var. maritimus (= Lathyrus maritimus)*, and *Poa eminens*. Older dunes support dwarf-shrubs (primarily *Empetrum nigrum*) mixed with herbaceous species which often grow in narrow stringers on the older beach ridges behind the *Leymus mollis* zone. *Lathyrus japonicus var. maritimus*, *Conioselinum chinense*, and *Cnidium cnidiifolium* are uncommon east of Cape Lisburne. The *Leymus mollis* and *Empetrum nigrum* zones are above the high tide line but still experience storm surges, high winds and salt spray.
Classification Comments: This system is known as Sandy Beach and Beach Meadow by the Alaska Natural Heritage Program. This is very similar to the Aleutian beach and beach meadow system; for now they are maintained as two distinct systems, but may be merged in the future.
Similar Ecological Systems:
- Alaskan Pacific Maritime Coastal Dune, Beach and Beach Meadow (CES204.166)
- Aleutian Marine Beach and Beach Meadow (CES105.239)

Related Concepts:
- III.A.1.a - Elymus (Viereck et al. 1992) Intersecting
- III.A.1.e - Hair-grass (Viereck et al. 1992) Intersecting
- III.B.2.a - Mixed herbs (Viereck et al. 1992) Intersecting
- III.B.2.b - Fireweed (Viereck et al. 1992) Intersecting
- III.B.2.c - Large umbel (Viereck et al. 1992) Intersecting
- III.B.3.d - Halophytic herb wet meadow (Viereck et al. 1992) Intersecting

DESCRIPTION

Dynamics: Processes that define the system include sand deposition, wind erosion, long-shore transport, dune formation, and water erosion such as overwash from storm surges. Herbaceous species stabilize the sand deposits (dunes, beaches), and the older deposits support dwarf-shrubs mixed with herbaceous species.

DISTRIBUTION

Range: This system occurs along Alaska's arctic coastline, from the Bristol Bay lowlands in southwestern Alaska to the North Slope on the Arctic Ocean.
Divisions: 102:C; 104:C
Nations: US
Subnations: AK
Map Zones: 67:C, 68:C, 72:C, 76:C
TNC Ecoregions: 73:C, 74:C, 75:C, 79:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818268#references
Description Author: K. Boggs
Version: 09 Oct 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKA ARCTIC MESIC HERBACEOUS MEADOW (CES102.186)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Arctic (102)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Herbaceous; Polar [Polar Oceanic]
Non-Diagnostic Classifiers: Sideslope; Toeslope/Valley Bottom
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - forbland, Perennial forb grassland
National Mapping Codes: EVT 2699; ESLF 7168; ESP 1699

CONCEPT

Summary: This mesic herbaceous system occurs throughout arctic Alaska on hill and mountain slopes, upper drainages, and lowlands including drained lake basins. It typically occurs as small patches and is more common in the western arctic. This system occurs on mesic sites with >25% cover of herbaceous species. Species include *Carex microchaeta ssp. nesophila* (dominant sedge in higher elevations), *Alopecurus alpinus, Artemisia arctica, Polygonum bistorta, Valeriana capitata, Pedicularis* spp., *Polemonium acutiflorum, Salix rotundifolia*, and *Salix reticulata*. Collapsed acidic lowland snowbeds that support *Phippsia algida* and *Alopecurus alpinus* and drained lake basins dominated by *Calamagrostis canadensis* (western Alaska) are also included in this system.
Classification Comments: This system is known as Mesic Herbaceous by the Alaska Natural Heritage Program.
Related Concepts:
- III.A.1.d - Midgrass-herb (Viereck et al. 1992) Intersecting
- III.A.1.e - Hair-grass (Viereck et al. 1992) Intersecting
- III.A.2.a - Bluejoint meadow (Viereck et al. 1992) Intersecting
- III.A.2.b - Bluejoint-herb (Viereck et al. 1992) Intersecting
- III.A.2.e - Mesic sedge-grass meadow tundra (Viereck et al. 1992) Intersecting
- III.A.2.f - Mesic sedge-herb meadow tundra (Viereck et al. 1992) Intersecting
- III.A.2.g - Mesic grass-herb meadow tundra (Viereck et al. 1992) Intersecting
- III.B.1.a - Seral herbs (Viereck et al. 1992) Intersecting
- III.B.1.b - Alpine herb-sedge (snowbed) (Viereck et al. 1992) Intersecting
- III.B.1.c - Alpine herbs (Viereck et al. 1992) Intersecting
- III.B.2.a - Mixed herbs (Viereck et al. 1992) Intersecting
- III.B.2.b - Fireweed (Viereck et al. 1992) Intersecting
- III.B.2.c - Large umbel (Viereck et al. 1992) Intersecting
- III.B.2.d - Ferns (Viereck et al. 1992) Intersecting

DESCRIPTION

Dynamics: Expert review suggests that this system is stable and rarely burns.

DISTRIBUTION

Range: This system occurs throughout arctic Alaska, from the Bristol Bay lowlands in southwestern Alaska to the North Slope on the Arctic Ocean.
Divisions: 102:C; 104:C
Nations: US
Subnations: AK
Map Zones: 67:C, 68:C, 69:C, 72:C, 76:C
TNC Ecoregions: 73:C, 74:C, 75:C, 79:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818240#references
Description Author: K. Boggs
Version: 09 Oct 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKA SUB-BOREAL AND MARITIME ALPINE MESIC HERBACEOUS MEADOW (CES204.145)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Alpine/AltiAndino [Alpine/AltiAndino]; Slope; Herbaceous; Soil creep slope; Boreal [Boreal Oceanic]; Avalanche
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - forbland, Perennial forb grassland
National Mapping Codes: EVT 2645; ESLF 7169; ESP 1645

CONCEPT

Summary: These are mesic subalpine and alpine herbaceous meadows that occur on mountain sideslopes in the boreal transition and maritime regions of Alaska. The slope position is often above the tall-shrub zone and below alpine dwarf-shrub tundra, and the slope shape is usually straight to concave. The substrate is colluvium, residuum, or glacial till. This system often occurs as a continuous band above or mixed with subalpine and alpine shrublands on moderate to steep slopes underlain by colluvium, talus, or bedrock. Species composition is diverse and species richness is often very high, typically no single species is dominant. Vegetation is dominated by herbaceous species, including *Carex macrochaeta, Geranium erianthum, Sanguisorba canadensis, Valeriana sitchensis, Lupinus nootkatensis, Veratrum viride, Aconitum delphiniifolium, Anemone narcissiflora, Polemonium acutiflorum, Chamerion angustifolium (= Epilobium angustifolium), Chamerion latifolium, Senecio triangularis, Nephrophyllidium crista-galli, Calamagrostis canadensis* (often present but not dominant), *Castilleja unalaschcensis, Artemisia arctica, Fritillaria camschatcensis*, and *Athyrium filix-femina*. The dominant disturbances are snow avalanche, soil creep and freeze-thaw action.
Classification Comments: This system combines those known as Boreal Transition Alpine Herbaceous Meadow and Maritime Alpine Mesic Herbaceous Meadow by the Alaska Natural Heritage Program.
Similar Ecological Systems:
- Western North American Sub-boreal Mesic Bluejoint-Forb Meadow (CES105.114)

Related Concepts:
- *Carex macrochaeta* (DeVelice et al. 1999) Finer
- *Carex macrochaeta* (Boggs et al. 2008a) Finer
- *Valeriana sitchensis* (DeVelice et al. 1999) Finer
- III.A.2.f - Mesic sedge-herb meadow tundra (Viereck et al. 1992) Intersecting
- III.B.2.a - Mixed herbs (Viereck et al. 1992) Intersecting
- Mesic Forb Alpine (Boggs et al. 2008a) Undetermined

DESCRIPTION

Environment: These are mesic subalpine and alpine herbaceous meadows that occur on mountain sideslopes in the boreal transition and maritime regions of Alaska. The slope position is often above the tall-shrub zone and below alpine dwarf-shrub tundra, and the slope shape is usually straight to concave. The substrate is colluvium, residuum, or glacial till. This system often occurs as a continuous band above or mixed with subalpine and alpine shrublands on moderate to steep slopes underlain by colluvium, talus, or bedrock.
Vegetation: Species composition is diverse and species richness is often very high, typically no single species is dominant. Vegetation is dominated by herbaceous species, including *Carex macrochaeta, Geranium erianthum, Sanguisorba canadensis, Valeriana sitchensis, Lupinus nootkatensis, Veratrum viride, Aconitum delphiniifolium, Anemone narcissiflora, Polemonium acutiflorum, Chamerion angustifolium (= Epilobium angustifolium), Chamerion latifolium, Senecio triangularis, Nephrophyllidium crista-galli, Calamagrostis canadensis* (often present but not dominant), *Castilleja unalaschcensis, Artemisia arctica, Fritillaria camschatcensis*, and *Athyrium filix-femina* (DeVelice et al. 1999).
Dynamics: The dominant disturbances are snow avalanche, soil creep and freeze-thaw action.

DISTRIBUTION

Range: This system occurs in the subalpine to alpine zones of the boreal transition region and from Kodiak Island through southeastern Alaska.
Divisions: 105:C; 204:C
Nations: US
Subnations: AK
Map Zones: 73:C, 74:?, 75:C, 76:C, 77:C, 78:C
TNC Ecoregions: 69:C, 70:C, 71:C, 72:C, 74:C, 76:C

SOURCES

References: DeVelice et al. 1999, Western Ecology Working Group n.d.
Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817500#references
Description Author: T. Boucher
Version: 12 Aug 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKAN PACIFIC MARITIME COASTAL DUNE, BEACH AND BEACH MEADOW (CES204.166)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Linear, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Coastal Grass/Shrub/Barren Mosaic; Lowland; Herbaceous; Dune (Substrate); Beach (Substrate); Salt Spray; Salt-tolerant Forbs
Non-Diagnostic Classifiers: Dune (Landform); Temperate [Temperate Oceanic]; Sand Soil Texture; Beach (Landform)
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2666; ESLF 7170; ESP 1666

CONCEPT

Summary: This system consists of coastal sandy beaches, meadows, beach dunes, and sand spits. Processes that define the system include sand deposition, wind and water erosion, long-shore transport, and overwash from storm surges. Soils are usually sandy and well-drained, though dune slacks may be poorly drained. Beaches and dunes are dominated by a mosaic of barren sands and herbaceous vegetation. Common species include *Leymus mollis*, *Hordeum brachyantherum*, *Poa eminens*, *Festuca rubra*, *Deschampsia* spp., *Calamagrostis canadensis*, *Achillea millefolium var. borealis (= Achillea borealis)*, *Angelica lucida*, *Angelica genuflexa*, *Ligusticum scoticum*, *Heracleum maximum*, *Senecio pseudoarnica*, *Lupinus nootkatensis*, *Fragaria chiloensis*, and *Lathyrus japonicus var. maritimus*. Tidally flooded dune slacks may be colonized by herbaceous communities dominated by *Equisetum variegatum* and may eventually succeed to shrub communities with *Myrica gale* and *Salix* spp.
Classification Comments: This system is known as Maritime Coastal Dune, Beach, and Beach Meadow by the Alaska Natural Heritage Program.
Similar Ecological Systems:
- Alaska Arctic Marine Beach and Beach Meadow (CES102.207)
- Aleutian Marine Beach and Beach Meadow (CES105.239)
- North Pacific Maritime Coastal Sand Dune and Strand (CES200.881)

Related Concepts:
- *Elymus arenarius - Achillea borealis* (Boggs 2000) Finer
- *Fragaria chiloensis - Achillea borealis* (Shephard 1995) Finer
- *Fragaria chiloensis* (Boggs 2000) Finer
- *Lathyrus maritimus* (Boggs 2000) Finer
- *Lupinus nootkatensis* (Boggs 2000) Finer
- III.A.1.a - Elymus (Viereck et al. 1992) Intersecting
- III.A.1.e - Hair-grass (Viereck et al. 1992) Intersecting
- III.B.2.a - Mixed herbs (Viereck et al. 1992) Intersecting
- III.B.2.c - Large umbel (Viereck et al. 1992) Intersecting
- III.B.3.d - Halophytic herb wet meadow (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: This system consists of coastal sandy beaches, meadows, beach dunes, and sand spits. Processes that define the system include sand deposition, wind and water erosion, long-shore transport, and overwash from storm surges (Boggs 2000). Soils are usually sandy and well-drained, though dune slacks may be poorly drained. Beaches and dunes are dominated by a mosaic of barren sands and herbaceous vegetation.
Vegetation: Common species include *Leymus mollis*, *Hordeum brachyantherum*, *Poa eminens*, *Festuca rubra*, *Deschampsia* spp., *Calamagrostis canadensis*, *Achillea millefolium var. borealis (= Achillea borealis)*, *Angelica lucida*, *Angelica genuflexa*, *Ligusticum scoticum*, *Heracleum maximum*, *Senecio pseudoarnica*, *Lupinus nootkatensis*, *Fragaria chiloensis*, and *Lathyrus japonicus var. maritimus* (Streveler et al. 1973, DeVelice et al. 1999, Boggs 2000). Tidally flooded dune slacks may be colonized by herbaceous communities dominated by *Equisetum variegatum* and may eventually succeed to shrub communities with *Myrica gale* and *Salix* spp. (Boggs 2000).

DISTRIBUTION

Range: This system occurs from the Cook Inlet Basin, Kodiak Island, and through southeastern Alaska.
Divisions: 204:C
Nations: US
Subnations: AK
Map Zones: 75:C, 76:C, 77:C, 78:C
TNC Ecoregions: 69:C, 70:C, 71:C, 72:C

SOURCES

References: Boggs 2000, DeVelice et al. 1999, Streveler et al. 1973, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817796#references
Description Author: T. Boucher
Version: 10 Dec 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKAN PACIFIC MARITIME MESIC HERBACEOUS MEADOW (CES204.163)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Herbaceous; Temperate [Temperate Oceanic]
Non-Diagnostic Classifiers: Montane; Lowland; Sideslope; Toeslope/Valley Bottom
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - forbland, Perennial forb grassland
National Mapping Codes: EVT 2653; ESLF 7171; ESP 1653

CONCEPT

Summary: This ecological system includes a wide variety of herbaceous vegetation types and occurs below subalpine shrublands on sideslopes, rolling hills, and alluvial deposits. Soils are typically mesic, well-drained, and underlain by colluvium, alluvium, glacial till or residuum. Vegetation may be dominated by forbs, graminoids, or ferns. The most common dominant species are *Calamagrostis canadensis* and *Chamerion angustifolium*. One or more of the following species can also be dominant: *Veratrum viride, Athyrium filix-femina*, or *Heracleum maximum*. Other common species may include *Lupinus nootkatensis, Aconitum delphiniifolium, Sanguisorba canadensis, Senecio triangularis*, and *Nephrophyllidium crista-galli*.
Classification Comments: This system is known as Mesic Herbaceous Meadow by the Alaska Natural Heritage Program. On Kodiak Island, mesic herbaceous meadows are placed into Aleutian Mesic Herbaceous Meadow (CES105.232). The transition between maritime and Aleutian mesic meadows, as well as north into the boreal transition region is not clearly defined.
Similar Ecological Systems:
- Aleutian Mesic Herbaceous Meadow (CES105.232)
- Western North American Sub-boreal Mesic Bluejoint-Forb Meadow (CES105.114)

Related Concepts:
- *Athyrium filix-femina* (DeVelice et al. 1999) Finer
- *Calamagrostis canadensis* (DeVelice et al. 1999) Finer
- *Fauria crista-galli (Nephrophyllidium crista-galli)* (DeVelice et al. 1999) Finer
- *Veratrum viride* (DeVelice et al. 1999) Finer
- III.A.2.a - Bluejoint meadow (Viereck et al. 1992) Intersecting
- III.A.2.b - Bluejoint-herb (Viereck et al. 1992) Intersecting
- III.A.2.c - Bluejoint-shrub (Viereck et al. 1992) Intersecting
- III.B.1.b - Alpine herb-sedge (snowbed) (Viereck et al. 1992) Intersecting
- III.B.2.a - Mixed herbs (Viereck et al. 1992) Intersecting
- III.B.2.b - Fireweed (Viereck et al. 1992) Intersecting
- III.B.2.c - Large umbel (Viereck et al. 1992) Intersecting
- III.B.2.d - Ferns (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: This ecological system includes a wide variety of herbaceous vegetation types and occurs below subalpine shrublands on sideslopes, rolling hills, and alluvial deposits. Soils are typically mesic, well-drained, and underlain by colluvium, alluvium, glacial till or residuum.
Vegetation: Vegetation may be dominated by forbs, graminoids, or ferns. The most common dominant species are *Calamagrostis canadensis* and *Chamerion angustifolium*. One or more of the following species can also be dominant: *Veratrum viride, Athyrium filix-femina*, or *Heracleum maximum*. Other common species may include *Lupinus nootkatensis, Aconitum delphiniifolium, Sanguisorba canadensis, Senecio triangularis*, and *Nephrophyllidium crista-galli* (Shephard 1995, DeVelice et al. 1999).

DISTRIBUTION

Range: This system occurs from Prince William Sound through southeastern Alaska. Its southern boundary has yet to be determined.
Divisions: 204:C
Nations: US
Subnations: AK
Map Zones: 77:C, 78:C
TNC Ecoregions: 69:C, 70:C

SOURCES

References: DeVelice et al. 1999, Shephard 1995, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817789#references
Description Author: T. Boucher

Version: 10 Dec 2008
Concept Author: Western Ecology Group and Alaska Natural Heritage Program

Stakeholders: West
ClassifResp: West

ALEUTIAN AMERICAN DUNEGRASS GRASSLAND (CES105.233)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Dune (Landform); Herbaceous; Boreal [Boreal Oceanic]
Non-Diagnostic Classifiers: Dune (undifferentiated); Dune field; Colluvial slope
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2671; ESLF 7172; ESP 1671

CONCEPT

Summary: Sites are level to steep. The substrates are commonly dunes or shallow to deep eolian sand deposits over bedrock, sometimes 2 km inland. This system is not subjected to typical coastal processes such as overwash. The sites may be unstable, including eroding coastal bluffs and isolated blowouts. Other sites have loamy soils on colluvium that are nutrient-enriched by seabirds. Sites may or may not receive salt spray. Patch size is small to large. *Leymus mollis* cover is >25%, and the sites are not part of Aleutian Marine Beach and Beach Meadow (CES105.239). Other dominant or codominant species include *Festuca rubra, Heracleum maximum, Ligusticum scoticum, Angelica lucida,* and *Claytonia sibirica*. Some sites have 1- to 2-foot tall tussocks. Recent research has shown that the abundance of graminoids in the Aleutian Islands has been significantly reduced due to a reduction in nutrient inputs from seabird colonies; where seabirds have been impacted by introduced predators, the cover of graminoid species is lower.
Classification Comments: This system is known as *Leymus mollis* by the Alaska Natural Heritage Program.
Similar Ecological Systems:
- Aleutian Marine Beach and Beach Meadow (CES105.239)

Related Concepts:
- III.A.1.a - Elymus (Viereck et al. 1992) Broader

DESCRIPTION

Environment: Sites are level to steep. The substrates are commonly dunes or shallow to deep eolian sand deposits over bedrock, sometimes 2 km inland. This system is not subjected to typical coastal processes such as overwash. The sites may be unstable, including eroding coastal bluffs and isolated blowouts. Other sites have loamy soils on colluvium that are nutrient-enriched by seabirds. Sites may or may not receive salt spray. Patch size is small to large.
Vegetation: *Leymus mollis* cover is >25%. Other dominant or codominant species include *Festuca rubra, Heracleum maximum, Ligusticum scoticum, Angelica lucida,* and *Claytonia sibirica*. Some sites have 1- to 2-foot tall tussocks.
Dynamics: Recent research has shown that the abundance of graminoids in the Aleutian Islands has been significantly reduced due to a reduction in nutrient inputs from seabird colonies; where seabirds have been impacted by introduced predators, the cover of graminoid species is lower.

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Aleutian Marine Beach and Beach Meadow (CES105.239)

DISTRIBUTION

Range: This system occurs on the Alaska Peninsula, Aleutian Islands and possibly Kodiak Island.
Divisions: 102:C; 105:C
Nations: US
Subnations: AK
Map Zones: 76:C
TNC Ecoregions: 70:?, 72:C, 73:C

SOURCES

References: Byrd 1984, Croll et al. 2005, Talbot and Talbot 1994, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818566#references
Description Author: K. Boggs
Version: 16 Oct 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALEUTIAN MARINE BEACH AND BEACH MEADOW (CES105.239)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Linear, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Coastal Grass/Shrub/Barren Mosaic; Lowland; Herbaceous; Dune (Substrate); Beach (Substrate); Boreal [Boreal Oceanic]; Salt Spray; Empetrum nigrum; Salt-tolerant Forbs
Non-Diagnostic Classifiers: Dune (Landform); Sand Soil Texture; Beach (Landform)
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2725; ESLF 7173; ESP 1725

CONCEPT

Summary: This ecological system consists of coastal beaches, beach dunes, and vegetation that has stabilized sand deposits. Cobble beaches are also included. Soils are dry to mesic (occasionally tidally inundated) and typically sandy. Patch size is small to moderate and often linear. This system sometimes grades into sandy loess deposits on rolling hills dominated Aleutian American Dunegrass Grassland (CES105.233). Three different vegetation types occur in this system: salt-tolerant forb communities, *Leymus mollis* grasslands, and *Empetrum nigrum* shrublands. Bare sand or cobble are also common. Salt-tolerant forb communities occur just above mean high tide and are dominated or codominated by *Cochlearia groenlandica, Achillea millefolium var. borealis, Honckenya peploides*, and/or *Mertensia maritima*. As dune height and distance from the ocean increase, sites are dominated by *Leymus mollis* communities that may include near-monocultures of *Leymus mollis* to more species-rich associations, including *Leymus mollis, Lathyrus japonicus var. maritimus, Achillea millefolium var. borealis, Festuca rubra, Fragaria chiloensis, Senecio pseudoarnica, Deschampsia beringensis, Heracleum maximum*, and *Poa eminens*. *Empetrum nigrum*-dominated communities often grow in narrow stringers on the older beach ridges behind the *Leymus mollis* zone. Herbaceous species are common, including *Cornus suecica*. The *Leymus mollis* and *Empetrum nigrum* existing vegetation types are above the high tide line but still experience storm surges, high winds and salt spray.
Classification Comments: This system is known as Marine Beach and Beach Meadow by the Alaska Natural Heritage Program. This system should probably be merged with other coastal dune and beach systems in Alaska; it's unlikely that coastal dunes and beaches in the Aleutians are significantly different from those in the southern arctic or maritime regions.
Similar Ecological Systems:
- Alaska Arctic Marine Beach and Beach Meadow (CES102.207)
- Alaskan Pacific Maritime Coastal Dune, Beach and Beach Meadow (CES204.166)
- Aleutian American Dunegrass Grassland (CES105.233)

Related Concepts:
- *Leymus mollis* (Boggs et al. 2003) Finer
- *Leymus mollis* - Mixed herbaceous (Boggs et al. 2003) Finer
- II.D.2.c - Crowberry tundra (Viereck et al. 1992) Intersecting
- III.A.1.a - Elymus (Viereck et al. 1992) Intersecting
- III.A.1.e - Hair-grass (Viereck et al. 1992) Intersecting
- III.B.2.a - Mixed herbs (Viereck et al. 1992) Intersecting
- III.B.2.c - Large umbel (Viereck et al. 1992) Intersecting
- III.B.3.d - Halophytic herb wet meadow (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: This ecological system consists of coastal beaches, beach dunes, and vegetation that has stabilized sand deposits. Cobble beaches are also included. Soils are dry to mesic (occasionally tidally inundated) and typically sandy. Patch size is small to moderate and often linear.
Vegetation: Three different vegetation types occur in this system: salt-tolerant forb communities, *Leymus mollis* grasslands, and *Empetrum nigrum* shrublands. Bare sand or cobble are also common. Salt-tolerant forb communities occur just above mean high tide and are dominated or codominated by *Cochlearia groenlandica, Achillea millefolium var. borealis, Honckenya peploides*, and/or *Mertensia maritima*. As dune height and distance from the ocean increase, sites are dominated by *Leymus mollis* communities that may include near-monocultures of *Leymus mollis* to more species-rich associations, including *Leymus mollis, Lathyrus japonicus var. maritimus, Achillea millefolium var. borealis, Festuca rubra, Fragaria chiloensis, Senecio pseudoarnica, Deschampsia beringensis, Heracleum maximum*, and *Poa eminens*. *Empetrum nigrum*-dominated communities often grow in narrow stringers on the older beach ridges behind the *Leymus mollis* zone. Herbaceous species are common, including *Cornus suecica*. The *Leymus mollis* and *Empetrum nigrum* existing vegetation types are above the high tide line but still experience storm surges, high winds and salt spray.
Dynamics: Processes that define the system include sand deposition, wind erosion, longshore transport, dune formation, and water erosion such as overwash from storm surges. Herbaceous species stabilize the sand deposits (dunes, beaches).

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Aleutian American Dunegrass Grassland (CES105.233)

Adjacent Ecological System Comments: This system sometimes grades into sandy loess deposits on rolling hills dominated Aleutian American Dunegrass Grassland (CES105.233).

DISTRIBUTION

Range: This system occurs on the Alaska Peninsula and Aleutian Islands.
Divisions: 102:C; 105:C
Nations: US
Subnations: AK
Map Zones: 76:C
TNC Ecoregions: 72:C, 73:C

SOURCES

References: Boggs et al. 2003, Byrd 1984, Fleming and Spencer 2007, Shacklette et al. 1969, Talbot and Talbot 1994, Talbot et al. 1984, Talbot et al. 2006, Viereck et al. 1992, Western Ecology Working Group n.d.

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818590#references

Description Author: K. Boggs
Version: 16 Oct 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALEUTIAN MESIC HERBACEOUS MEADOW (CES105.232)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch, Matrix, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland; Herbaceous; Temperate [Temperate Oceanic]
Non-Diagnostic Classifiers: Ravine; Slope; Talus (Landform); Alluvial fan; Sideslope; Toeslope/Valley Bottom; Bluff
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - forbland, Perennial forb grassland
National Mapping Codes: EVT 2651; ESLF 7174; ESP 1651

CONCEPT

Summary: This ecological system occurs on all slopes and aspects with a mesic moisture regime, including windswept coastal headlands, coastal bluffs, old beach ridges, hillside slopes, stabilized talus, alluvial fans, and ravine sideslopes, and commonly forms a mosaic with alder patches. Patch size is small to matrix-forming. Herbaceous cover is >25%, *Leymus mollis* cover is <25%. This system includes four predominant vegetation types: (1) The *Athyrium filix-femina* meadow type is dominated by *Athyrium filix-femina* with *Veratrum viride, Heracleum maximum, Streptopus amplexifolius*, *Angelica lucida*, and *Calamagrostis canadensis*; (2) The *Chamerion angustifolium ssp. angustifolium* meadow type is dominated by *Chamerion angustifolium ssp. angustifolium*, usually with ferns, *Calamagrostis canadensis,* and often *Heracleum maximum*; (3) The *Calamagrostis canadensis* meadow type is dominated by *Calamagrostis canadensis*, usually with ferns and scattered forbs. It is common on disturbed sites (human or natural) that are in early stages of recovery; and (4) The mixed herbaceous meadow type includes mesic herbaceous meadows not dominated by *Athyrium filix-femina, Chamerion angustifolium ssp. angustifolium*, or *Calamagrostis canadensis*; these species, however, often codominate. Common forbs include *Lupinus nootkatensis, Solidago canadensis var. lepida, Polemonium acutiflorum, Castilleja unalaschcensis, Sanguisorba canadensis, Veratrum viride, Valeriana capitata, Antennaria dioica, Cardamine oligosperma var. kamtschatica, Achillea millefolium var. borealis, Arnica unalaschcensis, Dendranthema arcticum ssp. arcticum, Claytonia sibirica, Geum calthifolium, Ranunculus occidentalis, Dryopteris expansa,* and *Angelica lucida*. Graminoids include *Carex macrochaeta, Festuca rubra, Agrostis exarata, Agrostis scabra,* and *Deschampsia beringensis*. *Empetrum nigrum* may also be common.
Classification Comments: This system is known as Mesic Herbaceous by the Alaska Natural Heritage Program.
Similar Ecological Systems:
- Alaskan Pacific Maritime Mesic Herbaceous Meadow (CES204.163)

Related Concepts:
- *Calamagrostis canadensis* (Boggs et al. 2003) Finer
- *Calamagrostis canadensis* - Forb (Boggs et al. 2003) Finer
- *Chamerion angustifolium ssp. angustifolium* (Boggs et al. 2003) Finer
- *Chamerion latifolium* (Boggs et al. 2003) Finer
- Forb - *Luetkea pectinata* (Boggs et al. 2003) Finer
- III.A.1.d - Midgrass-herb (Viereck et al. 1992) Intersecting
- III.A.1.e - Hair-grass (Viereck et al. 1992) Intersecting
- III.A.2.a - Bluejoint meadow (Viereck et al. 1992) Intersecting
- III.A.2.b - Bluejoint-herb (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: This ecological system occurs on all slopes and aspects with a mesic moisture regime, including windswept coastal headlands, coastal bluffs, old beach ridges, hillside slopes, stabilized talus, alluvial fans, and ravine sideslopes, and commonly forms a mosaic with alder patches. Patch size is small to matrix-forming.
Vegetation: Herbaceous cover is >25%, *Leymus mollis* cover is <25%. This system includes four predominant vegetation types: (1) The *Athyrium filix-femina* meadow type is dominated by *Athyrium filix-femina* with *Veratrum viride, Heracleum maximum, Streptopus amplexifolius, Angelica lucida*, and *Calamagrostis canadensis*; (2) The *Chamerion angustifolium ssp. angustifolium* meadow type is dominated by *Chamerion angustifolium ssp. angustifolium*, usually with ferns, *Calamagrostis canadensis,* and often *Heracleum maximum*; (3) The *Calamagrostis canadensis* meadow type is dominated by *Calamagrostis canadensis*, usually with ferns and scattered forbs. It is common on disturbed sites (human or natural) that are in early stages of recovery; and (4) The mixed herbaceous meadow type includes mesic herbaceous meadows not dominated by *Athyrium filix-femina, Chamerion angustifolium ssp. angustifolium*, or *Calamagrostis canadensis*; these species, however, often codominate. Common forbs include *Lupinus nootkatensis, Solidago canadensis var. lepida, Polemonium acutiflorum, Castilleja unalaschcensis, Sanguisorba canadensis, Veratrum viride, Valeriana capitata, Antennaria dioica, Cardamine oligosperma var. kamtschatica, Achillea millefolium var. borealis, Arnica unalaschcensis, Dendranthema arcticum ssp. arcticum, Claytonia sibirica, Geum calthifolium, Ranunculus occidentalis, Dryopteris expansa*, and *Angelica lucida*. Graminoids include *Carex macrochaeta, Festuca rubra, Agrostis exarata, Agrostis scabra*, and *Deschampsia beringensis*. *Empetrum nigrum* may also be common.

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Aleutian Mesic Alder-Salmonberry Shrubland (CES105.147)

DISTRIBUTION

Range: This system occurs on the Alaska Peninsula, Aleutian Islands and Kodiak Island.
Divisions: 102:C; 105:C
Nations: US
Subnations: AK
Map Zones: 76:C
TNC Ecoregions: 70:C, 72:C, 73:C

SOURCES

References: Boggs et al. 2003, Byrd 1984, Fleming and Spencer 2007, Shacklette et al. 1969, Talbot and Talbot 1994, Talbot et al. 1984, Talbot et al. 2006, Viereck et al. 1992, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818562#references
Description Author: K. Boggs
Version: 15 Oct 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ARKANSAS VALLEY PRAIRIE AND WOODLAND (CES202.312)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Herbaceous; Graminoid
Non-Diagnostic Classifiers: Lowland
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2415; ESLF 7128; ESP 1415

CONCEPT

Summary: This system of prairies and associated woodlands is found in the Arkansas River Valley region of Arkansas and adjacent Oklahoma. This region is distinctly bounded by the Boston Mountains to the north and the Ouachita Mountains to the south, although it has been considered part of the Ouachita Ecoregion. The valley is characterized by broad, level to gently rolling uplands derived from shales and is much less rugged and more heavily impacted by Arkansas River erosional processes than the adjacent mountainous regions. In addition, the valley receives annual precipitation total of 5-15 cm (2-6 inches) less than the surrounding regions due to a rainshadow produced by a combination of prevailing western winds and mountain orographic effects. The shale-derived soils associated with the prairies are thin and droughty. The combined effect of droughty soils, reduced precipitation, and prevailing level topography create conditions highly conducive to the ignition and spread of fires. Stands are typically dominated by *Andropogon gerardii, Sorghastrum nutans, Panicum virgatum*, and *Schizachyrium scoparium*. Some extant examples of this system remain, but most are small and isolated. They were common on the western edge of the region bordering or possibly included in the Crosstimbers and Southern Tallgrass Prairie where precipitation and agriculture conversion were lowest.
Classification Comments: There is little floristic and environmental overlap with the Grand Prairie and calcareous prairies of southern Arkansas. There may be stronger overlap with Southeastern Great Plains Tallgrass Prairie (CES205.685), and further review is needed to clarify the distinction between these two systems.
Similar Ecological Systems:
- Southeastern Great Plains Tallgrass Prairie (CES205.685)
- Texas Blackland Tallgrass Prairie (CES205.684)

Related Concepts:
- Eastern Redcedar: 46 (Eyre 1980) Finer
- Post Oak - Blackjack Oak: 40 (Eyre 1980) Finer
- Shortleaf Pine - Oak: 76 (Eyre 1980) Finer
- Shortleaf Pine: 75 (Eyre 1980) Finer
- White Oak - Black Oak - Northern Red Oak: 52 (Eyre 1980) Finer

DESCRIPTION

Environment: This region is distinctly bounded by the Boston Mountains to the north and the Ouachita Mountains to the south, although it has been considered part of the Ouachita Ecoregion (TNC Ecoregion 39). The valley is characterized by broad, level to gently rolling uplands derived from shales and is much less rugged and more heavily impacted by Arkansas River erosional processes than the adjacent mountainous regions. In addition, the valley receives annual precipitation total of 5-15 cm (2-6 inches) less than the surrounding regions due to a rainshadow produced by a combination of prevailing western winds and mountain orographic effects (T. Foti pers. comm. 2003). The shale-derived soils associated with the prairies are thin and droughty. The combined effect of droughty soils, reduced precipitation, and prevailing level topography create conditions highly conducive to the ignition and spread of fires. Some extant examples of this system remain, but most are small and isolated. They were common on the western edge of the Arkansas Valley region, bordering (or possibly included in) the Crosstimbers (TNC Ecoregion 32) where precipitation and agriculture conversion were lowest (T. Foti pers. comm. 2003). This western portion of the Arkansas Valley region is labeled as part of 231Gc by Cleland et al. (2005) and 37d, 37e by EPA (EPA 2013).
Vegetation: These prairies are typically dominated by *Schizachyrium scoparium, Andropogon gerardii, Sorghastrum nutans*, and *Panicum virgatum*. Other grasses include *Koeleria macrantha, Sporobolus heterolepis, Sphenopholis obtusata, Dichanthelium* spp., *Aristida purpurascens, Panicum brachyanthum*, and *Coelorachis cylindrica*. A rich forb diversity is commonly present and includes *Helianthus mollis, Echinacea pallida, Rudbeckia grandiflora, Silphium laciniatum, Symphyotrichum* spp., *Solidago* spp., *Callirhoe digitata, Asclepias hirtella, Eryngium yuccifolium, Delphinium carolinianum, Castilleja coccinea, Calopogon oklahomensis, Buchnera americana, Dodecatheon meadia, Tephrosia virginiana, Baptisia alba, Baptisia bracteata, Liatris pycnostachya*, and *Liatris squarrosa var. hirsuta*. Wetter areas support a rich diversity of rushes and sedges, including *Carex bicknellii var. opaca (= Carex opaca), Carex oklahomensis, Carex complanata*, and *Eleocharis wolfii* (T. Witsell pers. comm. 2006).
Dynamics: These prairies and woodlands were historically maintained by frequent fire. Drought cycles and grazing were also likely important ecosystem processes. Fires were frequent, primarily autumnal and of human origin. As *Quercus-Carya* regeneration becomes established, individuals of these species become largely fire-resistant with age. Surface fires within woodland and forest

types occurred every 12 to 15 years, reducing duff layers and allowing recruitment of young individuals of *Quercus* and *Carya* species (Landfire 2007a).

Component Associations:
- *Andropogon gerardii - Panicum virgatum - Helianthus grosseserratus* Herbaceous Vegetation (CEGL002024, G2G3)
- *Andropogon gerardii - Sorghastrum nutans* Unglaciated Herbaceous Vegetation (CEGL002204, G3)
- *Juncus (acuminatus, brachycarpus) - Panicum virgatum - Bidens aristosa - Hibiscus moscheutos ssp. lasiocarpos* Herbaceous Vegetation (CEGL004782, G2G3)
- *Pinus echinata - Quercus alba / Schizachyrium scoparium* Woodland (CEGL002394, G3G4)
- *Pinus echinata - Quercus stellata - Quercus marilandica / Schizachyrium scoparium* Woodland (CEGL002393, G2G3)
- *Pinus echinata / Schizachyrium scoparium - Solidago ulmifolia - Monarda russeliana - Echinacea pallida* Woodland (CEGL007815, G1G2)
- *Quercus alba - Quercus stellata - Quercus velutina / Schizachyrium scoparium* Woodland (CEGL002150, G2G3)
- *Quercus stellata - Quercus marilandica - Carya (glabra, texana) / Vaccinium arboreum* Forest (CEGL002075, G4)
- *Quercus stellata - Quercus marilandica - Quercus velutina - Carya texana / Schizachyrium scoparium* Woodland (CEGL002149, G2G3)
- *Schizachyrium scoparium - Bothriochloa laguroides ssp. torreyana - Croton willdenowii* Herbaceous Vegetation (CEGL008564, G1?)
- *Schizachyrium scoparium - Dichanthelium* spp. - *Buchnera americana - Echinacea pallida* Herbaceous Vegetation (CEGL007827, G2G3)

DISTRIBUTION

Range: This system occurs in the Arkansas River Valley region of Arkansas and adjacent Oklahoma.
Divisions: 202:C; 205:C
Nations: US
Subnations: AR, OK
Map Zones: 44:C
TNC Ecoregions: 32:C, 39:C

SOURCES

References: Cleland et al. 2005, Comer et al. 2003, DeSelm and Murdock 1993, Duffey et al. 1974, EPA 2005, Estes et al. 1979, Eyre 1980, Foti pers. comm., Landfire 2007a, McKinney and Lockwood 1999, Murdock pers. comm., Noss 2013, Taft 1997, Taft 2009, Taft et al. 1995, TNC 1996c, Wiens and Dyer 1975, Witsell pers. comm.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723184#references
Description Author: T. Foti and R. Evans, mod. T. Witsell and M. Pyne
Version: 14 Jan 2014 **Stakeholders:** Midwest, Southeast
Concept Author: T. Foti and R. Evans **ClassifResp:** Southeast

BLUEGRASS SAVANNA AND WOODLAND (CES202.888)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Herbaceous; Deep Soil; Very Short Disturbance Interval; Graminoid
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2413; ESLF 7126; ESP 1413

CONCEPT

Summary: This system represents deep soil savannas and woodlands of the Inner Bluegrass Basin of Kentucky (EPA Ecoregion 71l and "S. Fork Licking River arm" of EPA Ecoregion 71d). Only remnants or stands undergoing restoration are currently extant. The original woodland-savanna aspect, especially on drier uplands, is believed to have been dominated by fire-resistant oaks, especially *Quercus muehlenbergii* and *Quercus macrocarpa*, but also with a variety of other species such as *Fraxinus quadrangulata, Robinia pseudoacacia, Gleditsia triacanthos, Acer saccharum, Fraxinus americana, Fraxinus pennsylvanica, Carya cordiformis, Juglans nigra*, and the rare *Gymnocladus dioicus*. The understory is composed of cool-season grasses, as far as known (e.g., *Elymus, Dichanthelium*) with *Arundinaria gigantea* (extensive canebrakes). Settlers referred to a "buffalo grass" of unknown identity (possibly *Dichanthelium clandestinum* or *Dichanthelium scoparium*). The fire regime is unknown. Characteristic remnant trees (e.g., *Fraxinus quadrangulata, Quercus macrocarpa*) are fire-tolerant.
Classification Comments: This system may, in part, be related to mesic woodland variants of Central Interior Highlands Calcareous Glade and Barrens (CES202.691). The mesic barrens and woodlands in the Interior Low Plateau have all but disappeared from the landscape, making regional assessments difficult. For information elsewhere on mesic barrens/woodlands in the Interior Highlands, see description for *Quercus stellata - Quercus alba - (Quercus falcata) / Schizachyrium scoparium* Woodland (CEGL004217).
Similar Ecological Systems:
- Central Interior Highlands Calcareous Glade and Barrens (CES202.691)

Related Concepts:
- Bluegrass Mesophytic Cane Forest (Evans 1991) Finer
- Bluegrass Savanna-Woodland (Evans 1991) Finer
- Bur Oak: 42 (Eyre 1980) Finer

DESCRIPTION

Environment: These savannas or woodlands occur on deep fertile soils of the Inner Bluegrass Basin of Kentucky (Ecoregion 71l and "S. Fork Licking River arm" of Ecoregion 71d of EPA (EPA 2004) and Woods et al. (2002)).
Vegetation: The original woodland-savanna aspect, especially on drier uplands, is believed to have been dominated by fire-resistant oaks, especially *Quercus muehlenbergii* and *Quercus macrocarpa*, but also with a variety of other species such as *Fraxinus quadrangulata, Robinia pseudoacacia, Gleditsia triacanthos, Acer saccharum, Fraxinus americana, Fraxinus pennsylvanica, Carya cordiformis, Juglans nigra*, and the rare *Gymnocladus dioicus*. The understory is composed of cool-season grasses, as far as known (e.g., *Elymus, Dichanthelium*) with *Arundinaria gigantea* (extensive canebrakes). Settlers referred to a "buffalo grass" of unknown identity (possibly *Dichanthelium clandestinum* or Dichanthelium scoparium). Historical descriptions also mention "pea vine," two or three species of nettles, Vernonia species, Ageratina altissima, and *Trifolium stoloniferum*.
Dynamics: Central Kentucky grasslands were maintained by a combination of grazing, periodic drought, and fire, but one would expect that woody succession was also retarded by the heavy, clayey soils originating from the limestone substrate (Landfire 2007a). The first approximation map of presettlement fire regimes of the U.S. indicated fire regimes of 4-6 and 7-12 years in the model area (Frost 1998). Anthropogenic burning by Native Americans was probably an important part of the presettlement fire regime. This would have resulted in an expansion of these savannas and woodlands into otherwise forested areas. Native American population decline after the 1500s may have led to a decrease in the amount and frequency of burning in these savannas. Characteristic remnant trees (e.g., *Fraxinus quadrangulata*, *Quercus macrocarpa*) are fire-tolerant. Grazing by native herbivores (white-tailed deer and bison) may have been an important factor in maintaining the open character of these savannas.

In the gently rolling limestone regions, large expanses of land without significant firebreaks lie between the major firebreak streams. The large size of fire compartments in these areas suggests that fire frequency should have been high, perhaps 4-6 years where understory species were conducive to fire spread. Areas dominated by *Elymus* species may have experienced lower fire frequency because of the reduced capacity of this fuel type to carry fire (J. Campbell pers. comm.). Some writers think that these cool-season grasses (e.g., *Elymus*) predominated in preference to warm-season grasses such as *Schizachyrium*. In contrast, a fire frequency of 7-12 years could be expected in areas with broken topography such as the more rugged parts of the Outer Bluegrass and other limestone margin regions (Landfire 2007a). Lightning and Native Americans likely provided roughly equal influence as ignition sources in presettlement Kentucky, with Indian influence being the dominant factor locally near population concentrations and around fall and winter hunting camps. U.S. Weather Service lightning ground flash monitoring stations indicate a lightning strike density of 4-8 strikes per square kilometer per year in the limestone regions. While only a tiny fraction of strikes result in ignitions, this rate would

have produced a fire regime sufficient to support canebrakes and woodlands even in the absence of man (C. Frost pers. comm.).

Component Associations:
- *Acer (nigrum, saccharum) - Carya cordiformis* Forest (CEGL004411, G1)
- *Fraxinus quadrangulata - Quercus macrocarpa - Quercus muehlenbergii / Arundinaria gigantea ssp. gigantea / Elymus* spp. Woodland (CEGL004436, G1)
- *Fraxinus quadrangulata - Quercus macrocarpa / Arundinaria gigantea ssp. gigantea* Wooded Shrubland (CEGL003835, GH)
- *Juglans nigra - Aesculus glabra var. glabra - Gymnocladus dioicus / Arundinaria gigantea ssp. gigantea - (Asimina triloba)* Forest (CEGL004437, G1)

DISTRIBUTION

Range: This system is restricted to the Inner Bluegrass Basin of Kentucky (Ecoregion 71l and "S. Fork Licking River arm" of Ecoregion 71d of EPA (2004) and Woods et al. (2002)). Only remnants or stands undergoing restoration are currently extant.
Divisions: 202:C
Nations: US
Subnations: KY
Map Zones: 47:C
USFS Ecomap Regions: 223F:CC
TNC Ecoregions: 44:C

SOURCES

References: Braun 1950, Bryant et al. 1980, Campbell pers. comm., Comer et al. 2003, DeSelm and Murdock 1993, Duffey et al. 1974, EPA 2004, Estes et al. 1979, Evans 1991, Eyre 1980, Frost 1998, Frost pers. comm., Landfire 2007a, McEwan and McCarthy 2008, McHargue 1941, McInteer 1952, McKinney and Lockwood 1999, Murdock pers. comm., Noss 2013, Taft 1997, Taft 2009, Taft et al. 1995, TNC 1996c, Wiens and Dyer 1975, Woods et al. 2002
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722790#references
Description Author: M. Pyne and R. Evans
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: M. Pyne and R. Evans **ClassifResp:** Southeast

BOREAL ALPINE FESCUE DWARF-SHRUBLAND AND GRASSLAND (CES105.320)

CLASSIFIERS

Classification Status: Standard

Primary Division: Montane Boreal (105)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Alpine/AltiAndino; Boreal
National Mapping Codes: ESLF 7184

CONCEPT

Summary: This ecological system encompasses alpine grasslands and dwarf-shrubs characterized by *Festuca altaica* common in the Skeena and Ominega mountains.
Classification Comments: This system was developed for the purpose of capturing the coarse filter of terrestrial biodiversity in the interior of British Columbia Ecoregional Assessment, conducted by The Nature Conservancy of Canada, with NatureServe's assistance. The system was designed to be equivalent to those developed for neighboring ecoregions: Canadian Rocky Mountains (7), Okanagan (68), Alaska Coastal Forest and Mountains (69), and the North Cascades (3).
Related Concepts:
- no data (BAFAunp/) (BCMF 2006) Intersecting

DISTRIBUTION

Range: This ecological system is found in northern boreal British Columbia and fingers down into the interior regions of British Columbia.
Divisions: 105:C; 207:C
Nations: CA
Subnations: BC
TNC Ecoregions: 139:C, 144:C

SOURCES

References: BCMF 2006, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.820923#references
Description Author: G. Kittel
Version: 25 Jan 2009 **Stakeholders:** Canada, West
Concept Author: G. Kittel **ClassifResp:** West

CALIFORNIA CENTRAL VALLEY AND SOUTHERN COASTAL GRASSLAND (CES206.942)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Herbaceous; Valley; Toeslope/Valley Bottom; Mediterranean [Mediterranean Xeric-Oceanic]; Eutrophic Soil; Clay Soil Texture; F-Landscape/Low Intensity; Graminoid; Nassella pulchra
Non-Diagnostic Classifiers: Lowland [Foothill]; Lowland [Lowland]; Plateau; Woody-Herbaceous; Valley bottom; Valley floor; Valley side; Alluvial plain; Deep Soil; Mineral: W/ A-Horizon >10 cm; Udic; Short Disturbance Interval; Coastal plain
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2129; ESLF 7101; ESP 1129

CONCEPT

Summary: This system is found from 10-1200 m (30-3600 feet) elevation, in the Great Central Valley and along the southern coastal regions of California. It receives on average 50 cm (range 25-100 cm) of precipitation per year, mainly as winter rain. It is found with fine-textured soils, moist or even waterlogged in winter, but very dry in summer. Historically, these grasslands were common among oak savanna and woodland and probably experienced similar frequent fire regimes. Characteristic plant species include *Nassella pulchra, Aristida* spp., *Achillea millefolium var. borealis (= Achillea borealis), Achyrachaena mollis, Agoseris heterophylla, Bloomeria crocea, Triteleia ixioides (= Brodiaea lutea), Chlorogalum pomeridianum, Clarkia purpurea, Dodecatheon jeffreyi, Elymus glaucus, Leymus triticoides, Festuca californica, Melica californica, Castilleja attenuata (= Orthocarpus attenuatus),* and *Poa secunda (= Poa scabrella).*
Related Concepts:
- Coastal Prairie (214) (Shiflet 1994) Broader. Only small portions of this systems correspond to this SRM type (coastal grasslands between San Francisco Bay and Monterey).
- Valley Grassland (215) (Shiflet 1994) Intersecting. The SRM Valley grassland is described as predominantly annual grasslands and vernal pool communities.

DESCRIPTION

Environment: This ecosystem occurs from 10 to 1200 m (30-3600 feet) in elevation; receiving on average 50 cm (range 25-100 cm) of precipitation per year, mainly as winter rain. It is found with deep fine-textured soils, moist or even waterlogged in winter, but very dry in summer (Sawyer et al. 2009).
Dynamics: These grasslands have evolved to survive fire and long seasonal droughts (Keeley 2006). Invasion of non-native annual grasses out-compete natives through prolific seed production and the ability to re-seed quickly after fires, which generally means they maintain themselves at the expense of the native grasses and forbs (Sawyer et al. 2009).

DISTRIBUTION

Range: Found from in California from 10-1200 m (30-3600 feet) elevation, in the Great Central Valley and along the southern coastal region.
Divisions: 206:C
Nations: US
Subnations: CA
Map Zones: 4:C, 5:C
USFS Ecomap Regions: 261B:CC, 262A:CC, M261C:??
TNC Ecoregions: 13:C, 15:P, 16:P

SOURCES

References: Barbour and Billings 2000, Barbour and Major 1988, Bartolome et al. 2007, Comer et al. 2003, Holland and Keil 1995, Keeler-Wolf pers. comm., Keeley 2006, PRBO Conservation Science 2011, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Shiflet 1994, Stromberg et al. 2007
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722739#references
Description Author: P. Comer and T. Keeler-Wolf, mod. G. Kittel
Version: 14 Jan 2014 **Stakeholders:** West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

CALIFORNIA MESIC SERPENTINE GRASSLAND (CES206.943)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Herbaceous; Mediterranean [Mediterranean Xeric-Oceanic]; Ultramafic with low Ca:Mg ratio; Deep Soil; Udic; Calamagrostis ophitidis
Non-Diagnostic Classifiers: Montane [Lower Montane]; Lowland [Foothill]; Lowland [Lowland]; Woody-Herbaceous; Serpentine
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2130; ESLF 7102; ESP 1130

CONCEPT

Summary: These grasslands are of very limited distribution in California within the Coast Ranges, Sierra Nevada, and Transverse Ranges on deep soils with serpentine-rich parent material. Not all serpentinite outcrops support distinct vegetation; only those with very low Ca:Mg ratios impact biotic composition. In this system, native bunchgrass dominates, though typically in less dense cover than other perennial bunchgrass types. Characteristic species include *Calamagrostis ophitidis*, *Eschscholzia californica*, *Vulpia microstachys var. ciliata (= Festuca grayi)*, *Poa secunda (= Poa scabrella)*, *Hemizonia congesta ssp. luzulifolia (= Hemizonia luzulifolia)*, *Nassella cernua*, and *Nassella pulchra*. Historic fire regimes in this system are not well known.
Related Concepts:
- Valley Grassland (215) (Shiflet 1994) Intersecting

DESCRIPTION

Environment: This ecosystem occurs on deep soils with serpentine-rich parent material. Not all serpentinite outcrops support distinct vegetation; only those with very low Ca:Mg ratios impact biotic composition.
Dynamics: Serpentine soils are relatively infertile soils and mycorrhizal relationships are considered important to plant survival (Jimerson et al. 1995). Hopkins 1986 (as cited in Jimerson et al. 1995) found that 98% of the herbaceous plants in the serpentine grassland communities of the Santa Cruz Mountains were mycorrhizal. Ectomycorrhizae are often associated with members of the Ericaceae family, a well-represented family in the serpentine flora (Jimerson et al. 1995).

DISTRIBUTION

Range: This system is found in the Coast Ranges, Sierra Nevada, and Transverse Ranges of California on deep soils with serpentine-rich parent material. It may also occur on serpentine in the Klamath Mountains of southern Oregon.
Divisions: 206:C
Nations: US
Subnations: CA
Map Zones: 1:?, 2:?, 3:C, 4:C, 6:C, 7:P
USFS Ecomap Regions: 261B:??, 263A:??, M261A:CP, M261B:CC, M261C:CP, M261E:CC, M261F:C?
TNC Ecoregions: 5:C, 12:C, 14:C, 15:P

SOURCES

References: Barbour and Major 1988, CNRA 2009, Comer et al. 2003, Evens and San 2004, Faber-Langendoen et al. 2008b, Holland and Keil 1995, Jimerson et al. 1995, Keeler-Wolf pers. comm., Kruckberg 1984, PRBO Conservation Science 2011, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Shiflet 1994, Weiss 1999, WNHP 2011
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722738#references
Description Author: P. Comer and T. Keeler-Wolf, mod. G. Kittel
Version: 14 Jan 2014 **Stakeholders:** West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

CALIFORNIA NORTHERN COASTAL GRASSLAND (CES206.941)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland [Lowland]; Herbaceous; Terrace; Mediterranean [Mediterranean Xeric-Oceanic]; Very Short Disturbance Interval [Periodicity/Nonrandom Disturbance]; F-Patch/Low Intensity; Graminoid
Non-Diagnostic Classifiers: Hillslope bedrock outcrop; Woody-Herbaceous
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2131; ESLF 7103; ESP 1131

CONCEPT

Summary: This ecological system is found in discontinuous patches below 300 m (1000 feet) elevation from San Francisco Bay north into Oregon, on coastal terraces and ridgeline balds in the Coast Ranges and Klamath Mountains. Small patches have been documented as far south as Santa Barbara and San Luis Obispo counties. It has a similar distribution to coastal shrublands (Northern California Coastal Scrub (CES206.932)) in areas that receive more rainfall than other California grasslands of the interior or southern coastal California. In recent centuries, these were fire-dominated systems, and there is a known history of Native American use of fire in these areas. While still present, annual grasses and forbs are not as prevalent in these grasslands as elsewhere in California. With fire suppression, *Baccharis pilularis* and other shrub components of north coastal scrub often invade and can replace these grasslands with scrub-dominated systems. *Agrostis* spp., *Bromus carinatus, Calamagrostis nutkaensis, Danthonia californica, Festuca rubra, Festuca idahoensis, Deschampsia caespitosa, Koeleria macrantha, Trisetum canescens*, and perennial forbs such as *Iris douglasiana, Sisyrinchium bellum, Grindelia hirsutula*, and *Sanicula arctopoides* are characteristic.
Similar Ecological Systems:
- North Pacific Hypermaritime Shrub and Herbaceous Headland (CES204.088)

Related Concepts:
- Coastal Prairie (214) (Shiflet 1994) Broader. Most of the SRM Coastal Prairie type corresponds to this system.

DESCRIPTION

Environment: This ecosystem occurs on coastal terraces and ridgeline balds in the Coast Ranges in small patches in areas that receive more rainfall than the Central Valley grasslands or those of southern coastal California (south of Santa Barbara County), and wherever the cooling influence of the Pacific Ocean moderates summer drought (Ford and Hayes 2007). Soils are rich and moist, on terraces on the coast line and balds on inland ridges and hilltops (Sawyer et al. 2009).
Dynamics: Coastal prairies are maintained by salt spray that limits woody growth, and burning, likely annual ignitions by Native Americans (Stuart and Stephens 2006). Historical frequent fire, salt-laden wind, and windy ridgetops inhibit forest development in these areas (Franklin and Dyrness 1973, as cited in Sawyer et al. 2009). Fire is a useful management tool for control of non-native invasive species (Sawyer et al. 2009).

Component Associations:
- *Calamagrostis nutkaensis - Carex* spp. - *Juncus* spp. Herbaceous Vegetation (CEGL003378, G2)
- *Calamagrostis nutkaensis - Elymus glaucus* Herbaceous Vegetation (CEGL001564, G2)
- *Danthonia californica - Aira caryophyllea* Herbaceous Vegetation (CEGL003474, G3)
- *Danthonia californica - Festuca rubra* Herbaceous Vegetation (CEGL001597, G2)
- *Deschampsia caespitosa - Danthonia californica* Coastal Herbaceous Vegetation (CEGL003325, G2)
- *Empetrum nigrum - Gaultheria shallon* Dwarf-shrubland (CEGL000971, G2)

DISTRIBUTION

Range: This system is found below 300 m (1000 feet) elevation from San Francisco Bay (and possibly farther south) north into Oregon, on coastal terraces and ridgeline balds in the Coast Ranges and Klamath Mountains.
Divisions: 206:C
Nations: US
Subnations: CA, OR
Map Zones: 2:C, 3:C, 4:C
USFS Ecomap Regions: 263A:CC, M261A:CC, M261B:CC
TNC Ecoregions: 5:C, 14:C

SOURCES

References: Barbour and Billings 2000, Barbour and Major 1988, Barbour et al. 2007, Comer et al. 2003, Ford and Hayes 2007, Franklin and Dyrness 1973, Holland and Keil 1995, PRBO Conservation Science 2011, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Shiflet 1994, Stuart and Stephens 2006
Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722740#references
Description Author: P. Comer and T. Keeler-Wolf, mod. G. Kittel
Version: 14 Jan 2014 **Stakeholders:** West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

CENTRAL MIXEDGRASS PRAIRIE (CES303.659)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Western Great Plains (303)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Non-Diagnostic Classifiers: Lowland [Lowland]; Herbaceous; Temperate [Temperate Continental]; Shallow Soil; Loam Soil Texture; Silt Soil Texture; Ustic; F-Landscape/Medium Intensity; G-Landscape/High Intensity; Graminoid
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2132; ESLF 7104; ESP 1132

CONCEPT

Summary: This mixedgrass prairie system ranges from South Dakota into the Rolling Plains and the western Edwards Plateau of Texas. It is bordered by the shortgrass prairie on its western edge and the tallgrass prairie to the east. The loessal regions in west-central Kansas and central Nebraska, the Red Hills region of south-central Kansas and northern Oklahoma are all located within this system. Because of its proximity to other ecoregions, this system contains elements from both shortgrass and tallgrass prairies, which combine to form the mixedgrass prairie ecological system throughout its range. The distribution, species richness and productivity of plant species within the mixedgrass ecological system is controlled primarily by environmental conditions, in particular soil moisture and topography. Grazing and fire are important dynamic processes in this system. The relative dominance of the various grass and forb species within different associations in the system also can strongly depend on the degree of natural or human disturbance. This system can contain grass species such as *Bouteloua curtipendula, Schizachyrium scoparium, Andropogon gerardii, Hesperostipa comata, Sporobolus heterolepis*, and *Bouteloua gracilis*, although the majority of the associations within the region are dominated by *Pascopyrum smithii* or *Schizachyrium scoparium*. Numerous forb and sedge species (*Carex* spp.) can also occur within the mixedgrass system in the Western Great Plains. Although forbs do not always significantly contribute to the canopy, they can be very important. Some dominant forb species include *Ambrosia psilostachya, Echinacea angustifolia*, and *Lygodesmia juncea*. Oak species such as *Quercus macrocarpa* can occur also in areas protected from fire due to topographic position. This can cause an almost oak savanna situation in certain areas, although fire suppression may allow for a more closed canopy and expansion of bur oak beyond those sheltered areas. In those situations, further information will be needed to determine if those larger areas with a more closed canopy of bur oak should be considered part of Western Great Plains Dry Bur Oak Forest and Woodland (CES303.667). Likewise, within the mixedgrass system, small seeps may occur, especially during the wettest years. Although these are not considered a separate system, the suppression of fire within the region has enabled the invasion of both exotics and some shrub species such as *Juniperus virginiana* and also allowed for the establishment of *Pinus ponderosa* in some northern areas.
Classification Comments: This system is found primarily in the Central Mixed-grass Prairie (TNC Ecoregion 33); it becomes more restricted to mesic lowlands sites to the west and southwest in the shortgrass prairie region of Texas (S. Menard pers. comm. 2005). This is probably a reference to the Llano Estacado region rather than the Southern Shortgrass Prairie (TNC Ecoregion 28) (J. Teague pers. obs. 2005). The Central Mixed-grass Prairie (TNC Ecoregion 33) should be extended south to include the Rolling Plains of Texas; being separated from the Southern Shortgrass Prairie (TNC Ecoregion 28) by the Caprock Escarpment (L. Elliott pers. comm. 2005).
Similar Ecological Systems:
- Northwestern Great Plains Mixedgrass Prairie (CES303.674)
- Western Great Plains Dry Bur Oak Forest and Woodland (CES303.667)
- Western Great Plains Mesquite Woodland and Shrubland (CES303.668)
- Western Great Plains Sand Prairie (CES303.670)

Related Concepts:
- Blue Grama - Western Wheatgrass (704) (Shiflet 1994) Finer
- Bluestem - Grama (709) (Shiflet 1994) Broader
- Bluestem - Grama Prairie (604) (Shiflet 1994) Finer
- Central Mixed-Grass Prairie (Rolfsmeier and Steinauer 2010) Equivalent
- Eastern Redcedar: 46 (Eyre 1980) Finer. Only on really degraded sites.
- Rolling Plains: Mixedgrass Prairie (307) [CES303.659.9] (Elliott 2011) Equivalent

DESCRIPTION

Environment: Differences in topography and soil characteristics occur across the range of this system. It is often characterized by gently rolling to extremely hilly landscapes with soils developed from loess, shale, limestone or sandstone parent material, including Pennsylvanian formations of the Red Rolling Plains (Elliott 2011). Mollisol soils are most prevalent and range from silt loams and silty clay loams with sandy loams possible on the western edge of the range. The Red Hills region of Kansas and Oklahoma, which contains examples of this system, contains somewhat unique soil characteristics and has developed from a diversity of sources including red shale, red clay, sandy shale, siltstone, or sandstone. These soils have developed a characteristic reddish color from the primary material. These soils can consist of silt, loam, clay loam, or clay and can have textures ranging from a fine sandy loam to a

more clayey surface. Ecological Sites include Clay Slopes, Loamy Prairie, Clayey Upland, Claypan Prairie, Sandy Loam, and Clay Loam (Elliott 2011).

Vegetation: This system contains elements from both Western Great Plains Shortgrass Prairie (CES303.672) and Western Great Plains Tallgrass Prairie (CES303.673). This system typically contains grass species such as *Bouteloua curtipendula, Schizachyrium scoparium, Andropogon gerardii, Hesperostipa comata, Sporobolus heterolepis,* and *Bouteloua gracilis*, although the majority of the associations within the region are dominated by *Pascopyrum smithii* or *Schizachyrium scoparium.* Isolated patches of *Quercus macrocarpa* also can occur. Central Mixedgrass Prairie (CES303.659) represents the common prairie type in the Rolling Plains of Texas (Elliott 2011). This prairie often has *Schizachyrium scoparium* as a dominant, with *Bouteloua curtipendula, Bouteloua hirsuta, Bouteloua gracilis, Buchloe dactyloides, Andropogon gerardii, Pascopyrum smithii,* and *Nassella leucotricha* also commonly encountered. Grazing tends to favor shortgrass species such as *Buchloe dactyloides* and *Bouteloua gracilis.* This system is frequently invaded by juniper (primarily *Juniperus pinchotii*) and *Prosopis glandulosa* (Elliott 2011).

Dynamics: Fire, grazing, and drought are the primary processes occurring within the system. The diversity in this mixedgrass system likely reflects both the short- and long-term responses of the vegetation to these often concurrent disturbance regimes (Collins and Barber 1985). Fire is not as common as in more fertile, well-watered tallgrass prairies further east but is still important. Fire-return intervals have been estimated at 15-25 years (Landfire 2007a), but fires burn patchily across the landscape, consuming vegetation in some areas and missing others. This combined with the differential responses of species to burning results in greater diversity across the landscape (Wright 1974). Grazing by native ungulates, primarily bison (*Bison bison*) and small mammals, principally prairie dogs (*Cynomys* spp.) added a further degree of patchy disturbance to the mixedgrass prairie (Whicker and Detling 1988, Weltzin et al. 1997). Long-term precipitation variance affects diversity of the mixedgrass prairie, creating conditions more favorable to shortgrass species during droughts while allowing mixedgrass species to spread during wetter years (Albertson and Tomanek 1965).

Component Associations:

- *Artemisia tridentata ssp. wyomingensis* / Mixed Grasses Shrub Herbaceous Vegetation (CEGL001534, G5)
- *Bouteloua gracilis - Buchloe dactyloides* Herbaceous Vegetation (CEGL001756, G4)
- *Hesperostipa comata - Bouteloua gracilis - Carex filifolia* Herbaceous Vegetation (CEGL002037, G5)
- *Hesperostipa comata - Carex inops ssp. heliophila* Herbaceous Vegetation (CEGL001701, G4)
- *Hesperostipa curtiseta - Elymus lanceolatus* Herbaceous Vegetation (CEGL002253, GNR)
- *Hilaria belangeri - Bouteloua curtipendula* Herbaceous Vegetation (CEGL002238, G3?)
- *Juniperus virginiana var. virginiana / Schizachyrium scoparium - Bouteloua curtipendula* Great Plains Herbaceous Vegetation (CEGL004066, G2)
- *Krascheninnikovia lanata / Bouteloua gracilis* Dwarf-shrub Herbaceous Vegetation (CEGL001321, G4)
- *Panicum obtusum - Buchloe dactyloides* Herbaceous Vegetation (CEGL001573, GNRQ)
- *Pascopyrum smithii - Bouteloua gracilis* Herbaceous Vegetation (CEGL001578, G5)
- *Pascopyrum smithii - Hesperostipa comata* Central Mixedgrass Herbaceous Vegetation (CEGL002034, G4)
- *Pascopyrum smithii* Herbaceous Vegetation (CEGL001577, G3G5Q)
- *Pleuraphis mutica - Buchloe dactyloides* Herbaceous Vegetation (CEGL002272, G4?)
- *Quercus macrocarpa* / Mixedgrass Loam Wooded Herbaceous Vegetation (CEGL002163, G1Q)
- *Quercus macrocarpa* / Mixedgrass Sand Wooded Herbaceous Vegetation (CEGL002162, G1)
- *Quercus macrocarpa* / Mixedgrass Shale Wooded Herbaceous Vegetation (CEGL002164, G1Q)
- *Sarcobatus vermiculatus / Sporobolus airoides* Shrubland (CEGL001368, G3?)
- *Schizachyrium scoparium - (Sorghastrum nutans) - Sporobolus compositus var. compositus - Liatris mucronata* Herbaceous Vegetation (CEGL004211, GNR)
- *Schizachyrium scoparium - Bouteloua (curtipendula, gracilis) - Carex filifolia* Herbaceous Vegetation (CEGL001681, G3G4)
- *Schizachyrium scoparium - Bouteloua curtipendula - Bouteloua gracilis* Central Plains Herbaceous Vegetation (CEGL002246, G2G4)
- *Schizachyrium scoparium - Bouteloua curtipendula - Nassella leucotricha* Herbaceous Vegetation (CEGL004070, GNR)
- *Schizachyrium scoparium - Bouteloua curtipendula* Chalkflat Herbaceous Vegetation (CEGL002247, G2)
- *Schizachyrium scoparium - Bouteloua curtipendula* Loess Mixedgrass Herbaceous Vegetation (CEGL002036, G3?)
- *Schizachyrium scoparium - Bouteloua curtipendula* Western Great Plains Herbaceous Vegetation (CEGL001594, G3)
- *Schizachyrium scoparium - Lesquerella gordonii - Castilleja purpurea var. citrina* Herbaceous Vegetation (CEGL002252, G2?)
- *Yucca glauca / Calamovilfa longifolia* Shrub Herbaceous Vegetation (CEGL002675, G4)

DISTRIBUTION

Range: This system is found throughout the central and southern areas of the western Great Plains ranging from southern South Dakota into the Rolling Plains and western Edwards Plateau of Texas.

Divisions: 205:C; 303:C

Nations: US

Subnations: CO, KS, ND, NE, OK, SD, TX

Map Zones: 27:P, 30:C, 31:C, 32:C, 33:C, 34:C, 35:C, 38:C, 39:P, 43:P

USFS Ecomap Regions: 223A:??, 251A:CP, 251B:CC, 251E:CP, 251F:CC, 251G:CC, 251H:CC, 255A:??, 315F:CC, 331B:CC, 331C:CC, 331E:CC, 331F:CC, 331H:CC, 331I:CC, 331M:CP, 332B:CC, 332C:CC, 332D:CC, 332E:CC, 332F:CC

TNC Ecoregions: 27:P, 28:P, 29:C, 32:C, 33:C, 36:C, 37:P

SOURCES

References: Albertson and Tomanek 1965, Barbour and Billings 1988, Branson and Weaver 1953, Collins and Barber 1986, Comer et al. 2003, Elliott 2011, Eyre 1980, Landfire 2007a, Ricketts et al. 1999, Rolfsmeier and Steinauer 2010, Shiflet 1994, Weaver and Albertson 1956, Weaver and Bruner 1948, Weltzin et al. 1997, Whicker and Detling 1988, Wright 1974

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722999#references

Description Author: S. Menard and K. Kindscher, mod. L. Elliott and J. Drake

Version: 14 Jan 2014 **Stakeholders:** Midwest, Southeast, West

Concept Author: S. Menard and K. Kindscher **ClassifResp:** Midwest

CENTRAL TALLGRASS PRAIRIE (CES205.683)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Eastern Great Plains (205)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Non-Diagnostic Classifiers: Glaciated plains; Herbaceous; Temperate; Glaciated; Deep Soil; Loam Soil Texture
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2421; ESLF 7134; ESP 1421

CONCEPT

Summary: This system is found primarily in the Central Tallgrass Prairie ecoregion ranging from eastern Kansas and Nebraska to northwestern Indiana. This system differs from other prairie systems to the north and south by being the most mesic with primarily deep, rich Mollisol soils. These soils are usually greater than 1 meter deep. This system is dominated by tallgrass species such as *Andropogon gerardii*, *Sorghastrum nutans*, and *Panicum virgatum*. These species typically grow to 1-2 m tall in the rich soils found in this system. Other mid- and shortgrass species, such as *Bouteloua curtipendula*, *Hesperostipa spartea*, and *Schizachyrium scoparium*, are usually present and can be common or locally dominant on patches of this system, particularly slopes or other areas with drier habitats. Several forb species are also associated with this system making it one of the most diverse grassland systems. As many as 300 herbaceous plant species could occur in this system across its range. The environment and habitat of this system do not prevent invasion by shrubs and trees. High-quality examples of this system have trees and shrubs widely scattered or clustered in areas that are wetter and/or more sheltered from fire than the surrounding grassland. Fire, drought, and grazing are the primary natural dynamics influencing this system and help prevent woody species from invading. However, conversion to agriculture has been the prime disturbance since post-European settlement. The rich soils and long growing season make this an ideal location for farming row crops, and as a result very few examples of this system remain.

Similar Ecological Systems:
- Northern Tallgrass Prairie (CES205.686)
- Southeastern Great Plains Tallgrass Prairie (CES205.685)
- Texas Blackland Tallgrass Prairie (CES205.684)

Related Concepts:
- Central Tall-Grass Prairie (Rolfsmeier and Steinauer 2010) Equivalent

DESCRIPTION

Environment: This system differs from other prairie systems to the north and south by being the most mesic with primarily deep, rich Mollisol soils. These soils are usually greater than 1 m deep and organic matter is high. Litter can build up if sites are not burned or grazed for several years. This system occurs in a climate that allows the growth of trees and shrubs. These are kept out of the prairies largely by fires and periodic drought, so the prairies tended to be on flat to rolling topography with fewer firebreaks (wetlands, rivers, or steeply dissected topography).

Vegetation: This system is dominated by tallgrass species such as *Andropogon gerardii*, *Sorghastrum nutans*, and *Panicum virgatum*. These species typically grow to 1-2 m tall in the rich soils found in this system. Other mid- and shortgrass species, such as *Bouteloua curtipendula*, *Hesperostipa spartea*, and *Schizachyrium scoparium*, are usually present and can be common or locally dominant on patches of this system, particularly slopes or other areas with drier habitats. Several forb species are also associated with this system making it one of the most diverse grassland systems. As many as 300 herbaceous plant species could occur in this system across its range. The environment and habitat of this system do not prevent invasion by shrubs and trees. High-quality examples of this system have trees and shrubs widely scattered or clustered in areas that are wetter and/or more sheltered from fire than the surrounding grassland.

Dynamics: Fire, drought, and grazing are the primary natural dynamics influencing this system and help prevent woody species from invading. This system is found in a climate that can support trees and shrubs but woody vegetation is inhibited by frequent fires. Historically, fire-return intervals were short, estimated at between 2 and 5 years (Stambaugh et al. 2006, Landfire 2007a). The frequent but unpredictable fires created a patchwork of habitats across the landscape, with recently burned sites having less litter and forb cover and sites with infrequent fires possibly having more woody species and dense stands of grasses (Kucera and Koelling 1964). This system developed in an area with large numbers of native ungulates, notably bison (*Bison bison*) but including other species, and the grazing of these species affected species composition and the patchwork of habitat. Bison were likely more numerous and thus had more effect in the western portion of this system's range. Bison preferentially favor newly burned areas and graminoids over forbs (Vinton et al. 1993, Coppedge and Shaw 1998). Their grazing, trampling, and wallowing were important in creating habitat diversity across the landscape (Knapp et al. 1999). On unburned sites, grazing removes live and dead vegetation, allowing more light and heat to the soil surface and increasing available moisture thus favoring species, forbs or woody plants, in the case of bison grazing, that were resilient to the effects of grazing or avoided by the grazers (Damoureyeh and Hartnett 1997).

Component Associations:
- *Andropogon gerardii - Panicum virgatum - Helianthus grosseserratus* Herbaceous Vegetation (CEGL002024, G2G3)

- *Andropogon gerardii - Panicum virgatum - Schizachyrium scoparium - (Tradescantia tharpii)* Herbaceous Vegetation (CEGL005231, G3?)
- *Andropogon gerardii - Sorghastrum nutans - (Sporobolus heterolepis) - Liatris* spp. - *Ratibida pinnata* Herbaceous Vegetation (CEGL002203, G1G2)
- *Andropogon gerardii - Sorghastrum nutans - Hesperostipa spartea* Loess Hills Herbaceous Vegetation (CEGL002025, G2)
- *Schizachyrium scoparium - Bouteloua curtipendula - Agrostis hyemalis - Eleocharis* spp. Hardpan Herbaceous Vegetation (CEGL002249, G2?)
- *Schizachyrium scoparium - Bouteloua curtipendula - Bouteloua hirsuta - (Yucca glauca)* Herbaceous Vegetation (CEGL002035, G2)
- *Schizachyrium scoparium - Sorghastrum nutans - Bouteloua curtipendula* Herbaceous Vegetation (CEGL002214, G2G3)
- *Schizachyrium scoparium - Sorghastrum nutans - Bouteloua curtipendula* Hill Herbaceous Vegetation (CEGL005183, G2)
- *Schizachyrium scoparium - Sorghastrum nutans - Clinopodium arkansanum* Alkaline Herbaceous Vegetation (CEGL005179, G2)

DISTRIBUTION

Range: This system is found primarily in the Central Tallgrass Prairie (TNC Ecoregion 36) ranging from eastern Kansas and Nebraska to north-central Missouri and northwestern Indiana. In Missouri, it is attributed to EPA 47d, 47f, 72f.
Divisions: 205:C
Nations: US
Subnations: IA, IL, IN, KS, MO, NE, WI
Map Zones: 31:?, 38:C, 39:?, 42:C, 43:C, 44:P, 49:C, 50:C, 51:C, 52:C
USFS Ecomap Regions: 222Je:CC?, 222Jg:CC?, 222Jh:CCC, 222K:CC, 223A:CC, 251B:CC, 251C:CC, 251F:CC, 251G:CC, 251H:CC, 255A:CC, 332C:CC, 332D:CC, 332E:CC, 332F:CC
TNC Ecoregions: 36:C, 45:C, 46:C

SOURCES

References: Barbour and Billings 1988, Comer et al. 2003, Coppedge and Shaw 1998, Damoureyeh and Hartnett 1997, Heineman and Bragg 1982, Hulbert 1988, Kindscher and Tieszen 1998, Knapp et al. 1999, Kucera and Koelling 1964, Landfire 2007a, Rice and Parenti 1978, Ricketts et al. 1999, Rolfsmeier and Steinauer 2010, Samson and Knopf 1994, Stambaugh et al. 2006, Vinton et al. 1993
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722976#references
Description Author: S. Menard, mod. J. Drake
Version: 14 Jan 2014 **Stakeholders:** Midwest, Southeast
Concept Author: S. Menard **ClassifResp:** Midwest

CHIHUAHUAN LOAMY PLAINS DESERT GRASSLAND (CES302.061)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Warm Desert (302)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland; Plain; Valley; Alluvial flat
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2503; ESLF 7164; ESP 1503

CONCEPT

Summary: This ecological system occurs in the northern Chihuahuan Desert and extends into limited areas of the southern Great Plains on alluvial flats, loamy plains, and basins sometimes extending up into lower piedmont slopes. Sites are typically flat or gently sloping so precipitation does not run off and may be somewhat mesic if they receive runoff from adjacent areas, but these are not wetlands or mesic, bottomland grassland. Soils are non-saline, finer textured loams or clay loam. Vegetation is characterized by perennial grasses and is typically dominated by *Pleuraphis mutica* or with *Bouteloua eriopoda* codominant (more historically) or *Bouteloua gracilis*. In degraded stands, *Scleropogon brevifolius, Dasyochloa pulchella (= Erioneuron pulchellum)*, or *Aristida* spp. may codominate. *Pleuraphis jamesii* may become important in northern stands and *Bouteloua gracilis* in the Great Plains and on degraded stands. If present, mesic graminoids such as *Pascopyrum smithii, Panicum obtusum*, *Sporobolus airoides*, and *Sporobolus wrightii* typically have low cover and are restricted to drainages and moist depressions (inclusions). Scattered shrubs such as *Ephedra torreyana, Flourensia cernua, Gutierrezia sarothrae, Larrea tridentata, Opuntia imbricata, Prosopis glandulosa*, and *Yucca* spp. may be present, especially on degraded sites.
Classification Comments: NRCS Ecological Site Description MLRA 42 SD-2 Loamy Ecological Site (NRCS 2006) describes this system on the Jornada Experimental Range with State-and-Transition Model showing shifts in species composition with land use. Degraded stands often have scattered desert scrubs such as *Larrea tridentata, Flourensia cernua,* and *Prosopis glandulosa* present.

This upland grassland is similar to the bottomland/depressional wetland system Chihuahuan-Sonoran Desert Bottomland and Swale Grassland (CES302.746) and grades into Apacherian-Chihuahuan Semi-Desert Grassland and Steppe (CES302.735) in the foothills and piedmont desert grasslands. In similar loamy plains land positions in the Great Plains, *Bouteloua gracilis, Buchloe dactyloides*, or *Pleuraphis jamesii* are dominant grasses in Western Great Plains Shortgrass Prairie (CES303.672).

Similar Ecological Systems:
- Chihuahuan-Sonoran Desert Bottomland and Swale Grassland (CES302.746)

Related Concepts:
- MLRA 42 - Southern Desertic Basin (SD-1) Loamy (NRCS 2006a) Broader
- MLRA 42 - Southern Desertic Basin (SD-2) Loamy (NRCS 2006a) Broader
- MLRA 42 - Southern Desertic Basin (SD-3) Loamy (NRCS 2006a) Broader

DESCRIPTION

Environment: These upland grasslands occur at approximately 1450-2320 m (4750-7610 feet) elevation and are found on alluvial flats, loamy plains, and desert basins sometimes extending up into lower piedmont slopes including mesatops. Sites are typically flat or gently sloping so precipitation does not run off and may be somewhat mesic if they receive runoff from adjacent areas, but these are not wetlands or bottomland grasslands described in Chihuahuan-Sonoran Desert Bottomland and Swale Grassland (CES302.746). Annual precipitation is usually from 20-40cm (7.9-15.7 inches). Soils are non-saline, finer-textured loams or clay loam that are often derived from sedimentary parent materials but are quite variable and may include fine-textured soils derived from igneous and metamorphic rocks. These grasslands can occur on a variety of aspects and slopes ranging from flat to moderately steep. When they occur near foothill grasslands, they will be at lower elevations (Landfire 2007a).

Vegetation: The vegetation in examples of this system is characterized by perennial grasses and is typically dominated by *Pleuraphis mutica* (tobosa) or with *Bouteloua eriopoda* codominant (more historically) or *Bouteloua gracilis*. In degraded stands, *Scleropogon brevifolius, Dasyochloa pulchella (= Erioneuron pulchellum)*, or *Aristida* spp. may codominate. *Pleuraphis jamesii* may become important in northern stands and *Bouteloua gracilis* in the Great Plains and on degraded stands. If present, mesic graminoids such as *Pascopyrum smithii, Panicum obtusum, Sporobolus airoides*, and *Sporobolus wrightii* typically have low cover and are restricted to drainages and moist depressions (inclusions). Scattered shrubs such as *Ephedra torreyana, Flourensia cernua, Gutierrezia sarothrae, Larrea tridentata, Opuntia imbricata, Prosopis glandulosa*, and *Yucca* spp. may be present, especially on degraded sites.

Dynamics: Historic fire frequency in this ecosystem is not known, but is likely less frequent than other denser desert grasslands because of less fuel in this typically open grassland ecosystem (Humphrey 1963). The effects of burning tobosa-dominated grasslands is variable depending upon soil moisture and plant phenology at the time of the fire, precipitation in the months following the fire, and site characteristics that influence soil moisture availability, and fire intensity based on research in the Great Plains (Innes 2012). However, the dominant grass *Pleuraphis mutica* is likely to survive most fires and can sprout from rhizomes and grow quickly after top-kill by fire (Britton and Steuter1983).

These grasslands are prone to flooding during high precipitation events because of slow infiltration. This may result in overland flow

and erosion of topsoil and some short-term loss of vegetative cover. Landfire (2007a) modeled this system and predicted that during a >500-year flooding event in a swale or stream channel, sites could downcut, thus lowering the water table, and favor woody species in an altered state. Drought cycles likely resulted in a reduction in vegetative cover and production of these sites (Landfire 2007a). Annual growth of woody vegetation depends on annual rainfall; drought negatively affected woody species. Cyclic drought impacts vegetation growth two to three years out of every 10 years, and vegetation-killing drought has a mean return interval of 100 years (Landfire 2007a).

Some grasslands with deep argillic horizons in the San Rafael valley in Arizona and Animas valley in New Mexico have not shown shrub or tree encroachment and/or conversion in the absence of fire or presence of livestock grazing (McAuliffe 1995, Muldavin et al. 2012c). These deep-soil systems have maintained open grassland characteristics despite fire suppression, drought, and livestock grazing. However, there are other valley bottom areas that once supported grasslands, such as the San Simon valley, that have been converted to shrublands due to soil erosion. It is unclear exactly what mechanisms are responsible for the resilience seen in some areas and not in others. McAuliffe (1995) highlighted research on the Santa Rita Experimental Range in Arizona that shows sites of the mid-Pleistocene fan remnants with strongly developed argillic horizons that have not been significantly invaded by deep-rooted shrubs when compared to nearby younger substrates with weakly developed or absent argillic horizons. McAuliffe (1995) suggested these impermeable argillic layers restrict deep percolation of soil-water and may favor the shallower-rooted grasses like tobosa. These soil - water - vegetation relationships may apply to these grasslands in the Chihuahuan Desert.

Component Associations:
- *Pleuraphis mutica - Bouteloua gracilis* Herbaceous Vegetation (CEGL001638, GNRQ)
- *Pleuraphis mutica - Buchloe dactyloides* Herbaceous Vegetation (CEGL002272, G4?)
- *Pleuraphis mutica - Scleropogon brevifolius* Herbaceous Vegetation (CEGL001640, G5)
- *Pleuraphis mutica* Monotype Herbaceous Vegetation (CEGL001637, G5?)

DISTRIBUTION

Range: This grassland system is found from the northern to central Chihuahuan Desert and extends across the Trans-Pecos and into areas of the southwestern Great Plains. It extends from western Texas across New Mexico and into southeastern Arizona. Stands are described from Jornada del Muerto Basin, Marfa grasslands and Marathon Basin, south to central Chihuahua and Coahuila, Mexico.
Divisions: 302:C; 303:C
Nations: MX, US
Subnations: AZ, MXCH(MX), MXCO(MX), NM, TX
Map Zones: 25:C, 26:C
USFS Ecomap Regions: 313B:CC, 313C:CC, 315A:CC, 315B:CC, 315H:CC, 321A:CC, 322A:CC, 322B:CC, M313A:CC, M313B:CC
TNC Ecoregions: 22:C, 24:C, 28:C

SOURCES

References: Anable et al. 1992, Britton and Steuter 1983, Brown 1982a, Brown and Archer 1999, Cable 1971, Cooke and Reeves 1976, Dick-Peddie 1993, Gori and Enquist 2003, Humphrey 1963, Innes 2012, Landfire 2007a, MacMahon and Wagner 1985, McAuliffe 1995, McPherson 1995, Muldavin et al. 1998a, Muldavin et al. 2000b, Muldavin et al. 2012c, NRCS 2006a, Robinett 1994, TNC 2013, Western Ecology Working Group n.d., Wright 1980
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.797571#references
Description Author: K.A. Schulz
Version: 14 Jan 2014 **Stakeholders:** Latin America, Southeast, West
Concept Author: K.A. Schulz, S. Yanoff, and L. Elliott **ClassifResp:** West

CHIHUAHUAN SANDY PLAINS SEMI-DESERT GRASSLAND (CES302.736)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: North American Warm Desert (302)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Herbaceous; Sand Soil Texture; Graminoid
Non-Diagnostic Classifiers: Lowland [Foothill]; Lowland [Lowland]; Mesa; Plain; Toeslope/Valley Bottom; Tropical/Subtropical [Tropical Xeric]; Temperate [Temperate Continental]; Temperate [Temperate Xeric]; Aridic; Xeromorphic Shrub; Succulent Shrub
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2133; ESLF 7105; ESP 1133

CONCEPT

Summary: This ecological system occurs across the Chihuahuan Desert and extends into the southern Great Plains where soils have a high sand content. These dry grasslands or steppe are found on sandy plains and sandy mesatops. The graminoid layer is typically dominated or codominated by *Bouteloua eriopoda* and *Sporobolus flexuosus*. Other common species are *Aristida purpurea, Bouteloua gracilis, Hesperostipa neomexicana* (minor), *Muhlenbergia arenicola, Pleuraphis jamesii, Sporobolus airoides, Sporobolus contractus*, and *Sporobolus cryptandrus*. Typically, there are scattered desert shrubs and stem succulents present, such as *Ephedra torreyana, Ephedra trifurca, Opuntia imbricata, Yucca baccata, Yucca elata*, and *Yucca torreyi*, that are characteristic of the Chihuahuan Desert. The widespread shrub *Artemisia filifolia* is also frequently present along with *Atriplex canescens*, especially in the northern extent.
Classification Comments: When degraded, this grassland will convert to open to dense shrublands frequently dominated by *Prosopis glandulosa* or *Artemisia filifolia* (in its northern extent where it is too cold for *Prosopis glandulosa* to be abundant) (S. Yanoff pers. comm. 2006). This degraded type is classified as Chihuahuan Stabilized Coppice Dune and Sand Flat Scrub (CES302.737).
Related Concepts:
- Black Grama - Sideoats Grama (703) (Shiflet 1994) Intersecting
- Blue Grama - Sideoats Grama - Black Grama (707) (Shiflet 1994) Intersecting
- Grama -Muhly - Threeawn (713) (Shiflet 1994) Finer

DESCRIPTION

Environment: This grassland system occurs on gently sloping, undulating piedmont slopes or plains at elevations ranging from 1065-1525 m (3500-5000 feet). Mean annual precipitation ranges from 20-27 cm (8-10.5 inches), although rainfall is highly variable ranging from 5-50 cm (2-20 inches). Half of the precipitation or more typically falls during summer monsoonal events. Annual frost-free season exceeds 200 days. Spring southwesterly winds are an important factor for soil/sand distribution (Landfire 2007a).

Historically the grassland type was widespread in the northern Chihuahuan Desert occupying sandy sites and dominated by *Bouteloua eriopoda* and other grasses, especially *Sporobolus flexuosus* and *Sporobolus cryptandrus*. Natural spatial variation in the vegetation of this ecological system may be governed by slight variations in soil texture. For example, dropseeds may dominate on loamy sands. Variation in the depth to a restrictive horizon, such as caliche, may also drive variation in grass cover (Landfire 2007a). Frequently, mesquite shrublands have invaded former black grama grassland sites, including the development of coppice dunes (Landfire 2007a).
Dynamics: Wind is an important disturbance agent in this grassland system. The grassland is highly sensitive to grazing and frequent drought. Fire is relatively infrequent, but can result in a significant change of dominant vegetation (Landfire 2007a). The role of fire in New Mexico's black grama-dominated grasslands is unclear, as studies of historical records do not document fires in these grasslands (Wright 1960, Buffington and Herbal 1965). However, in contrast to other desert grasslands, fire has been shown to decrease black grama cover (Buffington and Herbel 1965, Drewa and Havstad 2000). Several other New Mexico studies have shown that black grama decreases with other disturbances, such as drought, livestock grazing, and clipping, recovering slowly, if at all, after such events (Buffington and Herbel 1965, Gibbens and Beck 1988, Gosz and Gosz 1996, Whitford et al. 1999, Drewa and Havstad 2000, Gibbens et al. 2005). While drought was a conflicting factor in many of these studies, it is important to note that studies in Arizona were also conducted during times of drought and resulted in longer recovery times, not a lack of recovery in perennial grasses (Schussman 2006a).

Bouteloua eriopoda is a key plant due to its dominance under pristine conditions, its high forage value and its consequent sensitivity to grazing. Shifts away from black grama dominance are thought to be due to overgrazing and/or multi-year periods of summer or spring drought, or due to the introduction of *Prosopis glandulosa* seeds with or without grazing. With continuous heavy grazing, the proportional representation of black grama declines because it is preferred by cattle over species of *Sporobolus, Aristida*, and *Gutierrezia* (Paulsen and Ares 1962). *Sporobolus* spp. are more palatable than *Aristida* spp., so dropseeds may also decline relative to threeawns and *Gutierrezia* spp. Under climatic conditions that are not conducive to black grama reproduction, or due to the loss of components of the soil biota, demographic limitations may lead to persistent absence of black grama, even without shrub invasion. Shrub invasion is, however, very common. Loss of soil stability and/or a reduction in black grama cover may permit either the survival or establishment mesquite seedlings due to reduced competition or fire frequency. These grasslands have been shown to trend

towards shrublands over the last 100 years (Buffington and Herbel 1965, Gibbens et al. 2005). Subsequent grazing by livestock and native herbivores, competition from shrubs, erosion, and concentration of nutrients under adult shrubs eventually lead to persistent reductions of grass cover and mesquite-dominated coppice dunes with bare or snakeweed-dominated interdunal areas. A substantial number of studies document states and potential causes of transitions. There are multiple competing and complementary explanations for individual transitions that have not been formally tested. If the operation of these mechanisms is case-contingent, it may be especially problematic to define the causes of transitions quantitatively (e.g., a threshold cover of black grama). Nonetheless, careful monitoring of black grama health should be a key feature of management. Overall, the high palatability of black grama during times of year when most other species are less palatable, coupled with the limited capacity of this grass to regenerate under current climatic conditions (Neilson 1986), leads to a relatively high probability of transition with poor range management. It is also possible that changes in climate over the last several hundred years have created an transition from the presumed historic plant community type and that good management can only delay the inevitable shift to shrubland (Landfire 2007a).

Component Associations:
- *Ephedra torreyana / Bouteloua eriopoda* Shrub Herbaceous Vegetation (CEGL001731, G2)
- *Ephedra trifurca / Bouteloua eriopoda* Shrub Herbaceous Vegetation (CEGL001732, G2)
- *Sporobolus flexuosus - Paspalum setaceum* Herbaceous Vegetation (CEGL001694, G1G2)
- *Sporobolus flexuosus - Sporobolus contractus* Herbaceous Vegetation (CEGL001696, GNRQ)
- *Yucca elata / Bouteloua eriopoda* Shrub Herbaceous Vegetation (CEGL001735, G2)

DISTRIBUTION

Range: This Chihuahuan Desert ecological system extends into the southern Great Plains where soils have a high sand content.
Divisions: 302:C
Nations: MX, US
Subnations: AZ, MXCH(MX), NM, TX
Map Zones: 15:?, 24:C, 25:C, 26:C, 27:C, 34:?
USFS Ecomap Regions: 313B:CC, 315A:CC, 315B:CC, 315H:CC, 321A:CC, 322B:??, M313A:CC, M313B:CC
TNC Ecoregions: 22:C, 24:C, 28:C

SOURCES

References: Anable et al. 1992, Buffington and Herbel 1965, Cable 1971, Comer et al. 2003, Dick-Peddie 1993, Drewa and Havstad 2000, Gibbens and Beck 1988, Gibbens et al. 2005, Gori and Enquist 2003, Gosz and Gosz 1996, Landfire 2007a, Muldavin et al. 2000b, Muldavin et al. 2002, Muldavin et al. 2012c, Neilson 1986, Paulsen and Ares 1962, Schussman 2006a, Shiflet 1994, TNC 2013, White and Sutter 1999b, Wright 1980, Yanoff pers. comm.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722936#references
Description Author: K.A. Schulz
Version: 14 Jan 2014 **Stakeholders:** Latin America, Southeast, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

COLUMBIA BASIN FOOTHILL AND CANYON DRY GRASSLAND (CES304.993)

CLASSIFIERS

Conf.: 3 - Weak **Classification Status:** Standard
Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland [Foothill]; Lowland [Lowland]; Sideslope; Very Shallow Soil; Landslide; Graminoid
Non-Diagnostic Classifiers: Herbaceous; Temperate [Temperate Continental]; Unconsolidated; Succulent Shrub
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2134; ESLF 7106; ESP 1134

CONCEPT

Summary: These grasslands are similar floristically to Columbia Basin Palouse Prairie (CES304.792) but are distinguished by landform, soil, and process characteristics. They occur in the canyons and valleys of the Columbia Basin, particularly along the Snake River canyon, the lower foothill slopes of the Blue Mountains, and along the main stem of the Columbia River in eastern Washington. Occurrences are found on steep open slopes, from 90 to 1525 m (300-5000 feet) elevation. Annual precipitation is low, ranging from 10 to 25 cm (4-10 inches). Settings are primarily long, steep slopes of 100 m to well over 400 m, with soils derived from residuum and having patchy, thin, wind-blown surface deposits. Slope failures are a common process. Fire frequency is presumed to be less than 20 years. The vegetation is dominated by patchy graminoid cover, cacti, and some forbs. *Pseudoroegneria spicata, Festuca idahoensis*, and *Opuntia polyacantha* are common species. Deciduous shrubs *Symphoricarpos* spp., *Physocarpus malvaceus, Holodiscus discolor*, and *Ribes* spp. are infrequent native species that may increase with fire exclusion.

Similar Ecological Systems:
- Columbia Basin Palouse Prairie (CES304.792)
- Inter-Mountain Basins Big Sagebrush Steppe (CES304.778)
- Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland (CES306.040)

Related Concepts:
- Bluebunch Wheatgrass (101) (Shiflet 1994) Intersecting
- Idaho Fescue (102) (Shiflet 1994) Intersecting

DESCRIPTION

Environment: These dry grasslands are distinguished by landform, soil, and process characteristics. Annual precipitation is low, ranging from 12-25 cm (5-10 inches) that occurs mostly in the winter, primarily as rain. They occur in the canyons and valleys of the Columbia Basin, particularly along the Snake River canyon, the lower foothill slopes of the Blue Mountains, and along the main stem of the Columbia River in eastern Washington. Occurrences are found on steep open slopes, from 90 to 1525 m (300-5000 feet) elevation. Landform settings of this grassland are primarily long, steep slopes of 100 m to well over 400 m in length, with colluvial soils derived from residuum and having patchy, thin, wind-blown surface deposits. Bare ground, gravel and rock between bunches are common features due to frequent soil movement and sun exposure. Biological soil crust cover is usually present but generally decreases with increasing vascular plant cover, elevation, loose surface rock, and coarseness of soil. Elk, deer and bighorn sheep are native large grazers in the canyon who used these grasslands, particularly in winter and spring (Tisdale 1986).

Vegetation: The vegetation is dominated by patchy graminoid cover, cacti, and some forbs. *Pseudoroegneria spicata, Festuca idahoensis*, and *Opuntia polyacantha* are common species. Deciduous shrubs *Symphoricarpos* spp., *Physocarpus malvaceus, Holodiscus discolor*, and *Ribes* spp. are infrequent native species that may increase with fire exclusion.

Dynamics: This grassland primarily occurs on long, steep slopes. Surface disturbances from slope failure are a common process. Most slips result from saturated soil layers over frozen ground (Tisdale 1986). Fire is the primary disturbance factor. Historically, fire resulted in top-kill and some mortality, although the overall grassland was not changed. Fires were low intensity due to limited fuel and significant internal spacing between fuel patches. Currently, cheatgrass and other introduced grasses often invade these habitats after fire. The historic frequency was 5-20 years. Fire frequency is presumed to be less than 20 years; the return interval may have been as low as 5-10 years (Landfire 2007a).

Biological soil crust cover diminishing or eliminated alters the composition of perennial species and increases the establishment of native disturbance-increasers and annual grasses, particularly *Bromus tectorum* and other exotic annual bromes (WNHP 2011). Crust cover and diversity are greatest where not impacted by trampling, other soil surface disturbance and fragmentation (Belnap et al. 2001, Rosentreter and Eldridge 2002, Tyler 2006).

Component Associations:
- *Aristida purpurea var. longiseta - Poa secunda* Herbaceous Vegetation (CEGL001781, G3)
- *Aristida purpurea var. longiseta - Pseudoroegneria spicata - Sporobolus cryptandrus* Herbaceous Vegetation (CEGL001589, G2)
- *Aristida purpurea var. longiseta - Sporobolus cryptandrus* Herbaceous Vegetation (CEGL001515, G1)
- *Pseudoroegneria spicata - Festuca idahoensis* Canyon Herbaceous Vegetation (CEGL001669, G3)
- *Pseudoroegneria spicata - Opuntia polyacantha - (Poa secunda)* Herbaceous Vegetation (CEGL001673, G3)
- *Sporobolus cryptandrus - Poa secunda* Herbaceous Vegetation (CEGL001516, G2)

DISTRIBUTION

Range: Occurs in the canyons and valleys of the Columbia Basin, particularly along the Snake River canyon, the lower foothill slopes of the Blue Mountains, and along the main stem of the Columbia River in eastern Washington, on steep open slopes, from 90 to 1525 m (300-5000 feet) elevation.
Divisions: 304:C; 306:C
Nations: US
Subnations: ID, OR, WA
Map Zones: 1:P, 8:C, 9:C, 10:C, 16:?, 17:?, 18:C
USFS Ecomap Regions: 331A:CC, 341G:PP, 342B:CC, 342C:CC, 342D:CC, 342H:CC, 342I:CC, 342J:CC, M242C:CC, M242D:CC, M261D:C?, M261G:CC, M331A:C?, M331D:CP, M332A:CC, M332E:CC, M332F:CC, M332G:CC, M333A:CC, M333B:CP, M333D:CC
TNC Ecoregions: 6:C, 8:C, 68:P

SOURCES

References: Belnap et al. 2001, Comer et al. 2003, Darambazar et al. 2007, Davies et al. 2009, Eldridge and Rosentreter 1999, Hall 1973, Johnson and Clausnitzer 1992, Johnson and Simon 1985, Landfire 2007a, Rosentreter and Eldridge 2002, Shiflet 1994, Tisdale 1986, Tisdale and Bramble-Brodahl 1983, TNC 2013, Tyler 2006, WNHP 2011
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722712#references
Description Author: R. Crawford, J. Kagan, M. Reid, mod. K.A. Schulz
Version: 14 Jan 2014 **Stakeholders:** West
Concept Author: R. Crawford, J. Kagan, M. Reid **ClassifResp:** West

COLUMBIA BASIN PALOUSE PRAIRIE (CES304.792)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Long (>500 yrs) Persistence; Loess deposit (undifferentiated); Herbaceous; Deep Soil; Mineral: W/ A-Horizon >10 cm; Graminoid; Cool-season bunch grasses
Non-Diagnostic Classifiers: Lowland [Foothill]; Lowland [Lowland]; Temperate [Temperate Continental]; Glaciated
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2142; ESLF 7115; ESP 1142

CONCEPT

Summary: This once-extensive grassland system occurs in eastern Washington and Oregon, and west-central Idaho, though in very small patches there. In much of its range it is characterized by rolling topography composed of loess hills and plains over basalt plains. The climate of this region has warm-hot, dry summers and cool, wet winters. Annual precipitation is high, 38-76 cm (15-30 inches). The soils are typically deep, well-developed, and old. The cool-season bunch grasses that dominate the vegetation are adapted to this winter precipitation. Characteristic species are *Pseudoroegneria spicata* and *Festuca idahoensis* with *Hesperostipa comata, Achnatherum scribneri, Leymus condensatus, Leymus cinereus, Koeleria macrantha, Pascopyrum smithii*, or *Poa secunda*. Shrubs commonly found include *Amelanchier alnifolia, Rosa* spp., *Eriogonum* spp., *Symphoricarpos albus*, and *Crataegus douglasii*. Excessive grazing, past land use and invasion by introduced annual species have resulted in a massive conversion to agriculture or shrub-steppe and annual grasslands dominated by *Artemisia* spp. and *Bromus tectorum* or *Poa pratensis*. Remnant grasslands are now typically associated with steep and rocky sites or small and isolated sites within an agricultural landscape.
Similar Ecological Systems:
- Columbia Basin Foothill and Canyon Dry Grassland (CES304.993)
- Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland (CES306.040)

Related Concepts:
- Bluebunch Wheatgrass (101) (Shiflet 1994) Intersecting
- Idaho Fescue (102) (Shiflet 1994) Intersecting

DESCRIPTION

Environment: This once-extensive grassland system occurs in eastern Washington and Oregon, and west-central Idaho, though in very small patches there. In much of its range it is characterized by rolling topography composed of loess hills and plains over basalt plains. The climate of this region has warm-hot, dry summers and cool, wet winters. Annual precipitation is high, 38-76 cm (15-30 inches). The soils are typically deep, well-developed, and old. The cool-season bunch grasses that dominate the vegetation are adapted to this winter precipitation.
Vegetation: Characteristic species are *Pseudoroegneria spicata* and *Festuca idahoensis* with *Hesperostipa comata, Achnatherum scribneri, Leymus condensatus, Leymus cinereus, Koeleria macrantha, Pascopyrum smithii*, or *Poa secunda*. Shrubs commonly found include *Amelanchier alnifolia, Rosa* spp., *Eriogonum* spp., *Symphoricarpos albus*, and *Crataegus douglasii*.
Dynamics: Fire is the primary disturbance factor. Fires were low intensity due to limited fuel and significant internal spacing between fuel patches. Currently, *Bromus tectorum* and other introduced grasses often invade these habitats after fire, building up a dense fuelbed that creates frequent, high-intensity fires that are lethal to native perennial grasses (Landfire 2007a). The historic frequency was 50 years to maintain this grassland (Landfire 2007a). Extending fires frequency to >50 years leads to increased shrub cover and shrub regeneration (Landfire 2007a).

Component Associations:
- *(Balsamorhiza serrata) - Poa secunda* Herbaceous Vegetation (CEGL001782, G2)
- *Elymus lanceolatus - Hesperostipa comata* Herbaceous Vegetation (CEGL001746, G1)
- *Eriogonum compositum / Poa secunda* Dwarf-shrub Herbaceous Vegetation (CEGL001784, G2)
- *Eriogonum douglasii / Poa secunda* Dwarf-shrub Herbaceous Vegetation (CEGL001785, G2)
- *Eriogonum sphaerocephalum / Poa secunda* Dwarf-shrub Herbaceous Vegetation (CEGL001448, G3)
- *Eriogonum thymoides / Poa secunda* Dwarf-shrub Herbaceous Vegetation (CEGL001449, G3)
- *Festuca idahoensis - Eriogonum caespitosum* Herbaceous Vegetation (CEGL001615, G2?Q)
- *Festuca idahoensis - Hieracium cynoglossoides* Herbaceous Vegetation (CEGL001619, G1G2)
- *Festuca idahoensis - Koeleria macrantha* Herbaceous Vegetation (CEGL001620, G3Q)
- *Festuca idahoensis - Symphoricarpos albus* Herbaceous Vegetation (CEGL001509, G1)
- *Hesperostipa comata - Poa secunda* Herbaceous Vegetation (CEGL001704, G1)
- *Leymus cinereus* Herbaceous Vegetation (CEGL001479, G2G3Q)
- *Pseudoroegneria spicata - Balsamorhiza sagittata - Poa secunda* Herbaceous Vegetation (CEGL001662, G2)
- *Pseudoroegneria spicata - Festuca idahoensis* Palouse Herbaceous Vegetation (CEGL001670, G1)

- *Pseudoroegneria spicata - Hesperostipa comata* Herbaceous Vegetation (CEGL001679, G4)
- *Pseudoroegneria spicata - Poa secunda* Herbaceous Vegetation (CEGL001677, G4?)
- *Pseudoroegneria spicata - Poa secunda* Lithosolic Herbaceous Vegetation (CEGL001678, G3)
- *Rosa nutkana - Festuca idahoensis* Herbaceous Vegetation (CEGL001626, G1G2Q)
- *Symphoricarpos albus - Rosa nutkana* Shrubland (CEGL001130, G3)

DISTRIBUTION

Range: This system occurs in eastern Washington and Oregon, and west-central Idaho.
Divisions: 304:C; 306:P
Nations: CA? , US
Subnations: BC?, ID, OR, WA
Map Zones: 8:C, 9:C, 10:P
USFS Ecomap Regions: 331A:CC, 342C:C?, 342D:CP, 342H:CC, 342I:CC, M242C:PP, M242D:PP, M332A:CP, M332G:CC, M333A:CC, M333D:CP
TNC Ecoregions: 6:C, 8:P

SOURCES

References: Comer et al. 2003, Daubenmire 1988, Landfire 2007a, Shiflet 1994, Tisdale 1982, TNC 2013
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722880#references
Description Author: NatureServe Western Ecology Team, mod. M.S. Reid
Version: 14 Jan 2014 **Stakeholders:** Canada, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

CUMBERLAND WET-MESIC MEADOW AND SAVANNA (CES202.053)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Herbaceous
National Mapping Codes: ESLF 7165

CONCEPT

Summary: This system consists of open, prairie-like vegetation of the undissected portions of the Cumberland Plateau of Kentucky and adjacent Tennessee in EPA Ecoregion 68a [Cumberland Plateau]; this is part of Subsection 221Hc. Stands are dominated by grasses and forbs with scattered shrubby vegetation and, occasionally, trees. The scattered trees are mainly *Quercus bicolor, Quercus falcata, Quercus palustris, Nyssa sylvatica, Liquidambar styraciflua*, and *Acer rubrum var. trilobum*. The primary dominant grass in the wetter phase is *Chasmanthium laxum*. This vegetation was the predominant type here in the early 1800s and earlier and probably was maintained from burning by Native Americans.

Similar Ecological Systems:
- Eastern Highland Rim Prairie and Barrens (CES202.354)
- North-Central Interior Wet Meadow-Shrub Swamp (CES202.701)
- Pennyroyal Karst Plain Prairie and Barrens (CES202.355)
- Western Highland Rim Prairie and Barrens (CES202.352)

DESCRIPTION

Environment: This system is found in an open, flat to gently rolling landscape which easily carries fire if maintained in a grassy condition. It is endemic to the undissected portions of the Cumberland Plateau of Kentucky and adjacent Tennessee (EPA Ecoregion 68a [Cumberland Plateau] of Griffith et al. (1998) and Woods et al. (2002); this is part of Subsection 221Hc of Keys et al. (1995)).
Vegetation: Stands are dominated by grasses and forbs with scattered shrubby vegetation and, occasionally, trees. The scattered trees are mainly *Acer rubrum var. trilobum, Liquidambar styraciflua, Nyssa sylvatica, Quercus bicolor, Quercus falcata*, and *Quercus palustris* (Braun 1937). The primary dominant grass in the wetter phase is *Chasmanthium laxum* (Braun 1937). Other common grasses include *Andropogon glomeratus, Calamagrostis coarctata (= Calamagrostis cinnoides)* (southern), *Dichanthelium sphaerocarpon var. isophyllum (= Panicum polyanthes)*, and *Dichanthelium scoparium (= Panicum scoparium)*, plus, in drier transitions, *Panicum anceps, Schizachyrium scoparium, Sorghastrum nutans*, and locally *Andropogon gerardii*. Sedges are common, especially *Carex atlantica* (with *var. capillacea*), *Carex debilis* (with vars.), *Carex lurida* (with *var. gracilis*), *Rhynchospora capitellata, Rhynchospora glomerata, Scirpus cyperinus, Scirpus polyphyllus*, etc. Rushes are also common, especially *Juncus canadensis* and *Juncus marginatus* on drier sites (?); *Juncus effusus* (with *var. pylaei*) and *Juncus coriaceus* on wetter sites (?). Common ferns are *Lygodium palmatum, Thelypteris noveboracensis* and, in wetter places, *Athyrium filix-femina ssp. asplenioides (= Athyrium asplenioides)* and *Osmunda cinnamomea*. The most abundant herbs often include *Eupatorium fistulosum* and *Solidago rugosa*. Other typical species include *Agalinis purpurea, Aletris farinosa, Apios americana, Symphyotrichum dumosum (= Aster dumosus), Doellingeria umbellata (= Aster umbellatus), Eupatorium pilosum, Eupatorium rotundifolium, Eupatorium perfoliatum* (richer soil?), *Linum striatum, Lobelia puberula, Lycopus virginicus, Platanthera ciliaris* (often in drier sites), *Potentilla simplex, Rhexia mariana* (less *Rhexia virginica*), *Viola X primulifolia*, and *Vernonia noveboracensis* (southern). The subshrubby vine *Rubus hispidus* is also common. Regionally rare species (mostly increasing to the south) include *Bartonia paniculata, Gratiola pilosa, Helianthus angustifolius, Hypericum crux-andreae, Lobelia nuttallii, Dichanthelium dichotomum var. ensifolium (= Panicum ensifolium), Panicum rigidulum var. pubescens (= Panicum longifolium)* (locally abundant on finer soils), *Platanthera cristata* (typically in boggy forest transitions), *Polygala cruciata, Pycnanthemum verticillatum*?, *Rhynchospora globularis, Sabatia campanulata*?, *Stenanthium gramineum, Xyris torta*, etc. The most abundant woody species include *Acer rubrum var. trilobum* and *Rhus copallinum*; others include *Alnus serrulata, Photinia* spp. (*Photinia pyrifolia (= Aronia arbutifolia), Photinia melanocarpa (= Aronia melanocarpa)*), *Ilex opaca, Liriodendron tulipifera, Liquidambar styraciflua, Lyonia ligustrina, Nyssa sylvatica, Oxydendrum arboreum, Pinus echinata, Quercus alba, Rhododendron* sp. (*Rhododendron cumberlandense*? (= *Rhododendron bakeri*?)), *Rubus* spp. (*Arguti* group), *Salix* spp. (*Salix humilis, Salix nigra, Salix sericea*), *Spiraea tomentosa* (local on finer textured soil?), and *Smilax glauca* (J. Campbell unpubl. data).
Dynamics: This vegetation was the predominant type of the undissected portions of the Cumberland Plateau of Kentucky and adjacent Tennessee in the early 1800s and earlier and probably was maintained by burning by Native Americans, and subject to natural fire as well. There are very few examples extant. It is the subject of some restoration efforts at Catoosa Wildlife Management Area, Tennessee. Data are lacking on the details of its exact fire and disturbance regime.

Component Associations:
- *Andropogon gerardii - (Sorghastrum nutans)* Kentucky Herbaceous Vegetation (CEGL004677, G1G2)

DISTRIBUTION

Range: This system is found in the Cumberland Plateau of Kentucky and adjacent Tennessee.

Divisions: 202:C
Nations: US
Subnations: KY, TN
Map Zones: 47:C
TNC Ecoregions: 50:C

SOURCES

References: Braun 1937, Campbell pers. comm., DeSelm and Murdock 1993, Duffey et al. 1974, Estes et al. 1979, Griffith et al. 1998, Keys et al. 1995, McKinney and Lockwood 1999, Murdock pers. comm., Noss 2013, Southeastern Ecology Working Group n.d., Taft 1997, Taft 2009, Taft et al. 1995, TNC 1996c, Wiens and Dyer 1975, Woods et al. 2002

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.792682#references

Description Author: M. Pyne, M. Evans, C. Nordman
Version: 14 Jan 2014
Concept Author: M. Pyne, M. Evans, C. Nordman

Stakeholders: Southeast
ClassifResp: Southeast

EAST GULF COASTAL PLAIN JACKSON PLAIN PRAIRIE AND BARRENS (CES203.353)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Herbaceous
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2427; ESLF 7140; ESP 1427

CONCEPT

Summary: This ecological system was locally dominant in the Jackson Purchase area of western Kentucky, extending into limited areas of adjacent Tennessee. This central region, called "the Barrens," has been historically subdivided from the rest of the Coastal Plain region of Kentucky. A number of early reports mentioned extensive prairies in this region and also emphasized the importance of annual fires in maintaining these grasslands. Interspersed among the extensive grasslands were likely scattered groves of oaks, especially those tolerant of frequent fires. Among the most frequent trees historically present in the entire region were *Quercus stellata, Quercus velutina*, and *Quercus marilandica*. With fire suppression, groves of trees rapidly expanded and largely replaced the prairies. In general, this system was found on "poorly consolidated Tertiary deposits," which are capped by loess, in the northern part of the Upper East Gulf ecoregion. High-quality examples would support a dense herbaceous layer dominated by tall grasses such as *Andropogon gerardii* and *Schizachyrium scoparium*, but the floristic composition of this type is poorly known since so few extant examples remain. *Sassafras albidum* and *Diospyros virginiana* are present in current sample data from stands attributed to this type, but their presence at higher cover values is probably a symptom of fire suppression.
Classification Comments: The component associations of this system are poorly known since so few extant examples remain. The best remaining examples may be found in the West Kentucky Wildlife Management Area (M. Evans pers. comm.). This system extends, at least historically, into adjacent Henry County, TN, interpreted from the occurrence of several barrens plant species (M. Pyne pers. obs.). Related systems are known from Cretaceous gravels in the Western Highland Rim of Tennessee and from flat uplands of the Southeastern Highland Rim (this latter one includes wetter (xerohydric) barrens). It is classed as a "large-patch" system today, but larger examples are rare if they exist at all, primarily due to its fragmentation by agriculture and fire suppression.
Similar Ecological Systems:
- Western Highland Rim Prairie and Barrens (CES202.352)

Related Concepts:
- Eastern Redcedar: 46 (Eyre 1980) Finer
- Post Oak - Blackjack Oak: 40 (Eyre 1980) Finer
- Tallgrass Prairie (Evans 1991) Intersecting
- Wet Prairie (Evans 1991) Intersecting
- White Oak - Black Oak - Northern Red Oak: 52 (Eyre 1980) Finer

DESCRIPTION

Environment: These grassy barren communities occur on soils are predominantly thin, well-drained, and gravelly, lying atop flat upland terrain in the Jackson Purchase area of western Kentucky, extending into limited areas of adjacent Tennessee. The former barrens were on flat to gently rolling lands just to the dry side of the moisture gradient (Bryant and Held 2001). These lands are flat and composed of drought-prone materials whose structure and composition serve to retard woody plant growth and reproductive success. The topography is flat to gently sloping. This system likely did not develop on the deeper loess soils of the region.
Vegetation: The exact floristic composition of this type is poorly known since so few extant examples remain. Interspersed among the extensive grasslands were likely scattered groves of oaks, especially those tolerant of frequent fires (M. Evans pers. comm.). Among the most frequent trees historically present in the entire region were *Quercus marilandica, Quercus stellata*, and *Quercus velutina* (Bryant and Martin 1988). With fire suppression, groves of trees rapidly expanded and largely replaced the prairies. In general, this system was found on "poorly consolidated Tertiary deposits" (Evans 1991), which are capped by loess, in the northern part of the Upper East Gulf ecoregion. High-quality examples would support a dense herbaceous layer dominated by tall grasses such as *Andropogon gerardii* and *Schizachyrium scoparium*, but the floristic composition of this type is poorly known since so few extant examples remain (M. Evans pers. comm.). Some stands sampled by Bryant and Held (2001) were recognized by them as perhaps representing "the former barrens of the JPR" (Jackson Prairie Region). *Diospyros virginiana, Quercus falcata, Quercus stellata*, and *Sassafras albidum* were generally present in the stands sampled, which were located in those portions of Ballard, Graves and Calloway counties mapped as barrens by Davis (1923). *Andropogon gerardii*, *Schizachyrium scoparium*, and *Sorghastrum nutans*, characteristic prairie grasses, and several scrub oaks were located together in Graves County near the stands sampled (Bryant and Held 2001). Some possible shrub species include *Rosa setigera* and *Rhus copallinum*. Wetter swales dominated by *Panicum virgatum* are probably imbedded within these predominantly dry-mesic barrens. *Sassafras albidum* and *Diospyros virginiana* are present in current sample data from stands attributed to this type (Bryant and Held 2001), but their presence at higher cover values is probably a symptom of fire suppression.

Dynamics: Past fire and grazing constitute the major dynamic processes for the "barrens" region of the Jackson Purchase area of western Kentucky and adjacent Tennessee. Fires were probably frequent (potentially on a five-year return interval), primarily of human origin, and are thought to have occurred in late summer to early autumn prior to European settlement. Some proposed factors which have functioned to maintain the openness of this system following the reduction of fire frequency include the droughty, gravelly soils and resulting stresses to vegetation, as well as more occasional fire. Other factors include natural and managed grazing, and modern anthropogenic factors such as mowing for hay, etc. (Landfire 2007a). Fralish et al. (1999) noted that both post oak and chestnut oak woodlands are essentially the result of fire suppression in the barrens and historic savannas. In some areas, where the soils are particularly harsh (droughty, nutrient-poor, rocky), stands may retain an open aspect in the absence of fire. Some of the extant examples are largely dependent on contemporary management regimes. A number of early reports mentioned extensive prairies in this region and also emphasized the importance of annual fires in maintaining these grasslands [see references in Bryant and Martin (1988)].

Component Associations:
- *Andropogon gerardii - (Andropogon glomeratus, Panicum virgatum, Sorghastrum nutans)* Herbaceous Vegetation (CEGL007705, G2?)
- *Andropogon gerardii - (Sorghastrum nutans)* Kentucky Herbaceous Vegetation (CEGL004677, G1G2)
- *Quercus alba - Quercus stellata - Quercus velutina / Schizachyrium scoparium* Woodland (CEGL002150, G2G3)
- *Quercus marilandica / Vaccinium arboreum / Danthonia spicata* Scrub Woodland (CEGL002425, G3G4)
- *Quercus stellata - Quercus marilandica / Schizachyrium scoparium* Wooded Herbaceous Vegetation (CEGL002391, G2G3)
- *Spartina pectinata* Western Kentucky Herbaceous Vegetation (CEGL004118, G1Q)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- East Gulf Coastal Plain Northern Loess Plain Oak-Hickory Upland (CES203.482)

DISTRIBUTION

Range: This system occurs in the Jackson Purchase area of western Kentucky (primarily Graves County and parts of Calloway County), extending into limited areas of adjacent Tennessee. This central region, called "the Barrens," has been historically subdivided from the rest of the Coastal Plain region of Kentucky (Davis 1923, Bryant and Martin 1988).
Divisions: 203:C
Nations: US
Subnations: KY, TN?
Map Zones: 47:C
USFS Ecomap Regions: 231H:CC
TNC Ecoregions: 43:C

SOURCES

References: Bryant and Held 2001, Bryant and Martin 1988, Comer et al. 2003, Davis 1923, DeSelm and Murdock 1993, Duffey et al. 1974, Estes et al. 1979, Evans 1991, Evans, M. pers. comm., Eyre 1980, Fralish et al. 1999, Haywood 1959, Landfire 2007a, McKinney and Lockwood 1999, Murdock pers. comm., Noss 2013, Shanks 1958, Taft 1997, Taft 2009, Taft et al. 1995, TNC 1996c, Wiens and Dyer 1975
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723159#references
Description Author: R. Evans and M. Evans, mod. M. Pyne
Version: 14 Jan 2014
Concept Author: R. Evans and M. Evans
Stakeholders: Southeast
ClassifResp: Southeast

EAST-CENTRAL TEXAS PLAINS XERIC SANDYLAND (CES205.897)

CLASSIFIERS

Classification Status: Standard

Primary Division: Eastern Great Plains (205)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Herbaceous; Sand Soil Texture; Xeric; Graminoid
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2424; ESLF 7137; ESP 1424

CONCEPT

Summary: This xeric system of east-central Texas is found primarily on the Carrizo geologic formation, but also on other Eocene sandy strata such as Queen City and Sparta. The combination of these very droughty soils with low levels of rainfall create extreme edaphic conditions and a locally unique environment which supports a number of endemic plant taxa. The vegetational component of this system includes open herbaceous-dominated sand "prairies" or "barrens" to open oak-dominated woodlands, with *Quercus incana* and *Quercus margarettiae*. A large number of narrowly distributed, endemic species are associated with this system, including *Abronia macrocarpa, Allium elmendorfii, Brazoria truncata var. pulcherrima (= Brazoria pulcherrima), Brazoria truncata var. truncata, Chaetopappa imberbis, Cryptantha texana, Dalea obovata, Galactia canescens, Hymenopappus carrizoanus, Lechea san-sabeana, Lesquerella grandiflora, Liatris elegans var. carizzana, Liatris elegans var. bridgesii, Polanisia erosa ssp. breviglandulosa, Polygonella parksii, Prunus texana, Rhododon ciliatus, Senecio ampullaceus, Sphaeralcea lindheimeri, Tephrosia lindheimeri*, and *Tetragonotheca repanda*.
Classification Comments: The endemism associated with this system has been well-documented (Sorrie and Weakley 2001, MacRoberts et al. 2003).
Similar Ecological Systems:
- East-Central Texas Plains Post Oak Savanna and Woodland (CES205.679)
- Western Great Plains Sandhill Steppe (CES303.671)

Related Concepts:
- Post Oak Savanna: Sandylands Grassland (707) [CES205.897.9] (Elliott 2011) Finer
- Post Oak Savanna: Sandylands Woodland and Shrubland (706) [CES205.897.6] (Elliott 2011) Finer

DESCRIPTION

Environment: This xeric system is found primarily on the Carrizo geologic formation, but also on other Eocene strata such as Queen City and Sparta. The combination of these very droughty soils with low levels of rainfall create extreme edaphic conditions and a locally unique environment which supports a number of endemic plant taxa. It is found on high topographic positions, and this, along with rapidly draining soils, results in conditions that only briefly retain surface moisture. Deep sandy soils typify this system (Elliott 2011).
Vegetation: This small-patch system is typically an open, herbaceous-dominated sand "prairie," sometimes with open, oak-dominated woodlands. Species such as *Quercus incana, Quercus margarettiae, Quercus stellata,* and *Carya texana* (often stunted) occur in the usually sparse overstory. Invasion by *Ilex vomitoria* is frequent in the absence of fire. Other woody plants that may be encountered include *Juniperus virginiana, Rhus aromatica, Vaccinium arboreum, Viburnum rufidulum, Rhus copallinum,* and *Cornus florida*. The herbaceous layer may be sparse, often with exposed sand, and includes *Cladonia* spp., and species such as *Aristida desmantha, Brazoria truncata var. truncata, Cnidoscolus texanus, Dichanthelium* spp., *Sporobolus junceus, Froelichia floridana, Hymenopappus artemisiifolius, Lechea* spp., *Loeflingia squarrosa, Opuntia humifusa, Paronychia drummondii, Polanisia erosa, Schizachyrium scoparium, Monarda punctata, Senecio ampullaceus, Sorghastrum elliottii, Stylisma pickeringii, Tetragonotheca* spp., *Gaillardia amblyodon, Rhynchosia americana, Zornia bracteata*, and *Triplasis purpurea*. Species such as *Cyperus grayoides, Penstemon murrayanus, Selaginella arenicola ssp. riddellii, Tradescantia reverchonii*, and *Yucca louisianensis* may be present, but primarily to the east, while *Tephrosia lindheimeri* and *Rhynchosia americana* are frequently encountered to the south. Texas endemics, such as *Brazoria truncata var. pulcherrima, Rhododon ciliatus*, and *Hymenopappus carrizoanus* may be found in this system (Elliott 2011). Some other narrowly distributed, endemic species that may be associated with this system include *Abronia macrocarpa, Allium elmendorfii, Chaetopappa imberbis, Cryptantha texana, Dalea obovata, Galactia canescens, Lechea san-sabeana, Lesquerella grandiflora, Liatris elegans var. carizzana, Polanisia erosa ssp. breviglandulosa, Polygonella parksii, Prunus texana, Sphaeralcea lindheimeri*, and *Tetragonotheca repanda*.
Dynamics: This small-patch system is associated higher topographic positions that shed water, and it is underlain by loose sandy soils that are rapidly drained resulting in xeric surface conditions. Fire maintains this system in an open condition with increased cover of herbaceous species. Woody species such as *Ilex vomitoria* tend to encroach in the absence of fire, leading to a loss of diversity.

Component Associations:
- *Schizachyrium scoparium - Lechea tenuifolia - Acalypha radians* Herbaceous Vegetation (CEGL004913, G2G3)

DISTRIBUTION

Range: This system is endemic to east-central Texas.
Divisions: 205:C
Nations: US
Subnations: TX
Map Zones: 32:C, 35:C, 36:C, 37:P
USFS Ecomap Regions: 255C:CC, 315E:CC
TNC Ecoregions: 32:C

SOURCES

References: Bezanson 2000, Comer et al. 2003, Elliott 2011, EPA 2004, MacRoberts et al. 2002a, Sorrie and Weakley 2001
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722784#references
Description Author: R. Evans and M. Pyne, mod. L. Elliott and J. Teague
Version: 14 Jan 2014
Concept Author: R. Evans and M. Pyne
Stakeholders: Southeast
ClassifResp: Southeast

EASTERN HIGHLAND RIM PRAIRIE AND BARRENS (CES202.354)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Herbaceous; Very Short Disturbance Interval; Graminoid
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2417; ESLF 7130; ESP 1417

CONCEPT

Summary: This system represents "The Barrens" of the Southeast Highland Rim of Tennessee. This is a distinctive part of the state and ecoregion and includes a series of plant communities with open canopies, ranging from herbaceous-dominated barrens (some of which are maintained today by mowing instead of fire and grazing) through savanna and woodland types. Open ponds and other wetlands are scattered throughout the landscape. The variety of relatively open habitats which are present here include prairie-like areas, as well as savanna woodlands and upland depression ponds.
Classification Comments: Western Highland Rim Prairie and Barrens (CES202.352), Eastern Highland Rim Prairie and Barrens (CES202.354), Pennyroyal Karst Plain Prairie and Barrens (CES202.355), and Southern Ridge and Valley Patch Prairie (CES202.453) form a series of similar systems in the eastern Interior Highlands and adjacent Ridge and Valley.
Similar Ecological Systems:
- Cumberland Wet-Mesic Meadow and Savanna (CES202.053)
- Pennyroyal Karst Plain Prairie and Barrens (CES202.355)
- Southern Ridge and Valley Patch Prairie (CES202.453)
- Western Highland Rim Prairie and Barrens (CES202.352)

Related Concepts:
- Eastern Redcedar: 46 (Eyre 1980) Finer
- Post Oak - Blackjack Oak: 40 (Eyre 1980) Finer
- Sweetgum - Willow Oak: 92 (Eyre 1980) Finer
- Willow Oak - Water Oak - Diamondleaf (Laurel) Oak: 88 (Eyre 1980) Finer

DESCRIPTION

Environment: These various barren communities occur on Fragiudult soils formed in Pleistocene loess over karstic Mississippian Limestone. Their topography is flat to gently sloping. Some proposed factors which have functioned to maintain their openness include the hardpan soils and fire (as well as natural and managed grazing, and modern anthropogenic factors such as mowing for hay, etc.). These barrens include a variety of systems whose primary presettlement environmental factors were specialized soils and extremes of hydrology, as influenced by fire and grazing. The prevalent soils within the polygon labeled "Dickson-Mountview-Guthrie" (D32 of Elder and Springer (1978), Springer and Elder (1980)) are generally flatter, wetter, and more likely to have fragipans than adjoining units. Average conditions in the area of The Barrens can be summarized as follows (Wolfe 1996): January is typically the coldest month, with average high and low temperatures of 8.8Âº C (47.8Âº F) and 1.9Âº C (35.4Âº F), respectively. July is the warmest month, with average high and low temperatures of 31.3Âº C (88.3Âº F) and 18.9Âº C (66.0Âº F), respectively. Monthly mean temperatures range from 3.5Âº C (38.3Âº F) in January to 25.11Âº C (77.2Âº F) in July. The mean annual precipitation is 1438 mm (56.6 inches) (Wolfe 1996, Pyne 2000). Precipitation is heaviest from November through May, averaging between 113 and 171 mm (4.4 to 6.7 in) per month. Rainfall is lightest during the months of June through October, with averages ranging from 83 mm (3.3 inches) per month to a minor peak of 122 mm (4.8 inches) in July.
Vegetation: Stands may vary in physiognomy from savanna-grasslands to oak-dominated woodlands and forests. Many stands are in a forested condition today due to lack of fire. Typical mesic grassland vegetation of the barrens of the southeastern Highland Rim of Tennessee is dominated by *Andropogon gerardii* along with *Schizachyrium scoparium* and *Sorghastrum nutans*. Other graminoid species present include *Andropogon glomeratus, Calamagrostis coarctata,* and *Panicum virgatum*. Other dominants may include *Eurybia hemispherica (= Aster paludosus ssp. hemisphericus), Symphyotrichum dumosum (= Aster dumosus), Helianthus angustifolius, Potentilla simplex, Solidago odora, Solidago rugosa, Pteridium aquilinum,* and *Polytrichum commune*; found to a lesser extent are *Aristida purpurascens var. virgata (= Aristida virgata), Chasmanthium laxum, Dichanthelium aciculare (= Dichanthelium angustifolium), Dichanthelium dichotomum, Gymnopogon brevifolius, Panicum anceps, Panicum rigidulum*, and *Panicum verrucosum*. Woody species may include *Quercus alba, Quercus stellata, Quercus falcata, Quercus marilandica, Carya* spp., *Acer rubrum, Rhus copallinum, Rosa setigera, Salix humilis, Diospyros virginiana, Rubus argutus*, and *Smilax glauca*. The Barrens contains a variety of natural, semi-natural, and managed openings which provide habitat for plants and animals which are unusual in the ecoregion, rare in the state, or globally rare. These include a variety of plants more at home in other ecoregions, most notably the Coastal Plain and the western prairies, including carnivorous plants and other specialized plants of ponds and other wetlands. In addition, globally rare endemic fish and disjunct amphibians and invertebrates call The Barrens their home.
Dynamics: Past fire and grazing constitute the major dynamic processes for this system. Fires were frequent (potentially on a

five-year return interval (Guyette et al. 2006), documented over approximately the last 370 years), primarily of human origin, occurring in late summer to early autumn. Forestry activities (including planting of off-site *Pinus taeda*, which is not truly native to the region) and fire suppression have led to the current forested condition with solar intensity as low as 10%. The current persistence of prairies, shrublands, and grassy-woodland/savannas is largely dependent on contemporary management regimes. The woodlands, savannas and prairies are often grown up in woody vegetation (e.g., *Acer rubrum, Liquidambar styraciflua*, as well as *Quercus* spp. and *Carya* spp.) due to fire suppression. Woodlands dominated by *Quercus alba, Quercus stellata*, and to a lesser extent *Quercus marilandica* often "fill in" with less fire-tolerant species (e.g., *Acer rubrum, Liquidambar styraciflua, Nyssa sylvatica, Quercus coccinea, Quercus falcata*, etc.) resulting in a closed-canopy forest.

Component Associations:
- *Andropogon gerardii - (Andropogon glomeratus, Panicum virgatum, Sorghastrum nutans)* Herbaceous Vegetation (CEGL007705, G2?)
- *Andropogon gerardii - Schizachyrium scoparium - (Calamagrostis coarctata, Panicum virgatum)* Herbaceous Vegetation (CEGL007706, G2?)
- *Andropogon gerardii - Schizachyrium scoparium - Dichanthelium scoparium - Rhynchospora glomerata* Herbaceous Vegetation (CEGL004006, G1)
- *Quercus (falcata, stellata) / Quercus marilandica / Gaylussacia (baccata, dumosa)* Woodland (CEGL004922, G2G3)
- *Quercus phellos - Quercus alba / Vaccinium fuscatum - (Viburnum nudum) / Carex (barrattii, intumescens)* Forest (CEGL007364, G2)
- *Quercus phellos - Quercus nigra - (Nyssa biflora)* Forest (CEGL007405, G1?)
- *Quercus stellata - (Quercus coccinea) / Quercus marilandica / Vaccinium pallidum - (Vaccinium stamineum)* Woodland (CEGL004709, G2G3)
- *Schizachyrium scoparium - Andropogon (gyrans, ternarius, virginicus)* Herbaceous Vegetation (CEGL007707, G3?)
- *Schizachyrium scoparium - Calamagrostis coarctata* Herbaceous Vegetation (CEGL007708, GNRQ)
- *Schizachyrium scoparium - Panicum anceps - Panicum virgatum - Lespedeza capitata - Scleria* spp. Herbaceous Vegetation (CEGL004063, G1)

SPATIAL CHARACTERISTICS

Spatial Summary: This system was the historic matrix system in a large region of five Tennessee counties of the southeastern Highland Rim. It is classed as a "large patch" system primarily due to its fragmentation by fire suppression, tree plantations, agriculture, and suburban development.

Adjacent Ecological Systems:
- Central Interior Highlands and Appalachian Sinkhole and Depression Pond (CES202.018)

Adjacent Ecological System Comments: The depression ponds which occur within the landscape of Eastern Highland Rim Prairie and Barrens (CES202.354) are examples of the Central Interior Highlands and Appalachian Sinkhole and Depression Pond (CES202.018); several depression pond associations particular to the Eastern Highland Rim are described. Small wet depressions in the Eastern Highland Rim Prairie and Barrens (CES202.354), which are not distinguished physiognomically or by canopy species, are included in the concept of Eastern Highland Rim Prairie and Barrens (CES202.354). These are akin to vernal pools or wet streamheads. These small wet depressions with extensive herbaceous vegetation (e.g., *Carex, Juncus*, and *Panicum* species) certainly would have burned during drier periods.

DISTRIBUTION

Range: This system is restricted to "The Barrens" of the southeastern Highland Rim of Tennessee (today primarily extant in Coffee, Franklin, and Warren counties, Tennessee). This is a small part of Subsection 223Eb (USFS) and EPA Level IV Ecoregion 71g.
Divisions: 202:C
Nations: US
Subnations: TN
Map Zones: 48:C, 53:P
USFS Ecomap Regions: 223E:CC
TNC Ecoregions: 44:C

SOURCES

References: Comer et al. 2003, DeSelm and Murdock 1993, Duffey et al. 1974, Elder and Springer 1978, Estes et al. 1979, Eyre 1980, Guyette et al. 2006, McKinney and Lockwood 1999, Murdock pers. comm., Noss 2013, Pyne 2000, Springer and Elder 1980, Taft 1997, Taft 2009, Taft et al. 1995, TNC 1996c, Wiens and Dyer 1975, Wolfe 1996

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723158#references

Description Author: M. Pyne, R. Evans, C. Nordman
Version: 14 Jan 2014
Concept Author: M. Pyne, R. Evans, C. Nordman
Stakeholders: Southeast
ClassifResp: Southeast

FLORIDA DRY PRAIRIE (CES203.380)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Herbaceous; Short Disturbance Interval; Graminoid
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2425; ESLF 7138; ESP 1425

CONCEPT

Summary: This system, which is endemic to subtropical Florida, is characterized by nearly treeless plains with dense cover of grasses and low shrubs, primarily *Serenoa repens*. Examples occur on flat, low-lying terrain over moderately to poorly drained soils with sandy surfaces overlying organic hardpans or clayey subsoil. The original extent has been heavily reduced by clearing for agriculture and conversion for forage production. Intact examples have been further altered by fire suppression which changes the proportion of grasses and shrubs and may further alter species composition. It is found on the plains near the Myakka River, Kissimmee River, as well as north of Lake Okeechobee and near Fisheating Creek (west of Lake Okeechobee).
Classification Comments: This system grades into mesic pine flatwoods and may have nearly identical composition except for the absent or nearly absent overstory layer (Abrahamson and Hartnett 1990, FNAI 1990, Huffman and Judd 1998).

The Florida Gap program recognizes a single map unit which is apparently analogous to this type.
Similar Ecological Systems:
- South Florida Pine Flatwoods (CES411.381)

Related Concepts:
- Cabbage Palmetto: 74 (Eyre 1980) Finer
- Dry Prairie (FNAI 1990) Equivalent

DESCRIPTION

Environment: The climate where this ecological system occurs is subtropical, characterized by hot, wet summers and mild, dry winters. Average annual rainfall is about 127 cm and occurs mostly in June through September. It occurs on flat, moderately to poorly drained sandy soils with sandy surfaces overlying organic hardpans or clayey subsoil (FNAI 1990). These extensive flat prairies are seldom inundated but may flood with several centimeters of water in the wet summer. Frequent spring fires followed by summer flooding may have limited the survival of *Pinus elliottii var. densa* (Platt et al. 2006a). The normal water table is several centimeters (in summer and fall) to several meters (in winter and spring) below the ground surface (Duever and Brinson 1984a, Abrahamson and Hartnett 1990, Hardin 1990). Soils consist of 0.1-0.9 m of undifferentiated quartz sand with a spodic horizon or clayey subsoil 30-107 cm below the surface. These acidic, nutrient-poor sands have few weatherable minerals and low clay nutrients in the surface soil (Abrahamson and Hartnett 1990). Soils supporting these sparse shrublands are classified as Arenic Haplaquods and include such series as Smyrna; types are Myakka (sandy, siliceous, hyperthermic Aeric Alaquod), Wabasso (sandy, siliceous, hyperthermic Alfic Alaquod), Oldsmar (sandy, siliceous, hyperthermic Alfic Arenic Alaquod), Immokalee (sandy, siliceous, hyperthermic Arenic Alaquod), Leon, Adamsville, and Keri sands (Moore and Swindel 1981, Duever and Brinson 1984a).
Vegetation: Intact examples of this system are generally open and essentially treeless areas dominated by *Serenoa repens* and low shrubs (*Quercus minima, Lyonia lucida, Lyonia fruticosa, Vaccinium darrowii, Vaccinium myrsinites, Ilex glabra,* and *Befaria racemosa*), as well as a variety of grasses (*Aristida beyrichiana, Schizachyrium scoparium var. stoloniferum, Sorghastrum secundum, Andropogon ternarius, Aristida spiciformis, Dichanthelium dichotomum var. ensifolium, Dichanthelium strigosum, Paspalum setaceum,* and others) (Huffman and Judd 1998). At least 5 fairly discrete phases or "states" of this system can be identified (Huffman and Werner 2000): good conditions are typified by abundant herbaceous cover and relatively low (<40%) cover of shrubs, especially *Serenoa repens*, degraded conditions resulting from long fire-free intervals result in reduced herbaceous cover and increased shrub coverage, to the eventual exclusion of all herbaceous cover.
Dynamics: Like the floristically and ecologically related pine flatwoods, the open structure and species composition of dry prairies is maintained by frequent fire. Frequent fires were an important natural process in this system, with an estimated frequency of every 1-2 years (FNAI 2010a). The natural fire frequency is thought to be greater than in the surrounding mesic pine flatwoods (Duever et al. 1982, Abrahamson and Hartnett 1990, Hardin 1990). Dry prairie is readily invaded by woody vegetation in the absence of frequent fire, especially in the absence of fires which occur during the dry portions of early spring. In "good condition" this system has abundant herbaceous cover and relatively low cover (<40%) of *Serenoa repens*; degraded conditions are indicated by reduced herbaceous cover and increased cover of *Serenoa repens* (Huffman and Werner 2000). Florida dry prairie occurs on extensive flat areas with few creeks. Due to the lack of landscape dissection, wildfires in the past may have been larger and more frequent than in pineland areas which had more creeks (Bridges 2006). Also, summer flooding, even for short durations, may have been another stress which limited the survival of pines (Platt et al. 2006a). With lack of fire, outright replacement of dry prairies by stands of *Quercus laurifolia, Quercus virginiana,* and *Serenoa repens* has been well-documented at Myakka River State Park (Huffman and Blanchard 1990). Most dry prairie has a long history of human use as native range for cattle (Penfield 2006).

Component Associations:
- *Sabal palmetto / Serenoa repens* Woodland (CEGL003796, G1G2)
- *Serenoa repens / Aristida beyrichiana* Shrubland (CEGL004236, G2)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Central Florida Herbaceous Pondshore (CES203.890)
- Central Florida Wet Prairie and Herbaceous Seep (CES203.491)
- South Florida Depression Pondshore (CES411.054)

DISTRIBUTION

Range: This system occurs in southern Florida mainly north of the Everglades and Big Cypress area. It is found on the plains near the Myakka River, Kissimmee River, as well as north of Lake Okeechobee and near Fisheating Creek (west of Lake Okeechobee). Early surveyors noted large expanses of this system on the plains near the Kissimmee River, north from Lake Okeechobee, and in the area west of Lake Okeechobee (Fisheating Creek) (Huffman and Judd 1998). The presettlement extent of dry prairie has been mapped based on historical sources (Bridges 2006). Areas of dry prairie included the Kissimmee River region (in Osceola, Okeechobee, Polk, and Highlands counties), the Big Prairie (in Desoto, Glades, and Charlotte counties), and the Myakka Prairie (in Manatee and Sarasota counties) in southern Florida (Bridges 2006). The Kissimmee River dry prairie region was determined to be about 2000 km2 (500,000 acres) prior to settlement (Bridges 2006). The original extent has been heavily reduced by clearing for agriculture and conversion for forage production (FNAI 2010a).
Divisions: 203:C
Nations: US
Subnations: FL
Map Zones: 56:C
USFS Ecomap Regions: 232D:CC, 232G:CC
TNC Ecoregions: 55:C

SOURCES

References: Abrahamson and Hartnett 1990, Bridges 2006, Comer et al. 2003, Duever and Brinson 1984a, Duever et al. 1982, Eyre 1980, FNAI 1990, FNAI 2010a, Hardin 1990, Harper 1927, Huffman and Blanchard 1990, Huffman and Judd 1998, Huffman and Werner 2000, Huffman pers. comm., Landfire 2007a, Moore and Swindel 1981, Orzell and Bridges 2006b, Penfield 2006, Platt et al. 2006a, Watts et al. 2006
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723136#references
Description Author: R. Evans, mod. C.W. Nordman
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: R. Evans **ClassifResp:** Southeast

HAWAI'I FUMAROLE (CES412.415)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Primary Division: Northern Polynesia (412)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lava; Acidic Soil; Volcanic Sulphur Dioxide Fumes; Alga
Non-Diagnostic Classifiers: Herbaceous; Cinder; Basalt; Tropical/Subtropical
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Nonvascular, Bryophyte
National Mapping Codes: EVT 2830; ESLF 7178; ESP 1830

CONCEPT

Summary: This ecological system is restricted to areas of ongoing volcanic activity on the island of Hawai'i from near sea level to the summit of Mauna Loa, especially near and leeward of the Kilauea summit caldera. Steam from the relatively permanent vents has varying amounts of chemical output (largely sulphur dioxide or other sulphur-rich compounds), which is a driving variable for this system. Substrates are recent volcanics, whether pÃ¢hoehoe, 'a'Ã¢ or overlain with cinder or ash. Fumarole communities are vegetated by blue-green algae and bryophytes, with zonal distribution apparently related to temperature and chemical concentrations. In the hottest, sulphur-rich areas, a slimy aggregate of blue-green algae may be the only vegetation, but outward from the vent, various species of bryophytes (mosses and liverworts) ring the vent in a manner analogous to algae in the intertidal zone. Finally, ferns and angiosperms from communities surrounding the vent appear at a variable distance from the vent, marking the transition out of the fumarole community.
Classification Comments: Fumarole communities are poorly understood biological communities currently restricted to habitats directly in and around volcanic steam vents. Should the concept be expanded to include broader areas generally downwind of vents affected by volcanic sulphur dioxide fumes/fog? Vegetation in these sulphur dioxide-affected areas is significantly sparser both in cover and diversity, and sites often appear barren. Volcanic areas can be active for long periods of time, maintaining the depauperate community. The animal portion of fumarole communities includes mites and springtails (*Collembola*), some of which are known (to date) only from fumaroles. However, as only a very small portion of existing fumaroles have been sampled, the full distribution of fumarole animals can not be predicted. In addition, the plants and animals of Hawaiian fumaroles can not yet be compared to fumaroles in other volcanic areas of the world, because of inadequate biological sampling.
Related Concepts:
- Hawaiian Fumarole Communities (Gon 1988) Equivalent

DESCRIPTION

Environment: This volcanic ecological system occurs independently of the 7 Moisture Zones developed for the Hawaiian Islands by Price et al. (2007) and likely occurs in most of the zones. Moisture in the vent is generally saturated where steam is escaping, but the overriding limiting features are high temperatures (on a gradient from above boiling to near ambient) and the presence of volcanic chemical compounds (generally sulphur-containing). Both of these features strongly limit all but a small set of adapted or tolerant plants and animals.

Component Associations:
- Hawaiian Fumarole Herbaceous Vegetation (CEGL008095, G3)

DISTRIBUTION

Range: This ecological system is only known from the Big Island of Hawai'i.
Divisions: 412:C
Nations: US
Subnations: HI
Map Zones: 79:C
USFS Ecomap Regions: M423:C
TNC Ecoregions: 65:C

SOURCES

References: Gagne and Cuddihy 1990, Gon 1988, Mueller-Dombois and Fosberg 1998, Price et al. 2007, Wagner et al. 1999, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.821144#references
Description Author: K.A. Schulz, mod. S. Gon III
Version: 02 Feb 2009
Stakeholders: West
Concept Author: K.A. Schulz
ClassifResp: West

HAWAI'I LOWLAND DRY GRASSLAND (CES412.410)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Northern Polynesia (412)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland; Tropical/Subtropical [Tropical Xeric]; Short Disturbance Interval; Graminoid
Non-Diagnostic Classifiers: Herbaceous
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2819; ESLF 7179; ESP 1819

CONCEPT

Summary: This lowland grassland ecological system mostly occurs on dry leeward sides of the larger islands of Hawai'i and Maui and on relatively dry smaller islands of LÃ¢na'i and Kaho'olawe. This ecological system also includes coastal dry grasslands that occur beyond the immediate coastal effects of the sea with wind, salt spray and salinity. Elevations range from 30-1000 m (100-3280 feet). Annual precipitation is generally between 100 and 1750 mm. Substrates are variable. Dominant native species are *Heteropogon contortus* (pili) which was fairly widespread. These stands were maintained and expanded by ancient Hawaiians by regular burning. Other species include low scattered shrubs such as *Dodonaea viscosa, Sida fallax*, and *Waltheria indica*. Woody plants invade in the absence of regular fire. Other native dry lowland grasslands are composed of *Eragrostis variabilis, Fimbristylis* spp., *Lepturus repens*, or *Sporobolus virginicus* which were more common near coasts. Many dry grasslands have been replaced by exotic grass species or converted to exotic shrublands.
Classification Comments: This dry grassland system grades into the dry coastal strand system near the leeward coasts. Coastal dry grasslands that are affected by immediate sea coast processes (salt spray and salinity) are classified in the dry coastal strand ecological system.
Similar Ecological Systems:
- Hawai'i Dry Coastal Strand (CES412.418)
- Hawai'i Lowland Dry Shrubland (CES412.409)
- Hawai'i Montane-Subalpine Dry Shrubland (CES412.403)

DESCRIPTION

Environment: This lowland ecological system occurs over a broad moisture range within the arid, very dry, moderately dry, and seasonally mesic zones (Zones 1, 2, 3 and 4) of the 7 Moisture Zones developed for the Hawaiian Islands by Price et al. (2007). This lowland grassland ecological system mostly occurs on dry leeward sides of the larger islands of Hawai'i and Maui and on relatively dry smaller islands of LÃ¢na'i and Kaho'olawe. This ecological system also includes coastal dry grasslands that occur beyond the immediate coastal effects of the sea with wind, salt spray and salinity. Elevations range from 30-1000 m (100-3280 feet). Annual precipitation is generally between 100 and 1750 mm (Gagne and Cuddihy 1990). Substrates are variable.
Vegetation: Vegetation in this ecological system is characterized by native dry grass species such as *Heteropogon contortus* (pili) which was fairly widespread. Stands were maintained and expanded by ancient Hawaiians by regular burning (Gagne and Cuddihy 1990). Other species include low scattered native shrubs such as *Dodonaea viscosa, Sida fallax*, and *Waltheria indica*. Woody plants invade in the absence of regular fire (Stone and Pratt 1994). Other native dry lowland grasslands were composed of *Eragrostis variabilis, Fimbristylis* spp., *Lepturus repens*, or *Sporobolus virginicus* which were more common near coasts. Many dry grasslands have been replace by exotic grass species such as *Andropogon virginicus, Cymbopogon refractus, Hyparrhenia hirta, Pennisetum setaceum, Melinis repens (= Rhynchelytrum repens),* and *Schizachyrium condensatum*, or been converted to exotic shrublands dominated by *Acacia farnesiana, Lantana camara, Leucaena leucocephala, Schinus terebinthifolius*, or *Prosopis pallida* (coastal only).
Dynamics: *Heteropogon contortus* is a fire-adapted grass. Ecologically stable *Heteropogon contortus*-dominated stands may occur on dry lowland cliffs where woody plants can not form dense canopies (Gagne and Cuddihy 1990).

Component Associations:
- *Eragrostis variabilis* Coastal Dry Herbaceous Vegetation (CEGL008087, G3)
- *Fimbristylis* spp. Coastal Dry Herbaceous Vegetation (CEGL008089, G3)
- *Heteropogon contortus* Lowland Dry Herbaceous Vegetation (CEGL008090, G4)
- *Lepturus repens* Annual Herbaceous Vegetation (CEGL008105, G3?)
- *Sporobolus virginicus* Coastal Dry Shrub Herbaceous Vegetation (CEGL008094, G4)

DISTRIBUTION

Range: This lowland dry grassland ecological system occurs on leeward sides of the larger islands of Hawai'i and Maui and relatively dry smaller islands of LÃ¢na'i and Kaho'olawe.
Divisions: 412:C
Nations: US

Subnations: HI
Map Zones: 79:C
USFS Ecomap Regions: M423:C
TNC Ecoregions: 65:C

SOURCES

References: Gagne and Cuddihy 1990, Mueller-Dombois and Fosberg 1998, Price et al. 2007, Stone and Pratt 1994a, Wagner et al. 1999, Western Ecology Working Group n.d.

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.821129#references

Description Author: K.A. Schulz
Version: 05 Mar 2009
Concept Author: K.A. Schulz

Stakeholders: West
ClassifResp: West

HAWAI'I LOWLAND MESIC GRASSLAND (CES412.413)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Primary Division: Northern Polynesia (412)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland; Tropical/Subtropical [Tropical Pluviseasonal]; Shallow Soil; Graminoid
Non-Diagnostic Classifiers: Herbaceous
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2820; ESLF 7180; ESP 1820

CONCEPT

Summary: Lowland mesic grasslands can be found on most of the islands from 300 to 2000 m (1000-6500 feet) elevation. Annual rainfall is 750-1000 mm (30-40 inches) and falls mostly from November to March. Soils are generally shallow. On the younger islands, it can occur on young pÃ¢hoehoe that is beginning to form a thin mantel of soil. These communities are floristically poor, dominated by *Eragrostis variabilis*, on moderate to steep slopes of Kaua'i, O'ahu, Moloka'i and Maui. These grasslands form a near-continuous dense ground cover, about 1.2 m (1.5 feet) tall, that may extend downslope to coastal dry slopes. Associated species include *Metrosideros tremuloides*, *Bidens* spp., *Dodonaea viscosa*, and *Gouania hillebrandii*. Most examples of this system have been invaded by alien species. Lowland mesic grasslands grade into mesic shrublands and forests where *Metrosideros polymorpha* is frequently a dominant species.

DESCRIPTION

Environment: This lowland ecological system occurs over a broad moisture range within the moderately dry and seasonally mesic zones (Zones 3 and 4) of the 7 Moisture Zones developed for the Hawaiian Islands by Price et al. (2007). Lowland mesic grasslands can be found on most of the islands from 300 to 2000 m (1000-6500 feet) elevation. Annual rainfall is 750-1000 mm (30-40 inches) and falls mostly from November to March. Soils are generally shallow. On the younger islands, it can occur on young pÃ¢hoehoe that is beginning to form a thin mantel of soil.
Vegetation: These communities are floristically poor, dominated by *Eragrostis variabilis*, on moderate to steep slopes of Kaua'i, O'ahu, Moloka'i and Maui. These grasslands form a near-continuous dense ground cover, about 1.2 m (1.5 feet) tall, that may extend downslope to coastal dry slopes. Associated species include *Metrosideros tremuloides*, *Bidens* spp., *Dodonaea viscosa*, and *Gouania hillebrandii*. Most examples of this system have been invaded by alien species. Lowland mesic grasslands grade into mesic shrublands and forests where *Metrosideros polymorpha* is frequently a dominant species.

Component Associations:
- *Eragrostis variabilis* Lowland Mesic Herbaceous Vegetation (CEGL008088, G3)

DISTRIBUTION

Range: This ecological system occurs on Kaua'i, O'ahu, Moloka'i and Maui islands of Hawai'i.
Divisions: 412:C
Nations: US
Subnations: HI
Map Zones: 79:C
USFS Ecomap Regions: M423:C
TNC Ecoregions: 65:C

SOURCES

References: Gagne and Cuddihy 1990, Mueller-Dombois and Fosberg 1998, Price et al. 2007, Wagner et al. 1999, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.821138#references
Description Author: G. Kittel, mod. S. Gon III
Version: 02 Feb 2009
Stakeholders: West
Concept Author: K.A. Schulz
ClassifResp: West

HAWAI'I MONTANE-SUBALPINE DRY GRASSLAND (CES412.405)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Northern Polynesia (412)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Upper Montane]; Montane [Montane]; Herbaceous; Tropical/Subtropical [Tropical Xeric]
Non-Diagnostic Classifiers: Mountainside; Saddle
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2822; ESLF 7181; ESP 1822

CONCEPT

Summary: This ecological system occurs on dry montane to subalpine saddles and slopes of Mauna Kea, Mauna Loa, Hualalai, Hawai'i, from near 1615 to 2300 m (5295-7540 feet) elevation. An inversion layer of warmer air forms 50-70% of the time between 1600 and 3000 m that dramatically reduces precipitation at higher elevations. This is because the wet trade winds generally do not rise above 1900 m (6230 feet) and are deflected around the mountains, leaving upper slopes too dry to support rain forests. Stands also occur at lower elevations on leeward sides of islands where there is a strong rainshadow effect. Annual rainfall is generally 400-500 mm. Many sites are wind-exposed. Substrates include well-drained, sandy loam soils derived from volcanic ash or cinder and weathered basaltic lava with little soil development. Edaphic properties tend to suppress woody lifeforms. Vegetation is characterized by a moderate to dense bunchgrass layer (<1 m tall) dominated by *Eragrostis atropioides* and sometimes codominated by *Panicum tenuifolium*. Other grass species include *Agrostis sandwicensis, Eragrostis deflexa*, and *Trisetum glomeratum*. Scattered shrubs may be present such as *Bidens menziesii, Chenopodium oahuense, Dodonaea viscosa, Dubautia linearis, Pseudognaphalium sandwicensium (= Gnaphalium sandwicensium), Osteomeles anthyllidifolia, Myoporum sandwicense*, and *Sophora chrysophylla*. Fire-adapted exotic grass *Pennisetum setaceum* has not significantly invaded and is only occasionally present. Weedy exotic forbs are common. *Heterotheca grandiflora, Senecio madagascariensis, Verbascum thapsus*, and *Verbesina encelioides* are common in disturbed stands (Shaw and Castillo 1997, J. Jacobi pers. comm.).

Similar Ecological Systems:
- Hawai'i Montane-Subalpine Dry Shrubland (CES412.403)

Related Concepts:
- *Eragrostis* Grassland (Shaw and Castillo 1997) Equivalent
- Lovegrass/Mountain Pili (*Eragrostis/Panicum*) Grassland (Gagne and Cuddihy 1990) Equivalent

DESCRIPTION

Environment: This montane to subalpine ecological system occurs within the arid, very dry, and moderately dry zones (Zones 1, 2 and 3) of the 7 Moisture Zones developed for the Hawaiian Islands by Price et al. (2007). This ecological system occurs on dry montane to subalpine saddles and slopes of Mauna Kea, Mauna Loa, Hualalai, Hawai'i, from near 1615 to 2300 m (5295-7540 feet) elevation. An inversion layer of warmer air forms 50-70% of the time between 1600 and 3000 m that dramatically reduces precipitation at higher elevations (Gagne and Cuddihy 1990). This is because the wet trade winds generally do not rise above 1900 m (6230 feet) and are deflected around the mountains, leaving upper slopes too dry to support rain forests (Mueller-Dombois and Fosberg 1998). Stands also occur at lower elevations on leeward sides of islands where there is a strong rainshadow effect. Annual rainfall is generally 400-500 mm. Many sites are wind-exposed. Substrates include well-drained, sandy loam soils derived from volcanic ash or cinder and weathered basaltic lava with little soil development. Edaphic properties tend to suppress woody lifeforms.
Vegetation: Vegetation is characterized by a moderate to dense bunchgrass layer (<1 m tall) dominated by *Eragrostis atropioides* and sometimes codominated by *Panicum tenuifolium* (Gagne and Cuddihy 1990). Other grass species include *Agrostis sandwicensis, Eragrostis deflexa*, and *Trisetum glomeratum*. Scattered shrubs may be present such as *Bidens menziesii, Chenopodium oahuense, Dodonaea viscosa, Dubautia linearis, Pseudognaphalium sandwicensium (= Gnaphalium sandwicensium), Osteomeles anthyllidifolia, Myoporum sandwicense*, and *Sophora chrysophylla*. Fire-adapted exotic grass *Pennisetum setaceum* has not significantly invaded and is only occasionally present. Weedy exotic forbs are common. *Heterotheca grandiflora, Senecio madagascariensis, Verbascum thapsus*, and *Verbesina encelioides* are common in disturbed stands (Shaw and Castillo 1997, J. Jacobi pers. comm.).

Component Associations:
- *Eragrostis atropioides* Subalpine Dry Herbaceous Vegetation (CEGL008086, G1)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Hawai'i Montane-Subalpine Dry Shrubland (CES412.403)
- Hawai'i Montane-Subalpine Mesic Grassland (CES412.407)

DISTRIBUTION

Range: This grassland ecological system is restricted to drier saddles and upper slopes of Mauna Kea, Hawai'i.

Divisions: 412:C
Nations: US
Subnations: HI
Map Zones: 79:C
USFS Ecomap Regions: M423:C
TNC Ecoregions: 65:C

SOURCES

References: Gagne and Cuddihy 1990, Jacobi pers. comm., Mueller-Dombois and Fosberg 1998, Price et al. 2007, Shaw and Castillo 1997, Wagner et al. 1999, Western Ecology Working Group n.d.

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.821108#references

Description Author: K.A. Schulz
Version: 02 Feb 2009
Concept Author: K.A. Schulz

Stakeholders: West
ClassifResp: West

HAWAI'I MONTANE-SUBALPINE MESIC GRASSLAND (CES412.407)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Primary Division: Northern Polynesia (412)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Upper Montane]; Montane [Montane]; Tropical/Subtropical [Tropical Pluviseasonal]; Graminoid
Non-Diagnostic Classifiers: Mountainside; Herbaceous
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2823; ESLF 7182; ESP 1823

CONCEPT

Summary: This ecological system occurs on cool windward subalpine slopes of east Maui and Mauna Loa, Hawai'i. Elevation ranges from 2100 m on Maui and 1680-1980 m on Hawai'i. Sites are relatively mesic as annual rainfall is generally 1300-2500 mm. Soils are shallow over rock, retaining soil moisture, or much deeper ash deposits. Vegetation is characterized by a moderate to dense bunchgrass layer (<1 m tall) dominated by *Deschampsia nubigena* with *Pteridium aquilinum var. decompositum* frequently codominate. Other herbaceous species include *Carex macloviana, Uncinia* cf. *uncinata, Luzula hawaiiensis, Plantago* spp., *Ranunculus hawaiensis,* and *Sanicula sandwicensis*. Scattered shrubs may be also present such as *Coprosma montana, Dubautia* spp., *Sophora chrysophylla,* and *Styphelia tameiameiae*. Several exotic species are common in disturbed stands.

DESCRIPTION

Environment: This montane to subalpine ecological system occurs within the seasonally mesic and moist mesic zones (Zones 4 and 5) of the 7 Moisture Zones developed for the Hawaiian Islands by Price et al. (2007). This ecological system occurs on cool windward subalpine slopes of east Maui and Mauna Loa, Hawai'i. Elevation ranges from 2100 m on Maui and 1680-1980 m on Hawai'i. Sites are relatively mesic as annual rainfall is generally 1300-2500 mm. Soils are shallow over rock, retaining soil moisture, or much deeper ash deposits.
Vegetation: Vegetation is characterized by a moderate to dense bunchgrass layer (<1 m tall) dominated by *Deschampsia nubigena* with *Pteridium aquilinum var. decompositum* frequently codominant (Gagne and Cuddihy 1990). Other herbaceous species include *Carex macloviana, Uncinia* cf. *uncinata, Luzula hawaiiensis, Plantago* spp., *Ranunculus hawaiensis,* and *Sanicula sandwicensis*. Scattered shrubs may be also present such as *Coprosma montana, Dubautia* spp., *Sophora chrysophylla*, and *Styphelia tameiameiae*. Several exotic species are common in disturbed stands.
Dynamics: Natural fires are extremely rare, though evidence exists as charcoal layers of past fire at Kalapawili, associated with lava flows on Hawai'i Island, and lightning throughout range. Storms might expand its range by opening tree canopies in adjacent forest and forming new alluvial pans, taking stands back to primary succession.

Component Associations:
- *Deschampsia nubigena* Montane and Subalpine Mesic Herbaceous Vegetation (CEGL008085, G1)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Hawai'i Montane-Subalpine Dry Grassland (CES412.405)

DISTRIBUTION

Range: This grassland ecological system is restricted to montane and subalpine slopes of Haleakala on Maui and Mauna Loa on Hawai'i.
Divisions: 412:C
Nations: US
Subnations: HI
Map Zones: 79:C
USFS Ecomap Regions: M423:C
TNC Ecoregions: 65:C

SOURCES

References: Gagne and Cuddihy 1990, Mueller-Dombois and Fosberg 1998, Price et al. 2007, Wagner et al. 1999, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.821117#references
Description Author: K.A. Schulz, mod. S. Gon III
Version: 05 Mar 2009
Stakeholders: West
Concept Author: K.A. Schulz
ClassifResp: West

INTER-MOUNTAIN BASINS SEMI-DESERT GRASSLAND (CES304.787)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland [Foothill]; Lowland [Lowland]; Herbaceous; Temperate [Temperate Xeric]; Alkaline Soil; Aridic; Graminoid
Non-Diagnostic Classifiers: Moderate (100-500 yrs) Persistence; Intermediate Disturbance Interval; F-Landscape/Medium Intensity; G-Landscape/Low Intensity; Forb
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2135; ESLF 7107; ESP 1135

CONCEPT

Summary: This widespread ecological system includes the driest grasslands throughout the intermountain western U.S. It occurs on xeric sites over an elevation range of approximately 1450 to 2320 m (4750-7610 feet) on a variety of landforms, including swales, playas, mesas, alluvial flats, and plains. This system may constitute the matrix over large areas of intermountain basins, and also may occur as large patches in mosaics with shrubland systems dominated by *Artemisia tridentata ssp. tridentata, Artemisia tridentata ssp. wyomingensis, Atriplex* spp., *Coleogyne* spp., *Ephedra* spp., *Gutierrezia sarothrae*, or *Krascheninnikovia lanata*. Grasslands in areas of higher precipitation, at higher elevation, typically belong to other systems. Substrates are often well-drained sandy or loam soils derived from sedimentary parent materials but are quite variable and may include fine-textured soils derived from igneous and metamorphic rocks. The dominant perennial bunch grasses and shrubs within this system are all drought-resistant plants. Dominant or codominant species are *Achnatherum hymenoides, Aristida* spp., *Bouteloua gracilis, Hesperostipa comata, Muhlenbergia* spp., *Pleuraphis jamesii*, or *Sporobolus* spp.,. Scattered shrubs and dwarf-shrubs often are present, especially *Artemisia tridentata ssp. tridentata, Artemisia tridentata ssp. wyomingensis, Atriplex* spp., *Coleogyne* spp., *Ephedra* spp., *Ericameria* spp., *Gutierrezia sarothrae*, and *Krascheninnikovia lanata*. Grasslands in the basins of south-central and southwestern Wyoming, dominated by *Pseudoroegneria spicata* and *Poa secunda* and containing cushion-form forbs and other species typical of dry basins, are included in this system.

Classification Comments: In the relatively high-elevation basins of Wyoming and south-central Montana, grass vegetation dominated or codominated by *Pseudoroegneria spicata* and *Poa secunda* seems to be transitional between more typical Inter-Mountain Basins Semi-Desert Grassland (CES304.787) as found farther west and south in the intermountain region and Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland (CES306.040) common on the foothills of the surrounding mountains. That grass vegetation is placed into this semi-desert grassland system, instead of into the foothill grassland system, for two reasons. The first is composition of the vegetation: *Pseudoroegneria*- and *Poa*-rich vegetation often contains shrubs (*Artemisia tridentata ssp. wyomingensis, Krascheninnikovia lanata*), other grasses (*Achnatherum hymenoides, Hesperostipa comata*), and cushion-form forbs common in drier vegetation of the same basins, while the species common in the foothills, especially *Festuca idahoensis* and *Leucopoa kingii*, are absent. The second is the setting: patches of the *Pseudoroegneria*- and *Poa*-rich vegetation occur in a mosaic with other basins systems, especially Inter-Mountain Basins Big Sagebrush Steppe (CES304.778), with which it often merges.

In the Columbia Plateau, this semi-desert ecological system does not include *Pseudoroegneria spicata*-dominated or -codominated associations such as *Pseudoroegneria spicata - Achnatherum hymenoides* Herbaceous Vegetation (CEGL001674) or *Pseudoroegneria spicata - Poa secunda* Herbaceous Vegetation (CEGL001677). Additionally, *Poa cusickii* Herbaceous Vegetation (CEGL001655) is restricted to relatively mesic sites there and does not occur in this semi-desert system as it occurs in the Columbia Plateau, but may be found in this system in Wyoming.

Similar Ecological Systems:
- Columbia Plateau Steppe and Grassland (CES304.083)
- Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland (CES306.040)

Related Concepts:
- Grama - Galleta (502) (Shiflet 1994) Finer

DESCRIPTION

Environment: Low-elevation grasslands in the Intermountain West region occur in semi-arid to arid climates at approximately 1450 to 2320 m (4750-7610 feet) elevation. These grasslands occur in lowland and upland areas and may occupy swales, playas, mesa tops, plateau parks, alluvial flats, and plains. These grasslands typically occur on xeric sites. This system experiences cold temperate conditions. Hot summers and cold winters with freezing temperatures and snow are common. Annual precipitation is usually from 20-40 cm (7.9-15.7 inches). A significant portion of the precipitation falls in July through October during the summer monsoon storms, with the rest falling as snow during the winter and early spring months. Because of this monsoonal aspect, there is a strong gradient of warm-season/cool-season grass dominance from southeast to northwest. One could almost accept two different grassland systems because of this. These grasslands occur on a variety of aspects and slopes. Sites may range from flat to moderately steep.

Soils supporting this system also vary from deep to shallow, and from sandy to finer-textured. The substrate is typically derived from sandstone or shale. Some occurrences on sandy soils have a high cover of cryptogams on the soil surface. These cryptogams tend to increase the stability of the highly erodible sandy soils of these grasslands during torrential summer rains and heavy wind storms (Kleiner and Harper 1977). Muhlenbergia-dominated grasslands which flood temporarily, combined with high evaporation rates in this dry system, can have accumulations of soluble salts in the soil. Soil salinity depends on the nature of the parent material and on the amount and timing of precipitation and flooding. Growth-inhibiting salt concentrations are diluted when the soil is saturated, allowing the growth of less salt-tolerant species. As the saturated soils dry, the salt concentrates until it precipitates out on the soil surface (Dodd and Coupland 1966, Ungar 1968).

Vegetation: The dominant perennial bunch grasses and shrubs within this system are all drought-resistant plants. Dominant or codominant species are *Achnatherum hymenoides, Aristida* spp., *Bouteloua gracilis, Hesperostipa comata, Muhlenbergia* spp., or *Pleuraphis jamesii*. Scattered shrubs and dwarf-shrubs often are present, especially *Artemisia tridentata ssp. tridentata, Artemisia tridentata ssp. wyomingensis, Atriplex* spp., *Coleogyne* spp., *Ephedra* spp., *Gutierrezia sarothrae*, and *Krascheninnikovia lanata*. Grasslands in the basins of south-central and southwestern Wyoming, dominated by *Pseudoroegneria spicata* and *Poa secunda* and containing cushion-form forbs and other species typical of dry basins, are included in this system.

Dynamics: Disturbance dynamics in this semi-arid grassland system are variable because of variation in the compositions; however, most are dominated by perennial bunch grasses that are adapted to low- to medium-frequency (<30 to <100 years) and low- to medium-intensity fires (Howard 1997a, 1997b, Tirmenstein 1999e, Zlatnik 1999a, 1999b, Johnson 2000c, Simonin 2000a, 2000b, 2000c, Anderson 2003, Sawyer et al. 2009). Most of the species are classified as resistant or tolerant of fire, with the exception of *Bouteloua eriopoda*, which is classified as sensitive, but will recover quickly if there is adequate summer moisture (Simonin 2000a). Season of burn is also important for predicting post-burn recovery.

The majority of characteristic grass species, such as *Achnatherum hymenoides, Aristida* spp., *Bouteloua eriopoda, Bouteloua gracilis, Hesperostipa comata, Pleuraphis jamesii, Poa secunda, Pseudoroegneria spicata, Sporobolus airoides*, and *Sporobolus cryptandrus*, will be top-killed after burning, then resprout from rootcrowns unless the fire was very severe (Howard 1997a, 1997b, Tirmenstein 1999e, Zlatnik 1999a, 1999b, Johnson 2000c, Simonin 2000a, 2000b, 2000c, Anderson 2003, Sawyer et al. 2009). This grassland system is maintained by fires that kill or reduce cover of the more fire-sensitive shrub species.

Achnatherum hymenoides is one of the most drought-tolerant grasses in the western U.S. (USFS 1937, Tirmenstein 1999e). It is also a valuable forage grass in arid and semi-arid regions. Improper grazing by ungulates decreases cover of this palatable plant species and increases weedy species and soil erosion (USFS 1937, Tirmenstein 1999e). *Hesperostipa comata* is a deep-rooted grass that uses soil moisture below 0.5 m during the dry summers. It is prone to litter accumulations at plant bases, which can increase intensity of fire, making it more susceptible to mortality (Zlatnik 1999a). *Bouteloua gracilis* is drought- and very grazing-tolerant, and generally forms a short sod. *Pleuraphis jamesii* is only moderately palatable to livestock, but decreases when heavily grazed during drought and in the more arid portions of its range where it is the dominant grass (West et al. 1972). This grass reproduces extensively from scaly rhizomes, which make the plant resistant to trampling by large wildlife or livestock and have good soil-binding properties (Weaver and Albertson 1956, West et al. 1972).

Semi-desert grassland can be large (>10,000 acres) when associated with extensive sandsheet systems. Historic disturbance (fire) likely ranged from small (<10 acres) to large (>10,000 acres) depending on conditions, time since last ignition and fuel loading. It is assumed that the average patch size of fire is 250 acres (Landfire 2007a). Drought cycles likely resulted in a reduction in vegetative cover, production and acreage of these sites (mean return interval of 100 years) (Landfire 2007a). During severe droughts there is a tendency for increased soil erosion primarily from wind processes, forming inter-canopy blowouts and coppice dunes where shrubs stabilize and prevent soil movement.

Component Associations:

- *Achnatherum hymenoides - Sporobolus contractus* Herbaceous Vegetation (CEGL001652, G2G4)
- *Achnatherum hymenoides* Colorado Plateau Herbaceous Vegetation (CEGL002343, GNR)
- *Achnatherum lettermanii - Oxytropis oreophila* Herbaceous Vegetation (CEGL002734, G2?)
- *Achnatherum nelsonii - Koeleria macrantha* Herbaceous Vegetation (CEGL001707, GNR)
- *Achnatherum speciosum* Herbaceous Vegetation (CEGL003112, G1Q)
- *Aristida purpurea* Herbaceous Vegetation (CEGL005800, GNR)
- *Aristida purpurea var. longiseta - Poa secunda* Herbaceous Vegetation (CEGL001781, G3)
- *Aristida purpurea var. longiseta - Pseudoroegneria spicata - Sporobolus cryptandrus* Herbaceous Vegetation (CEGL001589, G2)
- *Aristida purpurea var. longiseta - Sporobolus cryptandrus* Herbaceous Vegetation (CEGL001515, G1)
- *Atriplex obovata / Sporobolus airoides - Pleuraphis jamesii* Shrub Herbaceous Vegetation (CEGL001775, GU)
- *Bouteloua eriopoda - Hesperostipa neomexicana* Herbaceous Vegetation (CEGL001753, GNRQ)
- *Bouteloua eriopoda - Pleuraphis jamesii* Herbaceous Vegetation (CEGL001751, G3)
- *Bouteloua eriopoda* Coconino Plateau Shrub Herbaceous Vegetation (CEGL002787, GNR)
- *Bouteloua eriopoda* Semi-desert Herbaceous Vegetation (CEGL001752, G2Q)
- *Bouteloua gracilis - Bouteloua curtipendula* Herbaceous Vegetation (CEGL001754, G5)
- *Bouteloua gracilis - Bouteloua hirsuta* Herbaceous Vegetation (CEGL001755, G3G4)
- *Bouteloua gracilis - Pleuraphis jamesii* Herbaceous Vegetation (CEGL001759, G2G4)
- *Bouteloua gracilis - Sporobolus cryptandrus* Herbaceous Vegetation (CEGL001761, GNRQ)
- *Bouteloua gracilis* Herbaceous Vegetation (CEGL001760, G4Q)
- *Bouteloua hirsuta - Bouteloua radicosa* Herbaceous Vegetation (CEGL001765, G2)

- *Elymus lanceolatus* Herbaceous Vegetation (CEGL002588, GNR)
- *Ericameria nauseosa / Bouteloua gracilis* Shrub Herbaceous Vegetation (CEGL003495, GNR)
- *Gutierrezia sarothrae - Krascheninnikovia lanata - Atriplex canescens / Bouteloua eriopoda* Shrub Herbaceous Vegetation (CEGL001733, G2)
- *Hesperostipa comata - (Bouteloua eriopoda, Pleuraphis jamesii)* Herbaceous Vegetation (CEGL002997, GNR)
- *Hesperostipa comata - Achnatherum hymenoides* Herbaceous Vegetation (CEGL001703, G2?)
- *Hesperostipa comata* Great Basin Herbaceous Vegetation (CEGL001705, G2G4)
- *Hesperostipa neomexicana* Herbaceous Vegetation (CEGL001708, G3)
- *Muhlenbergia asperifolia* Herbaceous Vegetation (CEGL001779, GU)
- *Muhlenbergia pungens* Herbaceous Vegetation (CEGL002363, GNR)
- *Pascopyrum smithii* Herbaceous Vegetation (CEGL001577, G3G5Q)
- *Pleuraphis jamesii* Herbaceous Vegetation (CEGL001777, G2G4)
- *Pleuraphis rigida* Herbaceous Vegetation (CEGL003051, G3G4)
- *Poa cusickii* Herbaceous Vegetation (CEGL001655, G2)
- *Poa secunda - Muhlenbergia richardsonis* Herbaceous Vegetation (CEGL002755, GNR)
- *Poa secunda* Herbaceous Vegetation (CEGL001657, G4?)
- *Pseudoroegneria spicata - Achnatherum hymenoides* Herbaceous Vegetation (CEGL001674, G3G4)
- *Pseudoroegneria spicata - Hesperostipa comata* Herbaceous Vegetation (CEGL001679, G4)
- *Pseudoroegneria spicata - Poa secunda* Herbaceous Vegetation (CEGL001677, G4?)
- *Pseudoroegneria spicata* Herbaceous Vegetation (CEGL001660, G2)
- *Pseudoroegneria spicata ssp. inermis* Herbaceous Vegetation (CEGL001661, GNR)
- *Sphaeralcea (coccinea, parvifolia)* Herbaceous Vegetation (CEGL005366, GNR)
- *Sporobolus airoides - Bouteloua gracilis* Herbaceous Vegetation (CEGL001686, GNRQ)
- *Sporobolus airoides* Monotype Herbaceous Vegetation (CEGL001688, GUQ)
- *Sporobolus airoides* Southern Plains Herbaceous Vegetation (CEGL001685, G3Q)
- *Sporobolus cryptandrus - Poa secunda* Herbaceous Vegetation (CEGL001516, G2)
- *Sporobolus cryptandrus* Great Basin Herbaceous Vegetation (CEGL002691, GNR)
- *Sporobolus cryptandrus* Shrub Herbaceous Vegetation (CEGL001514, G2)

DISTRIBUTION

Range: This system occurs throughout the intermountain western U.S. on dry plains and mesas, at approximately 1450 to 2320 m (4750-7610 feet) elevation. In the Bighorn Basin of north-central Wyoming, there may be some desert grasslands, but this is uncertain.
Divisions: 304:C; 306:C
Nations: US
Subnations: AZ, CA, CO, ID, MT?, NM, NV, OR, UT, WA, WY
Map Zones: 6:P, 7:C, 8:C, 9:C, 12:C, 13:C, 14:P, 15:C, 16:C, 17:C, 18:C, 22:C, 23:C, 24:C, 25:C, 26:?, 28:C, 29:?
USFS Ecomap Regions: 313A:CC, 313B:CC, 313C:CC, 313D:CC, 315A:CC, 315H:CC, 321A:CC, 322A:CC, 331A:CC, 331J:CC, 341A:CC, 341B:CC, 341C:CC, 341D:CC, 341E:CC, 341F:CC, 341G:CC, 342B:CC, 342C:CC, 342D:CC, 342E:CC, 342F:CC, 342G:CC, 342H:CC, 342I:CC, 342J:CC, M242C:CC, M242D:CP, M261E:CC, M261G:CC, M313A:CC, M313B:CC, M331A:CC, M331B:C?, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CP, M331J:CP, M332G:CC, M333A:??, M341A:CC, M341B:CC, M341C:CC, M341D:CC
TNC Ecoregions: 4:C, 6:C, 8:C, 9:C, 10:C, 11:C, 18:C, 19:C, 20:C, 21:C

SOURCES

References: Anderson 2009, Cable 1967, Cable 1969, Cable 1975b, CNHP 2010b, Comer et al. 2003, Dodd and Coupland 1966, Howard 1997a, Howard 1997b, Johnson 2000c, Kleiner and Harper 1977, Landfire 2007a, Mast et al. 1997, Mast et al. 1998, McClaran and Van Devender 1995, Pellant 1990, Pellant 1996, Quinn 2004, Sawyer et al. 2009, Shiflet 1994, Simonin 2000a, Simonin 2000b, Simonin 2000c, Tirmenstein 1999e, TNC 2013, Tuhy et al. 2002, Ungar 1968, USDA-APHIS 2003, USDA-APHIS 2010, USFS 1937, Vander Haegen et al. 2000, Vander Haegen et al. 2001, Weaver and Albertson 1956, West 1983e, West et al. 1972, WNHP 2011, Zlatnik 1999a, Zlatnik 1999b
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722885#references
Description Author: NatureServe Western Ecology Team, mod. G.P. Jones
Version: 14 Jan 2014 **Stakeholders:** West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

LOWER MISSISSIPPI ALLUVIAL PLAIN GRAND PRAIRIE (CES203.549)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Herbaceous; Deep Soil
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2432; ESLF 7145; ESP 1432

CONCEPT

Summary: This system of prairies and woodlands occurs on the oldest land surfaces in the Mississippi River Alluvial Valley and the highest land surface in the river deposited portions of the ecoregion (EPA Ecoregion 73). It occupies a very flat region up to 20 miles wide and 60 miles long bounded by present day rivers, especially the Arkansas and White, which are much lower in elevation than the Grand Prairie terrace (Subsection 234Ae). This terrace is covered with thin soils underlain be deep layers of impervious clay. The surface soils have been considered to be loess by some sources but are more likely silts and silty clays (T. Foti pers. comm.). Although productive, these soils are droughty due to the impervious clay subsoils. The combination of droughty soils, very flat topography, and the lack of major stream corridors in the region create conditions suitable to the ignition and spread of fires. Almost annual fires would have been necessary to maintain these prairies, and anthropogenic influences have been critical for probably 5000 years. Typical examples are dominated by *Panicum virgatum* and *Andropogon gerardii*. The vegetation includes both wet and dry prairies as well as "slashes" dominated by *Fraxinus pennsylvanica* and *Crataegus* spp.
Classification Comments: There is little floristic and environmental overlap between the Grand Prairie and calcareous prairies of southern Arkansas and the Arkansas River Valley (Ecoregion 39) manifestations of Southeastern Great Plains Tallgrass Prairie (CES205.685).
Similar Ecological Systems:
- Lower Mississippi River Flatwoods (CES203.193)
- Southeastern Great Plains Tallgrass Prairie (CES205.685)
- Texas Blackland Tallgrass Prairie (CES205.684)

DESCRIPTION

Environment: This system occupies a very flat region up to 20 miles wide and 60 miles long bounded by present day rivers, especially the Arkansas and White, which are much lower in elevation than the Grand Prairie terrace (Subsection 234Ae). This terrace is covered with thin soils underlain be deep layers of impervious clay. The surface soils have been considered to be loess by some sources but are more likely silts and silty clays (T. Foti pers. comm.). Although productive, these soils are droughty due to the impervious clay subsoils. It occurs on the oldest land surfaces in the Mississippi River Alluvial Valley and the highest land surface in the river deposited portions of the ecoregion (EPA Ecoregion 73) (T. Foti pers. comm.).
Vegetation: Typical examples are dominated by *Panicum virgatum* and *Andropogon gerardii*. The vegetation includes both wet and dry prairies, as well as "slashes" dominated by *Fraxinus pennsylvanica* and *Crataegus* spp.
Dynamics: The combination of droughty soils, very flat topography, and the lack of major stream corridors in the region create conditions suitable to the ignition and spread of fires. Almost annual fires would have been necessary to maintain these prairies, and anthropogenic influences have been critical for probably 5000 years. The region is characterized by frequent surface fires, both lightning and anthropogenic in origin (Higgins 1986). Mixed fires occurred frequently in this BpS. Natural fires were possible during the dormant season through spring and during the late-growing season dependent on the availability of dry fine fuels sufficient to carry a fire. Prior to extirpation of bison, the fire-return interval was estimated to have been from 1 to 3 years based on observations of travelers through the region (Gregg 1844, Olmstead 1855). Historic accounts from later in the 1800s often depict very large landscape-scale burns where an entire landscape was described as burning (Irving 1935, Jackson 1965).

Component Associations:
- *Panicum virgatum - Andropogon gerardii* Grand Prairie Herbaceous Vegetation (CEGL007911, G2)
- *Panicum virgatum - Tripsacum dactyloides* Grand Prairie/Big Barrens Herbaceous Vegetation (CEGL004624, G2?)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Mississippi River Alluvial Plain Dry-Mesic Loess Slope Forest (CES203.071)

DISTRIBUTION

Range: Examples of this system occur on the oldest land surfaces in the Mississippi River Alluvial Valley and the highest land surface in the river deposited portions of the ecoregion (EPA Ecoregion 73) (T. Foti pers. comm.). It is confined to Subsection 234Ae (Keys et al. 1995).
Divisions: 203:C
Nations: US

Subnations: AR
Map Zones: 37:C, 45:C
USFS Ecomap Regions: 234Eb:CCC
TNC Ecoregions: 42:C

SOURCES

References: Comer et al. 2003, DeSelm and Murdock 1993, Duffey et al. 1974, Estes et al. 1979, Foti pers. comm., Gregg 1844, Higgins 1986, Irving 1935, Jackson 1965, Keys et al. 1995, LNHP 2004, McKinney and Lockwood 1999, Murdock pers. comm., Noss 2013, Olmsted 1855, Taft 1997, Taft 2009, Taft et al. 1995, TNC 1996c, Wiens and Dyer 1975

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723053#references

Description Author: R. Evans, mod. M. Pyne
Version: 14 Jan 2014
Concept Author: R. Evans

Stakeholders: Southeast
ClassifResp: Southeast

MEDITERRANEAN CALIFORNIA ALPINE DRY TUNDRA (CES206.939)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Alpine/AltiAndino [Alpine/AltiAndino]; Alpine Mosaic; Herbaceous; Temperate [Temperate Oceanic]; Udic; W-Landscape/High Intensity; Graminoid
Non-Diagnostic Classifiers: Late-lying snowpack; Ridge/Summit/Upper Slope; Sideslope; Glaciated; Shallow Soil; Forb
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2136; ESLF 7108; ESP 1136

CONCEPT

Summary: These dry meadows typically occur between 3200 and 4500 m (9700-13,600 feet) elevation in the northern Sierra Nevada, Klamath Mountains and Cascade Mountains. They are typically found on gentle to steep slopes, flat ridges and upper basins where the soil is thin and the water supply is constant and strongly regulated by snowpatch patterns. These sites are generally very well-drained and xeric once the snow melts. The system is commonly comprised of a mosaic of small-patch plant communities that are dominated by sedges, grasses and forbs. Characteristic species include *Phlox diffusa*, *Phlox covillei*, *Erigeron pygmaeus*, *Podistera nevadensis*, *Carex congdonii*, *Calamagrostis purpurascens*, *Eriogonum incanum*, *Raillardiopsis muirii (= Raillardella muirii)*, *Castilleja nana*, *Erigeron compositus*, *Eriogonum ovalifolium*, *Eriogonum gracilipes*, etc. There is a rocky mesic version of this system with *Hulsea algida*, *Saxifraga tolmiei*, *Carex helleri*, *Ranunculus eschscholtzii*, *Polemonium eximium*, *Salix reticulata* (rarely), *Oxyria digyna*, *Sibbaldia procumbens*, etc. that could be found near snowmelt patches generally on sheltered, steep, rocky slopes. Alpine dry tundra typically intermingles with alpine bedrock and scree, ice field, fell-field, alpine dwarf-shrubland, and alpine/subalpine wet meadows.

Related Concepts:
- Alpine Grassland (213) (Shiflet 1994) Broader. SRM type 213 includes all alpine communities in Sierra, Klamath and California Cascades, both herbaceous and shrub dominated, and wet meadows.

Component Associations:
- *Calamagrostis purpurascens - Leptodactylon pungens* Herbaceous Vegetation (CEGL008658, GNR)
- *Carex helleri - Eriogonum incanum - Raillardella argentea* Herbaceous Vegetation (CEGL003138, G3?)
- *Carex helleri - Saxifraga tolmiei - Luzula spicata* Herbaceous Vegetation (CEGL003139, G3?)

DISTRIBUTION

Range: This system occurs between 3200 and 4500 m (9700-13,600 feet) elevation in the northern Sierra Nevada, Klamath Mountains, and Cascade Mountains of California, Nevada and Oregon.
Divisions: 206:C
Nations: US
Subnations: CA, NV, OR
Map Zones: 3:?, 6:C, 7:C
USFS Ecomap Regions: M261D:CP, M261E:CC
TNC Ecoregions: 4:C, 5:C, 12:C

SOURCES

References: Barbour and Billings 2000, Barbour and Major 1988, Comer et al. 2003, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722742#references
Description Author: P. Comer, T. Keeler-Wolf
Version: 07 Oct 2005 **Stakeholders:** West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

MEDITERRANEAN CALIFORNIA SUBALPINE MEADOW (CES206.940)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Late-lying snowpack; Montane [Upper Montane]; Herbaceous; Ustic; W-Landscape/High Intensity
Non-Diagnostic Classifiers: Alpine Mosaic; Sideslope; Temperate [Temperate Oceanic]; Shallow Soil; Udic; Forb; Graminoid
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2137; ESLF 7109; ESP 1137

CONCEPT

Summary: This ecological system occurs at subalpine and montane elevations where finely textured soils, snow deposition, or windswept dry conditions limit tree establishment. It is typically found above 3000 m (9100 feet) elevation in California, western Nevada and Oregon. The soils in these sites can be seasonally moist to saturated in the spring but, if so, will dry out later in the growing season, and overall these are mesic to dry meadows, not wet. Characteristic plant species include *Achillea millefolium var. occidentalis (= Achillea lanulosa)*, *Artemisia rothrockii*, *Oreostemma alpigenum (= Aster alpigenus)*, *Calamagrostis breweri*, *Cistanthe umbellata (= Calyptridium umbellatum)*, *Carex exserta*, *Eriogonum incanum*, *Horkeliella purpurascens (= Ivesia purpurascens)*, and *Trisetum spicatum*. Burrowing mammals can increase the forb diversity. Herbs can include *Carex subnigricans*, *Carex vernacula*, *Calamagrostis breweri*, *Antennaria media*, *Potentilla drummondii*, *Lewisia pygmaea*, *Erigeron algidus*, *Lupinus lepidus*, *Dodecatheon alpinum*, and *Solidago multiradiata*. Wet meadows of *Carex*, *Calamagrostis*, *Camassia*, *Eleocharis*, *Juncus*, *Veratrum*, etc. from montane to subalpine are treated in Temperate Pacific Subalpine-Montane Wet Meadow (CES200.998).
Related Concepts:
- Montane Meadows (216) (Shiflet 1994) Broader

Component Associations:
- *Calamagrostis breweri - Juncus drummondii* Herbaceous Vegetation (CEGL008656, GNR)
- *Calamagrostis breweri - Oreostemma alpigenum* Herbaceous Vegetation (CEGL008654, GNR)
- *Calamagrostis breweri - Trisetum spicatum* Herbaceous Vegetation (CEGL008657, GNR)

DISTRIBUTION

Range: This system occurs at subalpine elevations where finely textured soils, snow deposition, or windswept dry conditions limit tree establishment, typically above 3000 m (9100 feet) in elevation in California, Nevada and Oregon.
Divisions: 206:C
Nations: US
Subnations: CA, NV, OR
Map Zones: 2:C, 3:C, 4:P, 6:C, 7:C
USFS Ecomap Regions: M242B:CC, M242C:CC, M261A:CC, M261D:CC, M261E:CC, M261G:CP
TNC Ecoregions: 4:P, 5:P, 12:C

SOURCES

References: Barbour and Billings 2000, Barbour and Major 1988, Comer et al. 2003, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722741#references
Description Author: P. Comer, T. Keeler-Wolf, mod. M.S. Reid
Version: 16 Jan 2009
Stakeholders: West
Concept Author: P. Comer, T. Keeler-Wolf
ClassifResp: West

NORTH PACIFIC ALPINE AND SUBALPINE DRY GRASSLAND (CES204.099)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Alpine/AltiAndino [Alpine/AltiAndino]; Montane [Upper Montane]; Herbaceous; Deep Soil; Ustic; Intermediate Disturbance Interval; Graminoid; Tussock-forming grasses
Non-Diagnostic Classifiers: Temperate [Temperate Continental]; Mineral: W/ A-Horizon <10 cm; F-Patch/Low Intensity
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2171; ESLF 7157; ESP 1171

CONCEPT

Summary: This high-elevation, grassland system is dominated by perennial grasses and forbs found on dry sites, particularly south-facing slopes, typically imbedded in or above subalpine forests and woodlands. Disturbance such as fire also plays a role in maintaining these open grassy areas, although drought and exposed site locations are primary characteristics limiting tree growth. It is most extensive in the eastern Cascades, although it also occurs in the Olympic Mountains. Alpine and subalpine dry grasslands are small openings to large open ridges above or drier than high-elevation conifer trees. In general, soil textures are much finer, and soils are often deeper under grasslands than in the neighboring forests. These grasslands, although composed primarily of tussock-forming species, do exhibit a dense sod that makes root penetration difficult for tree species. Typical dominant species include *Festuca idahoensis*, *Festuca viridula*, and *Festuca roemeri* (the latter species occurring only in the Olympic Mountains). This system is similar to Northern Rocky Mountain Subalpine-Upper Montane Grassland (CES306.806), differing in its including dry alpine habitats, more North Pacific floristic elements, greater snowpack, and higher precipitation.

Similar Ecological Systems:
- Northern Rocky Mountain Subalpine-Upper Montane Grassland (CES306.806)

Related Concepts:
- Green Fescue (103) (Shiflet 1994) Broader
- SG Subalpine Grassland (Ecosystems Working Group 1998) Broader

Component Associations:
- *Festuca roemeri - Delphinium glareosum* Herbaceous Vegetation (CEGL001613, G2)
- *Festuca roemeri - Phlox diffusa ssp. longistylis* Herbaceous Vegetation (CEGL001622, G2)
- *Festuca rubra* Montane Herbaceous Vegetation (CEGL001568, G2Q)
- *Festuca viridula - Eucephalus ledophyllus* Herbaceous Vegetation (CEGL001632, G4)
- *Festuca viridula - Festuca idahoensis* Herbaceous Vegetation (CEGL001633, G2?Q)
- *Festuca viridula - Lupinus latifolius* Herbaceous Vegetation (CEGL001635, G4)

DISTRIBUTION

Range: This system occurs only in the Pacific Northwest mountains (Coastal and westside Cascadian).
Divisions: 204:C; 306:C
Nations: CA? , US
Subnations: BC?, OR?, WA
Map Zones: 1:C, 2:?, 7:C
USFS Ecomap Regions: 342I:CC, M242B:CC, M242C:CC, M242D:CC
TNC Ecoregions: 1:C, 3:C, 4:C, 81:C

SOURCES

References: Ecosystems Working Group 1998, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.769638#references
Description Author: R. Crawford
Version: 31 Mar 2005
Concept Author: R. Crawford
Stakeholders: Canada, West
ClassifResp: West

NORTH PACIFIC HERBACEOUS BALD AND BLUFF (CES204.089)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Herbaceous; Ridge/Summit/Upper Slope; Bluff
National Mapping Codes: ESLF 7162

CONCEPT

Summary: This system consists of mostly herbaceous-dominated areas located primarily on shallow soils from eastern Vancouver Island and the Georgia Basin south to at least the southern end of the Willamette Valley and adjacent slopes of the Coast Ranges and western Cascades, excluding areas adjacent to the outer coastline (hypermaritime climate). They are largely, if not completely, absent from the windward side of Vancouver Island, the Olympic Peninsula, and the Coast Ranges of Washington and Oregon. Due to shallow soils, steep slopes, sunny aspect, and/or upper slope position, these sites are dry and marginal for tree establishment and growth except in favorable microsites. Rock outcrops are a typical small-scale feature within balds and are considered part of this system. Sites with many favorable microsites can have a "savanna" type structure with a sparse tree layer of *Pseudotsuga menziesii* or, less commonly, *Quercus garryana*. The climate is relatively dry to wet (20 to perhaps 100 inches annual precipitation), always with a distinct dry summer season when these sites usually become droughty enough to limit tree growth and establishment. Seeps are a frequent feature in many balds and result in vernally moist to wet areas within the balds that dry out by summer. Vegetation differences are associated with relative differences in soil moisture. Most sites have little snowfall, but sites in the *Abies amabilis* zone (montane *Tsuga heterophylla* in British Columbia) can have significant winter snowpacks. Snowpacks would be expected to melt off sooner on these sunny aspect sites than surrounding areas. Fog and salt spray probably have some influence (but less than in the hypermaritime) on exposed slopes or bluffs adjacent to saltwater shorelines in the Georgia Basin, where soils on steep coastal bluffs sometime deviate from the norm and are deep glacial deposits. Slightly to moderately altered serpentine soils occur rarely. Fires, both lightning-ignited and those ignited by Native Americans, undoubtedly at least occasionally burn all these sites. Lower elevation sites in the Georgia Basin, Puget Trough, and Willamette Valley probably were burned somewhat more frequently and in some cases intentionally. Because of this fire history, the extent of this system has declined locally through tree invasion and growth, as areas formerly maintained herbaceous by burning have filled in with trees.

Grasslands are the most prevalent vegetation cover, though forblands are also common especially in the mountains. Dwarf-shrublands occur commonly, especially in mountains or foothills, as very small patches for the most part, usually in a matrix of herbaceous vegetation, most often near edges. Dominant or codominant native grasses include *Festuca roemeri, Danthonia californica, Achnatherum lemmonii, Festuca rubra* (near saltwater), and *Koeleria macrantha*. Forb diversity can be high. Some typical codominant forbs include *Camassia quamash, Camassia leichtlinii, Triteleia hyacinthina, Mimulus guttatus* (seeps), *Plectritis congesta, Lomatium martindalei, Allium cernuum*, and *Phlox diffusa* (can be considered a dwarf-shrub). Important dwarf-shrubs are *Arctostaphylos uva-ursi, Arctostaphylos nevadensis*, and *Juniperus communis*. Small patches and strips dominated by the shrub *Arctostaphylos columbiana* are a common feature nested within herbaceous balds. Significant portions of some balds, especially on rock outcrops, are dominated by bryophytes (mosses) and to a lesser degree lichens.

Component Associations:
- *Achnatherum lemmonii / Racomitrium canescens* Herbaceous Vegetation (CEGL001800, G1)
- *Danthonia californica* Valley Grassland Herbaceous Vegetation (CEGL001598, G1Q)
- *Festuca roemeri - Cerastium arvense - Koeleria macrantha* Herbaceous Vegetation (CEGL003349, G1)
- *Festuca rubra - (Camassia leichtlinii, Grindelia stricta var. stricta)* Herbaceous Vegetation (CEGL003347, G1)
- *Festuca rubra* Montane Herbaceous Vegetation (CEGL001568, G2Q)
- *Lomatium martindalei* Herbaceous Vegetation (CEGL001972, G2)

DISTRIBUTION

Range: This system occurs in the Willamette Valley, Puget Trough, Georgia Basin, eastern and northern Olympic Mountains, eastern side of Vancouver Island, western and northwestern Cascades of Washington, probably on the leeward side of the Coast Mountains in British Columbia (submaritime climates)?, Old Cascades of western Oregon, and Oregon Coast Ranges (but not the coast itself).
Divisions: 204:C
Nations: CA, US
Subnations: BC, OR, WA
Map Zones: 1:C, 2:C, 7:C
USFS Ecomap Regions: 242A:CC, 242B:C?, M242A:CC, M242B:CC, M242C:CP, M242D:CC
TNC Ecoregions: 1:C, 2:C, 3:P, 81:C

SOURCES

References: Chappell and Christy 2004, Franklin and Dyrness 1973, Western Ecology Working Group n.d.

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.768130#references
Description Author: C. Chappell, mod. M.S. Reid
Version: 04 Apr 2005 **Stakeholders:** Canada, West
Concept Author: C. Chappell **ClassifResp:** West

NORTH PACIFIC HYPERMARITIME SHRUB AND HERBACEOUS HEADLAND (CES204.088)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Herbaceous; Ridge/Summit/Upper Slope; Bluff
National Mapping Codes: ESLF 7161

CONCEPT

Summary: This system consists of herbaceous- and shrub-dominated areas directly adjacent to the outer Pacific Coast from central Oregon north to Vancouver Island. These are very windy sites where wind and salt spray combine to limit tree growth. The climate is very wet, relatively warm in winter, and cool and foggy. In Oregon, fires apparently set by Native Americans also contributed to the open character of many of these sites. The relative prevalence of grasslands versus shrublands increases to the south. Steep slopes on coastal bluffs, headlands, or small islands are typical, though sometimes this system occurs on relatively level tops of headlands or islands. Soils can be shallow to bedrock or of glacial or marine sediment origin. Vegetation is dominated by perennial bunch grasses or shrubs. Dominant species include *Vaccinium ovatum, Gaultheria shallon, Rubus spectabilis, Calamagrostis nutkaensis,* and *Festuca rubra*. Scattered stunted trees, especially *Picea sitchensis*, are often present.
Classification Comments: California Northern Coastal Grassland (CES206.941) is somewhat similar to the grassland part of this but is more extensive (larger patches) and extends further inland and higher in elevation. In southern Oregon, the climate gets warmer and drier and the grasslands start climbing well up into the hills, picking up some southern elements of vegetation. Probably corresponds with where Northern California Coastal Scrub (CES206.932) starts also, somewhere south of Coos Bay.
Similar Ecological Systems:
- California Northern Coastal Grassland (CES206.941)

Related Concepts:
- North Coastal Shrub (204) (Shiflet 1994) Broader. This system includes portions of the SRM type that occur along coast of Oregon and Washington, particularly *Gaultheria shallon* and *Vaccinium* shrublands.

Component Associations:
- *Calamagrostis nutkaensis - Elymus glaucus* Herbaceous Vegetation (CEGL001564, G2)
- *Danthonia californica - Festuca rubra* Herbaceous Vegetation (CEGL001597, G2)
- *Empetrum nigrum - Gaultheria shallon* Dwarf-shrubland (CEGL000971, G2)
- *Festuca rubra* Coastal Headland Herbaceous Vegetation (CEGL001567, G2)
- *Lomatium martindalei* Herbaceous Vegetation (CEGL001972, G2)

DISTRIBUTION

Range: This system occurs from the southern Oregon coast north to Vancouver Island.
Divisions: 204:C
Nations: CA, US
Subnations: BC, OR, WA
Map Zones: 1:C, 2:C
USFS Ecomap Regions: 242A:CC, M242A:CC, M242D:CP, M261A:??
TNC Ecoregions: 1:C

SOURCES

References: Chappell and Christy 2004, Franklin and Dyrness 1973, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.768124#references
Description Author: C. Chappell and K. Boggs, mod. M.S. Reid
Version: 04 Apr 2005 **Stakeholders:** Canada, West
Concept Author: C. Chappell and K. Boggs **ClassifResp:** West

NORTH PACIFIC INTERIOR DRY GRASSLAND (CES207.389)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Warm Continental (207)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
National Mapping Codes: ESLF 7183

CONCEPT

Summary: This ecological system encompasses grasslands of the central, dry interior of British Columbia, dominated by *Pseudoroegneria spicata*, *Elymus trachycaulus*, *Calamagrostis purpurascens*, *Calamagrostis rubescens*, and *Koeleria macrantha*. *Pulsatilla occidentalis* may be codominant in some areas, other areas may have significant shrub cover, such as *Artemisia* spp. or *Amelanchier alnifolia*. Stunted *Populus tremuloides* and *Pinus contorta* are often present. These grasslands are common on south-facing slopes, and are maintained by a combination of dry and nutrient rich soils and frequent fire.
Classification Comments: This ecological system was developed for the purpose of capturing the coarse filter of terrestrial biodiversity in the interior of British Columbia Ecoregional Assessment, conducted by The Nature Conservancy of Canada, with NatureServe's assistance. This system was designed to be equivalent to those developed for neighboring ecoregions: Canadian Rocky Mountains (7), Okanagan (68), Alaska Coastal Forest and Mountains (69), and the North Cascades (3).
Related Concepts:

- Big sage - Pinegrass (MSxk/04) (Steen and Coupe 1997) Intersecting
- Bluebunch wheatgrass - Junegrass (MSxk/03) (Steen and Coupe 1997) Intersecting
- Bluebunch wheatgrass - Pasqueflower (ESSFxc/03) (Steen and Coupe 1997) Intersecting
- Bluegrass - Slender wheatgrass (SBSdk/82) (Steen and Coupe 1997) Intersecting
- Bluegrass - Slender wheatgrass (SBSdk/82) (DeLong et al. 1993) Intersecting
- Bluegrass - Slender wheatgrass (SBSdk/82) (Banner et al. 1993) Intersecting
- Bluejoint - Sedge (ESSFxc/09) (Steen and Coupe 1997) Intersecting
- Grassland/scrub (BWBSdk1/81) (MacKinnon et al. 1990) Intersecting
- Grassland/scrub (BWBSdk1/81) (Banner et al. 1993) Intersecting
- Grassland/scrub (BWBSdk2/81) (Banner et al. 1993) Intersecting
- Pinegrass - Meadowrue (ESSFxc/04) (Steen and Coupe 1997) Intersecting
- Saskatoon - Slender wheatgrass (SBSdk/81) (Steen and Coupe 1997) Intersecting
- Saskatoon - Slender wheatgrass (SBSdk/81) (Banner et al. 1993) Intersecting
- Saskatoon - Slender wheatgrass (SBSdk/81) (DeLong et al. 1993) Intersecting

DISTRIBUTION

Range: This ecological system occurs entirely within central interior British Columbia.
Divisions: 207:C
Nations: CA
Subnations: BC
TNC Ecoregions: 144:C

SOURCES

References: Banner et al. 1993, DeLong et al. 1993, MacKinnon et al. 1990, Steen and Coupe 1997, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.820978#references
Description Author: G. Kittel
Version: 26 Jan 2009
Concept Author: G. Kittel
Stakeholders: Canada, West
ClassifResp: West

NORTH PACIFIC MONTANE GRASSLAND (CES204.100)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Herbaceous; Temperate [Temperate Oceanic]; Mesotrophic Soil; Shallow Soil; Intermediate Disturbance Interval; F-Patch/Low Intensity
Non-Diagnostic Classifiers: Montane [Upper Montane]; Montane [Montane]; Ustic
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2138; ESLF 7110; ESP 1138

CONCEPT

Summary: This ecological system includes open dry meadows and grasslands on the west side of the Cascades Mountains and northern Sierra Nevada. They occur in montane elevations up to 3500 m (10,600 feet). Soils tend to be deeper and more well-drained than the surrounding forest soils. Soils can resemble prairie soils in that the A-horizon is dark brown, relatively high in organic matter, slightly acidic, and usually well-drained. Dominant species include *Elymus* spp., *Festuca idahoensis*, and *Nassella cernua*. These large-patch grasslands are intermixed with matrix stands of red fir, lodgepole pine, and dry-mesic mixed conifer forests and woodlands.
Classification Comments: Upon review, Washington Heritage ecologists determined this system does not occur in Washington. Review in November 2008 suggests this ecological system should be lumped with Mediterranean California Subalpine Meadow (CES206.940) and that system be redefined to include the small patches of dry montane grasslands found in the Sierras and southern Cascades. For now, we've retained this as a system pending further review and comment from California ecologists.
Related Concepts:
- Idaho Fescue (102) (Shiflet 1994) Intersecting

DISTRIBUTION

Range: This system is found on the west side of the Cascades Mountains and northern Sierra Nevada, in montane elevations up to 3500 m (10,600 feet).
Divisions: 204:C; 206:C
Nations: US
Subnations: CA, NV, OR
Map Zones: 1:C, 2:C, 3:C, 6:C, 7:C, 12:P
USFS Ecomap Regions: 242A:CC, 341D:CC, 342B:CP, 342I:CC, M242A:CC, M242B:CC, M242C:CC, M242D:CC, M261D:CP, M261E:CC, M261G:CP, M331D:CC, M332G:CC
TNC Ecoregions: 5:P, 12:C, 81:C

SOURCES

References: Barbour and Major 1988, Comer et al. 2003, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722705#references
Description Author: P. Comer, G. Kittel
Version: 24 Mar 2003 **Stakeholders:** West
Concept Author: P. Comer, G. Kittel **ClassifResp:** West

NORTH-CENTRAL INTERIOR SAND AND GRAVEL TALLGRASS PRAIRIE (CES202.695)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Non-Diagnostic Classifiers: Esker; Kame; Lakeplain; Moraine; Outwash plain; Outwash terrace; Herbaceous; Glaciated; Sand Soil Texture; F-Patch/High Intensity; W-Patch/High Intensity
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2412; ESLF 7125; ESP 1412

CONCEPT

Summary: This system is found in the northern Midwest, particularly in Minnesota, Wisconsin, Michigan, and possibly ranging into Ontario. It is often found on glacial features such as kames, eskers, moraines, lakeplains (though excluding the Great Lakes lakeplain) and sandplains, and along eolian dunes. In contrast to the deeper, richer soils supporting other tallgrass systems in the region, the underlying soils in this system tend to be more shallow, sandy, rocky, and/or gravelly outwash soils. Organic content is significantly lower. Grassland species such as *Schizachyrium scoparium*, *Andropogon gerardii*, and *Bouteloua* spp., varying in cover from sparse to moderately dense, dominate this system. *Hesperostipa spartea* and *Sporobolus heterolepis* are also common components of this system. Woody species more tolerant of droughty conditions may be found in some examples. The most common trees are *Pinus banksiana*, *Quercus ellipsoidalis*, *Quercus macrocarpa*, and *Populus tremuloides*. Fire and drought are the major dynamics influencing this system. If fire and periodic drought are not present, woody species begin to invade this system, especially in the eastern parts of its distribution. Wind can also play a role, especially on examples found on sandplains and/or eolian dunes.

DESCRIPTION

Environment: This system is often found on glacial features such as kames, eskers, moraines, lakeplains (though excluding the Great Lakes lakeplain), and sandplains, and along eolian dunes and river deltas. In contrast to the deeper, richer soils supporting other tallgrass systems in the region, the underlying soils in this system tend to be more shallow, sandy, rocky, and/or gravelly soils. Soil texture is sand or sandy loam. Organic content and soil moisture retention are significantly lower than the more mesic grasslands.
Vegetation: Grassland species such as *Schizachyrium scoparium*, *Andropogon gerardii*, and *Bouteloua* spp., varying in cover from sparse to moderately dense, dominate this system. *Hesperostipa spartea* and *Sporobolus heterolepis* are also common components of this system. Woody species more tolerant of droughty conditions may be found in some examples. The most common trees are *Pinus banksiana*, *Quercus ellipsoidalis*, *Quercus macrocarpa*, and *Populus tremuloides*.
Dynamics: Fire and drought are the major dynamics influencing this system. If fire and periodic drought are not present, woody species begin to invade this system, especially in the eastern parts of its distribution. Fire-return intervals were likely 1-8 years (Landfire 2007a). Drier examples of this system likely could not be maintained in the presence of long-term short fire-return intervals due to the lower fertility of the soils. The typical dominant perennial grasses would not have time to recover from repeated burning and shorter-lived opportunistic species could dominate (Loucks et al. 1985). These sites were maintained as grasslands by the dry soil conditions possibly supplemented by low-frequency fires, while other areas required fire to eliminate invasion by woody species. Wind can also play a role, especially on examples found on sandplains and/or eolian dunes or during droughts when vegetation cover is low. Blowouts can form, exposing bare sand (Burgess 1965). Productivity is lower on this system than on other tallgrass prairies, so vegetation responds more slowly to disturbance. This system can not persist with the same frequency of reductions in vegetation cover by fire, grazing, drought, or mowing as richer prairies can.

Component Associations:
- *Andropogon gerardii - Calamagrostis canadensis* Sand Herbaceous Vegetation (CEGL005177, G2G3)
- *Andropogon gerardii - Sorghastrum nutans - Schizachyrium scoparium - Aletris farinosa* Herbaceous Vegetation (CEGL005096, G2)
- *Schizachyrium scoparium - Bouteloua curtipendula* Gravel Herbaceous Vegetation (CEGL002215, G3)
- *Schizachyrium scoparium - Bouteloua* spp. - *Hesperostipa spartea* Gravel Herbaceous Vegetation (CEGL002499, G2G3)
- *Schizachyrium scoparium - Danthonia spicata - Carex pensylvanica - (Viola pedata)* Herbaceous Vegetation (CEGL002318, G2G3)
- *Schizachyrium scoparium - Hesperostipa spartea - Bouteloua (curtipendula, gracilis)* Sand Herbaceous Vegetation (CEGL005204, G2G3)
- *Schizachyrium scoparium - Sorghastrum nutans - Andropogon gerardii - Lespedeza capitata* Sand Herbaceous Vegetation (CEGL002210, G3)

DISTRIBUTION

Range: This system is found in the northern Midwest possibly ranging into Ontario.
Divisions: 202:C; 205:P
Nations: CA, US

Subnations: IA, IL, IN, MI, MN, MO, ND, ON, SD, WI
Map Zones: 39:C, 40:C, 41:P, 42:C, 43:P, 49:P, 50:C, 51:C, 52:C
USFS Ecomap Regions: 212Ha:CCC, 212Hb:CCC, 212Hc:CCC, 212Hd:CCC, 212He:CCC, 212Hf:CCC, 212Hg:CCC, 212Hh:CCP, 212Hi:CCC, 212Hk:CCC, 212Hm:CCP, 212K:CP, 212M:CP, 212N:CP, 212Tb:CCC, 222Ja:CCC, 222Jb:CCC, 222Jc:CCC, 222Je:CCC, 222Jf:CCP, 222Jg:CCC, 222Jh:CCC, 222Ji:CCP, 222K:CC, 222L:CC, 222M:CC, 222N:CC, 222R:CP, 222Ua:CCC, 222Ud:CCP, 222Ue:CCP, 251A:CC, 251B:CC
TNC Ecoregions: 35:C, 36:P, 45:C, 46:C, 47:C, 48:C

SOURCES

References: Burgess 1965, Comer et al. 2003, Landfire 2007a, Loucks et al. 1985, MNNHP 1993, Samson and Knopf 1994, Thompson 1940
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722964#references
Description Author: S. Menard, mod. J. Drake
Version: 14 Jan 2014 **Stakeholders:** Canada, Midwest, Southeast
Concept Author: S. Menard **ClassifResp:** Midwest

NORTHERN ROCKY MOUNTAIN LOWER MONTANE, FOOTHILL AND VALLEY GRASSLAND (CES306.040)

CLASSIFIERS

Conf.: 3 - Weak **Classification Status:** Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland [Foothill]; Lowland [Lowland]; Herbaceous; Sideslope; Very Shallow Soil; Loam Soil Texture; Silt Soil Texture; Ustic; Landslide; Graminoid; Cool-season bunch grasses
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2139; ESLF 7112; ESP 1139

CONCEPT

Summary: This ecological system of the northern Rocky Mountains is found at lower montane to foothill elevations in the mountains and large valleys of northeastern Wyoming and western Montana, west through Idaho into the Blue Mountains of Oregon, and north into the Okanagan and Fraser plateaus of British Columbia and the Canadian Rockies. They also occur to the east in the central Montana mountain "islands," foothills, as well as the Rocky Mountain Front and Big and Little Belt ranges. These grasslands are floristically similar to Inter-Mountain Basins Big Sagebrush Steppe (CES304.778), Columbia Basin Foothill and Canyon Dry Grassland (CES304.993), and Columbia Basin Palouse Prairie (CES304.792), but are defined by shorter summers, colder winters, and young soils derived from recent glacial and alluvial material. These northern lower montane and valley grasslands represent a shift in the precipitation regime from summer monsoons and cold snowy winters found in the southern Rockies to predominantly dry summers and winter precipitation. In the eastern portion of its range in Montana, winter precipitation is replaced by a huge spring peak in precipitation. They are found at elevations from 300 to 1650 m, ranging from small meadows to large open parks surrounded by conifers in the lower montane, to extensive foothill and valley grasslands below the lower treeline. In the southern extent, some of these valleys may have been primarily sage-steppe with patches of grassland in the past, but because of land-use history post-settlement (herbicide, grazing, fire, pasturing, etc.), they have been converted to grassland-dominated areas. Soils are relatively deep, fine-textured, often with coarse fragments, and non-saline, often with a microphytic crust. The most important species are cool-season perennial bunch grasses and forbs (>25% cover), sometimes with a sparse (<10% cover) shrub layer. *Pseudoroegneria spicata, Festuca campestris*, *Festuca idahoensis*, or *Hesperostipa comata* commonly dominate sites on all aspects of level to moderate slopes and on certain steep slopes with a variety of other grasses, such as *Achnatherum hymenoides, Achnatherum richardsonii, Hesperostipa curtiseta, Koeleria macrantha, Leymus cinereus, Elymus trachycaulus, Bromus inermis ssp. pumpellianus (= Bromus pumpellianus), Achnatherum occidentale (= Stipa occidentalis), Pascopyrum smithii*, and other graminoids such as *Carex filifolia* and *Danthonia intermedia*. Other grassland species include *Opuntia fragilis, Artemisia frigida, Carex petasata, Antennaria* spp., and *Selaginella densa*. Important exotic grasses include *Phleum pratense, Bromus inermis*, and *Poa pratensis*. Shrub species may be scattered, including *Amelanchier alnifolia*, *Rosa* spp., *Symphoricarpos* spp., *Juniperus communis, Artemisia tridentata*, and in Wyoming *Artemisia tripartita ssp. rupicola*. Common associated forbs include *Geum triflorum, Galium boreale, Campanula rotundifolia, Antennaria microphylla, Geranium viscosissimum*, and *Potentilla gracilis*. A soil crust of lichen covers almost all open soil between clumps of grasses; *Cladonia* and *Peltigera* are the most common lichens. Unvegetated mineral soil is commonly found between clumps of grass and the lichen cover. The fire regime of this ecological system maintains a grassland due to rapid fire return that retards shrub invasion or landscape isolation and fragmentation that limits seed dispersal of native shrub species. Fire frequency is variable, but is presumed to be generally less than 20 years to reduce shrub cover and maintain grassland. These are extensive grasslands, not grass-dominated patches within the sagebrush shrub-steppe ecological system. *Festuca campestris* is easily eliminated by grazing and does not occur in all areas of this system.
Classification Comments: This is the same as the Interior Plateau Grassland also called "Northern Plateau Grassland" of the Okanagan Ecoregional Plan. In Wyoming, this is distinguished from Northwestern Great Plains Mixedgrass Prairie (CES303.674) by the presence of *Festuca idahoensis* or *Carex rossii*, the lack of *Bouteloua gracilis* (which is common in CES303.674), or the presence of *Artemisia nova* or *Artemisia tripartita ssp. rupicola*, neither of which occur in CES303.674.
Similar Ecological Systems:
- Columbia Basin Foothill and Canyon Dry Grassland (CES304.993)
- Columbia Basin Palouse Prairie (CES304.792)
- Inter-Mountain Basins Big Sagebrush Steppe (CES304.778)
- Inter-Mountain Basins Semi-Desert Grassland (CES304.787)
- Northern Rocky Mountain Subalpine-Upper Montane Grassland (CES306.806)

Related Concepts:
- Bluebunch Wheatgrass (101) (Shiflet 1994) Intersecting. Several SRM range types of northern Rocky Mtns correspond to this system.
- Bluebunch Wheatgrass - Blue Grama (301) (Shiflet 1994) Finer. Several SRM range types of northern Rocky Mtns correspond to this system.
- Bluebunch Wheatgrass - Sandberg Bluegrass (302) (Shiflet 1994) Finer. Several SRM range types of northern Rocky Mtns correspond to this system.

- Bluebunch Wheatgrass - Western Wheatgrass (303) (Shiflet 1994) Finer. Several SRM range types of northern Rocky Mtns correspond to this system.
- BS Bunchgrass Grassland (BCCDC unpubl. data) Undetermined
- Fescue Grassland (613) (Shiflet 1994) Intersecting. *Festuca campestris* grasslands are important components of this ecological system.
- Idaho Fescue (102) (Shiflet 1994) Intersecting
- Idaho Fescue - Bluebunch Wheatgrass (304) (Shiflet 1994) Broader
- Idaho Fescue - Richardson Needlegrass (305) (Shiflet 1994) Intersecting
- Idaho Fescue - Western Wheatgrass (309) (Shiflet 1994) Finer
- Needle-and-thread - Blue Grama (310) (Shiflet 1994) Finer
- no data (BGxh3/01) (Steen and Coupe 1997) Intersecting
- no data (BGxw2/01) (Steen and Coupe 1997) Intersecting
- Rough Fescue - Bluebunch Wheatgrass (311) (Shiflet 1994) Finer
- Rough Fescue - Idaho Fescue (312) (Shiflet 1994) Intersecting
- Shrubby Cinquefoil - Rough Fescue (323) (Shiflet 1994) Intersecting

DESCRIPTION

Environment: This system is found at lower montane to foothill elevations in the mountains and large valleys of northeastern Wyoming and western Montana, west through Idaho into the Blue Mountains of Oregon, and north into the Okanagan and Fraser plateaus of British Columbia and the Canadian Rockies. They also occur to the east in the central Montana mountain "islands" and foothills, as well as the Rocky Mountain Front Range and Big and Little Belt ranges. These grasslands are floristically similar to Inter-Mountain Basins Big Sagebrush Steppe (CES304.778), Columbia Basin Foothill and Canyon Dry Grassland (CES304.993), and Columbia Basin Palouse Prairie (CES304.792), but are defined by shorter summers, colder winters, and young soils derived from recent glacial and alluvial material. These lower montane and valley grasslands represent a shift in the precipitation regime from summer monsoons and cold snowy winters found in the Southern Rockies to predominantly dry summers and winter precipitation. In the eastern portion of its range in Montana, winter precipitation is replaced by a huge spring peak in precipitation. They are found at elevations from 300 to 1650 m, ranging from small meadows to large open parks surrounded by conifers in the lower montane, to extensive foothill and valley grasslands below the lower treeline. In the southern extent some of these valleys may have been primarily sage-steppe with patches of grassland in the past, but because of land-use history post-settlement (herbicide, grazing, altered fire regime, pasturing, etc.), they have been converted to grassland-dominated areas. Soils are relatively deep, fine-textured, often with coarse fragments, and non-saline, often with a microphytic crust.

Dynamics: These are extensive grasslands, not grass-dominated patches within the sagebrush shrub-steppe ecological system. *Festuca campestris* is easily eliminated by grazing and does not occur in all areas of this system. The most droughty sites produce little and discontinuous fuel and likely have much longer fire regimes. Isolation of grassland patches by fragmentation may also limit seed dispersal of native shrubs leading to persistence of the grassland. Soil drought and herbivory retard shrub and tree invasion resulting in a patchy distribution of shrubs and trees when present.

The high-frequency fire regime of this ecological system maintains a grassland due to rapid fire return that retards shrub invasion or landscape isolation and fragmentation that limits seed dispersal of native shrub species. Fire frequency is presumed to be less than 20 years generally. Johnson and Swanson (2005) presumed fire frequency to be less than 35 years in the Blue and Ochoco mountains of Oregon. Wikeem and Wikeem (2004) compiled average fire intervals for interior grasslands in British Columbia which range from 5-20 years. Klenner et al. (2008) research supports a fire regime of predominantly mixed-severity fires that maintain grasslands in the dry forest and grasslands ecotone in the southern interior of British Columbia.

Biological soil crust cover is important in these grasslands. It alters the composition of perennial species and increases the establishment of native disturbance-increasers and annual grasses, particularly *Bromus tectorum* and other exotic annual bromes (WNHP 2011). Crust cover and diversity are greatest where not impacted by trampling, other soil surface disturbance and fragmentation (Belnap et al. 2001, Rosentreter and Eldridge 2002, Tyler 2006).

Component Associations:
- *Achnatherum nelsonii - Lupinus sericeus* Herbaceous Vegetation (CEGL005860, G2G3)
- *Calamagrostis rubescens* Herbaceous Vegetation (CEGL005862, G3G4)
- *Festuca campestris - (Festuca idahoensis) - Achnatherum richardsonii* Herbaceous Vegetation (CEGL005869, G2G3)
- *Festuca campestris - Festuca idahoensis - Geranium viscosissimum* Herbaceous Vegetation (CEGL005870, G3?)
- *Festuca campestris - Festuca idahoensis* Herbaceous Vegetation (CEGL005875, G3)
- *Festuca campestris - Pseudoroegneria spicata* Herbaceous Vegetation (CEGL001629, G4)
- *Festuca idahoensis - Achnatherum richardsonii* Herbaceous Vegetation (CEGL001625, G3)
- *Festuca idahoensis - Carex filifolia* Herbaceous Vegetation (CEGL001898, G3)
- *Festuca idahoensis - Carex hoodii* Herbaceous Vegetation (CEGL001609, G3G4)
- *Festuca idahoensis - Eriogonum heracleoides* Herbaceous Vegetation (CEGL001616, G2)
- *Festuca idahoensis - Koeleria macrantha* Herbaceous Vegetation (CEGL001620, G3Q)
- *Festuca idahoensis - Leucopoa kingii* Herbaceous Vegetation (CEGL001901, G2?)
- *Festuca idahoensis - Pascopyrum smithii* Herbaceous Vegetation (CEGL001621, G4)
- *Festuca idahoensis - Pseudoroegneria spicata* Herbaceous Vegetation (CEGL001624, G4)

- *Festuca idahoensis* Herbaceous Vegetation (CEGL001897, G3Q)
- *Leymus salinus ssp. salmonis - Enceliopsis nudicaulis* Sparse Vegetation (CEGL001642, G2Q)
- *Leymus salinus ssp. salmonis - Lupinus argenteus* Sparse Vegetation (CEGL001643, G2Q)
- *Pseudoroegneria spicata - Carex filifolia* Herbaceous Vegetation (CEGL001665, G4)
- *Pseudoroegneria spicata - Eriogonum heracleoides* Herbaceous Vegetation (CEGL001668, G2Q)

DISTRIBUTION

Range: This lower montane, foothill and valley grassland system occurs throughout the southern interior and southern portion of the Fraser Plateau, as well as the valleys around the Fraser River in the Pavilion Ranges, the Nicola River and the Similkameen River in British Columbia. It also occurs in the mountains and large valleys of northwestern Wyoming and western Montana, east to the central Montana Rocky Mountain Front and mountain "island" ranges, west through Idaho into the Blue Mountains of Oregon.
Divisions: 207:C; 306:C
Nations: CA, US
Subnations: BC, ID, MT, OR, WA, WY
Map Zones: 1:C, 8:C, 9:C, 10:C, 18:C, 19:C, 20:C, 21:C, 22:C, 29:C
USFS Ecomap Regions: 331A:CP, 331D:CC, 331N:CC, 341G:CC, 342A:CC, 342B:CC, 342C:CC, 342D:CP, 342H:CC, 342I:CC, 342J:CC, M242C:CC, M242D:CC, M331A:CP, M331B:CC, M331J:CP, M332A:CC, M332B:CC, M332D:CC, M332E:CC, M332F:CC, M332G:CC, M333A:CC, M333B:CP, M333C:CC, M333D:CP, M341A:CC
TNC Ecoregions: 6:P, 7:C, 8:C, 9:P, 26:C, 68:C

SOURCES

References: BCCDC unpubl. data, Belnap et al. 2001, Darambazar et al. 2007, Ecosystems Working Group 1998, Johnson and Swanson 2005, Klenner et al. 2008, Landfire 2007a, Rosentreter and Eldridge 2002, Shiflet 1994, Steen and Coupe 1997, TNC 2013, Tyler 2006, Western Ecology Working Group n.d., Wikeem and Wikeem 2004, WNHP 2011
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.769647#references
Description Author: R. Crawford, mod. M.S. Reid, G. Kittel, K.A. Schulz
Version: 14 Jan 2014 **Stakeholders:** Canada, West
Concept Author: R. Crawford **ClassifResp:** West

NORTHERN ROCKY MOUNTAIN SUBALPINE-UPPER MONTANE GRASSLAND (CES306.806)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Upper Montane]; Herbaceous; Deep Soil; Ustic; Intermediate Disturbance Interval; Graminoid; Tussock-forming grasses
Non-Diagnostic Classifiers: Temperate [Temperate Continental]; Mineral: W/ A-Horizon <10 cm; F-Patch/Low Intensity
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2140; ESLF 7113; ESP 1140

CONCEPT

Summary: This is an upper montane to subalpine, high-elevation, lush grassland system dominated by perennial grasses and forbs on dry sites, particularly south-facing slopes. It is most extensive in the Canadian Rockies portion of the Rocky Mountain cordillera, extending south into western Montana, eastern Oregon, eastern Washington and Idaho. Subalpine dry grasslands are small meadows to large open parks surrounded by conifer trees but lack tree cover within them. In general, soil textures are much finer, and soils are often deeper under grasslands than in the neighboring forests. Grasslands, although composed primarily of tussock-forming species, do exhibit a dense sod that makes root penetration difficult for tree species. Disturbance such as fire also plays a role in maintaining these open grassy areas. Typical dominant species include *Leymus innovatus (= Elymus innovatus), Koeleria macrantha, Festuca campestris, Festuca idahoensis, Festuca viridula, Achnatherum occidentale (= Stipa occidentalis), Achnatherum richardsonii (= Stipa richardsonii), Bromus inermis ssp. pumpellianus (= Bromus pumpellianus), Elymus trachycaulus, Phleum alpinum, Trisetum spicatum*, and a variety of Carices, such as *Carex hoodii, Carex obtusata*, and *Carex scirpoidea*. Important forbs include *Lupinus argenteus var. laxiflorus, Potentilla diversifolia, Potentilla flabellifolia, Fragaria virginiana*, and *Chamerion angustifolium (= Epilobium angustifolium)*. This system is similar to Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland (CES306.040) but is found at higher elevations and is more often composed of species of *Festuca, Achnatherum*, and/or *Hesperostipa* with additional floristic components of more subalpine taxa. Occurrences of this system are often more forb-rich than Southern Rocky Mountain Montane-Subalpine Grassland (CES306.824).

Similar Ecological Systems:
- North Pacific Alpine and Subalpine Dry Grassland (CES204.099)
- Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland (CES306.040)

Related Concepts:
- Alpine Idaho Fescue (108) (Shiflet 1994) Finer
- Green Fescue (103) (Shiflet 1994) Broader
- Idaho Fescue - Bluebunch Wheatgrass (304) (Shiflet 1994) Intersecting
- Idaho Fescue - Richardson Needlegrass (305) (Shiflet 1994) Intersecting. This SRM type is described as occurring at "medium to high elevations", which suggests it primarily crosswalks to this system.
- Idaho Fescue - Slender Wheatgrass (306) (Shiflet 1994) Finer
- Idaho Fescue - Threadleaf Sedge (307) (Shiflet 1994) Finer
- Idaho Fescue - Tufted Hairgrass (308) (Shiflet 1994) Finer
- Rough Fescue - Idaho Fescue (312) (Shiflet 1994) Intersecting
- Tufted Hairgrass - Sedge (313) (Shiflet 1994) Intersecting. Drier portions of this SRM type overlap with this system.

Component Associations:
- *Calamagrostis rubescens* Herbaceous Vegetation (CEGL005862, G3G4)
- *Carex hoodii - Festuca idahoensis* Herbaceous Vegetation (CEGL001595, G2)
- *Festuca idahoensis - (Festuca campestris) / Potentilla diversifolia* Herbaceous Vegetation (CEGL001623, G3)
- *Festuca idahoensis - Carex filifolia* Herbaceous Vegetation (CEGL001898, G3)
- *Festuca idahoensis - Carex obtusata* Herbaceous Vegetation (CEGL001611, G3Q)
- *Festuca idahoensis - Carex scirpoidea* Herbaceous Vegetation (CEGL001899, G2Q)
- *Festuca idahoensis - Danthonia intermedia* Herbaceous Vegetation (CEGL001612, G3?Q)
- *Festuca idahoensis - Deschampsia caespitosa* Herbaceous Vegetation (CEGL001900, G3G4)
- *Festuca idahoensis - Elymus trachycaulus* Herbaceous Vegetation (CEGL001614, G4)
- *Festuca viridula - Carex hoodii* Herbaceous Vegetation (CEGL001596, G3)
- *Festuca viridula - Festuca idahoensis* Herbaceous Vegetation (CEGL001633, G2?Q)
- *Festuca viridula - Lupinus argenteus var. laxiflorus* Herbaceous Vegetation (CEGL001634, G3Q)
- *Phleum alpinum - Elymus trachycaulus* Herbaceous Vegetation (CEGL001923, G2Q)

DISTRIBUTION

Range: This system is most extensive in the Canadian Rockies portion of the Rocky Mountain cordillera, extending south into

western Montana, central and eastern Oregon, eastern Washington and Idaho. It also occurs in the "island" ranges of central Montana, though it is not common, and is also found in the Bighorn Range of north-central Wyoming.
Divisions: 306:C
Nations: CA, US
Subnations: AB, BC, ID, MT, OR, WA, WY
Map Zones: 9:C, 10:C, 18:C, 19:C, 20:C, 21:C, 29:C
USFS Ecomap Regions: 331A:??, 341G:CC, 342A:CP, 342C:CC, 342D:CC, 342H:CC, 342I:C?, 342J:CC, M242B:C?, M242C:CP, M242D:CC, M331A:PP, M331B:PP, M332A:CC, M332B:CC, M332D:CC, M332E:CC, M332F:CC, M332G:CP, M333A:CC, M333B:CC, M333C:CC, M333D:CC
TNC Ecoregions: 4:P, 7:C, 8:C, 9:P, 26:C, 68:C

SOURCES

References: Comer et al. 2003, Cooper et al. 1995, Johnson 2004, Lane et al. 2000, NCC 2002, Shiflet 1994, Willoughby 2007
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722867#references
Description Author: M.S. Reid
Version: 07 Sep 2005 **Stakeholders:** Canada, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

NORTHERN TALLGRASS PRAIRIE (CES205.686)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Eastern Great Plains (205)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Non-Diagnostic Classifiers: Glaciated plains; Herbaceous; Glaciated; Deep Soil; Loam Soil Texture; F-Landscape/Low Intensity; G-Landscape/Medium Intensity
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2420; ESLF 7133; ESP 1420

CONCEPT

Summary: This system is found primarily in the Northern Tallgrass ecoregion ranging along the Red River basin in Minnesota and the Dakotas to Lake Manitoba in Canada. It constitutes the northernmost extension of the "true" prairies. Similar to Central Tallgrass Prairie (CES205.683), this system is dominated by tallgrass species such as *Andropogon gerardii*, *Sorghastrum nutans*, and *Panicum virgatum*. However, the soils in this region are not as rich nor deep, and thus this system does not have as much species diversity as grasslands to the south. This system is often found on well-drained, drier soils and can grade into Eastern Great Plains Tallgrass Aspen Parkland (CES205.688) to the north and east. Grazing and fire influenced this system historically. Much of this system has been converted to agriculture with very few unaltered and highly fragmented examples remaining.

Similar Ecological Systems:
- Central Tallgrass Prairie (CES205.683)

DESCRIPTION

Dynamics: Fire plays an important role in the maintenance of this prairie system. Fire promotes seed production and flowering necessary for plant regeneration. Because environmental conditions are suitable for tree growth, without recurrent fire (every 2-10 years), succession to forest or woodland will occur rapidly (Minnesota DNR 2005b). From Landfire BpS: Frequent fires impacted this prairie system every 1-3 years, maintaining grass and forb vegetation. Insect and small mammal herbivory impacts composition and dominance. Large mammals were present in low densities; main grazers were elk and deer, but impacts were likely minimal. Fire played an important role in the maintenance of the tallgrass prairie (Curtis 1959, Vogl 1964, Anderson 1990b). Fire could occur throughout the year with larger, less frequent fires occurring during the dormant season and smaller, more frequent fires occurring during the growing season. Native American burning, essential to maintaining the eastern tallgrass prairie, was bimodal in distribution, peaking in April and October with lightning ignition occurring primarily during July and August (Higgins 1986).

Bison grazing as a major disturbance was likely much more limited than prairies further west. Elk probably contributed to the impact of grazing and browsing as well, but it is assumed that the total contributions of these two species was still considerably less than to the west. The elk may have contributed to the reduction of young woody saplings invading prairie adjacent to protected woody areas. Prior to European settlement, episodic grazing by large, native mammals was common and encouraged the persistence of several native grass and forb species (Minnesota DNR 2005b). From Landfire BpS: Bison, with peripheral help from grasshoppers, elk, antelope and a myriad of smaller animals made herbivory one of the dominating factors of the northern tallgrass prairie (Severson and Sieg 2006). With estimates of 30-60 million bison in the Northern Great Plains (Isenberg 2000), herbivory by large mammals also was a significant disturbance to the grasslands. Bison herbivory occurred in a mob-grazing or flash-grazing method, with extensive herds migrating across the prairie as they graze. Modern rotational grazing systems simulate this by resting areas after intensive grazing. Elk, too, may have played an important role than generally believed, particularly in the eastern portion of the zone. Whether bison or elk, large mammals preferentially grazed recently burned sites.

Component Associations:
- *Andropogon gerardii - (Panicum virgatum) - Muhlenbergia richardsonis* Herbaceous Vegetation (CEGL002199, G3G4)
- *Andropogon gerardii - Hesperostipa spartea - Sporobolus heterolepis* Herbaceous Vegetation (CEGL002202, G2G3)
- *Carex prairea - Schoenoplectus pungens - Rhynchospora capillacea* Herbaceous Vegetation (CEGL002267, G2)
- *Populus tremuloides - Quercus macrocarpa - Salix* spp. / *Andropogon gerardii* Shrubland (CEGL002182, G2G3)
- *Schizachyrium scoparium - Bouteloua curtipendula - Hesperostipa spartea - (Pascopyrum smithii)* Herbaceous Vegetation (CEGL002377, G3?)
- *Schizachyrium scoparium - Bouteloua curtipendula* Loess Mixedgrass Herbaceous Vegetation (CEGL002036, G3?)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Eastern Great Plains Tallgrass Aspen Parkland (CES205.688)

Adjacent Ecological System Comments: It can grade into Eastern Great Plains Tallgrass Aspen Parkland (CES205.688) to the north and east.

DISTRIBUTION

Range: Found primarily in the Northern Tallgrass ecoregion ranging along the Red River basin in Minnesota and the Dakotas to Lake

Manitoba in Canada.
Divisions: 205:C
Nations: CA, US
Subnations: IA, MB, MN, ND, SD
Map Zones: 39:C, 40:C, 41:?, 42:C
USFS Ecomap Regions: 222N:CC, 251A:CC, 251B:CC, 251G:CC, 251H:C?, 332B:CC, 332D:CC
TNC Ecoregions: 35:C

SOURCES

References: Anderson 1990b, Barbour and Billings 1988, Comer et al. 2003, Curtis 1959, Higgins 1986, Isenberg 2000, Koper et al. 2010, Minnesota DNR 2005b, Ricketts et al. 1999, Severson and Sieg 2006, Vogl 1964
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722973#references
Description Author: S. Menard, mod. J. Drake
Version: 14 Jan 2014 **Stakeholders:** Canada, Midwest
Concept Author: S. Menard **ClassifResp:** Midwest

NORTHWESTERN GREAT PLAINS MIXEDGRASS PRAIRIE (CES303.674)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Western Great Plains (303)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Non-Diagnostic Classifiers: Herbaceous; Glaciated; Shallow Soil; Loam Soil Texture
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2141; ESLF 7114; ESP 1141

CONCEPT

Summary: This system extends from northern Nebraska into southern Canada and westward through the Dakotas to the Rocky Mountain Front in Montana and probably Wyoming, on both glaciated and non-glaciated substrates. Soil texture (which ultimately effects water available to plants) is the defining environmental descriptor; soils are primarily fine and medium-textured and do not include sands, sandy soils, or sandy loams. This system occurs on a wide variety of landforms (e.g., mesatops, stream terraces) and in proximity to a diversity of other systems. Most usually it is found in association with Western Great Plains Sand Prairie (CES303.670) which occupies the coarser-textured substrates. In various locales the topography where this system occurs is broken by many glacial pothole lakes, and this system may be proximate to Great Plains Prairie Pothole (CES303.661). On the eastern Montana plains, mixedgrass prairie is by far the predominant system. Here it occurs continuously for hundreds of square kilometers, interrupted only by riparian areas or sand prairies, which are associated with gentle rises, eroded ridges or mesas derived from sandstone. Historically, this system covered approximately 38 million ha in Nebraska, North and South Dakota, and Canada; now it covers approximately 270,000 square km in this region. The growing season and rainfall are intermediate to drier units to the southwest and mesic tallgrass regions to the east. Graminoids typically comprising the greatest canopy cover include *Pascopyrum smithii*, *Nassella viridula*, and *Festuca* spp. In Montana these include *Festuca campestris* and *Festuca idahoensis*. Other commonly dominant species in Montana are *Bouteloua gracilis*, *Hesperostipa comata*, and *Carex filifolia*, while *Festuca campestris* and *Festuca idahoensis* may be more abundant in the north and foothill/montane grassland transition areas. Remnants of *Hesperostipa curtiseta*-dominated vegetation are found in northernmost Montana and North Dakota associated with the most productive sites (largely plowed to cereal grains); this species, usually in association with *Pascopyrum smithii*, is much more abundant in Canada. Sites with a strong component of *Nassella viridula* indicate a more favorable moisture balance and perhaps a favorable grazing regime as well because this is one of the most palatable of the mid-grasses. *Hesperostipa comata* is also an important component and becomes increasingly so as improper grazing regimes favor it at the expense of (usually) *Pascopyrum smithii*; progressively more destructive grazing can result in the loss of *Pascopyrum smithii* from the system followed by drastic reduction in *Hesperostipa comata* and ultimately the dominance of *Bouteloua gracilis* (or *Poa secunda* and other short graminoids) and/or a lawn of *Selaginella densa*. *Koeleria macrantha*, at least in Montana and southern Canada, is the most pervasive grass; if it has high cover, past intensive grazing is the presumed reason. Shrub species such as *Symphoricarpos* spp. and *Artemisia frigida* and *Artemisia cana* also occur. Fire and grazing constitute the primary dynamics affecting this system. Drought can also impact this system, in general favoring the shortgrass component at the expense of the mid-grasses. With intensive grazing, cool-season exotics such as *Poa pratensis*, *Bromus inermis*, and *Bromus japonicus* can increase in dominance; both of the rhizomatous grasses have been shown to markedly depress species diversity. Shrub species such as *Juniperus virginiana* can also increase in dominance with fire suppression. This system is one of the most disturbed grassland systems in Nebraska, North and South Dakota, and Canada.

Classification Comments: This system was edited to expand the concept for central Montana mixedgrass prairie and to exclude specifically sandy soil grasslands, which are placed into Western Great Plains Sand Prairie (CES303.670). This system is similar to Central Mixedgrass Prairie (CES303.659) and can contain elements of Great Plains tallgrass and shortgrass systems. However, it differs from Central Mixedgrass Prairie (CES303.659) in that the cooler climate in this region allows natural cool-season grasses to be more important (greater than 50% cover). Cover of native, nongrazing-induced shrubs typically does not exceed 25% in conjunction with topographic relief (breaks); otherwise the stand would be considered part of Northwestern Great Plains Shrubland (CES303.662). Additional review and commentary by Canadian, Dakotan, and Nebraskan ecologists is needed to flesh out the compositional variation and range of distribution for this important grassland system. In Wyoming, this system transitions into Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland (CES306.040) in the foothills of the northern Wyoming mountains where *Pascopyrum smithii* communities finger up into foothills. If *Festuca idahoensis*, *Carex rossii*, *Artemisia nova*, or *Artemisia tripartita ssp. rupicola* occur, then the example is not this system.

Similar Ecological Systems:
- Central Mixedgrass Prairie (CES303.659)
- Northwestern Great Plains Shrubland (CES303.662)

Related Concepts:
- *Elymus lanceolatus - Nassella viridula* Herbaceous Vegetation (MTNHP 2002b) Finer
- Fescue Grassland (613) (Shiflet 1994) Intersecting
- Northwestern Great Plains Mixed-Grass Prairie (Rolfsmeier and Steinauer 2010) Equivalent
- Sagebrush - Grass (612) (Shiflet 1994) Intersecting. This mixedgrass prairie ecological system can have a sage component where

disturbed/grazed.
- Wheatgrass (610) (Shiflet 1994) Finer
- Wheatgrass - Bluestem - Needlegrass (606) (Shiflet 1994) Intersecting
- Wheatgrass - Grama (609) (Shiflet 1994) Finer
- Wheatgrass - Grama - Needlegrass (608) (Shiflet 1994) Finer
- Wheatgrass - Needlegrass (607) (Shiflet 1994) Finer
- Wheatgrass - Saltgrass - Grama (615) (Shiflet 1994) Intersecting

DESCRIPTION

Environment: Given the system's rather extensive geographic range, it not surprising to find it occurring on a wide variety of landforms (e.g., mesatops, stream terraces) and in proximity to a diversity of other systems. Climate and growing season length for the region this system occurs are intermediate to the shortgrass regions to the west and southwest and the tallgrass regions to the east with a shorter growing season and less humid climate compared to the range of Central Mixedgrass Prairie (CES303.659). Moisture conditions are semi-arid. This system occurs on soils derived primarily from fine-textured sedimentary rocks and deposits, but other rock types are included so long as their weathering products are not coarse-textured, namely not sands, sandy soils, or sandy loams and relatively stable. It is found primarily on planar to gently rolling topography but is found on broken topography hillslopes as well.
Vegetation: This system contains greater than 50% cover of natural, cool-season grasses such as *Festuca* spp., *Pascopyrum smithii, Elymus lanceolatus, Hesperostipa comata*, *Hesperostipa curtiseta*, and *Nassella viridula*. *Hesperostipa comata* becomes increasingly important where improper grazing regimes have favored it at the expense of (usually) *Pascopyrum smithii*; progressively more destructive grazing can result in the loss of *Pascopyrum smithii* from the system followed by drastic reduction in *Hesperostipa comata* and ultimately the dominance of *Bouteloua gracilis* (or *Poa secunda* and other short graminoids) and/or a lawn of *Selaginella densa*. *Koeleria macrantha*, at least in Montana and southern Canada, is the most pervasive grass; if it has high cover, past intensive grazing is the presumed reason. Shrub species such as *Symphoricarpos* spp. and *Artemisia frigida* also occur. Cover of native, nongrazing-induced shrubs typically does not exceed 25% in conjunction with topographic relief (breaks); otherwise the stand would be considered part of Northwestern Great Plains Shrubland (CES303.662). Cool-season exotics such as *Poa pratensis, Bromus inermis*, and *Bromus japonicus* can increase in dominance with overgrazing; both of the above-named rhizomatous grasses are sufficiently aggressive to outcompete natives regardless of disturbance regime. Likewise, shrub species such as *Juniperus virginiana* can also increase in dominance with fire suppression.
Dynamics: Fire and grazing constitute the primary dynamics affecting this system. Drought can also impact this system. It should be acknowledged that this system occurs within the very same biotope as Inter-Mountain Basins Big Sagebrush Steppe (CES304.778) or Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777), the only difference being that fire has not been present where the sagebrush systems occur, a purely stochastic outcome. Heavy grazing causes cool-season exotics such as *Poa pratensis* and *Bromus inermis* to increase in dominance. Conversion to agriculture also impacts this system; however, the degree of agricultural alteration of this system is highly variable by geographic region with Montana (and Wyoming??) having experienced much less impact than the estimated 75% percent of the Nebraska-Dakota-south-central Canada region, where this system has been heavily altered. In Montana, this system is the major sustainer of livestock grazing with overall far less than half of it having been lost to agriculture; several Montana counties have more than 90% of this system remaining intact, though impacted by grazing to varying degrees.

Component Associations:
- *Amelanchier alnifolia / Pseudoroegneria spicata* - Bunchgrass Shrubland (CEGL001065, G3G4Q)
- *Amelanchier alnifolia* Shrubland (CEGL002183, GNR)
- *Artemisia cana ssp. cana / Pascopyrum smithii* Shrub Herbaceous Vegetation (CEGL001556, G4)
- *Artemisia tridentata / Festuca idahoensis* Shrub Herbaceous Vegetation (CEGL001530, G4Q)
- *Artemisia tridentata ssp. vaseyana / Festuca campestris* Shrub Herbaceous Vegetation (CEGL001531, G3Q)
- *Betula pumila - Salix candida / Carex lasiocarpa - Symphyotrichum boreale* Prairie Fen Shrubland (CEGL002189, G3)
- *Dasiphora fruticosa ssp. floribunda / Festuca campestris* Shrub Herbaceous Vegetation (CEGL001503, G4)
- *Dasiphora fruticosa ssp. floribunda / Festuca idahoensis* Shrub Herbaceous Vegetation (CEGL001502, G4)
- *Dasiphora fruticosa ssp. floribunda / Schizachyrium scoparium* Shrub Herbaceous Vegetation (CEGL002198, G3G4)
- *Elaeagnus commutata / Pascopyrum smithii* Shrubland (CEGL001099, G3?)
- *Eleocharis palustris* Great Plains Herbaceous Vegetation (CEGL005291, GNR)
- *Elymus lanceolatus - Koeleria macrantha* Herbaceous Vegetation (CEGL002237, GNR)
- *Festuca altaica - (Hesperostipa* spp., *Achnatherum* spp.) Herbaceous Vegetation (CEGL002436, GNR)
- *Festuca campestris - Festuca idahoensis* Herbaceous Vegetation (CEGL005875, G3)
- *Festuca campestris - Pseudoroegneria spicata* Herbaceous Vegetation (CEGL001629, G4)
- *Festuca idahoensis - Carex inops ssp. heliophila* Herbaceous Vegetation (CEGL001610, G3)
- *Hesperostipa comata - Bouteloua gracilis - Carex filifolia* Herbaceous Vegetation (CEGL002037, G5)
- *Hesperostipa curtiseta - Elymus lanceolatus* Herbaceous Vegetation (CEGL002253, GNR)
- *Hesperostipa curtiseta - Pascopyrum smithii* Herbaceous Vegetation (CEGL003789, G3G4)
- *Hesperostipa neomexicana - Bouteloua curtipendula* Herbaceous Vegetation (CEGL001709, G3?)
- *Hesperostipa neomexicana* Herbaceous Vegetation (CEGL001708, G3)
- *Juniperus horizontalis / Schizachyrium scoparium* Dwarf-shrubland (CEGL001394, G4)
- *Juniperus virginiana var. virginiana / Schizachyrium scoparium - Bouteloua curtipendula* Great Plains Herbaceous Vegetation (CEGL004066, G2)

- *Pascopyrum smithii - Bouteloua gracilis - Carex filifolia* Herbaceous Vegetation (CEGL001579, G4)
- *Pascopyrum smithii - Hesperostipa comata* Central Mixedgrass Herbaceous Vegetation (CEGL002034, G4)
- *Pascopyrum smithii - Nassella viridula* Herbaceous Vegetation (CEGL001583, G3G4)
- *Pascopyrum smithii* Herbaceous Vegetation (CEGL001577, G3G5Q)
- *Pseudoroegneria spicata - Bouteloua curtipendula* Herbaceous Vegetation (CEGL001663, G3)
- *Pseudoroegneria spicata - Bouteloua gracilis* Herbaceous Vegetation (CEGL001664, G4)
- *Pseudoroegneria spicata - Pascopyrum smithii* Herbaceous Vegetation (CEGL001675, G4)
- *Schizachyrium scoparium - Carex inops ssp. heliophila* Herbaceous Vegetation (CEGL001682, G3)
- *Schizachyrium scoparium - Muhlenbergia cuspidata* Herbaceous Vegetation (CEGL001683, G3?)
- *Symphoricarpos occidentalis* Shrubland (CEGL001131, G4G5)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Great Plains Prairie Pothole (CES303.661)
- Northwestern Great Plains Shrubland (CES303.662)
- Western Great Plains Sand Prairie (CES303.670)
- Western Great Plains Shortgrass Prairie (CES303.672)
- Western Great Plains Tallgrass Prairie (CES303.673)

Adjacent Ecological System Comments: Across much of the western portion of its range, this system exists intimately associated with Western Great Plains Sand Prairie (CES303.670), at least as we have redefined Western Great Plains Sand Prairie). This system may be proximate to Great Plains Prairie Pothole (CES303.661) at various locations across its distribution.

DISTRIBUTION

Range: This system extends from northern Nebraska into southern Canada, and west to central Montana. The U.S. range corresponds to Bailey et al. (1994) sections 331D, 331E, 331F (mostly), 331G, 332A, 332B, and perhaps minor extensions into 251B, and in Canada to the Moist Mixed Grassland and Fescue Grassland.
Divisions: 205:P; 303:C
Nations: CA, US
Subnations: AB, MB, MT, ND, NE, SD, SK, WY
Map Zones: 20:C, 22:C, 29:C, 30:C, 31:C, 39:C, 40:C
USFS Ecomap Regions: 331D:CC, 331E:CC, 331F:CC, 331G:CC, 331H:CC, 331K:CC, 331L:CC, 331M:CC, 331N:CC, 332B:CC, 332C:CC, 332D:CC, 342A:CP, 342F:CC, 342G:CC, M331A:CP, M331B:CC, M331I:CC, M331J:C?, M334A:CC
TNC Ecoregions: 26:C, 34:C, 66:P, 67:C

SOURCES

References: Bailey et al. 1994, Barbour and Billings 1988, Comer et al. 2003, Ricketts et al. 1999, Weaver 1954
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722984#references
Description Author: S. Menard and K. Kindscher, mod. G. Kittel, S. Cooper, M.S. Reid
Version: 27 Apr 2006 **Stakeholders:** Canada, Midwest, West
Concept Author: S. Menard and K. Kindscher, mod. S. Cooper and G. Kittel **ClassifResp:** Midwest

OZARK PRAIRIE AND WOODLAND (CES202.326)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Herbaceous; Graminoid
Non-Diagnostic Classifiers: Lowland
FGDC Crosswalk: Vegetated
National Mapping Codes: EVT 2508; ESLF 5429; ESP 1508

CONCEPT

Summary: This system of prairies and associated woodlands is found in the undissected portions of the Springfield Plateau region of Arkansas, Oklahoma, and Missouri (EPA Ecoregion 39a). This region is characterized by broad, level to gently rolling uplands derived from limestone and chert. It is much less rugged than the adjacent mountainous regions and more dissected portions of the Springfield Plateau. In addition, this region receives an annual precipitation total of 5-15 cm (2-6 inches) less than the surrounding regions due to a rainshadow produced by a combination of prevailing western winds and orographic effects. The limestone and chert-derived soils associated with the prairies are thin and droughty. The combined effect of droughty soils, reduced precipitation, and prevailing level topography create conditions highly conducive to the ignition and spread of fires. Stands are typically dominated by *Andropogon gerardii, Sorghastrum nutans, Panicum virgatum,* and *Schizachyrium scoparium*. Few extant examples of this system remain and most are small and isolated.

Classification Comments: There is little floristic and environmental overlap with the Grand Prairie and calcareous prairies of southern Arkansas. There may be stronger overlap with Southeastern Great Plains Tallgrass Prairie (CES205.685), and further review is needed to verify the distinction between these two systems.

Similar Ecological Systems:

- Southeastern Great Plains Tallgrass Prairie (CES205.685)
- Texas Blackland Tallgrass Prairie (CES205.684)

DESCRIPTION

Environment: This system of prairies and associated woodlands is found in the undissected portions of the Springfield Plateau region, which is distinctly bounded by the Boston Mountains to the south. This region is characterized by broad, level to gently rolling uplands derived from limestone and chert. It is much less rugged than the adjacent mountainous regions and more dissected portions of the Springfield Plateau. In addition, this region receives an annual precipitation total of 5-15 cm (2-6 inches) less than the surrounding regions due to a rainshadow produced by a combination of prevailing western winds and orographic effects. The limestone and chert-derived soils associated with the prairies are thin and droughty. The combined effect of droughty soils, reduced precipitation, and prevailing level topography create conditions highly conducive to the ignition and spread of fires. Few extant examples of this system remain and most are small and isolated.

The alternating shale plains are separated by limestone scarps that in a broad sense decrease in elevation in a stairstep pattern, from northwest to southeast. The flatter plains were formerly nearly continuous tallgrass prairie, while the scarped limestone areas were more dissected with bedrock outcrops and a mixture of prairie and savanna (Nigh and Schroeder 2002). Because of the presence of the rocky substrate close to the surface and the rolling topography, this area is relatively unsuitable for agriculture. Most occurrences of this system are on gently to moderately rolling terraces developed predominately in sandstones and shales of Pennsylvanian age. Soils are moderately fertile to sterile and well-drained. In addition, this region receives an annual precipitation total of 5-15 cm (2-6 inches) less than the adjacent regions due to a rainshadow produced by a combination of prevailing western winds and orographic effects (Landfire 2007a).

Vegetation: These prairies are typically dominated by *Schizachyrium scoparium, Andropogon gerardii, Sorghastrum nutans,* and *Panicum virgatum*. Other grasses include *Koeleria macrantha, Sporobolus heterolepis, Sphenopholis obtusata, Dichanthelium* spp., *Aristida purpurascens, Panicum brachyanthum, Phalaris caroliniana, Tripsacum dactyloides,* and *Spartina pectinata*. A rich forb diversity is commonly present and includes *Helianthus mollis, Helianthus grosseserratus, Rudbeckia subtomentosa, Silphium laciniatum, Symphyotrichum* spp., *Solidago* spp., *Camassia scilloides, Echinacea pallida, Callirhoe digitata, Asclepias hirtella, Eryngium yuccifolium, Delphinium carolinianum, Castilleja coccinea, Calopogon oklahomensis, Buchnera americana, Dodecatheon meadia, Amorpha canescens, Tephrosia virginiana, Orbexilum pedunculatum, Baptisia alba, Baptisia bracteata, Liatris pycnostachya,* and *Liatris squarrosa var. hirsuta (= Liatris hirsuta)*. Wetter areas support a rich diversity of rushes and sedges, including *Carex bicknellii var. opaca (= Carex opaca), Carex oklahomensis, Carex buxbaumii, Carex scoparia, Carex conjuncta, Carex davisii, Carex arkansana, Eleocharis tenuis var. verrucosa, Eleocharis wolfii,* and *Rhynchospora macrostachya*.

Dynamics: These prairies and woodlands were historically maintained by frequent fire. Drought cycles and grazing were also likely important ecosystem processes. Fires were frequent, primarily autumnal and of human origin. As *Quercus-Carya* regeneration becomes established, individuals of these species become largely fire-resistant with age. Surface fires within woodland and forest types occurred every 12 to 15 years, reducing duff layers and allowing recruitment of young individuals of *Quercus* and *Carya* species

(Landfire 2007a).

Component Associations:
- *Andropogon gerardii - Panicum virgatum - Helianthus grosseserratus* Herbaceous Vegetation (CEGL002024, G2G3)
- *Andropogon gerardii - Sorghastrum nutans* Unglaciated Herbaceous Vegetation (CEGL002204, G3)
- *Juncus (acuminatus, brachycarpus) - Panicum virgatum - Bidens aristosa - Hibiscus moscheutos ssp. lasiocarpos* Herbaceous Vegetation (CEGL004782, G2G3)
- *Schizachyrium scoparium - Bothriochloa laguroides ssp. torreyana - Croton willdenowii* Herbaceous Vegetation (CEGL008564, G1?)
- *Schizachyrium scoparium - Dichanthelium* spp. - *Buchnera americana - Echinacea pallida* Herbaceous Vegetation (CEGL007827, G2G3)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Interior Highlands Unglaciated Flatwoods (CES202.454)

DISTRIBUTION

Range: This system is found in the Springfield Plateau subsection of the Ozark Plateau region of Arkansas, Oklahoma, and Missouri, possibly ranging into a limited area of Kansas.
Divisions: 202:C
Nations: US
Subnations: AR, KS?, MO, OK
Map Zones: 44:C
USFS Ecomap Regions: 223A:CC
TNC Ecoregions: 38:C

SOURCES

References: Arkansas Forestry Commission 2010, DeSelm and Murdock 1993, Duffey et al. 1974, EPA 2004, Estes et al. 1979, Foti pers. comm., Landfire 2007a, McKinney and Lockwood 1999, Murdock pers. comm., Nigh and Schroeder 2002, Noss 2013, Southeastern Ecology Working Group n.d., Taft 1997, Taft 2009, Taft et al. 1995, TNC 1996c, Wiens and Dyer 1975
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.798088#references
Description Author: T. Witsell, mod. M. Pyne
Version: 14 Jan 2014 **Stakeholders:** Midwest, Southeast
Concept Author: T. Witsell **ClassifResp:** Southeast

PENNYROYAL KARST PLAIN PRAIRIE AND BARRENS (CES202.355)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Herbaceous
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2418; ESLF 7131; ESP 1418

CONCEPT

Summary: This system consists of open, prairielike vegetation of the northwestern Highland Rim (Pennyroyal Plateau) of Tennessee and adjacent Kentucky (EPA Ecoregion 71e; part of Subsection 222Eh). Stands are dominated by grasses and forbs with scattered shrubby vegetation and, occasionally, trees. The scattered trees are mainly *Quercus falcata* and *Quercus imbricaria*. *Quercus alba* and *Quercus marilandica* would also be expected. The primary dominant grass is *Schizachyrium scoparium*, with some *Sorghastrum nutans* present. Other more mesic grasses (*Andropogon gerardii, Tripsacum dactyloides*) are restricted to ditches. The largest extant examples are presently found on Fort Campbell Military Reservation, Tennessee, where ecological burning and fires from live munitions use result in open herbaceous-dominated landscapes. This vegetation was the predominant type here in the early 1800s and probably originated from burning by Native Americans.
Classification Comments: Western Highland Rim Prairie and Barrens (CES202.352), Eastern Highland Rim Prairie and Barrens (CES202.354), Pennyroyal Karst Plain Prairie and Barrens (CES202.355), and Southern Ridge and Valley Patch Prairie (CES202.453) form a series of similar systems in the eastern Interior Highlands and adjacent Ridge and Valley.
Similar Ecological Systems:
- Cumberland Wet-Mesic Meadow and Savanna (CES202.053)
- Eastern Highland Rim Prairie and Barrens (CES202.354)
- Southern Ridge and Valley Patch Prairie (CES202.453)
- Western Highland Rim Prairie and Barrens (CES202.352)

Related Concepts:
- Limestone Prairie (Evans 1991) Finer
- Tallgrass Prairie (Evans 1991) Finer
- Wet Prairie (Evans 1991) Finer

DESCRIPTION

Environment: This system occurs in an open rolling Karst Plain landscape which easily carries fire if maintained in a grassy condition. Bedrocks are the St. Louis or Ste. Genevieve, Upper MiIan limestones of the Meramecian Series including some of the area which forms the base of the Dripping Springs Escarpment. Sinkholes mostly range up to 200 m wide and 10 m deep, with some areas nearly sinkhole-free while other areas have sinkholes up to 1600 m wide and 60 m deep with some sinkhole ponds and lakes. One sinkhole covers 1261 ha (3114 acres). Some sinkhole ponds were created by sinkhole plugging via agricultural erosion or human disturbance. The area exhibits well-developed underground drainage, low stream density, and soils quick to dry. Most upland streams have limited discharge with intermittent or ephemeral flow.

The barrens of this area exhibit two types of uncharacteristic conditions. Agricultural changes converted much of the landscape for use as fields and for grazing. With fire suppression they grew up with woody vegetation. Today in many areas, old pastures or agricultural fields have succeeded into areas dominated by *Juniperus virginiana*. It is not likely this would have been common in presettlement times. However, with fencerow habitats that encourage *Juniperus* survival being created in recent history, this has become the most common successional pathway (Landfire 2007a).
Vegetation: Stands of this system are dominated by grasses and forbs with scattered shrubby vegetation trees. The scattered trees are mainly *Quercus falcata* and *Quercus imbricaria*. The primary dominant grass is *Schizachyrium scoparium*, with some *Sorghastrum nutans* present. Other more mesic grasses (*Andropogon gerardii*, *Tripsacum dactyloides*) are restricted to ditches. Other herbaceous components may include *Andropogon gyrans, Andropogon ternarius, Lespedeza capitata, Lespedeza virginica, Symphyotrichum novae-angliae (= Aster novae-angliae), Sericocarpus linifolius (= Aster solidagineus), Coreopsis major, Coreopsis tripteris, Helianthus angustifolius, Helianthus hirsutus, Helianthus mollis, Helianthus occidentalis, Silphium trifoliatum, Solidago juncea, Pycnanthemum tenuifolium, Pycnanthemum verticillatum var. pilosum (= Pycnanthemum pilosum)*, and *Lobelia puberula*. In addition, *Rudbeckia subtomentosa, Prenanthes barbata*, and *Agalinis auriculata (= Tomanthera auriculata)* are rare plants found in some examples. Other typical woody species include *Cornus florida, Cercis canadensis, Prunus angustifolia, Ilex decidua, Rhus copallinum, Rosa carolina*, and *Symphoricarpos orbiculatus*.
Dynamics: This vegetation was the predominant type here in the early 1800s and probably originated from burning by Native Americans. The largest extant examples are presently found on Fort Campbell Military Reservation, Tennessee, where ecological burning and fires from live munitions use result in open herbaceous-dominated landscapes. Much of the area supports crops and livestock production. Very few "original" presettlement barrens exist. These barrens originated by burning of forests by Native

Americans. If not grazed or farmed, these barrens quickly grew into oak-dominated forests after settlement by Europeans and occur on soil that developed under forest vegetation (Landfire 2007a).

Component Associations:
- *Andropogon gerardii - (Sorghastrum nutans)* Kentucky Herbaceous Vegetation (CEGL004677, G1G2)
- *Schizachyrium scoparium - (Helianthus mollis, Helianthus occidentalis, Silphium trifoliatum)* Herbaceous Vegetation (CEGL007805, G2G3)

DISTRIBUTION

Range: This system is found in the northern Highland Rim (Pennyroyal Plateau) of Tennessee and adjacent Kentucky (EPA Ecoregion 71e [Western Pennyroyal Karst Plain] of Griffith et al. (1998) and Woods et al. (2002); part of Subsection 222Eh of Keys et al. (1995)).
Divisions: 202:C
Nations: US
Subnations: KY, TN
Map Zones: 47:C
USFS Ecomap Regions: 223E:CC
TNC Ecoregions: 44:C

SOURCES

References: Baskin et al. 1994, Baskin et al. 1999, Chester 1988, Chester et al. 1997, Comer et al. 2003, DeSelm 1994, DeSelm and Murdock 1993, Duffey et al. 1974, Estes et al. 1979, Evans 1991, Griffith et al. 1998, Keys et al. 1995, Landfire 2007a, McInteer 1946, McKinney and Lockwood 1999, Murdock pers. comm., Noss 2013, Taft 1997, Taft 2009, Taft et al. 1995, TNC 1996c, Wiens and Dyer 1975, Woods et al. 2002

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723157#references

Description Author: M. Pyne, R. Evans, C. Nordman
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: M. Pyne, R. Evans, C. Nordman **ClassifResp:** Southeast

ROCKY MOUNTAIN ALPINE FELL-FIELD (CES306.811)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Alpine Slopes; Alpine/AltiAndino [Alpine/AltiAndino]; Herbaceous; Ridge/Summit/Upper Slope; Oligotrophic Soil; Very Shallow Soil; Mineral: W/ A-Horizon <10 cm; Very Short Disturbance Interval; W-Patch/High Intensity; Cushion plants
Non-Diagnostic Classifiers: Patterned ground (undifferentiated); Saddle; Temperate [Temperate Continental]; Glaciated; Ustic; W-Landscape/Medium Intensity
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2143; ESLF 7116; ESP 1143

CONCEPT

Summary: This ecological system is found discontinuously at alpine elevations throughout the Rocky Mountains, west into the mountainous areas of the Great Basin, and north into the Canadian Rockies. Small areas are represented in the west side of the Okanagan Ecoregion in the eastern Cascades. These are wind-scoured fell-fields that are free of snow in the winter, such as ridgetops and exposed saddles, exposing the plants to severe environmental stress. Soils on these windy unproductive sites are shallow, stony, low in organic matter, and poorly developed; wind deflation often results in a gravelly pavement. Most fell-field plants are cushioned or matted, frequently succulent, flat to the ground in rosettes and often densely haired and thickly cutinized. Plant cover is 15-50%, while exposed rocks make up the rest. Fell-fields are usually within or adjacent to alpine tundra dry meadows. Common species include *Arenaria capillaris, Geum rossii, Kobresia myosuroides, Minuartia obtusiloba, Myosotis asiatica, Paronychia pulvinata, Phlox pulvinata, Sibbaldia procumbens, Silene acaulis, Trifolium dasyphyllum*, and *Trifolium parryi*.
Classification Comments: Alpine fell-fields in the Cascades occur at a very small-scale spatial pattern not mappable (recognizable) at landscape levels. These small-scale fell-fields are conceptually included here.
Related Concepts:
- Alpine Rangeland (410) (Shiflet 1994) Broader

Component Associations:
- *Arenaria capillaris / Polytrichum piliferum* Herbaceous Vegetation (CEGL005855, G2G3)
- *Carex albonigra - Myosotis asiatica* Herbaceous Vegetation (CEGL005863, G2G3)
- *Carex paysonis - Sibbaldia procumbens* Herbaceous Vegetation (CEGL005865, G3G4)
- *Dasiphora fruticosa ssp. floribunda / Artemisia michauxiana* Shrub Herbaceous Vegetation (CEGL005833, G3G4)
- *Geum rossii - Minuartia obtusiloba* Herbaceous Vegetation (CEGL001965, G3?)
- *Kobresia myosuroides - Euphrasia disjuncta* Herbaceous Vegetation (CEGL005872, G2?)
- *Minuartia obtusiloba* Herbaceous Vegetation (CEGL001919, G4)
- *Paronychia pulvinata - Silene acaulis* Dwarf-shrubland (CEGL001976, G5)
- *Phlox pulvinata - Trifolium dasyphyllum* Herbaceous Vegetation (CEGL001980, G2Q)
- *Potentilla sierrae-blancae* Herbaceous Vegetation (CEGL001982, G1)
- *Rubus idaeus* Scree Shrubland (CEGL001134, GU)
- *Sibbaldia procumbens - Polygonum bistortoides* Herbaceous Vegetation (CEGL001933, G3?)
- *Silene acaulis* Herbaceous Vegetation (CEGL001934, G5?)
- *Trifolium dasyphyllum* Herbaceous Vegetation (CEGL001935, G4)
- *Trifolium parryi* Herbaceous Vegetation (CEGL001936, GU)

DISTRIBUTION

Range: This system is found discontinuously at alpine elevations throughout the Rocky Mountains, west into the mountainous areas of the Great Basin. Outlier sites occur in the northeastern Cascades and on Mount Rainier in Washington.
Divisions: 304:C; 306:C
Nations: CA, US
Subnations: AB, AK?, BC, CO, ID, MT, NM, NV, OR, UT, WA, WY
Map Zones: 1:P, 9:P, 10:C, 12:?, 16:C, 17:C, 19:C, 20:?, 21:C, 23:P, 24:P, 25:C, 28:C
USFS Ecomap Regions: 331J:CC, 341G:PP, M242B:CP, M242C:CC, M242D:CC, M331A:CC, M331B:CC, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M331J:CC, M332A:CC, M332B:CC, M332D:CC, M332E:CC, M332F:CC, M333A:CC, M333B:CC, M333C:CC, M333D:CC, M341A:PP, M341B:PP, M341C:PP
TNC Ecoregions: 7:C, 8:C, 9:C, 11:C, 20:C, 21:C, 68:C

SOURCES

References: Bamberg 1961, Bamberg and Major 1968, Comer et al. 2003, Cooper et al. 1997, Douglas and Bliss 1977, Hamann

1972, Komarkova 1976, Komarkova 1980, Meidinger and Pojar 1991, NCC 2002, Neely et al. 2001, Willard 1963

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722862#references

Description Author: R. Crawford

Version: 07 Sep 2005 **Stakeholders:** Canada, West

Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

ROCKY MOUNTAIN ALPINE TURF (CES306.816)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Alpine Slopes; Alpine/AltiAndino [Alpine/AltiAndino]; Oligotrophic Soil; Very Shallow Soil; Mineral: W/ A-Horizon <10 cm; Aridic; Very Long Disturbance Interval; Graminoid
Non-Diagnostic Classifiers: Long (>500 yrs) Persistence; Herbaceous; Temperate [Temperate Continental]; Glaciated; Periglacial
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2144; ESLF 7117; ESP 1144

CONCEPT

Summary: This widespread ecological system occurs above upper treeline throughout the Rocky Mountain cordillera, including alpine areas of ranges in Utah and Nevada, and isolated alpine sites in the northeastern Cascades. It is found on gentle to moderate slopes, flat ridges, valleys, and basins, where the soil has become relatively stabilized and the water supply is more or less constant. Vegetation in these areas is controlled by snow retention, wind desiccation, permafrost, and a short growing season. This system is characterized by a dense cover of low-growing, perennial graminoids and forbs. Rhizomatous, sod-forming sedges are the dominant graminoids, and prostrate and mat-forming plants with thick rootstocks or taproots characterize the forbs. Dominant species include *Artemisia arctica*, *Carex elynoides*, *Carex siccata*, *Carex scirpoidea*, *Carex nardina*, *Carex rupestris*, *Festuca brachyphylla*, *Festuca idahoensis*, *Geum rossii*, *Kobresia myosuroides*, *Phlox pulvinata*, and *Trifolium dasyphyllum*. Many other graminoids, forbs, and prostrate shrubs can also be found, including *Calamagrostis purpurascens*, *Deschampsia caespitosa*, *Dryas octopetala*, *Leucopoa kingii*, *Poa arctica*, *Saxifraga* spp., *Selaginella densa*, *Sibbaldia procumbens*, *Silene acaulis*, *Solidago* spp., and *Trifolium parryi*. Although alpine dry tundra is the matrix of the alpine zone, it typically intermingles with alpine bedrock and scree, ice field, fell-field, alpine dwarf-shrubland, and alpine/subalpine wet meadow systems.

Related Concepts:
- Alpine Rangeland (410) (Shiflet 1994) Broader
- AT Alpine Tundra, Mesic to dry sites (Ecosystems Working Group 1998) Broader

Component Associations:
- *Arctostaphylos uva-ursi / Festuca campestris - Festuca idahoensis* Dwarf-shrubland (CEGL005830, G3G4)
- *Arctostaphylos uva-ursi / Pseudoroegneria spicata* Dwarf-shrubland (CEGL005831, G2G3)
- *Arctostaphylos uva-ursi / Solidago multiradiata* Dwarf-shrubland (CEGL005832, G2G3)
- *Artemisia arctica ssp. arctica* Herbaceous Vegetation (CEGL001848, GU)
- *Calamagrostis purpurascens* Herbaceous Vegetation (CEGL001850, G2)
- *Carex arapahoensis* Herbaceous Vegetation (CEGL001851, GU)
- *Carex duriuscula - Poa secunda* Herbaceous Vegetation (CEGL001736, G2Q)
- *Carex ebenea - Trifolium parryi* Herbaceous Vegetation (CEGL001873, GUQ)
- *Carex elynoides - Geum rossii* Herbaceous Vegetation (CEGL001853, G4)
- *Carex elynoides - Lupinus argenteus* Herbaceous Vegetation (CEGL001854, G3)
- *Carex elynoides - Oreoxis* spp. Herbaceous Vegetation (CEGL001855, G4)
- *Carex elynoides - Oxytropis sericea* Herbaceous Vegetation (CEGL001856, G3)
- *Carex elynoides* Herbaceous Vegetation (CEGL001852, G4)
- *Carex haydeniana* Herbaceous Vegetation (CEGL001875, GU)
- *Carex perglobosa - Silene acaulis* Herbaceous Vegetation (CEGL001858, GU)
- *Carex rupestris - Geum rossii* Herbaceous Vegetation (CEGL001861, G4)
- *Carex rupestris - Potentilla ovina* Herbaceous Vegetation (CEGL001862, G4)
- *Carex rupestris - Trifolium dasyphyllum* Herbaceous Vegetation (CEGL001863, G3G4)
- *Carex rupestris var. drummondiana* Herbaceous Vegetation (CEGL001864, G4)
- *Carex scirpoidea - Geum rossii* Herbaceous Vegetation (CEGL001866, G4)
- *Carex scirpoidea - Potentilla diversifolia* Herbaceous Vegetation (CEGL001867, G3?)
- *Carex scirpoidea - Zigadenus elegans* Herbaceous Vegetation (CEGL005866, G4G5)
- *Carex siccata - Geum rossii* Herbaceous Vegetation (CEGL001808, GU)
- *Carex* spp. - *Geum rossii* Herbaceous Vegetation (CEGL001870, G4Q)
- *Carex vernacula* Herbaceous Vegetation (CEGL001868, GU)
- *Cirsium scopulorum - Polemonium viscosum* Herbaceous Vegetation (CEGL001959, GU)
- *Dryas octopetala - Carex rupestris* Dwarf-shrub Herbaceous Vegetation (CEGL001892, G4)
- *Dryas octopetala - Carex* spp. Dwarf-shrub Herbaceous Vegetation (CEGL001893, G3?)
- *Dryas octopetala* Dwarf-shrub Herbaceous Vegetation (CEGL001891, G3?)

- *Festuca brachyphylla - Geum rossii var. turbinatum* Herbaceous Vegetation (CEGL001895, GUQ)
- *Festuca brachyphylla - Trisetum spicatum* Herbaceous Vegetation (CEGL001896, G3?)
- *Festuca brachyphylla* Herbaceous Vegetation (CEGL001797, G4?)
- *Festuca thurberi* Subalpine Grassland Herbaceous Vegetation (CEGL001631, G3)
- *Geum rossii - Carex albonigra* Herbaceous Vegetation (CEGL001966, G1G2Q)
- *Geum rossii - Minuartia obtusiloba* Herbaceous Vegetation (CEGL001965, G3?)
- *Geum rossii - Selaginella densa* Herbaceous Vegetation (CEGL001968, G2G3Q)
- *Geum rossii - Trifolium* spp. Herbaceous Vegetation (CEGL001970, G3)
- *Geum rossii* Herbaceous Vegetation (CEGL001964, G4G5Q)
- *Kobresia myosuroides - Carex rupestris var. drummondiana* Herbaceous Vegetation (CEGL001907, G3)
- *Kobresia myosuroides - Geum rossii* Herbaceous Vegetation (CEGL001908, G5)
- *Kobresia myosuroides - Trifolium dasyphyllum* Herbaceous Vegetation (CEGL001909, GU)
- *Leucopoa kingii - Carex elynoides* Herbaceous Vegetation (CEGL001911, G3)
- *Leucopoa kingii - Oxytropis campestris* Herbaceous Vegetation (CEGL001912, G3?)
- *Leucopoa kingii - Phlox pulvinata* Herbaceous Vegetation (CEGL001913, G3)
- *Leucopoa kingii - Poa fendleriana ssp. fendleriana* Herbaceous Vegetation (CEGL001914, G3)
- *Leucopoa kingii* Herbaceous Vegetation (CEGL001910, G3Q)
- *Minuartia obtusiloba* Herbaceous Vegetation (CEGL001919, G4)
- *Poa arctica ssp. grayana* Herbaceous Vegetation (CEGL001924, GU)
- *Poa lettermanii* Herbaceous Vegetation (CEGL001927, GU)
- *Poa nervosa - Achnatherum lettermanii* Herbaceous Vegetation (CEGL001656, G1G2)
- *Pseudoroegneria spicata* - Cushion Plants Herbaceous Vegetation (CEGL001666, G3?)
- *Ribes montigenum* Shrubland (CEGL001133, GU)
- *Saxifraga chrysantha* Sparse Vegetation (CEGL001929, GU)
- *Sibbaldia procumbens - Polygonum bistortoides* Herbaceous Vegetation (CEGL001933, G3?)

DISTRIBUTION

Range: This system occurs above upper treeline throughout the North American Rocky Mountain cordillera, including alpine areas of ranges in Utah and Nevada, central Wyoming, and isolated alpine sites in the northeastern Cascades.
Divisions: 204:P; 306:C
Nations: CA, US
Subnations: AB, AK?, AZ, BC, CO, ID, MT, NM, NV, OR, UT, WA, WY
Map Zones: 1:P, 7:P, 9:?, 10:C, 12:P, 16:C, 17:C, 18:?, 19:C, 20:?, 21:C, 22:?, 23:C, 24:C, 25:C, 28:C, 29:C
USFS Ecomap Regions: 341E:PP, 341G:PP, 342B:PP, 342J:PP, M242D:PP, M331A:CC, M331B:CC, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M331J:CC, M332A:CC, M332B:CP, M332D:CC, M332E:CC, M332F:CC, M332G:CC, M333A:CC, M333B:CC, M333C:CC, M333D:CC, M341A:CC, M341B:CP, M341C:CC, M341D:CC
TNC Ecoregions: 7:C, 8:C, 9:C, 11:C, 20:C, 21:C, 68:C

SOURCES

References: Baker 1980a, Bamberg 1961, Bamberg and Major 1968, Comer et al. 2003, Cooper et al. 1997, Douglas and Bliss 1977, Ecosystems Working Group 1998, Komarkova 1976, Komarkova 1980, Meidinger and Pojar 1991, NCC 2002, Neely et al. 2001, Schwan and Costello 1951, Thilenius 1975, Willard 1963
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722857#references
Description Author: R. Crawford, mod. M.S. Reid
Version: 26 Jan 2007 **Stakeholders:** Canada, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

ROCKY MOUNTAIN SUBALPINE-MONTANE MESIC MEADOW (CES306.829)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Upper Montane]; Herbaceous; Silt Soil Texture; Clay Soil Texture; Udic; Forb
Non-Diagnostic Classifiers: Sideslope; Temperate [Temperate Continental]; Shallow Soil; Mineral: W/ A-Horizon >10 cm; W-Patch/Medium Intensity; W-Landscape/Medium Intensity
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2145; ESLF 7118; ESP 1145

CONCEPT

Summary: This Rocky Mountain ecological system is restricted to sites from lower montane to subalpine where finely textured soils, snow deposition, or windswept dry conditions limit tree establishment. Many occurrences are small patch in spatial character, and are often found in mosaics with woodlands, more dense shrublands, or just below alpine communities. It is typically found above 2000 m in elevation in the southern part of its range and above 600 m in the northern part. These upland communities occur on gentle to moderate-gradient slopes and relatively moist habitats. The soils are typically seasonally moist to saturated in the spring, but if so will dry out later in the growing season. These sites are not as wet as those found in Rocky Mountain Alpine-Montane Wet Meadow (CES306.812). Vegetation is typically forb-rich, with forbs often contributing more to overall herbaceous cover than graminoids. Some stands are comprised of dense grasslands, these often being taxa with relatively broad and soft blades, but where the moist habitat promotes a rich forb component. Important taxa include *Erigeron* spp., Asteraceae spp., *Mertensia* spp., *Penstemon* spp., *Campanula* spp., *Lupinus* spp., *Solidago* spp., *Ligusticum* spp., *Thalictrum occidentale, Valeriana sitchensis, Rudbeckia occidentalis, Balsamorhiza sagittata*, and *Wyethia* spp. Important grasses include *Deschampsia caespitosa, Koeleria macrantha*, perennial *Bromus* spp., and a number of *Carex* species. *Dasiphora fruticosa ssp. floribunda* and *Symphoricarpos* spp. are occasional but not abundant. Burrowing mammals can increase the forb diversity.
Classification Comments: There are probably quite a number of *Carex*- and *Calamagrostis*-dominated types that could be cited as constituent associations.
Similar Ecological Systems:
- Rocky Mountain Alpine-Montane Wet Meadow (CES306.812)

Related Concepts:
- Idaho Fescue - Tufted Hairgrass (308) (Shiflet 1994) Intersecting
- Sedge - Sphagnum (ESSFdc2/09) (Steen and Coupe 1997) Intersecting
- Tall Forb (409) (Shiflet 1994) Intersecting
- Tufted Hairgrass - Sedge (313) (Shiflet 1994) Intersecting. Forb-rich portions of this SRM type overlap with this system.

Component Associations:
- *Agastache urticifolia - Heliomeris multiflora* Herbaceous Vegetation (CEGL001937, GNR)
- *Antennaria microphylla - Artemisia scopulorum* Herbaceous Vegetation (CEGL001847, G1Q)
- *Chamerion angustifolium* Rocky Mountain Herbaceous Vegetation (CEGL005856, G4G5)
- *Deschampsia caespitosa - Geum rossii* Herbaceous Vegetation (CEGL001884, G5)
- *Deschampsia caespitosa - Mertensia ciliata* Herbaceous Vegetation (CEGL001887, GU)
- *Geum rossii - Trifolium* spp. Herbaceous Vegetation (CEGL001970, G3)
- *Heracleum maximum - Rudbeckia occidentalis* Herbaceous Vegetation (CEGL001940, G4)
- *Ivesia gordonii - Eriogonum caespitosum* Herbaceous Vegetation (CEGL001903, G2?)
- *Ivesia gordonii - Minuartia obtusiloba* Herbaceous Vegetation (CEGL001902, G2?)
- *Ligusticum filicinum - Delphinium X occidentale* Herbaceous Vegetation (CEGL001941, G3)
- *Ligusticum porteri - Lupinus parviflorus ssp. myrianthus* Herbaceous Vegetation (CEGL001915, GU)
- *Ligusticum porteri - Vicia americana* Herbaceous Vegetation (CEGL001916, G3)
- *Ligusticum tenuifolium - Trollius laxus ssp. albiflorus* Herbaceous Vegetation (CEGL001917, GU)
- *Lupinus argenteus - Fragaria virginiana* Herbaceous Vegetation (CEGL001942, G3?)
- *Lupinus* spp. - *Poa* spp. Herbaceous Vegetation (CEGL001943, G1Q)
- *Luzula glabrata var. hitchcockii - Erythronium grandiflorum* Herbaceous Vegetation (CEGL005873, GNR)
- *Mertensia ciliata* Herbaceous Vegetation (CEGL001944, G3)
- *Phleum alpinum - Achillea millefolium* Herbaceous Vegetation (CEGL001920, G5)
- *Trifolium dasyphyllum* Herbaceous Vegetation (CEGL001935, G4)
- *Trifolium parryi* Herbaceous Vegetation (CEGL001936, GU)
- *Wyethia amplexicaulis* Herbaceous Vegetation (CEGL001947, G3?)
- *Xerophyllum tenax* Herbaceous Vegetation (CEGL005859, GNR)

DISTRIBUTION

Range: This system is very widespread in the Rocky Mountain cordillera from New Mexico north into Canada. It probably occurs in the Black Hills region, as well as the "island ranges" of central Montana.
Divisions: 304:C; 306:C
Nations: CA, US
Subnations: AB, AK?, AZ, BC, CO, ID, MT, NM, NV, OR, UT, WA, WY
Map Zones: 8:?, 9:C, 10:C, 12:C, 13:C, 15:C, 16:C, 17:P, 18:C, 19:C, 20:C, 21:C, 22:P, 23:C, 24:C, 25:C, 27:C, 28:C, 29:C
USFS Ecomap Regions: 313A:CC, 313B:CC, 322A:CC, 331A:CC, 331J:CC, 341A:CP, 341B:CC, 341E:CP, 341F:CP, 341G:CC, 342A:CC, 342B:CP, 342C:CC, 342D:CC, 342E:CC, 342H:CC, 342J:CC, M313B:CC, M331A:CC, M331B:CC, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M331J:CC, M332A:CC, M332B:CC, M332D:CC, M332E:CC, M332F:CC, M332G:CC, M333A:CC, M333B:CC, M333C:CC, M333D:CC, M334A:??, M341A:CC, M341B:CC, M341C:CC, M341D:CP
TNC Ecoregions: 7:C, 8:C, 9:C, 11:C, 18:C, 19:C, 20:C, 21:C, 26:C, 68:C

SOURCES

References: Buckner 1977, Comer et al. 2003, Ellison 1954, Fritz 1981, Gregory 1983, Hall 1971, Hammerson 1979, Marr 1977a, Meidinger and Pojar 1991, Nachlinger 1985, NCC 2002, Neely et al. 2001, Potkin and Munn 1989, Starr 1974
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722844#references
Description Author: NatureServe Western Ecology Team
Version: 23 Jan 2006 **Stakeholders:** Canada, Midwest, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

SOUTHEASTERN GREAT PLAINS TALLGRASS PRAIRIE (CES205.685)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Eastern Great Plains (205)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Herbaceous; Graminoid
Non-Diagnostic Classifiers: Lowland; Unglaciated; Shallow Soil; F-Landscape/Medium Intensity; G-Landscape/Medium Intensity
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2423; ESLF 7136; ESP 1423

CONCEPT

Summary: This system is found primarily within the Flint Hills and Osage Plains of Kansas and Oklahoma. Small patches can be found in the Ozarks of Missouri and the Arbuckle Mountains of Oklahoma. In southern Oklahoma and Texas, this is the primary natural system of the "Grand Prairie" or "Fort Worth Prairie," ranging south into the Lampasas Cutplain of Texas (EPA 29d and 29e, respectively). It is distinguished from Central Tallgrass Prairie (CES205.683) by having more species with southwestern geographic affinities and the presence of a thin soil layer over limestone beds ranging to more acidic substrates, although some areas of deeper soil are found within the region, especially on lower slopes, draws, and terraces. Because of the presence of the rocky substrate close to the surface and the rolling topography, this area is relatively unsuitable for agriculture. The Flint Hills contain one of the largest remaining, relatively intact pieces of tallgrass prairie. The vegetation in this system is typified by tallgrass species such as *Andropogon gerardii, Panicum virgatum, Schizachyrium scoparium*, and *Sorghastrum nutans* forming a dense cover. A moderate to high density of forb species also occurs. Species composition varies geographically, with *Oligoneuron rigidum (= Solidago rigida), Liatris punctata, Symphyotrichum ericoides, Lespedeza capitata*, and *Viola pedatifida* occurring in some localities. Areas of deeper soil, especially lower slopes along draws, slopes and terraces, can include *Baptisia alba var. macrophylla, Liatris pycnostachya*, and *Vernonia missurica*. Shrub and tree species are relatively infrequent and, if present, constitute less than 10% cover in the area. Fire and grazing constitute the major dynamic processes for this region. Although many of the native common plant species still occur, grazing does impact this region. Poor grazing practices can lead to soil erosion and invasion by cool-season grasses such as *Bromus inermis* within its range.
Classification Comments: This includes the Flint Hills, in addition to prairies in Oklahoma and Missouri south of the glacial line (including Ozarks of Missouri). There may need to be further review concerning the prairies in Missouri and Oklahoma. Southeastern Great Plains Tallgrass Prairie (CES205.685) lies to the west of the floristically related Texas Blackland Tallgrass Prairie (CES205.684), and is more widespread, ranging from Texas north to Kansas.
Similar Ecological Systems:
- Arkansas Valley Prairie and Woodland (CES202.312)
- Central Tallgrass Prairie (CES205.683)
- Lower Mississippi Alluvial Plain Grand Prairie (CES203.549)
- Ozark Prairie and Woodland (CES202.326)
- Texas Blackland Tallgrass Prairie (CES205.684)
- West Gulf Coastal Plain Northern Calcareous Prairie (CES203.377)

Related Concepts:
- Ashe Juniper - Redberry (Pinchot) Juniper: 66 (Eyre 1980) Finer
- Eastern Redcedar: 46 (Eyre 1980) Finer. Only on really degraded sites.
- Flint Hills Tallgrass Prairie (Lauver et al. 1999) Finer
- Grand Prairie: Tallgrass Prairie (2007) [CES205.685.9] (Elliott 2011) Equivalent

DESCRIPTION

Environment: This system is typified by a thin soil layer over limestone beds or acidic substrates such as chert or granite, although areas of deeper soils are possible along lower slopes, draws, and terraces. The topography is rolling and mostly unsuitable for agriculture. The typical geology is Lower Cretaceous formations, including various limestones, sands (such as from the Paluxy and Antlers formations), and clays (such as from the Walnut Formation). In contrast to Blackland Prairie, landform surfaces are flat rather than undulating, and valley slopes are angular rather than rounded. The "cuesta" landforms with gentle slopes leading up to relatively abrupt escarpments are characteristic of this portion of the Southeastern Great Plains Tallgrass Prairie. Soils of the Southeastern Great Plains Tallgrass Prairie in Texas differ from those of the Southern Blackland Prairie in being browner in color and containing more rock fragments, though much of the region occupied by this prairie is included in the Blackland Ecological Site. Clay Loam, Sandy Loam, Shallow, and Claypan Prairie are also significant Ecological Sites for this system. Soils of this area are more frequently characterized as Mollisols, as opposed to the Vertisols more characteristic of the Blackland Prairie. Calcareous clays are commonly encountered (Elliott 2011).
Vegetation: *Schizachyrium scoparium* tends to dominate examples of this system, with *Bouteloua curtipendula* as another significant component. Other grasses that are frequently present include *Nassella leucotricha, Bothriochloa laguroides ssp. torreyana, Aristida*

spp., *Andropogon gerardii, Andropogon ternarius, Aristida dichotoma, Buchloe dactyloides, Sporobolus compositus, Bouteloua eriopoda, Bouteloua gracilis, Bouteloua hirsuta, Sorghastrum nutans, Muhlenbergia reverchonii, Chloris verticillata*, and *Erioneuron pilosum*. Forbs species such as *Symphyotrichum ericoides, Ambrosia psilostachya, Tragia ramosa, Amphiachyris dracunculoides, Dyschoriste linearis, Salvia texana, Oenothera* spp., *Hedyotis nigricans var. nigricans (= Stenaria nigricans var. nigricans), Lindheimera texana, Thelesperma* spp., *Dalea* spp., and *Psoralidium* spp. may be encountered (Elliott 2011). Occurrences often contain, and are sometimes dominated by, the non-native grass *Bothriochloa ischaemum var. songarica* and/or *Cynodon dactylon*. Other forb species that can occur include *Oligoneuron rigidum (= Solidago rigida), Liatris punctata, Lespedeza capitata, Viola pedatifida, Coreopsis grandiflora, Danthonia spicata, Helianthus grosseserratus, Mentzelia oligosperma, Rudbeckia missouriensis, Silene regia, Croton willdenowii*, and *Tradescantia bracteata*. In areas of deeper soils, *Baptisia alba var. macrophylla, Liatris pycnostachya*, and *Vernonia missurica* can also occur within their ranges. Significant areas of this system remain within the Grand Prairie of Texas (Elliot 2011).

Dynamics: Fire and grazing are the prevalent dynamic processes in examples of this system. This system is found in a climate that can support trees and shrubs but woody vegetation is inhibited by frequent fires. Historically, fire-return intervals were short, estimated at between 2 and 15 years (Abrams 1986, Landfire 2007a). The frequent but unpredictable fires created a patchwork of habitats across the landscape, with recently burned sites having less litter and forb cover, and sites with infrequent fires possibly having more woody species and dense stands of grasses. This system developed in an area occupied by vast numbers of native ungulates, notably bison (*Bison bison*) but including other species, and the grazing of these species affected species composition and the patchwork of habitat. Bison preferentially favor newly burned areas and graminoids over forbs (Vinton et al. 1993, Coppedge and Shaw 1998). Their grazing, trampling, and wallowing were important in creating habitat diversity across the landscape (Knapp et al. 1999). On unburned sites, grazing removes live and dead vegetation, allowing more light and heat to the soil surface and increasing available moisture thus favoring species, forbs or woody plants, in the case of bison grazing, that were resilient to the effects of grazing or avoided by the grazers (Damoureyeh and Hartnett 1997).

Component Associations:

- *Andropogon gerardii - Panicum virgatum - Helianthus grosseserratus* Herbaceous Vegetation (CEGL002024, G2G3)
- *Andropogon gerardii - Sorghastrum nutans - Schizachyrium scoparium* Flint Hills Herbaceous Vegetation (CEGL002201, G4?)
- *Andropogon gerardii - Sorghastrum nutans* Unglaciated Herbaceous Vegetation (CEGL002204, G3)
- *Bouteloua curtipendula - Bouteloua (eriopoda, gracilis)* Herbaceous Vegetation (CEGL002250, G4)
- *Juniperus ashei / Bouteloua (curtipendula, hirsuta)* Woodland (CEGL002125, G2G3)
- *Muhlenbergia reverchonii - Croton monanthogynus* Herbaceous Vegetation (CEGL004785, G2G3)
- *Schizachyrium scoparium - (Sorghastrum nutans) - Sporobolus compositus var. compositus - Liatris mucronata* Herbaceous Vegetation (CEGL004211, GNR)
- *Schizachyrium scoparium - Aristida dichotoma - Croton willdenowii* / Lichens Wooded Herbaceous Vegetation (CEGL002242, G3)
- *Schizachyrium scoparium - Bouteloua curtipendula - Rudbeckia missouriensis - Mentzelia oligosperma* Wooded Herbaceous Vegetation (CEGL002251, G2)
- *Schizachyrium scoparium - Sorghastrum nutans - Andropogon ternarius - Coreopsis grandiflora* Sandstone - Shale Herbaceous Vegetation (CEGL002212, G3)
- *Schizachyrium scoparium - Sorghastrum nutans - Danthonia spicata - Silene regia* Chert Herbaceous Vegetation (CEGL002211, G3)
- *Schizachyrium scoparium - Sorghastrum nutans - Tradescantia bracteata* Alkaline Bedrock Herbaceous Vegetation (CEGL005280, G1G2)

DISTRIBUTION

Range: This system is found primarily within the Flint Hills and Osage Plains of Kansas and Oklahoma. Small patches can be found in the Ozarks of Missouri and the Arbuckle Mountains of Oklahoma. In southern Oklahoma and Texas, this is the primary natural system of the "Grand Prairie" or "Fort Worth Prairie," ranging south into the Lampasas Cutplain of Texas (EPA 29d and 29e, respectively). In Missouri, it is attributed to EPA 40c, 40d, and possibly 39k.

Divisions: 205:C

Nations: US

Subnations: KS, MO, OK, TX

Map Zones: 32:P, 35:C, 38:P, 43:C, 44:C

USFS Ecomap Regions: 223A:PP, 251E:CC, 251F:CC, 251G:CC, 251H:CC, 255A:CC, 255E:CC, 332E:CC

TNC Ecoregions: 32:C, 36:C, 37:C, 38:P

SOURCES

References: Abrams 1986, Barbour and Billings 1988, Bragg and Hulbert 1976, Briggs and Gibson 1998, Comer et al. 2003, Coppedge and Shaw 1998, Damoureyeh and Hartnett 1997, Elliott 2011, Eyre 1980, Hulbert 1988, Kindscher and Tieszen 1998, Knapp et al. 1999, Landfire 2007a, Lauver et al. 1999, Rice and Parenti 1978, Ricketts et al. 1999, Samson and Knopf 1994, Vinton et al. 1993

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722974#references

Description Author: S. Menard and K. Kindscher, mod. M. Pyne, J. Teague, L. Elliott, J. Drake

Version: 14 Jan 2014 **Stakeholders:** Midwest, Southeast

Concept Author: S. Menard and K. Kindscher, mod. M. Pyne and T. Foti **ClassifResp:** Midwest

SOUTHERN APPALACHIAN GRASS AND SHRUB BALD (CES202.294)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane; Herbaceous; Graminoid
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2414; ESLF 7127; ESP 1414

CONCEPT

Summary: This ecological system consists of dense herbaceous and shrubland communities in the highest elevational zone of the Southern Appalachians, generally above 1524 m (5000 feet) but occasionally to 1220 m (4000 feet), and at slightly lower elevations at its northern limit in Virginia and West Virginia, and in the Cumberland Mountains along the Virginia-Kentucky border. Vegetation consists either of dense shrub-dominated areas (heath balds) or dense herbaceous cover dominated by grasses or sedges (grassy balds). Heath balds are most often dominated by *Rhododendron catawbiense*, but substantial examples are also dominated by *Rhododendron carolinianum, Kalmia latifolia*, or a mixture of shrubs. One large example, dominated by *Alnus viridis ssp. crispa*, has been regarded as related to the heath balds, but is better treated separately due to much greater herbaceous diversity and coverage which is clearly different from typical heath balds. Grassy balds are characteristically dominated by *Danthonia compressa, Deschampsia flexuosa*, or *Carex* spp. Large areas have also become dominated by *Rubus allegheniensis* and/or *Rubus canadensis*, and by mixtures of native grasses with exotic pasture grasses. Most examples of grassy balds have some invading shrubs and trees, often dense enough to threaten the herbaceous vegetation. Heath balds may contain sparse stunted trees barely larger than the shrub canopy. The combination of high-elevation, non-wetland sites and dense herbaceous or shrub vegetation without appreciable rock outcrop conceptually distinguishes this system from all others in the Southern Appalachians. However, the widespread areas of degraded spruce-fir with grass and shrub cover and the invasion of grassy balds by trees blur the distinction somewhat.
Classification Comments: Grassy balds and heath balds differ in a number of ways and are often recognized as distinct entities. Whether these need to be split out at the system level, rather than just at the association level, has been questioned (M. Schafale pers. comm.). This system occurs in settings similar to Southern Appalachian Rocky Summit (CES202.327) and might be broadened to encompass that system.

DESCRIPTION

Environment: This system generally occurs at elevations above 1524 m (5000 feet) but may range as low as 1220 m (4000 feet) in the Southern Blue Ridge, with most examples from 1600-1780 m (5200-5800 feet) elevation (Mark 1958). It is also of limited extent above 1035 m (3400 feet) in the Cumberland Mountains along the Virginia-Kentucky border. It occurs on broad ridgetops and narrow spur ridges. Elevation and orographic effects (winds cooling as they rise to create increased condensation) make the climate cool and wet, with heavy moisture input from fog and cloud interception as well as high rainfall and snowfall. Convex slopes and exposure to wind offset the moisture input to some extent. The high peaks of the Southern Appalachians are not above the treeline; balds occur well below the elevation which would be a treeline today. Concentration of air pollutants has been implicated as an important anthropogenic stress in this elevational range in recent years. Soils range from shallow and rocky to fairly deep residual soils. Any kind of bedrock may be present, but most sites have erosion-resistant felsic igneous or metamorphic rocks, with slate and quartzite particularly frequent. Alder bald tends to occur on areas with thinner and rockier soils than nearby grassy bald (Brown 1941, J. Donaldson pers. comm. 2013), and is distinct from heath bald (Harshberger 1903b, Schafale 2012). The sites that support balds are not obviously different from similar sites that support spruce-fir forests, so the origin of the balds continues to be fodder for debate. Grazing and/or exposure to the elements may help maintain balds. Grass balds occur on less than one percent of the sites suitable for them (White and Sutter 1999b), and heath balds occur on 4-9% of the sites suitable for them (White et al. 2001). Forests occur on most of these sites, such as northern hardwood, high-elevation oak, or spruce-fir forests.
Vegetation: Vegetation consists either of dense shrubs (heath balds or blackberry) or dense herbaceous cover dominated by grasses or sedges (grassy balds). Heath balds are most often dominated by *Rhododendron catawbiense*, but substantial examples are also dominated by *Rhododendron carolinianum, Kalmia latifolia*, or a mixture of other shrubs, including *Prunus pensylvanica, Sorbus americana, Corylus cornuta, Gaylussacia baccata, Pieris floribunda, Vaccinium corymbosum*, and *Leiophyllum buxifolium*. One large example, dominated by *Alnus viridis ssp. crispa*, is generally also regarded as being related to the heath balds. Grassy balds are characteristically dominated by *Danthonia compressa, Carex pensylvanica*, or other *Carex* spp. with forbs including *Minuartia groenlandica, Paronychia argyrocoma, Saxifraga michauxii, Solidago glomerata, Solidago rugosa ssp. aspera, Sibbaldiopsis tridentata*, and others. Large areas have also become dominated by *Rubus allegheniensis*, possibly with other brambles (*Rubus canadensis, Rubus idaeus ssp. strigosus*) and by mixtures of native grasses with exotic pasture grasses (e.g., *Phleum pratense*). Most examples of grassy balds have some invading shrubs and trees, often dense enough to threaten the herbaceous vegetation. Heath balds may contain sparse stunted trees barely larger than the shrub canopy.
Dynamics: The dynamics that maintain and that created the communities in this system have been a major topic of debate, so far without resolution. Most grassy bald occurrences show a strong tendency to succeed to shrub or forest vegetation under present

conditions, suggesting that some important maintenance process has been lost. Northern hardwood, high-elevation oak, or spruce-fir forests may occur adjacent to balds. Grazing by native herbivores (elk and bison) and periodic fire have both been suggested as natural mechanisms to keep out woody vegetation. Others have suggested that all grassy balds are of anthropogenic origin and were never ecologically stable. The most definitive grassy balds have been documented as present at the time of the first European settlement, making documentation of their origin impossible. The presence of shade-intolerant endemic or disjunct herbaceous plant species in some suggests even greater age. These include *Lilium grayi, Geum radiatum, Packera schweinitziana*, and *Houstonia purpurea var. montana*. Some areas of the spruce-fir system degraded by a combination of logging, slash fires, and grazing resemble grassy balds, but most do not. The common practice of cattle grazing in grassy balds by early settlers has further obscured their presettlement character and evidence of presettlement disturbance processes.

Heath balds (not including alder balds) are more prone to disturbance by fire (Conkle 2004). However, heavy organic accumulations in the soil suggest great age for some. Most heath balds show limited tendency to succeed to forest, suggesting that the dense heath shrub layer is very competitive with tree seedlings. Spruce-fir forest stands which burned in historical times have not usually developed vegetation identical to heath balds.

Component Associations:
- *Alnus viridis ssp. crispa / Carex pensylvanica* Shrubland (CEGL003891, G1)
- *Carex pensylvanica* Herbaceous Vegetation (CEGL004094, G1)
- *Danthonia compressa - (Sibbaldiopsis tridentata)* Herbaceous Vegetation (CEGL004242, G1)
- *Kalmia latifolia - Gaylussacia (baccata, brachycera)* Cumberland Shrubland (CEGL008470, G3)
- *Kalmia latifolia - Rhododendron catawbiense - (Gaylussacia baccata, Pieris floribunda, Vaccinium corymbosum)* Shrubland (CEGL003814, G2G3)
- *Leiophyllum buxifolium* Dwarf-shrubland (CEGL003951, G1)
- *Photinia melanocarpa - Gaylussacia baccata / Carex pensylvanica* Shrubland (CEGL008508, G1?)
- *Rhododendron carolinianum - Rhododendron catawbiense - Leiophyllum buxifolium* Shrubland (CEGL007876, G1)
- *Rhododendron carolinianum* Shrubland (CEGL003816, G2)
- *Rhododendron catawbiense - Pieris floribunda* Shrubland (CEGL004516, G1)
- *Rhododendron catawbiense* Shrubland (CEGL003818, G2)

Spatial Characteristics

Spatial Summary: Small-patch to large-patch system, sometimes occurring as single patches, sometimes as complexes of small patches.
Size: Individual patches of both grassy bald and heath bald range from 10 acres or less, to occasional expanses of hundreds of acres. Heath balds sometimes occur as complexes of small patches on spur ridges. Separation rules will have a strong effect on the aggregate acreage of defined occurrences in these situations, but the largest occurrences are fairly contiguous.
Adjacent Ecological Systems:
- Central and Southern Appalachian Spruce-Fir Forest (CES202.028)
- Southern Appalachian Montane Pine Forest and Woodland (CES202.331)
- Southern Appalachian Northern Hardwood Forest (CES202.029)
- Southern Appalachian Rocky Summit (CES202.327)
- Southern Appalachian Seepage Wetland (CES202.317)

Adjacent Ecological System Comments: This system is virtually always bordered by Southern Appalachian Northern Hardwood Forest (CES202.029) or Central and Southern Appalachian Spruce-Fir Forest (CES202.028). It may also contain embedded small patches of Southern Appalachian Rocky Summit (CES202.327) and Southern Appalachian Seepage Wetland (CES202.317).

Distribution

Range: This system ranges from the Balsam Mountains and Great Smoky Mountains of North Carolina and Tennessee northward to Virginia and West Virginia. The system is also of limited extent in the Cumberland Mountains along the Virginia-Kentucky border. The current status in Georgia is open to question and the ecological system was apparently never extensive in any case. The distribution and classification of grassy balds and high-elevation pastures has been documented (Gersmehl 1970). Heath balds could be mapped separately from grassy balds as has been done for the Great Smoky Mountains (White et al. 2001). Alder bald can also be mapped separately, but it requires more field verification to map correctly.
Divisions: 202:C
Nations: US
Subnations: GA, KY, NC, TN, VA, WV
Map Zones: 57:C, 61:C
USFS Ecomap Regions: M221A:CC, M221B:CC
TNC Ecoregions: 50:C, 51:C, 59:C

Sources

References: Billings and Mark 1957, Boggs et al. 2005, Brown 1941, Cain 1930b, Camp 1931, Comer et al. 2003, Conkle 2004, DeSelm and Murdock 1993, Gates 1941, Gersmehl 1970, Gersmehl 1973, Gilbert 1954, Harshberger 1903b, Landfire 2007a, Lindsay 1976, Lindsay 1977, Lindsay and Bratton 1979a, Lindsay and Bratton 1979b, Mark 1958, Mark 1959, Nodvin et al. 1995, Post 2013, Schafale 2011, Stevens et al. 2004, Sturm et al. 2005, Weiss 1999, Wells 1936a, Wells 1936b, Wells 1937, Wells 1961b, White and Sutter 1999b, White et al. 2001

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723195#references
Description Author: M. Schafale and R. Evans, mod. S. Gawler, M. Pyne, C. Nordman
Version: 14 Jan 2014 **Stakeholders:** East, Southeast
Concept Author: M. Schafale and R. Evans **ClassifResp:** Southeast

SOUTHERN ATLANTIC COASTAL PLAIN DUNE AND MARITIME GRASSLAND (CES203.273)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Herbaceous; Graminoid; Coast
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2426; ESLF 7139; ESP 1426

CONCEPT

Summary: This ecological system consists primarily of grasslands and related shrublands of Atlantic Coastal Plain barrier islands and related coastal areas from North Carolina south to northern and central Florida. On the Florida coast from south of Cape Canaveral to the sandy portions of the Florida Keys, this system occurs in a more attenuated fashion. This ecological system includes upland dune grasslands and maritime wet grasslands and shrublands, which are not tidal, but may be flooded for short periods of time from storm surge or heavy rain. The environment of this system is highly dynamic. Reworking of sand by storms or by slower eolian processes may completely change the local environment. Vegetation responds to these natural coastal processes through primary succession. The combined effects of chronic and extreme salt spray and periodic ocean overwash by seawater prevent or dramatically inhibit woody plant growth.
Classification Comments: This system was separated from Northern Atlantic Coastal Plain Dune and Swale (CES203.264) to parallel broad-scale biogeographic and climatic differences believed to be important in this environment. The northern part of this broad transition was labeled by Cowardin et al. (1979) as the Virginian Province and the southern region as the Carolinian Province, although the demarcated boundary differs somewhat from that used here. A primary indicator of this transition is the shift in vegetation dominance on the dunes from *Uniola paniculata* in the south to *Ammophila breviligulata* in the north. Although the location of this shift itself is somewhat imprecise because of widespread planting of both species on artificially enhanced dunes, this boundary appears to be well approximated by Omernik Ecoregion 63g vs. 63d (EPA 2004).
Similar Ecological Systems:
- Central Atlantic Coastal Plain Maritime Forest (CES203.261)
- Northern Atlantic Coastal Plain Dune and Swale (CES203.264)--occurs to the north.
- Southeastern Coastal Plain Interdunal Wetland (CES203.258)
- Southern Atlantic Coastal Plain Maritime Forest (CES203.537)
- Southwest Florida Dune and Coastal Grassland (CES203.539)

Related Concepts:
- Beach Dune (FNAI 1990) Intersecting
- Cabbage Palmetto: 74 (Eyre 1980) Finer
- Coastal Grassland (FNAI 1990) Intersecting
- Coastal Strand (FNAI 1992b) Intersecting
- Live Oak: 89 (Eyre 1980) Finer

DESCRIPTION

Environment: Occurs on barrier islands and similar coastal strands, on sand dunes and sand flats. Strong salt spray is an important influence on vegetation in many parts. Overwash by sea water during storms is important on sand flats not protected by continuous dunes. On dunes, present or recent sand movement is an important factor. The combination of these factors prevents the dominance of woody vegetation. Sites may be either dry or saturated by freshwater from rainfall and local water table. Areas connected to tidal influence and areas with ponded freshwater are placed in other ecological systems. Soils are sandy, with little organic matter and little or no horizon development. Soils may be excessively drained on the higher dunes. Soils are low in nutrient-holding capacity, but aerosol input of sea salt provides a continuous source of nutrients. North of the Sea Islands region of coastal Georgia and South Carolina, barrier islands that face south tend to have better developed dune fields, and often have extensive maritime forest systems, and east-facing barrier islands naturally have less continuous dunes and more overwash flats. On islands that face east, the northern portion tends to experience shoreline and dune erosion and the south end may experience accretion. Many of Georgia's barrier islands (known as Sea Islands) show this pattern.
Vegetation: Vegetation consists of a set of grassland and other herbaceous associations. *Uniola paniculata* is the characteristic dominant on the youngest dunes and those most exposed to salt spray and less commonly *Panicum amarum* (Pinson 1973). *Spartina patens* or *Schizachyrium littorale* tend to dominate older dunes and sand flats. Component communities tend to be low in plant species richness, but have a characteristic set of forbs and occasional low shrubs associated with them. Wetter sand flats and dune swales may be dominated by a variety of herbs and sometimes have fairly high species richness. Also included in this system are patches of transition shrub communities or shrub thickets.
Dynamics: The environment of this system is one of the most dynamic in existence for terrestrial vegetation. Reworking of sand by storms or by slower eolian processes may completely change the local environment in a short time, changing one association to

another or changing this system into a different system. Many of these sites are fairly early in the process of primary succession on recent surfaces. Chronic salt spray is an ongoing stress. Overwash and extreme salt spray in storms is a frequent disturbance. Vegetation interacts strongly with geologic processes; the presence of dune grass is an important factor in the development of new dunes. Artificial enhancement of dunes by sand fencing or planting off-site species, including *Ammophila breviligulata*, can alter the dynamic processes of the dunes. Fire is probably not a major natural factor in this system, but may have been important locally. Most vegetation is too sparse to carry fire well.

Component Associations:
- *Iva imbricata / Uniola paniculata - Helianthus debilis ssp. debilis* Herbaceous Vegetation (CEGL004001, G2G3)
- *Morella cerifera / Spartina patens* Shrubland (CEGL003839, G3G4)
- *Morella pensylvanica / Diodia teres* Shrubland (CEGL003881, G2)
- *Muhlenbergia filipes - Spartina patens - Eustachys petraea* Herbaceous Vegetation (CEGL004051, G2)
- *Quercus virginiana - (Ilex vomitoria)* Shrubland (CEGL003833, G3)
- *Sabal palmetto / Glyceria septentrionalis - Carex stipata - Woodwardia virginica* Woodland (CEGL007784, G3?)
- *Salix caroliniana / Hibiscus grandiflorus / Polygonum punctatum* Woodland (CEGL004272, G3G4)
- *Salix caroliniana / Sacciolepis striata - Boehmeria cylindrica* Woodland (CEGL004222, G2?)
- *Serenoa repens - Sabal palmetto - Ilex vomitoria - Sideroxylon tenax* Scrub (CEGL003812, G1)
- *Smilax auriculata - Toxicodendron radicans* Vine-Shrubland (CEGL003885, GNRQ)
- *Smilax auriculata / Heterotheca subaxillaris - Strophostyles helvula - (Uniola paniculata)* Herbaceous Vegetation (CEGL004234, G2G3)
- *Spartina patens - Schoenoplectus pungens - Solidago sempervirens* Herbaceous Vegetation (CEGL004097, G2G3)
- *Uniola paniculata - Hydrocotyle bonariensis* Herbaceous Vegetation (CEGL004040, G3?)
- *Uniola paniculata - Schizachyrium littorale - Panicum amarum* Herbaceous Vegetation (CEGL004039, G3)
- *Vitis rotundifolia / Triplasis purpurea - Panicum amarum - Schizachyrium littorale* Mid-Atlantic Coastal MedaÃ±o Sparse Vegetation (CEGL004397, G1)

SPATIAL CHARACTERISTICS

Spatial Summary: Occurs as a large-patch or local matrix system.
Size: Occurs in narrow to broad bands, up to several miles wide, extending along the length of barrier islands. Individual patches may cover a thousand or more acres. However, some of the best remnants are naturally small, occurring on smaller islands.
Adjacent Ecological Systems:
- Central Atlantic Coastal Plain Maritime Forest (CES203.261)

DISTRIBUTION

Range: This system ranges on the Atlantic Coast from northern North Carolina (Omernik ecoregion 63g, Carolinian Barrier Islands and Coastal Marshes) to central Florida. The northern limit is a transition zone from around Kitty Hawk, North Carolina, to the Virginia-North Carolina border.
Divisions: 203:C
Nations: US
Subnations: FL, GA, NC, SC
Map Zones: 55:C, 56:?, 58:C
USFS Ecomap Regions: 232C:CC, 232I:CC
TNC Ecoregions: 55:?, 56:C, 57:C

SOURCES

References: Comer et al. 2003, Cowardin et al. 1979, Defeo et al. 2009, EPA 2004, FNAI 1992b, FNAI 2010a, Johnson and Muller 1993a, Pinson 1973
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723213#references
Description Author: R. Evans, mod. M. Pyne and C. Nordman
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: R. Evans **ClassifResp:** Southeast

SOUTHERN COASTAL PLAIN BLACKLAND PRAIRIE AND WOODLAND (CES203.478)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Circumneutral Soil; Deep Soil; Clay Soil Texture; Graminoid
Non-Diagnostic Classifiers: Herbaceous
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2430; ESLF 7143; ESP 1430

CONCEPT

Summary: This system includes natural grassland vegetation and associated wooded vegetation found primarily in two relatively small natural regions in the southeastern Coastal Plains, primarily in Alabama and Mississippi (with one of these extending barely into southern Tennessee), and a related area of southern Georgia. The larger of these, the so-called Black Belt, is approximately 480 km (300 miles) long and 40-50 km (25-30 miles) wide, and is delineated as the Black Belt Subsection 231Ba and the Blackland Prairie EPA Ecoregion 65a. The smaller and more southerly one of the two is known as the Jackson Prairie region, is found on younger geologic strata and is delineated as the Jackson Hills Subsection (231Bj) and as the Jackson Prairie EPA Ecoregion (65r). The vegetation of this system is comprised of natural grasslands and associated wooded vegetation (woodlands and savannas). The Black Belt region derives its name from the nearly black, rich topsoil that developed over Selma Chalk, and has long been noted as a distinct topographic region in the state of Mississippi. In Alabama, the formations on which this system primarily occurs are Demopolis Chalk and Mooreville Chalk (members of the Selma Group). In Tennessee, only Demopolis Chalk is mapped. Examples occur over relatively deep soils (as opposed to "glades and barrens" on or adjacent to rock outcrops), with circumneutral surface soil pH. Vegetation of this ecological system includes evergreen *Juniperus virginiana*-dominated forests and deciduous *Quercus*-dominated woodlands of varying densities, interspersed with native prairielike grasslands. Much of the natural vegetation of the region has been converted to pasture and agricultural uses, but even old-field vegetation reflects the distinctive composition of the flora and ecological dynamics. In most cases individual prairie openings are small and isolated from one another, but were formerly more extensive prior to European settlement, forming a mosaic of grasslands and woodlands under frequent fire regimes. The flora has much in common with other prairies of the East Gulf Coastal Plains, as well as the classic Midwestern prairies. Within this natural region, there are pockets of acidic soils which produce more typical pine-oak woodland or forest vegetation. The Jackson Prairie component of the system includes natural grassland vegetation and associated wooded vegetation in the Jackson Hills Subsection (231Bj), also called the Jackson Prairie EPA Ecoregion (65r), a relatively small natural region of Mississippi and adjacent Alabama. This system occurs on montmorillonitic Vertisols, which are deep, slowly permeable soils formed in residuum weathered from marl or chalk. Examples occur in a larger matrix of primarily acidic soils and of generally *Pinus taeda*-dominated forest vegetation. In most cases individual prairie openings are small and isolated from one another but were formerly more extensive prior to European settlement, forming a mosaic of grassland and woodland under frequent fire regimes. Much of the natural vegetation of the region has been converted to pasture and agricultural uses, with concomitant destruction of most prairie remnants.
Classification Comments: "Blackland Prairies" occur primarily in two discrete areas of the East Gulf Coastal Plain: Jackson Prairie and the Black Belt. There is also an area in the Atlantic Coastal Plain of Georgia which is included here. It is a "blackland" but not a "black belt" prairie. Much of the natural vegetation of the region has been converted to pasture and agricultural uses, with concomitant destruction of most prairie remnants (DeSelm and Murdock 1993). Of the approximately 100,000 acres of Blackland Prairies mapped during the general land surveys of the early and mid 1800s in Mississippi, probably less than 500 acres of Jackson Prairie vegetation exists today, even if one considers grazed areas and vacant agricultural lands with a semblance of prairie species (R. Wieland pers. comm.). Almost all of the lands were converted to agriculture. Some of the lands are now reverting back to prairie after being abandoned. More recently, lands are being converted to fescue pasture; other abandoned lands have become stands of eastern red-cedar. The number of acres in good condition is probably less than 100. The flora has much in common with other prairies of the East Gulf Coastal Plains as well as the classic Midwestern prairies.
Related Concepts:
- Eastern Redcedar: 46 (Eyre 1980) Finer
- Post Oak - Blackjack Oak: 40 (Eyre 1980) Finer

DESCRIPTION

Environment: The Black Belt component of this system generally occurs on Cretaceous age chalk, marl and calcareous clay. This includes calcareous soils of the Sumter, Binnsville, and Demopolis series, described as beds of marly clay over Selma Chalk (including the Demopolis and Mooreville formations). The area has an average annual precipitation of 130-140 cm and a frost-free period of 200-250 days. The soils of the Jackson Prairie openings are presently mapped as the Maytag Series, a fine montmorillonitic, thermic Entic Chromudert. This deep slowly permeable soil has formed in residuum weathered from marl of chalk of the Blackland Prairies (Wieland 1995). Examples occur in a larger matrix of primarily acidic soils and of generally Pinus taeda-dominated forest vegetation (Jones 1971).

Vegetation: Vegetation of this ecological system includes evergreen *Juniperus virginiana*-dominated forests and deciduous *Quercus*-dominated woodlands of varying densities, interspersed with native prairie-like grasslands. Much of the natural vegetation of the region has been converted to pasture and agricultural uses, but even old-field vegetation reflects the distinctive composition of the flora and ecological dynamics. The oak woodlands of the Black Belt component typically contain *Quercus stellata, Quercus muehlenbergii*, and *Quercus marilandica*. Other woody components include *Quercus falcata, Carya alba, Carya glabra, Fraxinus americana, Celtis laevigata, Cercis canadensis var. canadensis, Crataegus engelmannii, Diospyros virginiana, Ilex decidua, Prunus angustifolia, Frangula caroliniana, Sideroxylon lycioides*, and *Ulmus alata*. Prairie forbs and grasses may persist in small openings and in edge situations in the more heavily forested areas of the Black Belt. The presence of *Juniperus virginiana*-dominated zones may represent invasion by this species in the absence of sufficiently frequent or intense fire (DeSelm and Murdock 1993). Pines are generally absent, being inhibited by the higher surface soil pH. In the grass-dominated areas of the Black Belt, *Schizachyrium scoparium* and *Sorghastrum nutans* are the principal herbs. Other herbaceous taxa include *Andropogon glomeratus, Andropogon virginicus, Bouteloua curtipendula, Panicum virgatum*, and *Schizachyrium scoparium*, with lesser amounts of *Paspalum floridanum, Setaria parviflora*, and *Sporobolus indicus* (exotic). Other common species include *Arnoglossum plantagineum, Symphyotrichum dumosum (= Aster dumosus), Symphyotrichum patens (= Aster patens), Crotalaria sagittalis, Dalea candida, Dalea purpurea, Desmanthus illinoensis, Desmodium ciliare, Dracopis amplexicaulis, Liatris aspera, Liatris squarrosa, Liatris squarrulosa, Neptunia lutea, Ratibida pinnata, Ruellia humilis, Silphium terebinthinaceum, Silphium trifoliatum var. latifolium*, and *Solidago nemoralis*. In depressions and drainages, *Andropogon gerardii* and/or *Panicum virgatum* will have greater importance (DeSelm and Murdock 1993). At this more mesic end of the continuum, invasion by woody plants is a more serious threat to the system. Moist, seepy inclusions within this system are often dominated by *Rhynchospora colorata* and *Scleria verticillata*; *Rhynchospora divergens, Lythrum alatum var. lanceolatum, Mitreola petiolata*, and *Mecardonia acuminata* also occur but much less frequently (A. Schotz pers. comm.). The most prominent tall grasses of the Jackson Prairie component are *Andropogon gerardii, Schizachyrium scoparium, Sorghastrum nutans*, and *Panicum virgatum*. Additional tall grasses include *Tripsacum dactyloides, Andropogon glomeratus*, and *Paspalum floridanum*. Along with *Schizachyrium scoparium*, two other species provide over 50% cover in prairie openings: *Carex cherokeensis* and *Helenium autumnale*. Other plants closely affiliated with less disturbed prairie openings include *Dalea purpurea, Dalea candida, Sporobolus compositus var. macer, Muhlenbergia capillaris, Penstemon laxiflorus (= Penstemon australis ssp. laxiflorus), Symphyotrichum novae-angliae (= Aster novae-angliae), Echinacea purpurea, Manfreda virginica, Ruellia purshiana, Desmanthus illinoensis*, and *Spiranthes magnicamporum* (Wieland 1995).

Dynamics: In the presettlement landscape and throughout the nineteenth century, a combination of fire and grazing (first by native ungulates and then by free-ranging cattle) kept these sites open and grass-dominated (DeSelm and Murdock 1993).

Blackland prairie and woodland occurs on eponymous rich, black, circumneutral topsoils formed over clayey, heavy, usually calcareous subsoils with carbonatic or montmorillonitic mineralogy. The system occurs in association with formations of the Tertiary Jackson (Yazoo Clay), Claiborne (Cook Mountain) and Fleming groups, and the Cretaceous Selma group (Selma, Mooreville or Demopolis chalks). The matrix around the blackland prairies is pine-oak forests growing in acidic, sandier soils with less clay (recent STATSGO soils maps).

Floristic similarity among sites across this geographic range generally appears to be 50% or greater, although a number of different alliances within this type have been recognized according to dominant, codominant, and diagnostic species. Extant prairies occur in single patches as well as mosaics less than one acre to over several hundred acres in response to soil depth, slope and fire. Mosaics may include virtually treeless patches associated with other patches of widely scattered trees, open deciduous woodlands and evergreen thickets (eastern red-cedar "balds"). This vegetation is a mosaic of *Juniperus virginiana* woodland, *Quercus stellata - Quercus marilandica* woodland, and *Schizachyrium scoparium - Sorghastrum nutans* herbaceous alliances. It is a rare and imperiled vegetation type consisting of scattered remnants. Most of the original cover has been destroyed or altered by conversion to agriculture and the exclusion of fire (Landfire 2007a).

For the last 500-1000 years, fires were probably annual in most of the system, many if not most set by Native Americans. Fires were probably used to clear prairies for agricultural planting, to eliminate woody growth, and to aid in hunting. The modern landscape shows a tendency toward erosion, creating shallow-soil areas known as "cedar balds" where soil erosion, presumably from historic agriculture or overgrazing, has reduced topsoil. These areas often show exposures of underlying chalk. Such areas may have resulted (albeit at much lower frequencies) from aboriginal agriculture or overgrazing by native herbivores (Landfire 2007a).

Component Associations:

- *(Quercus sinuata) / Sorghastrum nutans - Ratibida pinnata - Hedyotis nigricans var. nigricans - (Glandularia bipinnatifida)* Georgia Chalk Prairie Herbaceous Vegetation (CEGL004247, G1)
- *Crataegus crus-galli - Ilex decidua - Crataegus viridis* Shrubland (CEGL004532, GNR)
- *Juniperus virginiana var. virginiana - (Celtis laevigata, Prunus angustifolia, Sideroxylon lycioides)* Woodland (CEGL007747, G2)
- *Quercus stellata - Quercus muehlenbergii / Schizachyrium scoparium - Sorghastrum nutans* Black Belt Woodland (CEGL004670, G2G3)
- *Schizachyrium scoparium - Sorghastrum nutans - Dalea candida - Liatris squarrosa - (Silphium terebinthinaceum)* Black Belt Herbaceous Vegetation (CEGL004664, G1)
- *Schizachyrium scoparium - Sorghastrum nutans - Dalea purpurea - Silphium integrifolium* Jackson Prairie Herbaceous Vegetation (CEGL004020, G1)

DISTRIBUTION

Range: This system has several distinct components. The Black Belt Prairie component is primarily restricted to the Black Belt

(Subsection 231Ba of Keys et al. 1995) or Blackland Prairie area (EPA Ecoregion 65a) and Flatwoods/Blackland Prairie Margins area (EPA Ecoregion 65b) of Griffith et al. (2001). This region is primarily in Alabama and Mississippi, ranging north in a depauperate form to southern Tennessee (McNairy County) (DeSelm 1989b). The Jackson Prairie component of this system is found in a relatively small natural region of Mississippi, known as the Jackson Hills Subsection 231Bj of Keys et al. (1995) and the Jackson Prairie Ecoregion 65r of EPA (EPA 2004). There is also a recently recognized component found in limited parts of Georgia (e.g., on both sides of the Ocmulgee River on the Fort Valley Plateau of Bleckley, Houston, Peach, and Twiggs counties). There are also outlying occurrences southward in the Chunnenuggee Hills and Red Hills (both of these parts of the Southern Hilly Coastal Plain -EPA Ecoregion 65d), and Buhrstone/Lime Hills (EPA Ecoregion 65q) of southern Alabama (in Washington, Wilcox, Monroe, and Clark counties). There are some limited examples in EPA Ecoregion 65i (Fall Line Hills; e.g., Jones Bluff in Alabama).

Divisions: 203:C
Nations: US
Subnations: AL, GA, MS, TN
Map Zones: 46:C, 55:C
USFS Ecomap Regions: 231B:CC, 232B:CC
TNC Ecoregions: 43:C, 53:?, 56:C

SOURCES

References: Comer et al. 2003, DeSelm 1989b, DeSelm and Murdock 1993, Duffey et al. 1974, EPA 2004, Estes et al. 1979, Eyre 1980, Griffith et al. 2001, Hardeman 1966, Jones 1971, Keys et al. 1995, Landfire 2007a, Lowe 1921, McKinney and Lockwood 1999, Murdock pers. comm., Noss 2013, Schotz and Barbour 2009, Taft 1997, Taft 2009, Taft et al. 1995, TNC 1996c, Wieland 1995, Wieland pers. comm., Wiens and Dyer 1975

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723108#references

Description Author: A. Schotz, R. Evans, M. Pyne
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: A. Schotz, R. Evans, M. Pyne, R. Wieland **ClassifResp:** Southeast

SOUTHERN RIDGE AND VALLEY PATCH PRAIRIE (CES202.453)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Herbaceous; Graminoid
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2419; ESLF 7132; ESP 1419

CONCEPT

Summary: This system is a collection of deep soil prairies and barrens found historically in the Coosa Valley of northwestern Georgia and adjacent Alabama and related areas including barrens at Oak Ridge, Tennessee. This system was formerly widespread, but is now found only in scattered and isolated remnants. Vegetation is typically prairie-like and may have supported scattered trees depending upon fire-return interval. Some typical species found in examples of this system include *Andropogon gerardii, Sorghastrum nutans, Panicum anceps, Panicum virgatum, Tripsacum dactyloides, Schizachyrium scoparium, Helianthus mollis, Helianthus occidentalis, Silphium trifoliatum*, and *Silphium terebinthinaceum*.
Classification Comments: Western Highland Rim Prairie and Barrens (CES202.352), Eastern Highland Rim Prairie and Barrens (CES202.354), Pennyroyal Karst Plain Prairie and Barrens (CES202.355), and Southern Ridge and Valley Patch Prairie (CES202.453) form a series of similar systems in the eastern Interior Highlands and adjacent Ridge and Valley.
Similar Ecological Systems:
- Eastern Highland Rim Prairie and Barrens (CES202.354)
- Pennyroyal Karst Plain Prairie and Barrens (CES202.355)
- Western Highland Rim Prairie and Barrens (CES202.352)

DESCRIPTION

Environment: See DeSelm (1993) for an extensive discussion.
Vegetation: Some typical species found in examples of this system include *Andropogon gerardii, Sorghastrum nutans, Panicum anceps, Panicum virgatum, Tripsacum dactyloides, Schizachyrium scoparium, Helianthus mollis, Helianthus occidentalis, Silphium trifoliatum*, and *Silphium terebinthinaceum*.
Dynamics: This system was formerly widespread, but is now found only in scattered and isolated remnants (DeSelm and Murdock 1993). Vegetation is typically prairie-like and may have supported scattered trees depending upon fire-return interval. With prolonged lack of fire (and grazing) areas may succeed to forested vegetation, becoming indistinguishable from adjacent hardwood forests.

Component Associations:
- *Andropogon gerardii - Bouteloua curtipendula - Echinacea simulata* Coosa Valley Barren Herbaceous Vegetation (CEGL004045, G1)
- *Andropogon gerardii - Panicum (anceps, virgatum)* Herbaceous Vegetation (CEGL007931, G2?)
- *Schizachyrium scoparium - Andropogon gerardii - Silphium terebinthinaceum* Coosa Valley Barren Herbaceous Vegetation (CEGL004757, G1)
- *Schizachyrium scoparium - Sorghastrum nutans - Silphium* spp. Herbaceous Vegetation (CEGL007932, G2?)

DISTRIBUTION

Range: This system occurs in the Coosa River valley of northwestern Georgia, Tennessee, and northeastern Alabama, and related areas of the Ridge and Valley physiographic province, including barrens at Oak Ridge, Tennessee.
Divisions: 202:C
Nations: US
Subnations: AL, GA, TN
Map Zones: 48:C, 53:P
USFS Ecomap Regions: 221J:CC, 231D:CC, M221A:CC
TNC Ecoregions: 50:C

SOURCES

References: Comer et al. 2003, DeSelm and Murdock 1993, DeSelm et al. 1969, Duffey et al. 1974, Estes et al. 1979, McKinney and Lockwood 1999, Murdock pers. comm., Noss 2013, Taft 1997, Taft 2009, Taft et al. 1995, TNC 1996c, Wiens and Dyer 1975
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723129#references
Description Author: M. Pyne and R. Evans
Version: 14 Jan 2014
Concept Author: M. Pyne and R. Evans
Stakeholders: Southeast
ClassifResp: Southeast

SOUTHERN ROCKY MOUNTAIN MONTANE-SUBALPINE GRASSLAND (CES306.824)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Herbaceous; Acidic Soil; Mineral: W/ A-Horizon >10 cm; Loam Soil Texture; Silt Soil Texture; Aridic; Short Disturbance Interval; Graminoid; Cool-season bunch grasses
Non-Diagnostic Classifiers: Moderate (100-500 yrs) Persistence; Montane [Montane]; Montane [Lower Montane]; Sideslope; Temperate [Temperate Continental]; Shallow Soil; F-Patch/Low Intensity
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2146; ESLF 7119; ESP 1146

CONCEPT

Summary: This Rocky Mountain ecological system typically occurs between 2200 and 3000 m elevation on flat to rolling plains and parks or on lower sideslopes that are dry, but it may extend up to 3350 m on warm aspects. Soils resemble prairie soils in that the A-horizon is dark brown, relatively high in organic matter, slightly acidic, and usually well-drained. An occurrence usually consists of a mosaic of two or three plant associations with one of the following dominant bunch grasses: *Danthonia intermedia*, *Danthonia parryi*, *Festuca idahoensis*, *Festuca arizonica*, *Festuca thurberi*, *Muhlenbergia filiculmis*, or *Pseudoroegneria spicata*. The subdominants include *Muhlenbergia montana*, *Bouteloua gracilis*, and *Poa secunda*. These large-patch grasslands are intermixed with matrix stands of spruce-fir, lodgepole pine, ponderosa pine, and aspen forests. In limited circumstances (e.g., South Park in Colorado), they form the "matrix" of high-elevation plateaus. Small-patch representations of this system do occur at high elevations of the Trans-Pecos where they present as occurrences of *Festuca arizonica - Blepharoneuron tricholepis* Herbaceous Vegetation (CEGL004508). These occurrences often occupy sites adjacent to Madrean Oriental Chaparral (CES302.031).
Classification Comments: Montane grasslands are very similar and intergrade with their subalpine counterparts, but are separated here to represent those species that do not occur at higher altitudes.

Component Associations:
- *Agrostis variabilis* Herbaceous Vegetation (CEGL001846, G2G3)
- *Carex duriuscula* Herbaceous Vegetation (CEGL001874, GUQ)
- *Carex siccata - Carex rossii* Herbaceous Vegetation (CEGL005388, GNR)
- *Danthonia intermedia - Solidago multiradiata* Herbaceous Vegetation (CEGL001879, G3G4)
- *Danthonia intermedia* Herbaceous Vegetation (CEGL001794, G2G3)
- *Danthonia parryi* Herbaceous Vegetation (CEGL001795, G3)
- *Deschampsia caespitosa* Herbaceous Vegetation (CEGL001599, G4)
- *Elymus lanceolatus* Herbaceous Vegetation (CEGL002588, GNR)
- *Festuca (calligera, arizonica, brachyphylla)* Herbaceous Vegetation (CEGL005500, GNR)
- *Festuca arizonica - Blepharoneuron tricholepis* Herbaceous Vegetation (CEGL004508, G1G2)
- *Festuca arizonica - Muhlenbergia filiculmis* Herbaceous Vegetation (CEGL001605, GU)
- *Festuca arizonica - Muhlenbergia montana* Herbaceous Vegetation (CEGL001606, G3)
- *Festuca idahoensis - Danthonia intermedia* Herbaceous Vegetation (CEGL001612, G3?Q)
- *Festuca idahoensis - Festuca thurberi* Herbaceous Vegetation (CEGL001617, G3G4)
- *Festuca idahoensis - Geranium viscosissimum* Herbaceous Vegetation (CEGL001618, G2G3)
- *Festuca idahoensis - Pseudoroegneria spicata* Herbaceous Vegetation (CEGL001624, G4)
- *Festuca thurberi* - (*Lathyrus lanszwertii var. leucanthus, Potentilla* spp.) Herbaceous Vegetation (CEGL001630, G4)
- *Festuca thurberi - Danthonia parryi / Potentilla hippiana* Herbaceous Vegetation (CEGL005377, GNR)
- *Festuca thurberi* Subalpine Grassland Herbaceous Vegetation (CEGL001631, G3)
- *Leymus cinereus* Herbaceous Vegetation (CEGL001479, G2G3Q)
- *Muhlenbergia filiculmis* Herbaceous Vegetation (CEGL001780, G2)
- *Muhlenbergia montana - Hesperostipa comata* Herbaceous Vegetation (CEGL001647, G1G2)
- *Muhlenbergia montana - Schizachyrium scoparium* Herbaceous Vegetation (CEGL005381, GNR)
- *Muhlenbergia montana* Herbaceous Vegetation (CEGL001646, G3G4)
- *Muhlenbergia pungens* Herbaceous Vegetation (CEGL002363, GNR)
- *Pascopyrum smithii - Bouteloua gracilis* Herbaceous Vegetation (CEGL001578, G5)
- *Pascopyrum smithii* Herbaceous Vegetation (CEGL001577, G3G5Q)
- *Poa fendleriana* Herbaceous Vegetation (CEGL001925, GU)
- *Poa secunda* Herbaceous Vegetation (CEGL001657, G4?)
- *Pseudoroegneria spicata - Hesperostipa comata* Herbaceous Vegetation (CEGL001679, G4)
- *Pseudoroegneria spicata - Poa fendleriana* Herbaceous Vegetation (CEGL001676, G1G2)

- *Pseudoroegneria spicata* Herbaceous Vegetation (CEGL001660, G2)

DISTRIBUTION

Range: This system occurs between 2200 and 3000 m elevation in the Colorado Rockies. Where it transitions in Wyoming to Northern Rocky Mountain Subalpine-Upper Montane Grassland (CES306.806) still needs to be clarified.
Divisions: 304:C; 306:C
Nations: US
Subnations: AZ, CO, NM, UT, WY
Map Zones: 12:C, 15:C, 16:C, 17:P, 21:P, 22:C, 23:C, 24:C, 25:C, 26:C, 27:C, 28:C, 29:C, 33:P
USFS Ecomap Regions: 313A:CC, 313B:CC, 313C:CP, 313D:CP, 315A:CC, 315H:CP, 321A:PP, 322A:??, 331B:CC, 331G:CC, 331H:CC, 331I:CC, 331J:CC, 341A:CC, 341B:CC, 341C:CC, 341F:CP, 342A:CC, 342E:CC, 342F:CC, 342G:CC, 342J:CC, M313A:CC, M313B:CC, M331A:CP, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M331J:CC, M341A:CC, M341B:CC, M341C:CC
TNC Ecoregions: 18:C, 19:C, 20:C, 21:C

SOURCES

References: Bowns and Bagley 1986, Comer et al. 2002, Comer et al. 2003, Hess 1981, Hess and Wasser 1982, Moir 1967, Neely et al. 2001, Passey et al. 1982, Shepherd 1975, Stewart 1940, Tuhy et al. 2002, Turner 1975, Turner and Dortignac 1954
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722849#references
Description Author: NatureServe Western Ecology Team
Version: 22 Dec 2006 **Stakeholders:** Midwest, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

SOUTHWEST FLORIDA DUNE AND COASTAL GRASSLAND (CES203.539)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Herbaceous; Graminoid; Coast
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2431; ESLF 7144; ESP 1431

CONCEPT

Summary: This system occurs along the southwest coast of Florida, one of the four distinctive coastal regions of Florida. It includes herbaceous vegetation on dunes and just inland of the dunes, often on recently deposited sands. These are generally upland plant communities and less commonly non-flooded dune swale wetlands. Although the vegetation is mostly herbaceous, there are typically scattered shrubs of various heights present. The dune vegetation includes *Uniola paniculata*, *Panicum amarum var. amarulum*, and *Iva imbricata*. *Scaevola plumieri*, *Chamaesyce mesembrianthemifolia*, and *Coccoloba uvifera* help distinguish this system from similar dune and coastal grasslands found farther north.
Classification Comments: The spatial boundary between this system and Florida Panhandle Beach Vegetation (CES203.266) is clearly separated by the Big Bend region (see Tanner 1960, Johnson and Muller 1993a). Within this system, there is a large amount of variation along a north-to-south gradient. A finer distinction could be made in the future.
Similar Ecological Systems:
- Florida Panhandle Beach Vegetation (CES203.266)
- Southern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.273)

Related Concepts:
- Beach Dune (FNAI 1990) Intersecting
- Coastal Grassland (FNAI 1990) Intersecting

DESCRIPTION

Environment: The vegetation consists largely of herbaceous vegetation and patches of shrublands on barrier islands and other coastal areas where salt spray, saltwater overwash, and sand movement are important ecological forces. Soils are sandy, with little organic matter and little or no horizon development. Soils may be excessively drained on the higher dunes. Soils are low in nutrient-holding capacity, but aerosol input of sea salt provides a continuous source of nutrients. Winter low temperatures are warmer along the southwest coast of Florida, than along the coast further north. Killing frosts are more unusual further south along the coast of the Florida Peninsula.
Vegetation: Although the vegetation is mostly herbaceous, there are typically scattered shrubs of various heights present. Although the vegetation may overlap in species composition with other Florida coastal regions, there are important differences based on plant species composition, vegetation structure, and physical site characteristics (Johnson and Muller 1993a). The dune vegetation, like that of other Florida regions, includes *Uniola paniculata*, *Panicum amarum var. amarulum*, and *Iva imbricata*. *Scaevola plumieri*, *Chamaesyce mesembrianthemifolia*, and *Coccoloba uvifera* help distinguish this system from those to the north. However, while all other dune communities in Florida have frequently occurring distinctive species which help distinguish them, such species are lacking in this system. However, more inland coastal grassland components of this system sometimes include *Schizachyrium sanguineum (= Schizachyrium semiberbe)* and *Bouteloua hirsuta*, among other species not found in coastal grasslands elsewhere in Florida (Johnson and Muller 1993a).
Dynamics: The natural coastal dynamics include the movement of sand from wind, tides, and storm surge along this low-energy coastline. This includes transport of sand along the coast, and movement of sand by wind or water between the dunes, beach and subtidal areas, and the movement of sand from the foredunes to the interior. If not restricted by infrastructure or engineered hard structures, beaches and dunes can migrate as coastlines change over time in response to the action of wind and water. The Gulf of Mexico coast is affected by one tide per day. Coastal grassland develops as a barrier island builds seaward, developing new dune ridges along the shore which protect the inland ridges from sand burial and salt spray, or as a beach recovers after storm overwash and a new foredune ridge builds up along the shore, protecting the overwashed area behind it from sand burial and salt spray (FNAI 2010a). Wrack and seaweed deposited along the shore is an important source of nutrients for the coastal ecosystem, and helps promote revegetation in newly disturbed areas. Fire is rare and local to small areas.

Component Associations:
- *Bouteloua hirsuta - (Muhlenbergia filipes)* Herbaceous Vegetation (CEGL004093, G1)
- *Cladium mariscus ssp. jamaicense - Fimbristylis castanea - Symphyotrichum tenuifolium* Herbaceous Vegetation (CEGL003968, G2?)
- *Ernodea littoralis / Uniola paniculata - Muhlenbergia filipes* Herbaceous Vegetation (CEGL004000, G1G2)
- *Schizachyrium sanguineum var. sanguineum - Muhlenbergia filipes - Cirsium horridulum - (Waltheria indica)* Herbaceous Vegetation (CEGL003964, G1)

DISTRIBUTION

Range: Found along the western coast of Florida south of the Big Bend region to the Florida Keys, one of the four distinctive coastal regions of Florida.
Divisions: 203:C; 411:C
Nations: US
Subnations: FL
Map Zones: 56:C
USFS Ecomap Regions: 232D:CC, 411A:CC
TNC Ecoregions: 54:C, 55:C

SOURCES

References: Comer et al. 2003, Defeo et al. 2009, FNAI 2010a, Johnson and Muller 1993a, Tanner 1960
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723063#references
Description Author: R. Evans, mod. C.W. Nordman
Version: 14 Jan 2014
Concept Author: R. Evans
Stakeholders: Southeast
ClassifResp: Southeast

TAMAULIPAN CALICHE GRASSLAND (CES301.989)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Madrean Semidesert (301)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Caliche Layer; Lowland [Lowland]; Plain; Herbaceous; Tropical/Subtropical [Tropical Xeric]; Alkaline Soil; Calcareous; Very Shallow Soil; Sand Soil Texture
Non-Diagnostic Classifiers: Toeslope/Valley Bottom; Oligotrophic Soil
National Mapping Codes: ESLF 9410

CONCEPT

Summary: This ecological system is restricted to the Loreto Plain in Tamaulipas, Mexico. It occurs on shallow sandy loam soils with a caliche hardpan subhorizon. These small-patch grasslands are less than 40 ha in area and are dominated by perennial grasses often with sparse low shrubs within a mosaic of thornscrub. Dominant grasses may include *Aristida purpurea, Bouteloua hirsuta, Bouteloua radicosa, Cenchrus spinifex, Paspalum setaceum*, and *Tridens muticus*. Perennial forbs may be abundant such as *Boerhavia coccinea, Chamaecrista flexuosa, Heliotropium confertifolium*, or *Rhynchosia americana*. Low shrubs are *Calliandra conferta* and *Krameria ramosissima*.

Related Concepts:
- South Texas: Caliche Grassland (6707) [CES301.989] (Elliott 2011) Equivalent

DESCRIPTION

Environment: This system is described from the vicinity of Loreto in Tamaulipas, Mexico, but the conditions of sand veneer over caliche outcrop may also be present on the edge of the sandsheet where it passes over the Goliad Formation in northern Hidalgo and Starr counties (Elliott 2011). Soils are a reddish sandy loam about 0.3 m in depth or less. These grasslands occur on relatively level sites atop the Goliad Formation. These are areas that have a relatively thin veneer of eolian sand over caliche substrate. Such sites occur on the edge of the South Texas Sand Sheet where it overlies caliche of the Goliad Formation. Soils are shallow sands and sandy loams, sometimes red sandy loams, over caliche substrate. This Tamaulipan ecological system occurs on clay prairies near the Gulf Coast and drier sites further inland. Substrates are fine calcareous clays and clay loam. Occasional fires and root-pruning from montmorillonitic clay limit shrub invasion, if the grassland is not overgrazed. If overgrazed, the land will convert to stable thornscrub dominated by *Prosopis glandulosa* and *Celtis pallida*.

Vegetation: Sites may currently be occupied by non-native grasses such as *Pennisetum ciliare* and *Bothriochloa ischaemum var. songarica*, though invasion by these species is not observed in Mexican occurrences (Chris Best pers. obs.). These grasslands are known to occur within a mosaic of calcareous shrublands. Johnston (1963) describes them as grassland patches (the largest of which are 50 to 100 acres in extent) within a matrix of shrubland. Grasses often dominate sites, including species such as *Schizachyrium littorale, Aristida purpurea, Bouteloua hirsuta, Elionurus tripsacoides, Trachypogon spicatus, Heteropogon contortus, Bouteloua curtipendula, Tridens texanus*, and *Tridens muticus*. *Brachiaria ophryodes* and *Bouteloua radicosa* are also noted from occurrences in Mexico. Shrubs and subshrubs are scattered and sometimes coalesce into larger areas, and include species such as *Calliandra conferta, Krameria ramosissima, Calliandra biflora, Chamaecrista greggii*, and *Macrosiphonia lanuginosa*. Perennial forbs are conspicuous and include species such as *Heliotropium confertifolium, Melampodium cinereum, Simsia calva, Acalypha radians, Cnidoscolus texanus, Galphimia angustifolia, Hermannia texana, Croton capitatus, Rhynchosia americana*, and *Dalea nana*. Scattered shrubs that may be present include *Prosopis glandulosa, Zanthoxylum fagara, Cordia boissieri*, and *Condalia hookeri* (Elliott 2011).

Dynamics: Occurrences are naturally small with the larger brush-free stands only 50-100 acres in extent. Larger areas occur as mosaics of grassland mixed with brush mottes (Johnston 1963). Fire is a key process that limits invasion by brush (Landfire 2007a). Fire occurs on a frequent 2- to 5-year return interval. The fire regime has frequent replacement fires, both lightning and anthropogenic in origin (Stewart 1951, Lehmann 1965, Drawe 1980, Stewart 2002, Jurney et al. 2004). Fire was dependent on the availability of dry fine fuel sufficient to carry a fire. Both native grazing and wet/dry periods would have dictated whether sufficient dry fine fuels were present to carry a burn and strongly influenced the probable size of burns. Drought may shift composition and cause minor changes in herbaceous cover (Landfire 2007a).

DISTRIBUTION

Range: This system is restricted to the Loreto Plain in Tamaulipas, Mexico. It may also be present in Texas on the edge of the sandsheet where it passes over the Goliad Formation in northern Hidalgo and Starr counties (Elliott 2011).
Divisions: 301:C
Nations: MX, US
Subnations: MXTM(MX), TX
Map Zones: 36:C
USFS Ecomap Regions: 315E:CC
TNC Ecoregions: 30:C, 31:C

SOURCES

References: Best pers. comm., Comer et al. 2003, Drawe 1980, Elliott 2011, Elliott, L. pers. comm., Johnston 1955, Johnston 1963, Jurney et al. 2004, Landfire 2007a, Lehmann 1965, Stewart 1951, Stewart 2002, TNC 2013

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722716#references

Description Author: L. Elliott, mod. K.A. Schulz

Version: 14 Jan 2014 **Stakeholders:** Latin America, Southeast

Concept Author: NatureServe Western Ecology Team **ClassifResp:** Southeast

TAMAULIPAN SAVANNA GRASSLAND (CES301.985)

CLASSIFIERS

Conf.: 3 - Weak **Classification Status:** Standard
Primary Division: Madrean Semidesert (301)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland [Lowland]; Herbaceous; Tropical/Subtropical [Tropical Xeric]
Non-Diagnostic Classifiers: Toeslope/Valley Bottom
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2438; ESLF 7151; ESP 1438

CONCEPT

Summary: This Tamaulipan ecological system is dominated by perennial grasses with sparse overstory of mesquite or oak trees and thornscrub. Stands of the system are typically dominated by *Prosopis glandulosa* in the overstory, which may be sparse, giving the aspect of an open grassland with scattered trees and shrubs. Or, more commonly, the system occurs as shrub-dominated patches within a grassy matrix. There will typically be an emergent canopy ranging to about 6 or more meters in height, composed of *Prosopis glandulosa* sometimes with *Ebenopsis ebano* and/or *Celtis pallida (= Celtis ehrenbergiana)*. Sometimes the overstory canopy is well-developed and would be considered woodland. These patches often coalesce to form significant expanses of shrubland. Dominant grasses are *Cynodon* spp. This system was once a common matrix system, but has largely been converted to desert scrub and exists as remnant patches. Degraded subtropical forests and woodlands may have similar structure but are not included in this system because different ecological processes maintain them.

Similar Ecological Systems:
- Tamaulipan Mixed Deciduous Thornscrub (CES301.983)
- Tamaulipan Saline Thornscrub (CES301.711)

Related Concepts:
- Mesquite (southern type): 68 (Eyre 1980) Intersecting
- South Texas: Sandy Live Oak Motte and Woodland (7102) [CES301.985.2] (Elliott 2011) Finer
- South Texas: Sandy Mesquite / Evergreen Woodland (7103) [CES301.985.3] (Elliott 2011) Finer
- South Texas: Sandy Mesquite Dense Shrubland (7105) [CES301.985.5] (Elliott 2011) Finer
- South Texas: Sandy Mesquite Savanna Grassland (7107) [CES301.985.7] (Elliott 2011) Finer
- South Texas: Sandy Mesquite Woodland and Shrubland (7104) [CES301.985.4] (Elliott 2011) Finer

DESCRIPTION

Environment: Examples of the system are found on thinner eolian sands on the western side of the South Texas Sand Sheet, as well as other sandy sites such as those of the Eocene sands of the Carrizo, Queen City, and Sparta formations. It may also be found associated with other formations, such as Oakville sandstone and other formations producing sandy residuum. Typical sites are level to gently rolling. This system occurs on sandy soils, including sandy, sandy loam, and loamy sands. Ecological Sites include sandy to sandy loam sites, such as those of the Sandy, Loamy Sand and Sandy Loam Ecological Sites (Elliott 2011).

Vegetation: This system is typically dominated by *Prosopis glandulosa* in the overstory, which may be sparse, giving the aspect of an open grassland with scattered trees and shrubs. Or, more commonly, the system occurs as shrub-dominated patches within a grassy matrix. There will typically be an emergent canopy ranging to about 6 or more meters in height, composed of *Prosopis glandulosa* sometimes with *Ebenopsis ebano* and/or *Celtis pallida (= Celtis ehrenbergiana)*. Sometimes the overstory canopy is well-developed and would be considered woodland. These patches often coalesce to form significant expanses of shrubland. Sites with somewhat tighter soils tend to have a denser shrub stratum, while deep sands and sandy sites tend to be more open, often with sizeable areas lacking significant shrub cover and dominated by a primarily graminoid herbaceous layer. The shrub component of woody patches or shrublands is commonly dominated by species such as *Zanthoxylum fagara, Condalia hookeri, Celtis pallida, Opuntia engelmannii var. lindheimeri, Diospyros texana, Colubrina texensis, Opuntia leptocaulis (= Cylindropuntia leptocaulis),* and *Acacia farnesiana* (Elliott 2011). *Prosopis glandulosa* is almost always present, and is often dominant to codominant and occupies the highest canopy position (sometimes sharing that position with few other species), sometimes to 6 m in height. Numerous other species may also occur in the shrub layer, including but not limited to *Schaefferia cuneifolia, Mahonia trifoliolata, Forestiera angustifolia, Lycium berlandieri, Aloysia gratissima, Salvia ballotiflora,* and *Ziziphus obtusifolia*. The diversity of the shrub layer is significantly influenced by land-use history, with recently cleared areas sometimes being represented by a near monoculture of *Prosopis glandulosa* in the overstory, *Pennisetum ciliare* in the herbaceous layer, and *Opuntia engelmannii var. lindheimeri* as the most conspicuous component of the shrub layer. The herbaceous layer is typically dominated by graminoids and may be quite dense (60-100% cover). Grasses, such as *Schizachyrium scoparium, Schizachyrium littorale, Chloris cucullata, Paspalum monostachyum, Paspalum plicatulum, Elionurus tripsacoides, Bouteloua rigidiseta, Urochloa ciliatissima, Heteropogon contortus, Eragrostis secundiflora, Bothriochloa laguroides ssp. torreyana, Chloris pluriflora (= Trichloris pluriflora), Aristida* spp., *Sporobolus cryptandrus,* and/or *Dichanthelium* spp., commonly dominate or codominate the herbaceous layer. Forbs are also common, including species such as *Gaillardia pulchella, Eriogonum multiflorum, Croton* spp., *Cnidoscolus texanus, Aphanostephus skirrhobasis, Rudbeckia hirta,*

Verbesina encelioides, Clematis drummondii, Cynanchum barbigerum, Thymophylla pentachaeta, Siphonoglossa pilosella (= Justicia pilosella), Nama jamaicense, Monarda punctata, Palafoxia texana, Florestina tripteris, Zornia bracteata, Croptilon divaricatum, Rhynchosia americana, and *Wedelia texana*, though some of these species are restricted to the sandiest sites (Elliott 2011).
Dynamics: Fire and drought are key ecological processes in this system. This system was modeled by Landfire (2007a) using three classes: early-, mid- and late-seral. The early-seral class (1-20 years) is dominated by perennial grasses. This class was maintained by frequent replacement fire (MFRI = 5 years) as the dominant disturbance type in this class. Droughts slow progression of this class to mid-seral class. This class is modeled to last 20 years; this duration is extended due to limited mesquite seed dispersal mechanisms historically (prior to livestock introduction) (Landfire 2007a).

Mid-seral class (21-50 years) is the early development of shrub patches, often surrounding a mesquite trees. Tree canopy is sparse, but shrub cover is dense. Herbaceous cover is declining due to increased shrub and overstory canopy. Replacement fire is modeled to occur with a 20-year return interval. A mixed fire is modeled to occur with a 7-year return interval. Twenty-year drought is modeled to slow successional progression to late-seral class. The mechanism for drought effect may be an enhanced effect of fire. This class is modeled to last 30 years (Landfire 2007a).

The late-seral class (51+ years) is a closed-canopy, late-development stage that represents the continued development of shrub patches as they coalesce into more well-developed woodlands of *Prosopis glandulosa* (Archer 1989). In these late stages other species begin to colonize into woodlands and shrublands. Species present in mid-seral class are still present in late-seral class, but other species begin to colonize, such as *Mahonia trifoliolata*, *Schaefferia cuneifolia*, and *Lycium berlandieri*. Replacement fire is modeled to occur with a 200-year return interval. A mixed fire is modeled to occur with a 20-year return interval. Twenty-year drought is modeled and may slow increase in patch size but does not cause transition (Landfire 2007a).

Component Associations:
- *Bothriochloa barbinodis - Chloris pluriflora* Herbaceous Vegetation (CEGL002236, G2?)
- *Prosopis glandulosa var. glandulosa - Parkinsonia texana var. macra - (Cordia boissieri, Koeberlinia spinosa)* Shrubland (CEGL007762, G4)

Spatial Characteristics

Adjacent Ecological Systems:
- Tamaulipan Closed Depression Wetland (CES301.197)

Distribution

Range: Examples of the system are found on thinner eolian sands on the western side of the South Texas Sand Sheet in Texas and related areas of Mexico.
Divisions: 301:C
Nations: MX, US
Subnations: MXCO(MX), MXNU(MX), MXTM(MX), TX
Map Zones: 36:C
USFS Ecomap Regions: 255D:CC, 315E:CC
TNC Ecoregions: 30:C, 31:C

Sources

References: Archer 1989, Brown 1982a, Brown et al. 1998, Comer et al. 2003, CONABIO 2003b, Elliott 2011, Eyre 1980, Landfire 2007a, TNC 2013, Webster 2001
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722720#references
Description Author: L. Elliott, mod. K.A. Schulz
Version: 14 Jan 2014 **Stakeholders:** Latin America, Southeast
Concept Author: NatureServe Western Ecology Team **ClassifResp:** Southeast

TEXAS BLACKLAND TALLGRASS PRAIRIE (CES205.684)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Eastern Great Plains (205)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Non-Diagnostic Classifiers: Mima mound; Herbaceous; Unglaciated; Loam Soil Texture; G-Landscape/Medium Intensity
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2422; ESLF 7135; ESP 1422

CONCEPT

Summary: This grassland system is found primarily in the Blackland Prairie region of Texas but may range into southern Oklahoma. It is typified by the presence of dark alkaline Vertisol soils over calcareous parent material, although substantial belts of acidic, sandy clay loam Alfisols and loamy or clay loam Mollisols also occur. These soil types relate directly to the underlying surface geology. Microtopography such as gilgai occurs over Vertisols, and mima mounds occur over Alfisols. These create important microhabitats that increase plant diversity in this system. *Schizachyrium scoparium, Sorghastrum nutans,* and *Andropogon gerardii* are the most common dominants. *Tripsacum dactyloides* and *Panicum virgatum* are common associates on the Vertisol soils, especially on the gilgai microtopography. Fire, drought, and possibly grazing were the major natural dynamics influencing this system.
Classification Comments: This system (CES205.684) lies to the east of the floristically related Southeastern Great Plains Tallgrass Prairie (CES205.685), and is primarily, if not entirely, found in Texas (and possibly Oklahoma).
Similar Ecological Systems:
- Arkansas Valley Prairie and Woodland (CES202.312)
- Central Tallgrass Prairie (CES205.683)
- Lower Mississippi Alluvial Plain Grand Prairie (CES203.549)
- Ozark Prairie and Woodland (CES202.326)
- Southeastern Great Plains Tallgrass Prairie (CES205.685)
- West Gulf Coastal Plain Northern Calcareous Prairie (CES203.377)

Related Concepts:
- Blackland Prairie: Disturbance or Tame Grassland (207) [CES205.684.9] (Elliott 2011) Finer

DESCRIPTION

Environment: This system is typified by the presence of dark alkaline Vertisol soils over calcareous parent material interspersed with patches of acidic, sandy loam Alfisols and Mollisols. The detailed geology includes Cretaceous shales, marls and limestones, such as those of the Pecan Gap Chalk, Marlbrook Marl, Eagle Ford, Gober Chalk, Annona Chalk, and Austin Chalk formations, and Taylor and Navarro groups, as well as portions of the Eocene Midway Group and Wilcox Formation. Also, Miocene formations (Fleming and Oakville Sandstone formations) underlie the southern outlier of Blackland prairie recognized as the Fayette Prairie. Landforms are flat to gently rolling and dissected by drainages, with the most significant ridges associated with harder chalk formations. Microtopography such as gilgai and mima mounds can occur and are important microhabitats that lead to an increase in plant diversity in this system (Diamond and Smeins 1990). Soils are typically Vertisols, but this system may occupy Mollisols or Alfisols with the latter more common. The system generally occurs on calcareous clays, but may also occur on loams, clay loams, or even sandy clay loams or silt loams. Annual rainfall averages 890mm, wettest seasons are spring and fall (Harmel et al. 2003).
Vegetation: Currently, only remnants of this system exist, with most of the historical distribution replaced by crop production or improved pasture. *Schizachyrium scoparium* is the most ubiquitous component of occurrences of this system. *Andropogon gerardii* and *Sorghastrum nutans* are also common dominants. Other species commonly encountered include *Bouteloua curtipendula, Carex microdonta, Sporobolus compositus, Nassella leucotricha, Bothriochloa laguroides ssp. torreyana, Eriochloa sericea, Paspalum floridanum,* and *Tridens strictus*. Forbs commonly encountered in this system include *Symphyotrichum ericoides, Hedyotis nigricans var. nigricans (= Stenaria nigricans var. nigricans), Helianthus maximiliani, Rudbeckia hirta, Bifora americana, Acacia angustissima var. hirta, Desmanthus illinoensis,* and many more. Perhaps more commonly encountered species include *Croton monanthogynus, Amphiachyris dracunculoides,* and *Asclepias* spp. Lowland sites and swales are often dominated by *Tripsacum dactyloides* and *Panicum virgatum* (Elliott 2011). Heavy grazing has allowed species such as *Buchloe dactyloides* and *Bouteloua rigidiseta* to invade. *Tripsacum dactyloides* and *Panicum virgatum* are common associates on the Vertisols, especially on the gilgai microtopography.
Dynamics: Fire, drought and possibly and grazing constitute the major natural dynamics influencing this system. Frequent fires (mean fire-return interval of 2.5 years) prevent woody species from establishing and favor grassland species adapted to fire for reproduction and vigor (Landfire 2007a) prevent woody species from establishing and favor grassland species adapted to fire for reproduction and vigor. Bison and other ungulates possibly played an important role in the vegetation composition and structure of this system (Eidson and Smeins 1999). Fire suppression and overgrazing have allowed woody species to invade. Heavy grazing has also altered the floristic composition by allowing species such as *Buchloe dactyloides (= Bouteloua dactyloides)* and *Bouteloua rigidiseta* to invade. This system is important for a suite of wildlife, many of which are declining, that are dependent on native grasslands (TPWD 2012a).

Component Associations:
- *Schizachyrium scoparium - Andropogon gerardii - Sorghastrum nutans - Bifora americana* Mollisol Herbaceous Vegetation (CEGL004025, G1G2)
- *Schizachyrium scoparium - Sorghastrum nutans - Andropogon gerardii - Bifora americana* Vertisol Herbaceous Vegetation (CEGL004027, G1G2)
- *Schizachyrium scoparium - Sorghastrum nutans - Bifora americana* Alfisol Herbaceous Vegetation (CEGL004026, G1G2)
- *Sporobolus silveanus - Carex meadii* Herbaceous Vegetation (CEGL004521, G1)
- *Sporobolus silveanus - Tridens strictus* Herbaceous Vegetation (CEGL002216, G2)
- *Tripsacum dactyloides - Panicum virgatum - Sorghastrum nutans - Helianthus maximiliani* Herbaceous Vegetation (CEGL002217, G1)
- *Tripsacum dactyloides - Sporobolus compositus var. compositus* Herbaceous Vegetation (CEGL004036, G1)

DISTRIBUTION

Range: This system is restricted to the Blackland Prairie region, part of the Crosstimbers and Southern Tallgrass Prairie Ecoregion, in Texas and possibly adjacent southern Oklahoma.
Divisions: 205:C
Nations: US
Subnations: OK?, TX
Map Zones: 32:C, 35:C, 36:C, 37:C
USFS Ecomap Regions: 255B:CC, 255C:CC, 315E:CC
TNC Ecoregions: 32:C

SOURCES

References: Barbour and Billings 1988, Comer et al. 2003, Diamond and Smeins 1988, Diamond and Smeins 1990, Diggs et al. 1999, Eidson and Smeins 1999, Elliott 2011, Harmel et al. 2003, Landfire 2007a, Ricketts et al. 1999, Riskind and Collins 1975, Smeins and Diamond 1986b, TPDW 2012a
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722975#references
Description Author: S. Menard, mod. L. Elliott and J. Teague
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: S. Menard **ClassifResp:** Southeast

TEXAS SALINE INLAND PRAIRIE (CES301.720)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Primary Division: Madrean Semidesert (301)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Herbaceous; Saline Substrate Chemistry
National Mapping Codes: ESLF 9443

CONCEPT

Summary: This non-coastal saline system is found along floodplains in south-central Texas. It is typically herbaceous and usually occurs within floodplains on soils of relatively high salinity. It is often comprised of *Spartina spartinae* as the single dominant, but some occurrences may have a significant cover of salt-tolerant shrubs.

Similar Ecological Systems:

- Texas Saline Coastal Prairie (CES203.543)

Related Concepts:

- Texas Saline Inland Flat (2400) (Elliott 2011) Finer
- Texas Saline Inland Prairie (2407) (Elliott 2011) Finer
- Texas Saline Inland Prairie Shrubland (2406) (Elliott 2011) Finer

DESCRIPTION

Environment: This system often occurs on relatively level sites, typically within floodplains on Quaternary-aged alluvium, sometimes juxtaposed with Eocene deposits of the Jackson Group or Yegua Formation. Soils that support this system are often mapped as the Salty Prairie Ecological Site type. Salts are leached from the surrounding landscape and deposited into these alluvial settings where repeated flooding and evaporation brings the salts to the surface.

Vegetation: *Spartina spartinae* typically dominates these sites, sometimes to the near exclusion of other species. Other species that may be encountered include *Sporobolus virginicus, Distichlis spicata, Monanthochloe littoralis, Paspalidium geminatum, Chloracantha spinosa, Coreopsis tinctoria, Heliotropium curassavicum, Isocoma drummondii, Borrichia frutescens*, and *Helianthus ciliaris*. Shrubs such as *Prosopis glandulosa, Prosopis reptans, Lycium carolinianum*, and *Opuntia engelmannii var. lindheimeri* may be present. Occasionally shrubs, particularly *Prosopis glandulosa*, may gain sufficient cover. Dense stands of *Chloracantha spinosa, Isocoma drummondii*, or *Borrichia frutescens* may also occur, and these sites may also have a sparse overstory of *Prosopis glandulosa*.

DISTRIBUTION

Range: This system is found along floodplains in south-central Texas.
Divisions: 301:C
Nations: US
Subnations: TX
USFS Ecomap Regions: 315Eb:CCP, 315Ec:CCP, 315Ed:CCP
TNC Ecoregions: 30:C

SOURCES

References: Elliott 2011, Southeastern Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.859571#references
Description Author: L. Elliott, mod. J. Teague
Version: 25 Feb 2011
Stakeholders: Southeast
Concept Author: L. Elliott, D. Diamond, A. Treuer-kuehn, D. German, J. Teague
ClassifResp: Southeast

WEST GULF COASTAL PLAIN NORTHERN CALCAREOUS PRAIRIE (CES203.377)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Herbaceous; West Gulf Coastal Plain; Circumneutral Soil; Deep Soil; Graminoid
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2428; ESLF 7141; ESP 1428

CONCEPT

Summary: This is one of two described calcareous prairie ecological systems which occur within the pine-dominated portions of the Coastal Plain west of the Mississippi River. This type is the more northerly ranging of the two [compare against West Gulf Coastal Plain Southern Calcareous Prairie (CES203.379)]. This system includes natural grassland vegetation and associated wooded vegetation in a relatively small natural region of the Upper West Gulf Coastal Plain of Arkansas and adjacent Oklahoma. Although other calcareous prairies are found west of the Mississippi River, this system represents some of the largest known and highest quality remaining examples. Plant communities in this system occur over relatively deep soils (as well as shallow soils over chalk and limestone) with circumneutral surface soil pH, which is unusual given the predominance of acidic, generally forested soils in the region. In most cases individual prairie openings are small and isolated from one another, but were formerly more extensive prior to European settlement, forming a mosaic of grassland and woodlands under frequent fire regimes. The flora has much in common with other prairie systems of the East Gulf Coastal Plains as well as classic Midwestern prairies.

Similar Ecological Systems:
- Southeastern Great Plains Tallgrass Prairie (CES205.685)
- Texas Blackland Tallgrass Prairie (CES205.684)
- West Gulf Coastal Plain Southern Calcareous Prairie (CES203.379)

Related Concepts:
- Eastern Redcedar: 46 (Eyre 1980) Finer
- Post Oak - Blackjack Oak: 40 (Eyre 1980) Finer

DESCRIPTION

Environment: This system is characterized by deep to shallow soils with circumneutral surface soil pH that have developed over Cretaceous-aged calcareous substrates. Soils vary from well-drained to poorly drained clays, silty clays, silty clay loams, and fine sandy loams, and are typically excessively dry in summer exhibiting high shrink-swell potential. Within this general landscape, fine-scale abiotic characteristics in conjunction with ecological processes, frequent fire in particular, supported a mosaic of grasslands and short-statured woodlands comprising the ecological system.

Vegetation: Dominant plants in stands of this system vary from example to example; there are several subtypes and associations with variability among these. Typical trees include *Quercus stellata, Quercus muehlenbergii, Quercus shumardii, Quercus pagoda, Quercus sinuata, Carya illinoinensis, Carya myristiciformis, Juniperus virginiana var. virginiana,* and *Maclura pomifera*. Some typical shrubs include *Forestiera ligustrina, Symphoricarpos orbiculatus, Ilex decidua,* and *Rhus aromatica*. Herbs may include *Sorghastrum nutans, Bouteloua curtipendula, Andropogon glomeratus, Leersia virginica, Panicum anceps, Panicum flexile, Sporobolus compositus, Fimbristylis puberula var. puberula, Carex cherokeensis, Carex microdonta, Echinacea pallida, Liatris aspera, Marshallia caespitosa, Silphium integrifolium, Silphium laciniatum, Solidago auriculata, Symphyotrichum lanceolatum, Packera tampicana, Thelesperma filifolium, Nemastylis geminiflora, Dalea purpurea, Lythrum alatum, Allium canadense var. mobilense,* and *Zigadenus nuttallii*.

Dynamics: The composition and structure of this grassland and open woodland ecological system are primarily maintained by edaphic conditions, fire, and climate. Fires less than every four or so years are necessary to maintain the grassland and open woodland states. Under normal weather conditions, eight to ten years without fire will result in a shrub-dominated physiognomy. Continued fire suppression under normal climate conditions will result in a closed-canopy condition. Tight soils provide a barrier to root penetration and limit water availability during dry periods, thereby also inhibiting the establishment and growth of woody plants, but soils alone cannot limit woody growth. Historically, native grazers or browsers also played a role in the maintenance of this system.

Component Associations:
- *Crataegus crus-galli - Ilex decidua - Crataegus viridis* Shrubland (CEGL004532, GNR)
- *Juniperus virginiana - Maclura pomifera / Bouteloua curtipendula - Thelesperma filifolium - Packera tampicana* Wooded Herbaceous Vegetation (CEGL007812, G1?)
- *Quercus falcata - Carya illinoinensis / Silphium integrifolium - Panicum anceps - (Carex cherokeensis)* Mesic Wooded Herbaceous Vegetation (CEGL007963, G1)
- *Quercus muehlenbergii - Quercus sinuata / Rhus aromatica / Liatris aspera - Allium canadense var. mobilense - Schizachyrium scoparium* Woodland (CEGL007968, G2)
- *Quercus shumardii - Carya myristiciformis - (Quercus muehlenbergii) / Carex cherokeensis - Sorghastrum nutans* Woodland

(CEGL007775, G1)
- *Quercus sinuata / Solidago auriculata - Zigadenus nuttallii* Mixed Herb Dry-mesic Blackland Ravine Woodland (CEGL007966, G1)
- *Quercus stellata / Forestiera ligustrina - Symphoricarpos orbiculatus / Carex cherokeensis - Schizachyrium scoparium* Woodland (CEGL007777, G1G2)
- *Schizachyrium scoparium - Sorghastrum nutans - Bouteloua curtipendula* Herbaceous Vegetation (CEGL002214, G2G3)
- *Schizachyrium scoparium - Sorghastrum nutans - Echinacea pallida - Dalea purpurea* Herbaceous Vegetation (CEGL007769, G2G3)
- *Schizachyrium scoparium - Sporobolus compositus - Fimbristylis puberula var. puberula* Wooded Herbaceous Vegetation (CEGL007768, G1G2)
- *Sorghastrum nutans - Andropogon glomeratus - Silphium laciniatum* Herbaceous Vegetation (CEGL007774, G1?)
- *Typha latifolia - Thalia dealbata* Herbaceous Vegetation (CEGL004526, GNR)

DISTRIBUTION

Range: This system is known only from a relatively small natural region of the Upper West Gulf Coastal Plain of Arkansas and adjacent Oklahoma.
Divisions: 203:C
Nations: US
Subnations: AR, OK
Map Zones: 37:?, 44:C
USFS Ecomap Regions: 232E:CC
TNC Ecoregions: 40:C

SOURCES

References: Comer et al. 2003, Eyre 1980, Landfire 2007a, Zollner pers. comm.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723139#references
Description Author: T. Foti and R. Evans, mod. M. Pyne and J. Teague
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: T. Foti and R. Evans **ClassifResp:** Southeast

WEST GULF COASTAL PLAIN SOUTHERN CALCAREOUS PRAIRIE (CES203.379)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Herbaceous; West Gulf Coastal Plain; Circumneutral Soil; Deep Soil; Graminoid
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2429; ESLF 7142; ESP 1429

CONCEPT

Summary: This is one of two described calcareous prairie ecological systems which occur within the pine-dominated portions of the West Gulf Coastal Plain west of the Mississippi River. This type is the more southerly-ranging of the two [compare against West Gulf Coastal Plain Northern Calcareous Prairie (CES203.377)]. Examples include natural grassland vegetation and adjacent wooded vegetation in a relatively small natural region of Arkansas, Louisiana and Texas. Although most examples are typically upland, some include small stream bottoms or riparian areas that bisect the prairies. Plant communities in this system occur over relatively deep soils that are unusual in the local landscape because they are much less acidic than the soils of the surrounding forests. Stands are dominated by perennial grasses and graminoids, including *Carex cherokeensis, Carex microdonta, Muhlenbergia expansa, Schizachyrium scoparium, Schizachyrium tenerum, Sorghastrum nutans*, and *Sporobolus silveanus*. Historically, this system is thought to have occupied large patches (up to a couple thousand acres), but currently, most individual prairie openings are small and isolated from one another.

Similar Ecological Systems:
- West Gulf Coastal Plain Northern Calcareous Prairie (CES203.377)

Related Concepts:
- Cook Mountain Calcareous Prairie (LNHP 2004) Finer
- Eastern Redcedar: 46 (Eyre 1980) Finer
- Fleming Calcareous Prairie (LNHP 2004) Finer
- Fleming Glade (LNHP 2004) Finer
- Jackson Calcareous Prairie (LNHP 2004) Finer
- Longleaf Pine: 70 (Eyre 1980) Finer
- Morse Clay Calcareous Prairie (LNHP 2004) Finer
- Pineywoods: Southern Calcareous Mixedgrass Prairie (4407) [CES203.379] (Elliott 2011) Equivalent
- Post Oak - Blackjack Oak: 40 (Eyre 1980) Finer
- Swamp Chestnut Oak - Cherrybark Oak: 91 (Eyre 1980) Finer

DESCRIPTION

Environment: This system is best documented from the Fleming geologic formation, but is also known from the Cook Mountain Formation in Louisiana. Examples from the Jackson Group (in Louisiana) are also included here, as well as the Morse Clay Calcareous Prairie of northwestern Louisiana and adjacent Arkansas. It occupies deep vertic soils with circumneutral surface pH, a condition uncommon in a region of predominantly acidic, forested soils. It typically occurs on upper slopes and broad uplands in gently undulating landscapes. Soils are circumneutral to moderately alkaline, including vertic soils such as Ferris, Houston Black, or Wiergate clays (Elliott 2011). Occurrences may reflect a relationship to the Blackland Prairie further to the west (including the Fayette Prairie), and some consider these small-patch prairies to be outliers of the Blackland Tallgrass Prairie. In Arkansas, it also occurs on the Gore silt loam and McKamie silt loam, as well as the Morse clay (Foti 1987). Within this general landscape, fine scale abiotic characteristics in conjunction with ecological processes, frequent fire in particular, supported a mosaic of grasslands and short stature woodlands comprising the ecological system. Prior to European settlement this system is believed to have occupied patches up to a couple thousand acres.

Vegetation: The flora has much in common with that of other prairie systems of the East Gulf Coastal Plain as well as that of classic Midwestern prairies, although there is variability among examples. Stands are dominated by perennial grasses and graminoids, including *Schizachyrium scoparium, Schizachyrium tenerum, Muhlenbergia expansa, Sorghastrum nutans, Bothriochloa laguroides ssp. torreyana, Bouteloua curtipendula, Andropogon gerardii, Nassella leucotricha, Paspalum pubiflorum, Panicum virgatum, Carex cherokeensis*, and *Carex microdonta*. Much of the typical flora are species uncommon in the rest of the Pineywoods region, such as *Dalea compacta var. compacta, Rudbeckia hirta, Rudbeckia missouriensis, Acacia angustissima, Croton monanthogynus, Liatris mucronata, Eustoma exaltatum ssp. russellianum (= Eustoma russellianum), Grindelia lanceolata, Agalinis heterophylla, Stenosiphon linifolius, Neptunia lutea, Indigofera miniata (= Indigofera miniata var. leptosepala), Palafoxia reverchonii, Indigofera miniata, Arnoglossum plantagineum, Coreopsis tinctoria, Symphyotrichum* spp., *Onosmodium molle ssp. occidentale (= Onosmodium occidentale)*, and *Euphorbia bicolor*. Some of these species are found either most commonly or exclusively in the more western examples of this system when compared with those in Louisiana. Arkansas examples may contain *Mimosa nuttallii (= Mimosa quadrivalvis var. nuttallii), Dalea purpurea, Neptunea lutea, Baptisia nuttalliana, Arnoglossum plantagineum, ryngium yuccifolium,*

Manfreda virginica, Silphium laciniatum, Nemastylis geminiflora, and other prairie species (Foti 1987). Various woody species from the surrounding landscape, including *Pinus taeda, Ulmus alata, Liquidambar styraciflua, Juniperus virginiana, Crataegus spathulata, Crataegus crus-galli, Sideroxylon lanuginosum*, and others, may invade these prairies. Non-native woody species such as *Rosa bracteata* may also invade, this presumably being a result of long-term fire suppression (Elliott 2011). Non-native grasses such as *Bothriochloa ischaemum var. songarica, Bromus arvensis, Cynodon dactylon*, and/or *Lolium perenne* may be conspicuous to dominant (Elliott 2011).

Dynamics: The composition and structure of this grassland and open woodland ecological system are primarily maintained by edaphic conditions, fire, and climate. Examples historically formed a mosaic of grassland and open woodlands under frequent fire regimes. With fire suppression, trees invade from surrounding pine forests. As a result, some evidence suggests that soil properties are modified, especially the surface pH and nutrient dynamics. Fires every four or so years are necessary to maintain the grassland and open woodland states. Under normal weather conditions, 15 to 20 years without fire will result in a shrub-dominated physiognomy. Continued fire suppression under normal climate conditions will result in a closed-canopy condition. Tight soils provide a barrier to root penetration and limit water availability during dry periods, thereby also inhibiting the establishment and growth of woody plants.

Component Associations:

- *Celtis laevigata - Gleditsia triacanthos - Sapindus saponaria var. drummondii / Lithospermum tuberosum - Carex willdenowii* Forest (CEGL007318, G1)
- *Crataegus spathulata - Cornus drummondii - Berchemia scandens* Shrubland (CEGL003879, G2)
- *Juniperus virginiana var. virginiana - Pinus taeda - Quercus sinuata var. sinuata* Woodland (CEGL007799, G1)
- *Pinus palustris / Quercus marilandica / Schizachyrium tenerum - Muhlenbergia expansa - Bigelowia nuttallii - Packera obovata* Woodland (CEGL003597, G1)
- *Quercus shumardii - Fraxinus americana - Carya myristiciformis / Viburnum dentatum / Carex cherokeensis* Forest (CEGL007194, G1Q)
- *Quercus similis - Quercus pagoda - Carya (glabra, myristiciformis, ovata)* Temporarily Flooded Forest (CEGL007360, G1)
- *Quercus sinuata var. sinuata - Fraxinus americana - Quercus muehlenbergii / Rhus aromatica - Cornus drummondii* Forest (CEGL007256, G1)
- *Quercus stellata / Forestiera ligustrina - Symphoricarpos orbiculatus / Carex cherokeensis - Schizachyrium scoparium* Woodland (CEGL007777, G1G2)
- *Schizachyrium scoparium - Marshallia caespitosa - Nemastylis geminiflora* Herbaceous Vegetation (CEGL004022, G1G2)
- *Schizachyrium scoparium - Panicum flexile - Carex microdonta* Herbaceous Vegetation (CEGL004021, G1)
- *Schizachyrium scoparium - Rudbeckia missouriensis - Grindelia lanceolata - (Liatris mucronata)* Herbaceous Vegetation (CEGL007930, G1)
- *Schizachyrium scoparium - Sorghastrum nutans* Jackson Prairie Herbaceous Vegetation (CEGL004721, G1)

SPATIAL CHARACTERISTICS

Size: A very few extant examples may range into the large-patch size category, but most are small. Historical patch size is hard to estimate. Small patch is the best attribute for this system, fide Jason Singhurst (TPWD).

DISTRIBUTION

Range: This system is restricted to a relatively small natural region of Arkansas, Louisiana and Texas.
Divisions: 203:C
Nations: US
Subnations: AR, LA, TX
Map Zones: 37:C
USFS Ecomap Regions: 231E:CC, 232F:CC
TNC Ecoregions: 40:C, 41:C

SOURCES

References: Comer et al. 2003, Elliott 2011, Eyre 1980, Foti 1987?, Landfire 2007a, LDWF 2005, LNHP 2004, Newton 1972, Smith 1993, Smith, L. pers. comm.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723137#references
Description Author: R. Evans and T. Foti, mod. M. Pyne, L. Elliott, J. Teague
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: R. Evans and T. Foti **ClassifResp:** Southeast

WESTERN CANADIAN BOREAL DRY GRASSLAND AND BLUFF (CES103.864)

CLASSIFIERS

Conf.: 3 - Weak
Classification Status: Standard
Primary Division: Boreal (103)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Herbaceous
Non-Diagnostic Classifiers: Montane [Montane]; Lowland [Lowland]
National Mapping Codes: ESLF 7160

CONCEPT

Summary: This grassland and shrub-steppe system occurs throughout the boreal regions of western Canada including Yukon Territory, British Columbia, Alberta and probably Saskatchewan. This system consists of communities dominated by herbaceous vegetation on dry to mesic sites, such as ridgetops, rolling foothills, steep south-facing river bluffs, or openings in predominantly upland forest. Soils are well-drained to excessively drained, and permafrost is absent. These sites are typically dominated by grasses, though forbs may codominate on some sites. Shrub cover is less than 25%. Dominant species include *Leymus innovatus, Calamagrostis purpurascens, Koeleria macrantha, Elymus trachycaulus (= Agropyron pauciflorum), Elymus lanceolatus (= Elymus dasystachya), Piptatherum pungens (= Oryzopsis pungens), Festuca hallii, Festuca saximontana, Danthonia californica, Hesperostipa spartea*, and *Hesperostipa curtiseta*. Sagebrushs also occur, predominantly *Artemisia frigida* and *Artemisia ludoviciana*. The steep, dry south-facing bluffs along the Peace and Smoky rivers in western Alberta and eastern British Columbia have communities dominated by *Artemisia frigida*, dryland *Carex* spp., *Koeleria macrantha, Hesperostipa comata, Hesperostipa spartea*, and *Hesperostipa curtiseta* interspersed with bare mineral soil. On less pronounced slopes where moisture is in greater supply, *Elymus lanceolatus, Elymus trachycaulus*, and *Opuntia fragilis* are more abundant.
Classification Comments: The dry bluffs of interior boreal Alaska (Western North American Boreal Dry Aspen-Steppe Bluff (CES105.109)) are compositionally very similar to this system, but without the suite of Great Plains mixedgrass species found in Alberta and British Columbia. But certainly the environmental setting of south-facing steep bluffs above major boreal rivers is very similar, and some species are shared between the two types. Upon review, Oregon and Washington ecologists determined that this system does not occur in those states. However, it is a poorly defined system and needs further review and a better definition of its concept. In Alaska, dry boreal meadows are placed into Western North American Boreal Dry Grassland (CES105.115), which perhaps should be merged into this system. Undoubtedly, dry meadows occur across subarctic Canada.
Similar Ecological Systems:
- Western North American Boreal Dry Grassland (CES105.115)

DISTRIBUTION

Range: This grassland and shrub-steppe system occurs throughout the boreal regions of western Canada including Yukon Territory, British Columbia, Alberta and probably Saskatchewan.
Divisions: 103:C; 105:C; 207:?
Nations: CA
Subnations: AB, BC, SK, YT
TNC Ecoregions: 140:C

SOURCES

References: Comer et al. 2003, Lane et al. 2000, Natural Regions Committee 2006, Willoughby 2007
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722811#references
Description Author: G. Kittel
Version: 08 Dec 2008
Stakeholders: Canada, West
Concept Author: G. Kittel
ClassifResp: West

WESTERN GREAT PLAINS FOOTHILL AND PIEDMONT GRASSLAND (CES303.817)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Western Great Plains (303)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Lowland [Foothill]; Toeslope/Valley Bottom; Clay Soil Texture; Aridic; Short Disturbance Interval [Periodicity/Irregular Disturbance]; F-Patch/Low Intensity; Graminoid
Non-Diagnostic Classifiers: Short (50-100 yrs) Persistence; Herbaceous; Temperate [Temperate Continental]
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2147; ESLF 7120; ESP 1147

CONCEPT

Summary: This ecological system typically occurs between 1600 and 2200 m in elevation. It is best characterized as a mixedgrass to tallgrass prairie on mostly moderate to gentle slopes, usually at the base of foothill slopes, e.g., the hogbacks of the Rocky Mountain Front Range where it typically occurs as a relatively narrow elevational band between montane woodlands and shrublands and the shortgrass steppe and mixedgrass prairie, but extends east on the Front Range piedmont alongside the Chalk Bluffs near the Colorado-Wyoming border, out into the Great Plains on the Palmer Divide, and on piedmont slopes below mesas and foothills in northeastern New Mexico. A combination of increased precipitation from orographic rain, temperature, and soils limits this system to the lower elevation zone with approximately 40 cm of precipitation/year. It is maintained by frequent fire and associated with well-drained clay soils. Usually occurrences of this system have multiple plant associations that may be dominated by *Andropogon gerardii, Schizachyrium scoparium, , Nassella viridula, Pascopyrum smithii, Sporobolus cryptandrus, Bouteloua gracilis, Hesperostipa comata*, or *Hesperostipa neomexicana*. In Wyoming, typical grasses found in this system include *Pseudoroegneria spicata, Schizachyrium scoparium, Hesperostipa neomexicana, Hesperostipa comata*, and species of *Poa*. Typical adjacent ecological systems include foothill shrublands, ponderosa pine savannas, juniper savannas, as well as shortgrass prairie.
Classification Comments: Need to incorporate northern Rockies information. How does this differ from Northwestern Great Plains Mixedgrass Prairie (CES303.674) which seems pretty similar? In southeastern Wyoming, it is mostly in mapzone 33, along bluffs.
Related Concepts:
- Bluestem - Grama Prairie (604) (Shiflet 1994) Intersecting. This ecological system overlaps this SRM type along the Wyoming-Colorado-New Mexico eastern foothills of the Rocky Mtns.
- Grama - Feathergrass (716) (Shiflet 1994) Finer
- Sideoats Grama - New Mexico Feathergrass - Winterfat (724) (Shiflet 1994) Finer
- Sideoats Grama - Sumac - Juniper (735) (Shiflet 1994) Intersecting

DESCRIPTION

Environment: This ecological system occurs between 1600 and 2200 m in elevation. It is best characterized as a mixedgrass to tallgrass grassland on mostly moderate to gentle slopes, usually at the base of foothill slopes, e.g., the hogbacks of the Rocky Mountain Front Range where it typically occurs as a relatively narrow elevational band between montane woodlands and shrublands and the shortgrass steppe and mixedgrass prairie, but extends east on the Front Range piedmont alongside the Chalk Bluffs near the Colorado-Wyoming border, out into the Great Plains on the Palmer Divide, and on piedmont slopes below mesas and foothills in northeastern New Mexico. This mixed grassland receives more precipitation than shortgrass steppe or occurs on coarser-textured substrates allowing for increased infiltration and water storage (Noy-Meir 1973). A combination of increased precipitation from orographic rain, temperature, and soils limits this system to the lower elevation zone with approximately 40 cm of precipitation/year. It is maintained by frequent fire and associated with well-drained clay soils. Typical adjacent ecological systems include foothill shrublands, ponderosa pine savannas, juniper savannas, as well as shortgrass prairie.
Dynamics: Relatively frequent surface fire (FRI = 20 years -15 years in the southern extent) maintains this ecosystem by reducing seedling survival of shrubs such as *Cercocarpus montanus* and *Rhus trilobata* and trees such as *Pinus ponderosa, Pinus edulis*, and *Juniperus* spp. thus preventing conversion to shrublands and woodlands (Landfire 2007a). There is little information on this natural frequency, size, intensity, or severity of fire in this ecosystem. Ungulate grazing (Landfire 2007a) and herbivory are a key process that includes grazing and browsing by large and small mammals and insects. Soils are naturally disturbed by burrowing mammals such as prairie dogs, rabbits, pocket gophers, ground squirrels, and badgers providing habitat for disturbance-dependent species. Drought occurs periodically (approximately every 20-50 years) and can cause shifts in species compositions to more drought-tolerant species (Landfire 2007a).

Component Associations:
- *Andropogon gerardii - Schizachyrium scoparium* Western Great Plains Herbaceous Vegetation (CEGL001463, G2?)
- *Andropogon gerardii - Sorghastrum nutans* Western Great Plains Herbaceous Vegetation (CEGL001464, G2)
- *Andropogon gerardii - Sporobolus heterolepis* Western Foothills Herbaceous Vegetation (CEGL001465, G2)
- *Bouteloua gracilis - Bouteloua curtipendula* Herbaceous Vegetation (CEGL001754, G5)
- *Bouteloua gracilis - Bouteloua hirsuta* Herbaceous Vegetation (CEGL001755, G3G4)

- *Bouteloua gracilis - Buchloe dactyloides* Herbaceous Vegetation (CEGL001756, G4)
- *Bouteloua gracilis* Herbaceous Vegetation (CEGL001760, G4Q)
- *Bouteloua hirsuta - Bouteloua curtipendula* Herbaceous Vegetation (CEGL001764, G4)
- *Bouteloua hirsuta - Hesperostipa neomexicana* Herbaceous Vegetation (CEGL001766, GNRQ)
- *Gutierrezia sarothrae / Bouteloua gracilis* Dwarf-shrub Herbaceous Vegetation (CEGL005382, GNR)
- *Hesperostipa comata - Achnatherum hymenoides* Herbaceous Vegetation (CEGL001703, G2?)
- *Hesperostipa comata* Colorado Front Range Herbaceous Vegetation (CEGL001702, G1G2)
- *Hesperostipa neomexicana* Herbaceous Vegetation (CEGL001708, G3)
- *Nassella viridula* Herbaceous Vegetation (CEGL001713, GU)
- *Poliomintha incana / Bouteloua gracilis* Shrubland (CEGL001339, G2?)
- *Pseudoroegneria spicata - Hesperostipa comata* Herbaceous Vegetation (CEGL001679, G4)
- *Pseudoroegneria spicata - Pascopyrum smithii* Herbaceous Vegetation (CEGL001675, G4)
- *Pseudoroegneria spicata - Poa secunda* Herbaceous Vegetation (CEGL001677, G4?)
- *Pseudoroegneria spicata* Herbaceous Vegetation (CEGL001660, G2)
- *Schizachyrium scoparium - Bouteloua curtipendula* Western Great Plains Herbaceous Vegetation (CEGL001594, G3)
- *Schizachyrium scoparium - Muhlenbergia cuspidata* Herbaceous Vegetation (CEGL001683, G3?)
- *Yucca glauca / Pseudoroegneria spicata* Shrub Herbaceous Vegetation (CEGL001499, G4Q)

DISTRIBUTION

Range: This mixed grassland ecological system occurs in a transitional band between the Rocky Mountains and the Shortgrass Steppe where increased soil moisture from orographic lifting and local topography favor tall and mid-height grasses. The band is restricted to the Rocky Mountain foothills and piedmont and adjacent plains, extending farther east on the Palmer Divide, north alongside the Chalk Bluffs near the Colorado-Wyoming border, and south on and below mesas and escarpments in southeastern Colorado, northeastern New Mexico, and the panhandles of Oklahoma and Texas. These grasslands also occur around the edges of the Black Hills uplift, where Schizachyrium scoparium is the dominant grass.
Divisions: 303:C; 306:C
Nations: US
Subnations: AZ?, CO, NM, OK, SD, TX, WY
Map Zones: 19:?, 21:?, 22:C, 24:?, 25:C, 26:P, 27:C, 28:C, 29:C, 30:P, 31:P, 33:C, 34:?
USFS Ecomap Regions: 315A:CC, 315B:CC, 315H:CC, 331B:CC, 331C:CC, 331F:CC, 331G:CC, 331H:CC, 331I:CC, 331J:CC, 342F:CC, M313A:CP, M313B:CC, M331F:CC, M331G:CC, M331I:CC, M341A:CC
TNC Ecoregions: 10:C, 20:C, 21:C, 24:C, 25:P, 26:P, 27:C, 28:P

SOURCES

References: CNHP 2010b, Comer et al. 2003, Hess and Wasser 1982, Landfire 2007a, Lauenroth and Milchunas 1992, Mast et al. 1997, Mast et al. 1998, Neely et al. 2001, Opler and Krizek 1984, Shiflet 1994, TNC 2013, Weaver and Albertson 1956
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722856#references
Description Author: NatureServe Western Ecology Team, mod. K.A. Schulz
Version: 14 Jan 2014 **Stakeholders:** Midwest, Southeast, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

WESTERN GREAT PLAINS SAND PRAIRIE (CES303.670)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Western Great Plains (303)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Non-Diagnostic Classifiers: Lowland [Lowland]; Herbaceous; Sand Soil Texture; Ustic; G-Landscape/Low Intensity; W-Patch/High Intensity
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2148; ESLF 7121; ESP 1148

CONCEPT

Summary: The sand prairies constitute a very unique system within the western Great Plains. These sand prairies are often considered part of the tallgrass or mixedgrass regions in the western Great Plains but can contain elements from Western Great Plains Shortgrass Prairie (CES303.672), Central Mixedgrass Prairie (CES303.659), and Northwestern Great Plains Mixedgrass Prairie (CES303.674). The largest expanse of sand prairies (approximately 5 million ha) can be found in the Sandhills of north-central Nebraska and southwestern South Dakota. These areas are relatively intact. The primary use of this system has been grazing (not cultivation), and areas such as the Nebraska Sandhills can experience less degeneration than other prairie systems. Although greater than 90% of the Sandhills region is privately owned, the known fragility of the soils and the cautions used by ranchers to avoid poor grazing practices have allowed for fewer significant changes in the vegetation of the Sandhills compared to other grassland systems. The unifying and controlling feature for this system is that coarse-textured soils predominate and the dominant grasses are well-adapted to this condition. Soils in the sand prairies can be relatively undeveloped and are highly permeable. Soil texture and drainage along with a species' rooting morphology, photosynthetic physiology, and mechanisms to avoid transpiration loss are highly important in determining the composition of the sand prairies. In the northwestern portion of its range, stand size corresponds to the area of exposed caprock sandstone, and small patches predominate, but large patches are also found embedded in the encompassing Northwestern Great Plains Mixedgrass Prairie (CES303.674). Another important feature is their susceptibility to wind erosion. Blowouts and sand draws are some of the unique wind-driven disturbances in the sand prairies, particularly the Nebraska Sandhills. In most of eastern Montana, substrates supporting this system have weathered in place from sandstone caprock; thus the solum is relatively thin, and the wind-sculpted features present further east, particularly in Nebraska, do not develop. Graminoid species dominate the sand prairies, although relative dominance can change due to impacts of wind disturbance. *Andropogon hallii* and *Calamovilfa longifolia* are the most common species, but other grass and forb species such as *Hesperostipa comata, Carex inops ssp. heliophila*, and *Panicum virgatum* may be present. Apparently only *Calamovilfa longifolia* functions as a dominant throughout the range of the system. In the western extent, *Hesperostipa comata* becomes more dominant, and *Andropogon hallii* is less abundant but still present. Communities of *Artemisia cana ssp. cana* are included here in central and eastern Montana. Patches of *Quercus havardii* can also occur within this system in the southern Great Plains. Fire and grazing constitute the other major dynamic processes that can influence this system.
Classification Comments: This system was edited to expand the concept to include sandy portions of the mixedgrass prairie of the Montana plains. Although in terms of potentially dominant graminoids there is virtually a complete overlap between the eastern and western extremities of the system, there is a distinct shift from west to east from midgrass species dominance, most notably *Hesperostipa comata*, to tallgrass species dominance, including prominently *Andropogon gerardii* and *Andropogon hallii*. Prevailing patch size also shifts from smaller to larger moving west to east. Current thinking is to include this variation within this system, but with more information and input from other Great Plains ecologists in the U.S. and Canada, this concept is subject to change, including the possibility of creating a new system.
Similar Ecological Systems:
- Central Mixedgrass Prairie (CES303.659)
- Western Great Plains Sandhill Steppe (CES303.671)
- Western Great Plains Shortgrass Prairie (CES303.672)
- Western Great Plains Tallgrass Prairie (CES303.673)

Related Concepts:
- Blue Grama - Sideoats Grama - Black Grama (707) (Shiflet 1994) Intersecting
- Bluestem - Prairie Sandreed (602) (Shiflet 1994) Finer
- Bluestem -Dropseed (708) (Shiflet 1994) Broader
- Grama -Bluestem (714) (Shiflet 1994) Finer. soil texture ranges from sand to clay loam? Inclusions?
- Mohrs (Shin) Oak: 67 (Eyre 1980) Finer
- Prairie Sandreed - Needlegrass (603) (Shiflet 1994) Finer. This SRM type is found in the more northerly and northwest portions of this ecological system (as far west as central Montana).
- Sand Bluestem - Little Bluestem Dunes (720) (Shiflet 1994) Finer
- Sand Bluestem - Little Bluestem Plains (721) (Shiflet 1994) Finer
- Western Great Plains Sand Prairie (Rolfsmeier and Steinauer 2010) Equivalent

- Wheatgrass - Grama - Needlegrass (608) (Shiflet 1994) Intersecting. Sandy portions of this SRM type are included in this ecological system.

DESCRIPTION

Environment: The distribution, species richness and productivity of plant species within the sand prairie ecological system are controlled primarily by environmental conditions, in particular the temporal and spatial distribution of soil moisture and topography. Soils in the sand prairies can be relatively undeveloped and are highly permeable. Soil texture and drainage along with a species' rooting morphology, photosynthetic physiology, and mechanisms to avoid transpiration loss are highly important in determining the composition and distribution of communities/associations within the sand prairies. Another important aspect of soils in the sand prairies is their susceptibility to wind erosion. Blowouts and sand draws are some of the unique wind-driven disturbances in the sand prairies, particularly the Nebraska Sandhills, which can profoundly impact vegetation composition and succession within this system. This tallgrass system is found primarily on sandy and sandy loam soils that can be relatively undeveloped and highly permeable as compared to Western Great Plains Tallgrass Prairie (CES303.673), which occurs on deeper loams. This system is usually found in areas with a rolling topography and can occur on ridges, midslopes and/or lowland areas within a region. It often occurs on moving sand dunes, especially within the Sandhills region of Nebraska and South Dakota. In Montana, occurrences are intimately associated with Northwestern Great Plains Mixedgrass Prairie (CES303.674), usually occupying higher positions in local landscapes due to the fact that sandy members of some formations (that are predominantly marine shales) constitute the highest (and most weathering-resistant) points in the landscape.

Vegetation: This system is distinguished by the dominance of graminoids such as *Andropogon hallii* and *Calamovilfa longifolia*. Other graminoids such as *Hesperostipa comata, Carex inops ssp. heliophila*, and *Panicum virgatum* may be present. Characteristic forbs differ by region, but species of *Psoralidium* and *Pediomelum* are a common feature. *Penstemon haydenii* is endemic to the sand prairie system and of special conservation concern because of its probable decline due to grazing and fire suppression. Very diffuse patches of *Rhus trilobata* are found on shallow sandy soils, often associated with breaklands; other shrubs occasionally occurring include *Artemisia cana ssp. cana, Betula occidentalis, Juniperus horizontalis*, and *Yucca glauca*. Many of the warm-season graminoids extend at least to the Rocky Mountain Front as dominant components on appropriate sites or as a response to disturbance. All the characteristic species mentioned for Nebraska and South Dakota are also found in Montana stands (and possibly Wyoming and perhaps the rest of the states cited). Some of the communities cited as part of the concept in Nebraska and South Dakota are only marginally present in Montana, but others are found throughout Montana's Great Plains region. In the southern range of this system, patches of *Quercus havardii* can also occur.

Dynamics: The distribution, species richness and productivity of plant species within the sand prairie ecological system are controlled primarily by environmental conditions, in particular the temporal and spatial distribution of soil moisture and topography. Another important aspect of this system is its susceptibility to wind erosion. Blowouts and sand draws are some of the unique wind-driven disturbances in the sand prairies, particularly the Nebraska Sandhills, which can profoundly impact vegetation composition and succession within this system. Fire and grazing constitute the other major disturbances that can influence this system. Overgrazing, fire and trampling that leads to the removal of vegetation within those areas susceptible to blowouts can either instigate a blowout or perpetuate one already occurring. Overgrazing can also lead to significant erosion.

Component Associations:

- *Andropogon gerardii - Panicum virgatum* Sandhills Herbaceous Vegetation (CEGL002023, G3?)
- *Andropogon hallii - Calamovilfa gigantea* Herbaceous Vegetation (CEGL004016, G2G3)
- *Andropogon hallii - Calamovilfa longifolia* Herbaceous Vegetation (CEGL001467, G4G5)
- *Andropogon hallii - Carex inops ssp. heliophila* Herbaceous Vegetation (CEGL001466, G3)
- *Artemisia cana ssp. cana / Calamovilfa longifolia* Shrub Herbaceous Vegetation (CEGL001555, G3Q)
- *Artemisia cana ssp. cana / Hesperostipa comata* Shrub Herbaceous Vegetation (CEGL001553, G3)
- *Betula occidentalis - Juniperus horizontalis / Calamovilfa longifolia* Shrubland (CEGL002184, GNR)
- *Calamovilfa longifolia - Carex inops ssp. heliophila* Herbaceous Vegetation (CEGL001471, G3)
- *Calamovilfa longifolia - Hesperostipa comata* Herbaceous Vegetation (CEGL001473, G3)
- *Carex interior - Eleocharis elliptica - Thelypteris palustris* Herbaceous Vegetation (CEGL002390, G1G2)
- *Hesperostipa comata - Bouteloua gracilis - Carex filifolia* Herbaceous Vegetation (CEGL002037, G5)
- *Hesperostipa comata - Carex filifolia* Herbaceous Vegetation (CEGL001700, G4)
- *Pseudoroegneria spicata - Achnatherum hymenoides* Herbaceous Vegetation (CEGL001674, G3G4)
- *Pseudoroegneria spicata - Hesperostipa comata* Herbaceous Vegetation (CEGL001679, G4)
- *Quercus havardii / Sporobolus cryptandrus - Schizachyrium scoparium* Shrubland (CEGL002171, G3)
- *Rhus trilobata / Calamovilfa longifolia* Shrub Herbaceous Vegetation (CEGL001457, G3Q)
- *Rhus trilobata / Pseudoroegneria spicata* Shrub Herbaceous Vegetation (CEGL001120, G4)
- *Schizachyrium scoparium - Aristida basiramea - Sporobolus cryptandrus - Eragrostis trichodes* Herbaceous Vegetation (CEGL005221, GNR)
- *Yucca glauca / Calamovilfa longifolia* Shrub Herbaceous Vegetation (CEGL002675, G4)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:

- Northwestern Great Plains Mixedgrass Prairie (CES303.674)

DISTRIBUTION

Range: This system is found throughout the Western Great Plains Division. The largest and most intact example of this system is found within the Sandhills region of Nebraska and South Dakota. However, it is also common (though occurring in predominantly small patches) farther west into central and eastern Montana. Its western extent in Wyoming is still to be determined, but it does occur in mapzone 29 on weathered-in-place sandy soils, where *Calamovilfa longifolia* is found, along with *Artemisia cana*.
Divisions: 303:C
Nations: US
Subnations: CO, KS, MT, ND, NE, NM?, OK, SD, TX?, WY
Map Zones: 20:C, 27:P, 29:C, 30:C, 31:C, 32:C, 33:C, 34:C, 38:C, 39:C, 40:C
USFS Ecomap Regions: 251F:CC, 251H:CC, 255A:PP, 315A:CC, 315B:CC, 315F:CC, 321A:??, 331B:CC, 331C:CC, 331D:CC, 331E:CC, 331F:CC, 331G:CC, 331H:CC, 331K:CC, 331L:CC, 331M:CP, 331N:C?, 332C:CC, 332D:CC, 332E:CC, 332Fb:CCC
TNC Ecoregions: 26:C, 27:C, 28:C, 33:C, 34:C

SOURCES

References: Barbour and Billings 1988, Comer et al. 2003, Tolstead 1942
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722988#references
Description Author: S. Menard and K. Kindscher, mod. M.S. Reid
Version: 27 Apr 2006 **Stakeholders:** Midwest, Southeast, West
Concept Author: S. Menard and K. Kindscher **ClassifResp:** Midwest

WESTERN GREAT PLAINS SHORTGRASS PRAIRIE (CES303.672)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Western Great Plains (303)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Non-Diagnostic Classifiers: Herbaceous; Loam Soil Texture; Ustic; F-Landscape/Low Intensity
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2149; ESLF 7122; ESP 1149

CONCEPT

Summary: This system is found primarily in the western half of the Western Great Plains Division in the rainshadow of the Rocky Mountains and ranges from the Nebraska Panhandle south into Texas and New Mexico, although grazing-impacted examples may reach as far north as southern Canada where it grades into Northwestern Great Plains Mixedgrass Prairie (CES303.674). This system occurs primarily on flat to rolling uplands with loamy, ustic soils ranging from sandy to clayey. In much of its range, this system forms the matrix system with *Bouteloua gracilis* dominating this system. Associated graminoids may include *Aristida purpurea, Bouteloua curtipendula, Bouteloua hirsuta, Buchloe dactyloides, Hesperostipa comata, Koeleria macrantha (= Koeleria cristata), Pascopyrum smithii (= Agropyron smithii), Pleuraphis jamesii, Sporobolus airoides*, and *Sporobolus cryptandrus*. Although mid-height grass species may be present, especially on more mesic land positions and soils, they are secondary in importance to the sod-forming short grasses. Sandy soils have higher cover of *Hesperostipa comata*, and *Sporobolus cryptandrus*. Scattered shrub and dwarf-shrub species such as *Artemisia filifolia, Artemisia frigida, Artemisia tridentata, Atriplex canescens, Eriogonum effusum, Gutierrezia sarothrae, Lycium pallidum*, and *Yucca glauca* may also be present. Also, because this system spans a wide range, there can be some differences in the relative dominance of some species from north to south and from east to west. Large-scale processes such as climate, fire and grazing influence this system. High variation in amount and timing of annual precipitation impacts the relative cover of cool- and warm-season herbaceous species.

In contrast to other prairie systems, fire is less important, especially in the western range of this system, because the often dry and xeric climate conditions can decrease the fuel load and thus the relative fire frequency within the system. However, historically, fires that did occur were often very extensive. Currently, fire suppression and more extensive grazing in the region have likely decreased the fire frequency even more, and it is unlikely that these processes could occur at a natural scale. A large part of the range for this system (especially in the east and near rivers) has been converted to agriculture. Areas of the central and western range have been impacted by the unsuccessful attempts to develop dryland cultivation during the Dust Bowl of the 1930s. The short grasses that dominate this system are extremely drought- and grazing-tolerant. These species evolved with drought and large herbivores and, because of their stature, are relatively resistant to overgrazing. This system in combination with the associated wetland systems represents one of the richest areas for mammals and birds. The endemic bird species of the shortgrass system may constitute one of the fastest declining bird populations in North America.

Classification Comments: In Texas, this system occurs on the Llano Estacado and ranges to but does not include the Stockton Plateau.

Similar Ecological Systems:
- Madrean Juniper Savanna (CES301.730)
- Southern Rocky Mountain Juniper Woodland and Savanna (CES306.834)
- Western Great Plains Mesquite Woodland and Shrubland (CES303.668)
- Western Great Plains Sand Prairie (CES303.670)

Related Concepts:
- Black Grama - Alkali Sacaton (702) (Shiflet 1994) Finer
- Black Grama - Sideoats Grama (703) (Shiflet 1994) Finer
- Blue Grama - Buffalograss (611) (Shiflet 1994) Finer
- Blue Grama - Galleta (705) (Shiflet 1994) Finer
- Blue Grama - Sideoats Grama (706) (Shiflet 1994) Finer
- Blue Grama - Sideoats Grama - Black Grama (707) (Shiflet 1994) Finer
- Blue Grama - Western Wheatgrass (704) (Shiflet 1994) Finer
- Galleta -Alkali Sacaton (712) (Shiflet 1994) Finer
- Grama - Buffalograss (715) (Shiflet 1994) Finer
- Grama - Feathergrass (716) (Shiflet 1994) Finer
- High Plains: Shortgrass Prairie (2907) [CES303.672.9] (Elliott 2011) Equivalent
- Vine Mesquite - Alkali Sacaton (725) (Shiflet 1994) Intersecting
- Western Great Plains Mixed-Grass Prairie (Rolfsmeier and Steinauer 2010) Equivalent
- Wheatgrass - Saltgrass - Grama (615) (Shiflet 1994) Intersecting

DESCRIPTION

Environment: This system occurs on various geologic formations, primarily on flat to rolling uplands. Soils typically are loamy and ustic but can range from sandy to clayey. Climate is continental with mean annual precipitation generally about 300 mm ranging to 500 mm to the south in Texas. Most of the annual precipitation occurs during the growing season as thunderstorms. Precipitation events are mostly <10 cm with occasional larger events. High variation in amount and timing of annual precipitation impacts the relative cover of cool- and warm-season herbaceous species. This is the driest of the Great Plains grasslands ecosystems. In the southeasternmost expression of the system in Texas, it occurs on sites with soils providing relatively dry conditions such as Rough Breaks, Shallow Clay, Very Shallow, and Very Shallow Clay Ecological Sites (Elliott 2011).
Vegetation: Vegetation: This system spans a wide range and thus there can be some differences in the relative dominance of some species from north to south and from east to west. This system is primarily dominated by *Bouteloua gracilis* throughout its range with various associated graminoid species depending on precipitation, soils and management. Associated graminoids may include *Achnatherum hymenoides, Aristida purpurea, Bouteloua curtipendula, Bouteloua hirsuta, Buchloe dactyloides, Carex filifolia, Hesperostipa comata, Koeleria macrantha (= Koeleria cristata), Muhlenbergia torreyana, Pascopyrum smithii (= Agropyron smithii), Pleuraphis jamesii, Sporobolus airoides*, and *Sporobolus cryptandrus*. In addition, *Bouteloua rigidiseta, Erioneuron pilosum*, and *Hilaria belangeri* may occur in Texas examples (Elliott 2011). Although mid-height grass species may be present especially on more mesic land positions and soils, they are secondary in importance to the sod-forming short grasses. Sandy soils have higher cover of *Hesperostipa comata, Sporobolus cryptandrus*, and *Yucca elata*. Scattered shrub and dwarf-shrub species such as *Artemisia filifolia, Artemisia frigida, Artemisia tridentata, Atriplex canescens, Eriogonum effusum, Gutierrezia sarothrae*, and *Lycium pallidum* may also be present. In Texas examples, shrub cover is generally low but may include species such as *Acacia greggii, Rhus microphylla, Rhus trilobata, Dalea formosa, Mahonia trifoliolata, Juniperus* sp., and *Prosopis glandulosa*. Forbs such as *Calylophus* sp., *Melampodium leucanthum, Krameria lanceolata*, and others are often present. *Gutierrezia sarothrae* may be present with significant cover, especially on sites with intense and continuous grazing (Elliott 2011). High annual variation in amount and timing of precipitation impacts relative cover of herbaceous species. Cover of cool-season grasses is dependant on winter and early spring precipitation.
Dynamics: Large-scale processes such as climate, fire and grazing constitute the primary processes impacting this system. The short grasses that dominate this system are extremely drought- and grazing-tolerant (Lauenroth and Milchunas 1992, Lauenroth et al. 1994a). These species evolved with large herbivores and drought (Milchunas and Lauenroth 2008) and adapted to historical heavy grazing with their low stature making them relatively resistant to overgrazing (Lauenroth et al. 1994a). The return intervals for grazing varied with areas distant from water sources likely grazed less heavily as those near water. However, the shortgrass steppe is probably the system with the highest intensity of grazing than other systems historically (Lauenroth et al. 1994a, Milchunas 2006). This is a drought-tolerant system. However, extended drought (over 3-4 years) will reduce cover (Landfire 2007a). Many shortgrass species are drought-tolerant and have root systems that extend up near the soil surface where they can utilize low precipitation events (Salas and Lauenroth 1982). If blue grama is eliminated from an area by extended drought (3-4 years) or disturbance such as plowing, regeneration is slow because of very slow tillering rates (Samuel 1985), low and variable seed production (Coffin and Lauenroth 1992), minimal seed storage in soil (Coffin and Lauenroth 1989) and limited seedling germination and establishment due to particular temperature and extended soil moisture requirements for successful seedling establishment (Hyder et al. 1971, Briske and Wilson 1978, 1980). Patterns and scales of heterogeneity related to historic natural grazing and fire regimes within the system are not well understood, but are assumed to be important to biodiversity (Fuhlendorf et al. 2006).

In contrast to other prairie systems, fire is less frequent, especially in the western range of this system, because the often dry and xeric climate conditions can decrease the fuel load and thus the relative fire frequency within the system. However, historically, fires that did occur were often very extensive. Wright and Bailey (1982c) suggest that in semiarid areas, big prairie fires usually occurred during drought years that followed one to three years of above average precipitation, because of the abundant and continuous fuel. Consequently, these wildfires could travel far when the winds and air temperatures were high and relative humidity was low. There is debate as to the mean fire-return interval (MFRI) for this shortgrass system. Because of the lack of long-lived trees, and trees that do exist are in relatively productive sites, there is absolutely no way to reconstruct a reliable historic fire-return interval. All estimates of historic fire-return intervals must be based on those for surrounding vegetation types that do have means for reconstruction, and then extrapolating based on differences in primary production and herbivore removal of fuel loads. Therefore, there is no means to directly obtain the estimate, and the range is varied. It depends on many factors: portions will be drier, and portions will vary in frequency over time and there will be decadal variation. Anderson (2003) reports a broad fire-return interval (FRI) of <35 years for shortgrass prairie. There is a wide variability of MFRI across this system, based on precipitation, fuel and ignition sources (Landfire 2007a).

Component Associations:
- *Aristida purpurea* Herbaceous Vegetation (CEGL005800, GNR)
- *Bouteloua curtipendula - Bouteloua (eriopoda, gracilis)* Herbaceous Vegetation (CEGL002250, G4)
- *Bouteloua eriopoda - Bouteloua gracilis* Herbaceous Vegetation (CEGL001748, G2)
- *Bouteloua gracilis - Bouteloua curtipendula* Herbaceous Vegetation (CEGL001754, G5)
- *Bouteloua gracilis - Bouteloua hirsuta* Herbaceous Vegetation (CEGL001755, G3G4)
- *Bouteloua gracilis - Buchloe dactyloides - Pleuraphis jamesii* Herbaceous Vegetation (CEGL002271, GNR)
- *Bouteloua gracilis - Buchloe dactyloides* Herbaceous Vegetation (CEGL001756, G4)
- *Bouteloua gracilis - Buchloe dactyloides* Xeric Soil Herbaceous Vegetation (CEGL002270, G3G5)
- *Bouteloua gracilis - Pleuraphis jamesii* Herbaceous Vegetation (CEGL001759, G2G4)
- *Bouteloua gracilis* Herbaceous Vegetation (CEGL001760, G4Q)
- *Bouteloua hirsuta - Bouteloua curtipendula* Herbaceous Vegetation (CEGL001764, G4)
- *Hesperostipa neomexicana* Mixed Prairie Herbaceous Vegetation (CEGL001711, GU)

- *Sporobolus airoides* Southern Plains Herbaceous Vegetation (CEGL001685, G3Q)
- *Yucca glauca / Calamovilfa longifolia* Shrub Herbaceous Vegetation (CEGL002675, G4)

Spatial Characteristics

Adjacent Ecological Systems:
- Northwestern Great Plains Mixedgrass Prairie (CES303.674)
- Western Great Plains Tallgrass Prairie (CES303.673)

Adjacent Ecological System Comments: Some examples may reach as far north as southern Canada where it grades into Northwestern Great Plains Mixedgrass Prairie (CES303.674).

Distribution

Range: This system is found primarily in the western half of the Western Great Plains Division east of the Rocky Mountains and ranges from the Nebraska Panhandle south into the panhandles of Oklahoma and Texas and New Mexico, although some examples may reach as far north as southern Canada where it grades into Northwestern Great Plains Mixedgrass Prairie (CES303.674).
Divisions: 303:C
Nations: US
Subnations: CO, KS, NE, NM, OK, TX, WY
Map Zones: 22:C, 24:?, 25:C, 26:C, 27:C, 28:C, 29:C, 30:C, 31:P, 33:C, 34:C, 35:P, 38:P
USFS Ecomap Regions: 315A:CC, 315B:CC, 315F:CC, 321A:CC, 331B:CC, 331C:CC, 331F:CC, 331H:CC, 331I:CC, 332C:CC, 332E:CC, 332F:CC, M313B:CC, M331F:CC, M331I:CC
TNC Ecoregions: 26:P, 27:C, 28:C, 33:P

Sources

References: Anderson 2003, Bamforth 1987, Barbour and Billings 1988, Bragg 1986, Bragg and Hulbert 1976, Briske and Wilson 1978, Briske and Wilson 1980, CNHP 2010b, Coffin and Lauenroth 1989, Coffin and Lauenroth 1992, Comer et al. 2003, Dick-Peddie 1993, Elliott 2011, Fuhlendorf et al. 2006, Gober 2000, Hyder et al. 1971, Landfire 2007a, Lauenroth and Milchunas 1992, Laurenroth et al. 1994a, Malainey and Sherriff 1996, Milchunas 2006, Milchunas and Lauenroth 2008, Milchunas et al. 1989, Polley et al. 2013, Ricketts et al. 1999, Rolfsmeier and Steinauer 2010, Rondeau pers. comm., Sala and Lauenroth 1982, Samson and Knopf 1994, Samuel 1985, Shaw and Lee 1997, Shiflet 1994, TNC 2013, Umbanowar 1996, Wright and Bailey 1982c
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722986#references
Description Author: S. Menard and K. Kindscher, mod. M. Pyne, L. Elliott, K.A. Schulz
Version: 14 Jan 2014 **Stakeholders:** Midwest, Southeast, West
Concept Author: S. Menard and K. Kindscher **ClassifResp:** Midwest

WESTERN GREAT PLAINS TALLGRASS PRAIRIE (CES303.673)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Western Great Plains (303)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Non-Diagnostic Classifiers: Herbaceous; Deep Soil; Loam Soil Texture; Ustic; F-Patch/Low Intensity; G-Patch/Medium Intensity
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2150; ESLF 7123; ESP 1150

CONCEPT

Summary: This system can be found throughout the Western Great Plains Division. It is found primarily in areas where soil characteristics allow for mesic conditions more typical of the Eastern Great Plains Division and thus are able to sustain tallgrass species. This system may be small patches interspersed within Northwestern Great Plains Mixedgrass Prairie (CES303.674) or Western Great Plains Shortgrass Prairie (CES303.672) and may also be associated with upland terraces above a floodplain system where these more mesic conditions persist. Soils are primarily loamy Mollisols that are moderately deep and rich. Those areas that contain more sandy soils should be considered part of Western Great Plains Sand Prairie (CES303.670). This system is dominated primarily by *Andropogon gerardii* and may also include *Sorghastrum nutans, Schizachyrium scoparium, Pascopyrum smithii, Hesperostipa spartea*, and *Sporobolus heterolepis*. *Andropogon gerardii* often dominates the lowland regions, although *Pascopyrum smithii* can be prolific if conditions are favorable. Forbs in varying density may also be present. The primary dynamics for this system include fire, climate and grazing. Fire suppression in these areas has allowed for the invasion of woody species such as *Juniperus virginiana* and *Prunus* spp. Grazing also has contributed to these changes and likewise led to a decrease of this system as overgrazing favors shortgrass and mixedgrass systems. Conversion to agriculture likewise has probably decreased the range of this system. Thus, this system likely only occurs in small patches and in scattered locations throughout the division. Large-patch occurrences are mostly isolated to slopes and swales of rolling uplands where either grazing or cultivation are more problematic.
Classification Comments: A granitic woodland association of the Wichita Mountains of Oklahoma (*Quercus fusiformis - (Quercus stellata) / Schizachyrium scoparium* Granite Woodland (CEGL004937)), formerly included here, now is included in Crosstimbers Oak Forest and Woodland (CES205.682).
Similar Ecological Systems:
- Western Great Plains Sand Prairie (CES303.670)
- Western Great Plains Sandhill Steppe (CES303.671)

Related Concepts:
- Bluestem - Grama (709) (Shiflet 1994) Broader
- Bluestem Prairie (601) (Shiflet 1994) Finer
- Bluestem Prairie (710) (Shiflet 1994) Finer
- Wheatgrass - Bluestem - Needlegrass (606) (Shiflet 1994) Intersecting

DESCRIPTION

Environment: This system is found primarily on loam, moderately deep, and rich Mollisols throughout the Western Great Plains Division. These soils tend to be more mesic and deep than the majority of soils within the Western Great Plains and are more typical of the Eastern Great Plains Division. This system requires more moisture than is available from precipitation in the Western Great Plains so it occurs in valleys, on lower slopes, and sometimes on floodplains (Albertson 1937, Heitschmidt et al. 1970). Occurrences are usually medium to small.
Vegetation: The mesic, deep soils of this system allow for dominance by *Andropogon gerardii*. Other species, such as *Sorghastrum nutans, Schizachyrium scoparium, Pascopyrum smithii, Hesperostipa spartea*, and *Sporobolus heterolepis*, can also be present. In more lowland areas, *Pascopyrum smithii* can become more prevalent. Fire suppression can lead to the invasion of these areas by woody species such as *Juniperus virginiana* and *Prunus* spp.
Dynamics: Fire, climate and grazing constitute the primary dynamic processes impacting this system. Fire may have occurred as often as every 5 years, especially in the wetter eastern portions of this system's range (Landfire 2007a). This system occurred in a landscape dominated by mixedgrass and shortgrass vegetation. These systems do not have the rapid build up of litter that occurs in tallgrass prairies further east and thus do not carry fire as readily so there were fewer fires that could affect this system.

This system developed in an area occupied by vast numbers of native ungulates, notably bison (*Bison bison*) but including other species, and the grazing of these species affected species composition and the patchwork of habitat. Bison preferentially favor newly burned areas and graminoids over forbs (Coppedge and Shaw 1998, Vinton et al. 1993). On unburned sites, grazing removes live and dead vegetation, allowing more light and heat to the soil surface and increasing available moisture thus favoring species, forbs or woody plants, in the case of bison grazing, that were resilient to the effects of grazing or avoided by the grazers (Damoureyeh and Hartnett 1997).

Component Associations:
- *Andropogon gerardii - Panicum virgatum - Schizachyrium scoparium - (Tradescantia tharpii)* Herbaceous Vegetation

(CEGL005231, G3?)
- *Andropogon gerardii - Schizachyrium scoparium* Northern Plains Herbaceous Vegetation (CEGL002205, G3G5)
- *Andropogon gerardii - Schizachyrium scoparium* Western Great Plains Herbaceous Vegetation (CEGL001463, G2?)
- *Andropogon gerardii - Sorghastrum nutans* Western Great Plains Herbaceous Vegetation (CEGL001464, G2)
- *Andropogon gerardii - Sporobolus heterolepis - Schizachyrium scoparium - Pascopyrum smithii* Herbaceous Vegetation (CEGL002376, G2)
- *Andropogon gerardii - Sporobolus heterolepis* Western Foothills Herbaceous Vegetation (CEGL001465, G2)
- *Spartina pectinata* Western Herbaceous Vegetation (CEGL001476, G3?)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Northwestern Great Plains Mixedgrass Prairie (CES303.674)
- Western Great Plains Shortgrass Prairie (CES303.672)

Adjacent Ecological System Comments: This system may be small patches interspersed within Northwestern Great Plains Mixedgrass Prairie (CES303.674) or Western Great Plains Shortgrass Prairie (CES303.672) and may also be associated with upland terraces above a floodplain system where these more mesic conditions persist.

DISTRIBUTION

Range: This system occurs throughout the Western Great Plains Division, however, grazing and conversion to agriculture have likely decreased its natural range.
Divisions: 303:C
Nations: US
Subnations: CO, KS, MT, ND, NE, OK, TX?, WY
Map Zones: 29:C, 30:C, 31:C, 33:C, 34:C, 38:C, 39:C, 40:C
USFS Ecomap Regions: 331C:PP, 331H:PP
TNC Ecoregions: 26:C, 27:C, 28:?, 33:C, 34:C

SOURCES

References: Albertson 1937, Barbour and Billings 1988, Branson and Weaver 1953, Comer et al. 2003, Coppedge and Shaw 1998, Damoureyeh and Hartnett 1997, Heitschmidt et al. 1970, Landfire 2007a, Shiflet 1994, Vinton et al. 1993, Weaver 1954
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722985#references
Description Author: S. Menard and K. Kindscher, mod. J. Drake
Version: 14 Jan 2014 **Stakeholders:** Midwest, Southeast, West
Concept Author: S. Menard and K. Kindscher **ClassifResp:** Midwest

WESTERN HIGHLAND RIM PRAIRIE AND BARRENS (CES202.352)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Herbaceous; Deep Soil; Graminoid
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2416; ESLF 7129; ESP 1416

CONCEPT

Summary: This system includes open, fire-maintained vegetation (often called "barrens") on uplands in western middle Tennessee (USFS Subsection 223Eg and EPA Level IV Ecoregion 71f). Although parts of the region are highly dissected, extensive interfluvial areas formerly supported fire-adapted "barrens" vegetation. These barrens occur, at least in part, on Cretaceous gravels which cap Mississippian limestone strata on hills in the Tennessee counties of Dickson, Hickman, Lewis, and Lawrence. The general terrain is flat to gently sloping. Some proposed factors which have functioned to maintain the openness of this system include the droughty, gravelly soils and resulting stresses to vegetation, as well as fire. The same gravels are mapped in Land Between the Lakes, and this vegetation could be expected there (if all examples have not succeeded to woody vegetation due to lack of fire). There may be similar habitats in Kentucky, including relatively extensive areas of Tertiary age material in eastern Calloway and Marshall and southern Livingston counties. The areas are transitional between Highland Rim and Coastal Plain, but they are included in EPA Ecoregion 71f.
Classification Comments: Western Highland Rim Prairie and Barrens (CES202.352), Eastern Highland Rim Prairie and Barrens (CES202.354), Pennyroyal Karst Plain Prairie and Barrens (CES202.355), and Southern Ridge and Valley Patch Prairie (CES202.453) form a series of similar systems in the eastern Interior Highlands and adjacent Ridge and Valley.
Similar Ecological Systems:
- Cumberland Wet-Mesic Meadow and Savanna (CES202.053)
- East Gulf Coastal Plain Jackson Plain Prairie and Barrens (CES203.353)
- Eastern Highland Rim Prairie and Barrens (CES202.354)
- Pennyroyal Karst Plain Prairie and Barrens (CES202.355)
- Southern Ridge and Valley Patch Prairie (CES202.453)

Related Concepts:
- Chestnut Oak: 44 (Eyre 1980) Finer
- Eastern Redcedar: 46 (Eyre 1980) Finer
- Post Oak - Blackjack Oak: 40 (Eyre 1980) Finer

DESCRIPTION

Environment: As noted by Shanks (1958) and described by DeSelm (1989a), these barrens occur, at least in part, on Cretaceous gravels which cap Mississippian limestone strata on hills in the Tennessee counties of Dickson, Hickman, Lewis, and Lawrence; these are mapped in Miller et al. (1966). The general terrain is flat to gently sloping. An example on slopes in northwestern Davidson County (Ridgetop Barrens) is also included here (DeSelm and Chester 1993). Shanks (1958) also specifically refers to barrens on "cherty residuum, elsewhere characterized by Planosols with impeded drainage." Haywood (1959) noted extensive prairie in the southern portion of Land Between the Lakes, and DeSelm (1988) noted the existence of barrens remnants in the region, describing the substrate for non-limestone barrens of the Western Highland Rim of Tennessee as "upland over loess. silty clay loam or silty clay soils."
Vegetation: Some stands may be in a woodland or fire-suppressed forest condition, dominated by dry-site oaks such as *Quercus marilandica*, *Quercus prinus*, and/or *Quercus stellata*. These trees would become more scattered under an appropriate fire regime. In the herbaceous layer of well-managed examples of this system, *Schizachyrium scoparium* is codominant along with a variable mixture of *Andropogon gyrans*, *Andropogon ternarius*, and/or *Andropogon virginicus*. Other dominant grasses may include *Dichanthelium aciculare (= Dichanthelium angustifolium)*, *Gymnopogon brevifolius*, and *Dichanthelium dichotomum var. dichotomum (= var. ramulosum)*. Other common species may include *Symphyotrichum dumosum (= Aster dumosus)*, *Sericocarpus linifolius (= Aster solidagineus)*, *Coreopsis major*, *Eupatorium hyssopifolium*, *Eupatorium rotundifolium*, *Helianthus angustifolius*, *Liatris microcephala*, *Liatris spicata*, *Packera anonyma (= Senecio anonymus)*, *Solidago juncea*, *Solidago odora*, *Chamaecrista fasciculata*, *Chamaecrista nictitans*, *Stylosanthes biflora*, *Lobelia puberula*, *Diodia teres*, *Potentilla simplex*, *Aristida longispica*, *Calamagrostis coarctata*, *Dichanthelium dichotomum*, *Sorghastrum nutans*, *Pteridium aquilinum*, and *Smilax glauca*.
Dynamics: Past fire and grazing constitute the major dynamic processes for this region. Fires were frequent (potentially on a 5-year return interval), primarily of human origin, and are thought to have occurred in late summer to early autumn prior to European settlement. Some proposed factors which have functioned to maintain the openness of this system following the reduction of fire frequency include the droughty, gravelly soils and resulting stresses to vegetation, as well as more occasional fire. Fralish et al. (1999) noted that both post oak and chestnut oak woodlands are essentially the result of fire suppression in the barrens and historic savannas. In some areas, where the soils are particularly harsh (droughty, nutrient-poor, rocky), stands may retain an open aspect in the absence

of fire. Shanks (1958) also specifically refers to barrens on "cherty residuum, elsewhere characterized by Planosols with impeded drainage." Some of the extant examples are largely dependent on contemporary management regimes.

Component Associations:
- *Quercus marilandica / Schizachyrium scoparium - (Helianthus mollis, Silphium asteriscus, Liatris aspera)* Woodland (CEGL004756, G2)
- *Quercus prinus / Smilax* spp. Forest (CEGL005022, G4)
- *Quercus stellata / Viburnum rufidulum / Schizachyrium scoparium - (Sorghastrum nutans, Helianthus eggertii)* Woodland (CEGL004686, G2G3)
- *Schizachyrium scoparium - Andropogon (gyrans, ternarius, virginicus)* Herbaceous Vegetation (CEGL007707, G3?)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- East Gulf Coastal Plain Interior Shortleaf Pine-Oak Forest (CES203.506)

DISTRIBUTION

Range: This system is restricted to the Western Highland Rim of Tennessee and equivalent landforms in adjacent Alabama and Kentucky. Examples (good-condition examples are limited and of small size) are found in Dickson. Hickman, Lawrence, and Lewis counties of Tennessee (DeSelm 1988, NatureServe unpubl. data). These areas are scattered across Subsection 223Eg (Cleland et al. 2005) and EPA Level IV Ecoregion 71f (EPA 2004).
Divisions: 202:C
Nations: US
Subnations: KY?, TN
Map Zones: 47:C, 48:C
USFS Ecomap Regions: 223E:CC
TNC Ecoregions: 44:C

SOURCES

References: Cleland et al. 2005, Comer et al. 2003, DeSelm 1988, DeSelm 1989a, DeSelm and Chester 1993, DeSelm and Murdock 1993, Duffey et al. 1974, EPA 2004, Estes et al. 1979, Eyre 1980, Fralish et al. 1999, Haywood 1959, McDowell et al. 1981, McKinney and Lockwood 1999, Miller et al. 1966, Murdock pers. comm., NatureServe Ecology - Southeastern U.S. unpubl. data, Noss 2013, Shanks 1958, Taft 1997, Taft 2009, Taft et al. 1995, TNC 1996c, Wiens and Dyer 1975
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723160#references
Description Author: C. Nordman, R. Evans, M. Pyne
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: C. Nordman, R. Evans, M. Pyne **ClassifResp:** Southeast

WESTERN NORTH AMERICAN BOREAL ALPINE MESIC HERBACEOUS MEADOW (CES105.131)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Alpine/AltiAndino; Herbaceous; Boreal [Boreal Subcontinental]; Carex bigelowii
Non-Diagnostic Classifiers: Sideslope; Toeslope/Valley Bottom
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - forbland, Perennial forb grassland
National Mapping Codes: EVT 2633; ESLF 7175; ESP 1633

CONCEPT

Summary: This ecological system occurs throughout boreal Alaska on gentle slopes in subalpine and alpine environments. *Carex bigelowii* is the dominant species. Other common species may include *Luzula confusa* and lichens. Dwarf-shrubs such as *Arctostaphylos alpina, Empetrum nigrum, Salix pulchra,* and *Betula nana* are usually present, but contribute less than 25% to the canopy cover. This system may form a mosaic with dwarf- and low-shrub systems.
Classification Comments: This system is known as Boreal Alpine Herbaceous Meadow by the Alaska Natural Heritage Program. There is no species overlap between boreal and boreal transition herbaceous alpine meadow types. Slope position may also be different: *Carex macrochaeta* types usually occur on sites just above subalpine alder on straight or concave slopes.
Related Concepts:

- III.A.2.e - Mesic sedge-grass meadow tundra (Viereck et al. 1992) Intersecting
- III.A.2.g - Mesic grass-herb meadow tundra (Viereck et al. 1992) Intersecting
- III.A.2.h - Sedge-willow tundra (Viereck et al. 1992) Intersecting
- III.A.2.j - Sedge-dryas tundra (Viereck et al. 1992) Intersecting
- III.B.1.b - Alpine herb-sedge (snowbed) (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: This ecological system occurs throughout boreal Alaska on gentle slopes in subalpine and alpine environments.
Vegetation: *Carex bigelowii* is the dominant species. Other common species may include *Luzula confusa* and lichens. Dwarf-shrubs such as *Arctostaphylos alpina, Empetrum nigrum, Salix pulchra,* and *Betula nana* are usually present, but contribute less than 25% to the canopy cover (Boggs and Sturdy 2005). This system may form a mosaic with dwarf- and low-shrub systems.

DISTRIBUTION

Range: This system occurs throughout boreal Alaska in subalpine and alpine sites.
Divisions: 105:C
Nations: US
Subnations: AK
Map Zones: 69:C, 70:C, 71:C, 73:C, 74:C, 75:C
TNC Ecoregions: 74:?, 75:C, 76:C, 77:C, 78:C, 79:C

SOURCES

References: Boggs and Sturdy 2005, Boggs et al. 2001, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817451#references
Description Author: T. Boucher
Version: 08 Aug 2008
Stakeholders: West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program
ClassifResp: West

WESTERN NORTH AMERICAN BOREAL DRY GRASSLAND (CES105.115)

CLASSIFIERS

Classification Status: Standard

Primary Division: Montane Boreal (105)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Herbaceous; Aridic; Graminoid
Non-Diagnostic Classifiers: Sideslope; Toeslope/Valley Bottom; Boreal [Boreal Subcontinental]
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2612; ESLF 7176; ESP 1612

CONCEPT

Summary: This system occurs across the boreal and boreal transition regions of Alaska on dry sideslopes or well-drained lowland sites. Soils are well-drained to excessively drained and permafrost is absent. These sites are typically dominated by grasses, though forbs may codominate on some sites. Shrub cover is less than 25%. Common species include *Festuca altaica, Festuca rubra, Calamagrostis purpurascens, Leymus innovatus (= Elymus innovatus), Artemisia frigida,* and *Achillea* spp.
Classification Comments: This system is known as Boreal Dry Meadow by the Alaska Natural Heritage Program. It does not include coastal *Leymus*-forb meadows that occur in the Aleutians, southwestern, south-central, and southeastern Alaska.
Similar Ecological Systems:
- Western Canadian Boreal Dry Grassland and Bluff (CES103.864)
- Western North American Boreal Dry Aspen-Steppe Bluff (CES105.109)

Related Concepts:
- III.A.1.b - Dry fescue (Viereck et al. 1992) Finer
- III.A.1.c - Midgrass-shrub (Viereck et al. 1992) Intersecting
- III.A.1.d - Midgrass-herb (Viereck et al. 1992) Intersecting
- III.A.1.e - Hair-grass (Viereck et al. 1992) Intersecting

DISTRIBUTION

Range: This system occurs in upland through alpine in the boreal and boreal transition regions of Alaska.
Divisions: 105:C
Nations: US
Subnations: AK
Map Zones: 69:C, 70:C, 71:C, 73:C, 74:C, 75:C
TNC Ecoregions: 71:C, 76:C, 77:C, 78:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817402#references
Description Author: T. Boucher
Version: 08 Aug 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

WESTERN NORTH AMERICAN SUB-BOREAL MESIC BLUEJOINT-FORB MEADOW (CES105.114)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Montane [Upper Montane]; Herbaceous
Non-Diagnostic Classifiers: Flat; Slope; Boreal [Boreal Subcontinental]
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2611; ESLF 7177; ESP 1611

CONCEPT

Summary: This ecological system occurs throughout the boreal and boreal transition regions of Alaska, and extends south and east into western Canada. Soils are typically fine-textured mineral and may be poorly drained (on flats) to well-drained (on sideslopes). In the boreal transition region, mesic *Calamagrostis canadensis* meadows often occur near treeline interspersed with subalpine tall shrub. Its elevational limit is just above the limit of tall shrubs (within 100 m). This system appears to be less common north of the Alaska Range. Mesic meadows also occur as seral stages in drained lakebeds, or after disturbance such as fire or logging. The vegetation is usually dense, with canopy height of 0.8 to 1.4 m, occasionally reaching 2 m. Species composition ranges from nearly pure stands of *Calamagrostis canadensis* to mixtures of *Calamagrostis canadensis* with forbs, such as *Chamerion angustifolium*. Forb- or fern -dominated patches also occur. Common forbs and ferns include *Heracleum maximum, Thalictrum* spp., *Veratrum viride, Angelica lucida, Athyrium filix-femina, Dryopteris expansa,* and *Equisetum arvense*. Short-term mesic meadow seral stages, such as post-fire *Chamerion angustifolium,* are considered seral stages of the forested system they replaced and not included in this description.
Classification Comments: This system is known as Boreal Transition Mesic Meadow by the Alaska Natural Heritage Program. While it undoubtedly occurs in many areas of boreal Canada, its exact distribution remains to be sorted out.
Similar Ecological Systems:
- Alaska Sub-boreal and Maritime Alpine Mesic Herbaceous Meadow (CES204.145)
- Alaskan Pacific Maritime Mesic Herbaceous Meadow (CES204.163)

Related Concepts:
- III.A.2.a - Bluejoint meadow (Viereck et al. 1992) Intersecting
- III.A.2.b - Bluejoint-herb (Viereck et al. 1992) Intersecting
- III.A.2.c - Bluejoint-shrub (Viereck et al. 1992) Intersecting
- III.B.2.b - Fireweed (Viereck et al. 1992) Intersecting
- III.B.2.c - Large umbel (Viereck et al. 1992) Intersecting
- III.B.2.d - Ferns (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: This system occurs throughout the boreal and boreal transition regions of Alaska, as well as throughout western boreal Canada. Soils are typically fine-textured mineral and may be poorly drained (on flats) to well-drained (on sideslopes). In the boreal transition region, mesic *Calamagrostis canadensis* meadows often occur near treeline interspersed with subalpine tall shrub. Its elevational limit is just above the limit of tall shrubs (within 100 m). This system appears to be less common north of the Alaska Range. Mesic meadows also occur as seral stages in drained lakebeds, or after disturbance such as fire or logging.
Vegetation: The vegetation is usually dense, with canopy height of 0.8 to 1.4 m, occasionally reaching 2 m (Viereck et al. 1992). Species composition ranges from nearly pure stands of *Calamagrostis canadensis* to mixtures of *Calamagrostis canadensis* with forbs, such as *Chamerion angustifolium*. Forb- or fern -dominated patches also occur. Common forbs and ferns include *Heracleum maximum, Veratrum viride, Angelica lucida, Athyrium filix-femina, Dryopteris expansa,* and *Equisetum arvense* (Viereck et al. 1992).

DISTRIBUTION

Range: This systems occurs in the upland, lowland, and subalpine zones of the boreal transition and, less commonly, boreal regions of Alaska. It also occurs in scattered locations throughout western Canada.
Divisions: 103:C; 105:C
Nations: CA, US
Subnations: AB, AK, BC, YT
Map Zones: 68:?, 69:C, 70:C, 71:C, 72:?, 73:C, 74:C, 75:C, 76:?
TNC Ecoregions: 70:C, 71:C, 74:C, 75:C, 76:C, 77:C, 78:C, 79:C, 140:C

SOURCES

References: Viereck et al. 1992, Western Ecology Working Group n.d., Willoughby et al. 2006
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817399#references
Description Author: T. Boucher

WOODY WETLANDS AND RIPARIAN

ACADIAN MARITIME BOG (CES201.580)

CLASSIFIERS

Classification Status: Standard

Primary Division: Laurentian-Acadian (201)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Maritime Climate; Organic Peat (>40 cm); Dwarf-Shrub; Graminoid
Non-Diagnostic Classifiers: Oligotrophic Water; Acidic Water; Saturated Soil; >180-day hydroperiod; Moderate (100-500 yrs) Persistence; Shrubland (Shrub-dominated); Extensive Wet Flat; Depressional; Bryophyte
National Mapping Codes: ESLF 9301

CONCEPT

Summary: These ombrotrophic acidic peatlands occur along the north Atlantic Coast from downeast Maine east into the Canadian Maritimes. When these form in basins, they develop raised plateaus with undulating sedge and dwarf-shrub vegetation. *Trichophorum caespitosum* may form sedge lawns on the raised plateau. The system may also occur as "blanket bogs" over a sloping rocky substrate in extreme maritime settings; here, dwarf-shrubs and *Sphagnum* are the dominant cover. Species characteristic of this maritime setting include *Empetrum nigrum* and *Rubus chamaemorus*. Typical bog heaths such as *Kalmia angustifolia, Kalmia polifolia, Gaylussacia baccata, Ledum groenlandicum*, and *Gaylussacia dumosa* are also present. Morphological characteristics and certain coastal species distinguish these from more inland raised bogs. The distribution is primarily Canadian, and these peatlands are rare in the U.S.
Similar Ecological Systems:
- Boreal-Laurentian Bog (CES103.581)

Related Concepts:
- Black Spruce (eastern type): 12 (Eyre 1980) Finer
- Bog Moss Lawn (Gawler and Cutko 2010) Finer
- Deer-hair Sedge Bog Lawn (Gawler and Cutko 2010) Finer
- Heath - Crowberry Maritime Slope Bog (Gawler and Cutko 2010) Finer
- Huckleberry - Crowberry Bog (Gawler and Cutko 2010) Finer
- Sheep Laurel Dwarf Shrub Bog (Gawler and Cutko 2010) Finer

Component Associations:
- *Empetrum nigrum - Gaylussacia dumosa - Rubus chamaemorus / Sphagnum* spp. Dwarf-shrubland (CEGL006248, G3G5)
- *Kalmia angustifolia - Chamaedaphne calyculata - (Picea mariana) / Cladina* spp. Dwarf-shrubland (CEGL006225, G5)
- *Picea mariana / Rubus chamaemorus / Sphagnum* spp. Woodland (CEGL006082, G3G5)
- *Trichophorum caespitosum - Gaylussacia dumosa / Sphagnum (fuscum, rubellum, magellanicum)* Herbaceous Vegetation (CEGL006260, GNR)

DISTRIBUTION

Range: This system occurs near the coast from eastern Maine (Mount Desert Island) eastward into the Canadian Maritimes.
Divisions: 201:C
Nations: CA, US
Subnations: ME, NB
Map Zones: 66:C
USFS Ecomap Regions: 211Cb:CCC
TNC Ecoregions: 63:C

SOURCES

References: Comer et al. 2003, Damman and French 1987, Worley 1980a
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723025#references
Description Author: S.C. Gawler
Version: 09 Jan 2003
Concept Author: S.C. Gawler
Stakeholders: Canada, East
ClassifResp: East

ACADIAN-APPALACHIAN CONIFER SEEPAGE FOREST (CES201.576)

CLASSIFIERS

Classification Status: Standard

Primary Division: Laurentian-Acadian (201)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Mesotrophic Water; Seepage-Fed Sloping; Picea (glauca, mariana, rubens) - Abies; Thuja occidentalis - Fraxinus nigra
Non-Diagnostic Classifiers: Circumneutral Water; Acidic Water; Saturated Soil; Moderate (100-500 yrs) Persistence; Forest and Woodland (Treed); Isolated Wetland [Partially Isolated]; Mineral: W/ A-Horizon >10 cm; Mineral: W/ A-Horizon <10 cm; Needle-Leaved Tree
National Mapping Codes: ESLF 9344

CONCEPT

Summary: These forests occur as large-patch landscape features near the southern periphery of the boreal forest in the northeastern U.S. and adjacent Canada. They are found on gentle to moderate slopes in the colder regions of the Northern Appalachians, often adjacent to (but above) drainage channels, in settings where groundwater seepage provides constant moisture. *Thuja occidentalis* and *Picea rubens* are the typical dominants; some areas may have a prominent deciduous component. The herbaceous and bryophyte flora is typically extensive. Because of their setting, these are often not mapped as wetlands.
Classification Comments: This system may have application in other parts of the Laurentian-Acadian Division, depending on how the break is made between "wet-mesic" lowland white-cedar forests (with subsurface gleyed soils) and the white-cedar seepage forests described here.
Related Concepts:
- Cedar - Spruce Seepage Forest (Gawler and Cutko 2010) Finer
- Northern White-Cedar: 37 (Eyre 1980) Finer
- Red Spruce: 32 (Eyre 1980) Finer

Component Associations:
- *Thuja occidentalis - (Picea rubens) / Tiarella cordifolia* Forest (CEGL006175, GNR)

DISTRIBUTION

Range: Northernmost parts of New England, north and east into Canada.
Divisions: 201:C
Nations: CA, US
Subnations: ME, NB, NH, NY, QC, VT
Map Zones: 64:C, 66:C
TNC Ecoregions: 63:C

SOURCES

References: Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723029#references
Description Author: S.C. Gawler
Version: 09 Jan 2003
Concept Author: S.C. Gawler
Stakeholders: Canada, East
ClassifResp: East

ALASKA ARCTIC COASTAL SEDGE-DWARF-SHRUBLAND (CES102.211)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Arctic (102)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Shrubland (Shrub-dominated); Polar [Polar Hyperoceanic]; Tidal / Estuarine [Haline]; Tidal / Estuarine [Oligohaline]
Non-Diagnostic Classifiers: Herbaceous; Aquic; Dwarf-Shrub
FGDC Crosswalk: Vegetated, Shrub-dominated, Dwarf-shrubland, Deciduous dwarf-shrubland
National Mapping Codes: EVT 2701; ESLF 9357; ESP 1701

CONCEPT

Summary: This system typically occurs immediately above coastal brackish meadows or tidal marshes in arctic Alaska. These are tidal deposits that are only periodically tidally flooded and typically have permafrost. It is a dominant system on the Yukon-Kuskokwim Delta, but occurs elsewhere along the arctic Alaska coast. It has >25% dwarf- and low-shrub cover and >25% herbaceous cover. Dominant dwarf-shrubs are *Empetrum nigrum, Salix fuscescens, Salix ovalifolia,* and sometimes *Betula nana*. Diagnostic herbaceous species are *Carex rariflora, Calamagrostis deschampsioides, Deschampsia caespitosa,* and *Puccinellia andersonii*. Additional species include *Dupontia fisheri, Arctagrostis latifolia, Alopecurus alpinus, Tanacetum bipinnatum (= Chrysanthemum bipinnatum),* and *Petasites frigidus*.
Classification Comments: This system is known as Dwarf Shrub by the Alaska Natural Heritage Program.

DESCRIPTION

Dynamics: This system's disturbance processes and succession have not been described.

DISTRIBUTION

Range: This system occurs along Alaska's arctic coastline, from the Bristol Bay lowlands in southwestern Alaska to the North Slope on the Arctic Ocean.
Divisions: 102:C; 104:C
Nations: US
Subnations: AK
Map Zones: 67:C, 68:C, 72:C, 76:C
TNC Ecoregions: 73:C, 74:C, 75:C, 79:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818280#references
Description Author: K. Boggs
Version: 09 Oct 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKA ARCTIC DWARF-SHRUB-SPHAGNUM PEATLAND (CES102.201)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Arctic (102)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Permafrost; Lowland [Lowland]; Shrubland (Shrub-dominated); Polar [Polar Oceanic]; Acidic Soil; Organic Peat (>40 cm); Bog; Dwarf-Shrub; Sphagnum spp.
FGDC Crosswalk: Vegetated, Shrub-dominated, Dwarf-shrubland, Deciduous dwarf-shrubland
National Mapping Codes: EVT 2703; ESLF 9358; ESP 1703

CONCEPT

Summary: This ecological system occurs primarily on the Yukon-Kuskokwim Delta and the Kotzebue Sound lowlands ecoregions on flat permafrost plateaus and raised bogs. Soils are poorly drained and acidic, typically with a well-developed peat layer. Permafrost is present. Patch size is small to large. Dwarf- and low shrub cover is >25%, *Sphagnum* spp. cover is >25%, and lichen cover is <25%. The dominant dwarf-shrubs are *Betula nana* and *Ledum palustre ssp. decumbens*. Other species include *Empetrum nigrum, Chamaedaphne calyculata, Vaccinium uliginosum, Salix pulchra, Spiraea stevenii (= Spiraea beauverdiana), Vaccinium vitis-idaea, Arctostaphylos* spp., *Eriophorum* spp., *Carex aquatilis*, and *Carex microchaeta*.
Classification Comments: This system is known as Lowland Dwarf Shrub Sphagnum by the Alaska Natural Heritage Program.
Related Concepts:
- III.A.3.g - Subarctic lowland sedge-shrub wet meadow (Viereck et al. 1992) Intersecting
- III.A.3.j - Subarctic lowland sedge bog meadow (Viereck et al. 1992) Intersecting
- III.A.3.k - Subarctic lowland sedge-moss bog meadow (Viereck et al. 1992) Intersecting
- III.C.1.a - Wet bryophyte (Viereck et al. 1992) Intersecting

DESCRIPTION

Dynamics: This system occurs as a late-seral stage created by permafrost uplift within the thaw-pond cycle and on raised bogs due to organic matter buildup, but could also develop due to permafrost uplift outside the thaw-pond cycle. It likely persists for more than 100 years. Thaw pond succession starts with the collapse of a permafrost plateau, resulting in a wet depression often with open water. This is colonized by marsh species or *Sphagnum* spp. or a combination of both. Sedges eventually invade, and Alaska Arctic Wet Sedge-Sphagnum Peatland (CES102.200) develops. If organic matter buildup or permafrost uplift the surface, then this system may be seral to Alaska Arctic Dwarf-Shrub-Sphagnum Peatland (CES102.201). In turn, this system may be seral to Alaska Arctic Permafrost Plateau Dwarf-Shrub Lichen Tundra (CES102.202). The seral sequence may not be unidirectional, and the timeframe is unclear, possibly taking hundreds of years.

DISTRIBUTION

Range: This system occurs on the Yukon-Kuskokwim Delta and the Kotzebue Sound lowlands ecoregions of Alaska.
Divisions: 102:C; 104:C
Nations: CA, US
Subnations: AK
Map Zones: 68:C, 72:C, 76:C
TNC Ecoregions: 74:C, 75:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818252#references
Description Author: K. Boggs
Version: 09 Oct 2008 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKA ARCTIC FLOODPLAIN (CES102.227)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Arctic (102)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Riparian Mosaic [Trees, shrublands, meadows]; Polar [Polar Oceanic]; Riverine / Alluvial; Braided channel or stream
Non-Diagnostic Classifiers: Lowland [Lowland]; Forest and Woodland (Treed); Shrubland (Shrub-dominated); Alluvial terrace
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Deciduous shrubland
National Mapping Codes: EVT 2715; ESLF 9359; ESP 1715

CONCEPT

Summary: This ecological system includes active and inactive glacially- and non-glacially-fed floodplains. It is mosaiced with various floodplain wetland systems and is widespread and common. The rivers are typically braided, and floodplain terraces may be short-lived (<100 years) or last for more than a 1000 years. Soils develop on alluvium and are typically shallow and well-drained; barren alluvium is common. Permafrost is usually absent. The low- and tall-willow-dominated communities may be absent at higher elevations. Common existing vegetation types include mesic herbaceous meadow, low-tall willow shrublands, *Dryas* dwarf-shrubland, ericaceous dwarf-shrublands, and patches of *Populus balsamifera* or *Betula papyrifera*. Herbaceous species include *Chamerion latifolium* and *Lupinus* spp. Common willows include *Salix alaxensis, Salix arbusculoides, Salix richardsonii (= Salix lanata), Salix glauca*, and *Salix pulchra*. *Dryas integrifolia* dominates the *Dryas* communities, but other species may also be common, such as *Lupinus* spp., *Cassiope tetragona, Vaccinium uliginosum, Salix* spp., and *Arctostaphylos rubra*.
Classification Comments: This system is known as Floodplain by the Alaska Natural Heritage Program.
Related Concepts:
- I.B.1.c - Balsam poplar (forest) (Viereck et al. 1992) Intersecting
- I.B.1.d - Paper birch (closed) (Viereck et al. 1992) Intersecting
- I.B.2.a - Paper birch (open) (Viereck et al. 1992) Intersecting
- I.B.2.c - Balsam poplar (black cottonwood) (Viereck et al. 1992) Intersecting
- I.B.3.b - Balsam poplar (woodland) (Viereck et al. 1992) Intersecting
- I.B.3.c - Paper birch-balsam poplar (Viereck et al. 1992) Intersecting
- I.C.2.c - Paper birch-balsam poplar-spruce (Viereck et al. 1992) Intersecting
- II.B.1.a - Willow (closed) (Viereck et al. 1992) Intersecting
- II.B.1.b - Alder (closed) (Viereck et al. 1992) Intersecting
- II.B.1.d - Alder-willow (closed) (Viereck et al. 1992) Intersecting
- II.B.2.a - Willow (open) (Viereck et al. 1992) Intersecting
- II.B.2.b - Alder (open) (Viereck et al. 1992) Intersecting
- II.B.2.d - Alder-willow (open) (Viereck et al. 1992) Intersecting
- II.C.1.b - Low willow (Viereck et al. 1992) Intersecting
- II.C.1.e - Low alder-willow (closed) (Viereck et al. 1992) Intersecting
- II.C.2.g - Willow low (open) (Viereck et al. 1992) Intersecting
- II.C.2.k - Low alder-willow (open) (Viereck et al. 1992) Intersecting
- II.C.2.l - Low alder (Viereck et al. 1992) Intersecting
- II.D.1.a - Dryas tundra (Viereck et al. 1992) Intersecting
- II.D.2.c - Crowberry tundra (Viereck et al. 1992) Intersecting
- II.D.2.e - Cassiope tundra (Viereck et al. 1992) Intersecting
- III.B.1.a - Seral herbs (Viereck et al. 1992) Intersecting

DESCRIPTION

Dynamics: Frequent river channel migration and associated flooding and fluvial processes constitute the major disturbances. *Dryas* terraces, if not eroded, eventually (possibly over 1000+ years) develop into systems no longer part of the floodplain**.**

DISTRIBUTION

Range: This system occurs throughout arctic Alaska, from the Bristol Bay lowlands in southwestern Alaska to the North Slope on the Arctic Ocean.
Divisions: 102:C; 104:C
Nations: CA, US
Subnations: AK
Map Zones: 67:C, 68:C, 69:C, 72:C, 76:C
TNC Ecoregions: 73:C, 74:C, 75:C, 79:C

SOURCES

References: Western Ecology Working Group n.d.

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818289#references

Description Author: K. Boggs

Version: 09 Oct 2008 **Stakeholders:** Canada, West

Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKA ARCTIC LARGE RIVER FLOODPLAIN (CES102.213)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Arctic (102)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear, Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Short (<5 yrs) Flooding Interval [Short interval, Spring Flooding]; Riparian Mosaic [Trees, shrublands, meadows]; Floodplain; Lowland [Lowland]; Polar [Polar Oceanic]; Riverine / Alluvial
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Deciduous shrubland
National Mapping Codes: EVT 2714; ESLF 9360; ESP 1714

CONCEPT

Summary: This system includes floodplains associated with two of Alaska's high-volume arctic rivers: the Yukon and Kuskokwim. It includes active (flooded frequently) and inactive floodplains (flooded infrequently) and is mosaiced with the various floodplain wetland ecological systems. The flooding regime is characterized by large spring floods at ice break-up. The active flooding zone is often several kilometers wide. Permafrost is usually absent. Patch size is matrix-forming and linear, following the river courses. These floodplains are beyond the distribution of *Picea glauca*, which is a major component of interior boreal floodplains. Species composition is diverse, as are structural characteristics. Some of the predominant vegetation types include mesic herbaceous meadows, alder and alder-willow shrublands, tall and low willow shrublands, and *Populus balsamifera*. Some of the common woody species can include *Populus balsamifera, Alnus viridis, Alnus incana ssp. tenuifolia, Salix* spp., and a number of other shrubs.
Classification Comments: This system is known as Large River Floodplain by the Alaska Natural Heritage Program.
Related Concepts:
- I.B.1.c - Balsam poplar (forest) (Viereck et al. 1992) Intersecting
- I.B.1.d - Paper birch (closed) (Viereck et al. 1992) Intersecting
- I.B.2.a - Paper birch (open) (Viereck et al. 1992) Intersecting
- I.B.3.b - Balsam poplar (woodland) (Viereck et al. 1992) Intersecting
- I.B.3.c - Paper birch-balsam poplar (Viereck et al. 1992) Intersecting
- II.B.1.a - Willow (closed) (Viereck et al. 1992) Intersecting
- II.B.1.b - Alder (closed) (Viereck et al. 1992) Intersecting
- II.B.1.d - Alder-willow (closed) (Viereck et al. 1992) Intersecting
- II.B.2.a - Willow (open) (Viereck et al. 1992) Intersecting
- II.B.2.b - Alder (open) (Viereck et al. 1992) Intersecting
- II.B.2.d - Alder-willow (open) (Viereck et al. 1992) Intersecting
- II.C.1.b - Low willow (Viereck et al. 1992) Intersecting
- II.C.1.e - Low alder-willow (closed) (Viereck et al. 1992) Intersecting
- II.C.2.g - Willow low (open) (Viereck et al. 1992) Intersecting
- II.C.2.k - Low alder-willow (open) (Viereck et al. 1992) Intersecting
- II.C.2.l - Low alder (Viereck et al. 1992) Intersecting
- III.B.1.a - Seral herbs (Viereck et al. 1992) Intersecting

DESCRIPTION

Dynamics: Ice-scour and ice dams are important dynamics. This causes regeneration of willow carrs where scoured by ice. Some mesic sites may eventually become wetlands due to silt deposition from overbank flooding.

DISTRIBUTION

Range: This system occurs along the Yukon and Kuskokwim rivers in Alaska.
Divisions: 102:C; 104:C
Nations: CA, US
Subnations: AK
Map Zones: 72:C
TNC Ecoregions: 75:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818286#references
Description Author: K. Boggs
Version: 09 Oct 2008 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKA ARCTIC PERMAFROST PLATEAU DWARF-SHRUB LICHEN TUNDRA (CES102.202)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Arctic (102)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Permafrost; Lowland [Lowland]; Shrubland (Shrub-dominated); Moss/Lichen (Nonvascular); Acidic Soil; Dwarf-Shrub; Lichen
FGDC Crosswalk: Vegetated, Shrub-dominated, Dwarf-shrubland, Deciduous dwarf-shrubland
National Mapping Codes: EVT 2704; ESLF 9361; ESP 1704

CONCEPT

Summary: This system occurs on the Yukon-Kuskokwim Delta and the Kotzebue Sound lowlands ecoregions but not on the Beaufort Coastal Plain. It occurs on flat permafrost plateaus and gently sloping terrain. Soils are poorly drained and acidic, typically with a well-developed peat layer. Permafrost is present. Patch size is small to large. Dwarf- and low-shrub cover is >25% and lichen cover is >25%. Fruticose lichen species (*Cladina* and *Cladonia*) codominate with *Betula nana* and *Ledum palustre ssp. decumbens*. Other possible shrubs include *Empetrum nigrum*, *Chamaedaphne calyculata*, *Vaccinium uliginosum*, *Salix pulchra*, *Spiraea stevenii (= Spiraea beauverdiana)*, *Vaccinium vitis-idaea*, and *Arctostaphylos* spp. Graminoids usually have <10% cover and may include *Eriophorum* spp., *Carex aquatilis*, and *Carex microchaeta*.
Classification Comments: This system is known as Lowland Dwarf Shrub Lichen by the Alaska Natural Heritage Program.
Related Concepts:
- II.D.1.c - Dryas-lichen tundra (Viereck et al. 1992) Intersecting
- II.D.2.a - Bearberry tundra (Viereck et al. 1992) Intersecting
- II.D.2.b - Vaccinium tundra (Viereck et al. 1992) Intersecting
- II.D.2.c - Crowberry tundra (Viereck et al. 1992) Intersecting

DESCRIPTION

Dynamics: This system occurs as a late-seral stage created by permafrost uplift within the thaw-pond cycle, but could also develop due to permafrost uplift outside the thaw-pond cycle. Thaw pond succession starts with the collapse of a permafrost plateau, resulting in a wet depression often with open water. This is colonized by marsh species or *Sphagnum* spp. or a combination of both. Sedges eventually invade, and Alaska Arctic Wet Sedge-Sphagnum Peatland (CES102.200) develops. If organic matter buildup or permafrost uplift the surface, then this system may be seral to Alaska Arctic Dwarf-Shrub-Sphagnum Peatland (CES102.201). In turn, this system may be seral to Alaska Arctic Permafrost Plateau Dwarf-Shrub Lichen Tundra (CES102.202). The seral sequence may not be unidirectional, and the timeframe is unclear, possibly taking hundreds of years.

DISTRIBUTION

Range: This system occurs on the Yukon-Kuskokwim Delta and the Kotzebue Sound lowlands ecoregions of Alaska.
Divisions: 102:C; 104:C
Nations: CA, US
Subnations: AK
Map Zones: 68:C, 72:C, 76:C
TNC Ecoregions: 74:C, 75:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818253#references
Description Author: K. Boggs
Version: 09 Oct 2008 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKA ARCTIC POLYGONAL GROUND MESIC SHRUB TUNDRA (CES102.206)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Arctic (102)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Ice-Wedge Polygons; Shrubland (Shrub-dominated); Polar [Polar Oceanic]; Dwarf-Shrub
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Deciduous shrubland
National Mapping Codes: EVT 2700; ESLF 9362; ESP 1700

CONCEPT

Summary: Ice-wedge polygons and the thaw-lake cycle dominate the Beaufort Coastal Plain ecoregion. The ice-wedge polygons generally occur on level surfaces (0- to 2-degree slopes), and the ice wedges may be 2 m wide at the top. Polygon diameter ranges from several to more than 30 m. In addition to the Beaufort Coastal Plain, ice-wedge polygons are a common feature on level ground within foothills and mountains, on terraces, glacial drift, and lacustrine surficial deposits. This mesic shrub tundra system occurs on high-center polygons, raised areas along drainages, terraces and other mesic flat to slightly sloping sites. The combined cover of dwarf-shrubs and low shrubs is >25%, and sedge cover is typically <25%. Some tussocks may occur but are often degenerating. The open to closed shrub canopy has *Salix pulchra, Betula nana, Vaccinium vitis-idaea, Ledum palustre ssp. decumbens*, and *Cassiope tetragona*. Common herbaceous species include *Eriophorum angustifolium, Carex aquatilis*, and *Eriophorum vaginatum* (the latter is often dead). Common mosses include *Sphagnum* spp., *Hylocomium splendens*, and *Aulacomnium turgidum*. Lichens are common.
Related Concepts:
- II.C.1.a - Shrub birch (Viereck et al. 1992) Intersecting
- II.C.1.b - Low willow (Viereck et al. 1992) Intersecting
- II.C.1.c - Shrub birch-willow (closed) low (Viereck et al. 1992) Intersecting
- II.C.1.d - Ericaceous shrub (Viereck et al. 1992) Intersecting
- II.C.2.c - Mesic shrub birch-ericaceous shrub (Viereck et al. 1992) Intersecting
- II.C.2.f - Shrub birch-willow (open) low (Viereck et al. 1992) Intersecting
- II.C.2.g - Willow low (open) (Viereck et al. 1992) Intersecting
- II.C.2.h - Willow-sedge shrub tundra (Viereck et al. 1992) Intersecting
- II.D.1.a - Dryas tundra (Viereck et al. 1992) Intersecting
- II.D.1.b - Dryas-sedge tundra (Viereck et al. 1992) Intersecting
- II.D.1.c - Dryas-lichen tundra (Viereck et al. 1992) Intersecting
- II.D.2.a - Bearberry tundra (Viereck et al. 1992) Intersecting
- II.D.2.b - Vaccinium tundra (Viereck et al. 1992) Intersecting
- II.D.2.c - Crowberry tundra (Viereck et al. 1992) Intersecting
- II.D.2.d - Mountain-heath tundra (Viereck et al. 1992) Intersecting
- II.D.2.e - Cassiope tundra (Viereck et al. 1992) Intersecting
- II.D.3.a - Willow tundra (Viereck et al. 1992) Intersecting
- Moist shrub tundra on high-centered polygons map class (Jorgenson et al. 1994) Equivalent

DESCRIPTION

Dynamics: Ice-wedge polygons are formed by large ice wedges which grow in thermal contraction cracks in permafrost. High-center polygons indicate that erosion, deposition, or thawing are more prevalent than the up-pushing of the sediments along the sides of the wedge. Ice-wedge polygons are typically part of a spatially coarser thaw-lake cycle.

Most of the land on the Beaufort Coastal Plain (Nowacki et al. (2001) ecoregion 1) is polygonal ground and pond complexes. To be able to model and map polygonal ground systems in this region, first mask out lakes, ponds, floodplains and tidal marshes. Then, use only land with less than a 2-degree slope as being polygonal ground.

DISTRIBUTION

Range: This system is typically found in the lowland regions of arctic Alaska, particularly on the Beaufort Coastal Plain in northern Alaska, and the Kotzebue Sound lowlands of west-central Alaska, but it also occurs in other scattered locations of arctic Alaska where there ice-wedge processes occur.
Divisions: 102:C; 104:C
Nations: CA, US
Subnations: AK
Map Zones: 67:C, 68:C, 69:C, 72:?
TNC Ecoregions: 73:C, 75:C, 79:C

SOURCES

References: Nowacki et al. 2001a, Western Ecology Working Group n.d.

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818265#references
Description Author: K. Boggs
Version: 09 Oct 2008 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKA ARCTIC POLYGONAL GROUND SHRUB-TUSSOCK TUNDRA (CES102.205)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Arctic (102)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Ice-Wedge Polygons; Shrubland (Shrub-dominated); Woody-Herbaceous; Polar [Polar Oceanic]; Shallow Soil; Silt Soil Texture; Dwarf-Shrub; Graminoid; Tussock-forming grasses
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Deciduous shrubland
National Mapping Codes: EVT 2708; ESLF 9363; ESP 1708

CONCEPT

Summary: Ice-wedge polygons and the thaw-lake cycle dominate the Beaufort Coastal Plain ecoregion. The ice-wedge polygons generally occur on level surfaces (0- to 2-degree slopes), and the ice wedges may be 2 m wide at the top. Polygon diameter ranges from several to more than 30 m. In addition to the Beaufort Coastal Plain, ice-wedge polygons are a common feature on level ground within foothills and mountains, on glacial drift, lacustrine and floodplain terrace surficial deposits. These sites are cold, poorly drained, and underlain by mesic, silty mineral soils with a shallow surface organic layer surrounding the tussocks. Permafrost is present. Patch size is small to large. This tundra ecological system occurs primarily on high-center polygons. Their centers are mesic and dominated by tussocks and shrubs, and their perimeters are commonly wet, supporting wet sedges. *Betula nana* and *Salix pulchra* dominate the shrub layer. Other species include *Ledum palustre ssp. decumbens, Vaccinium vitis-idaea, Vaccinium uliginosum*, and *Empetrum nigrum*. *Eriophorum vaginatum* is the primary tussock-former in most sites, but *Carex bigelowii* may dominate some sites. *Calamagrostis canadensis, Arctagrostis latifolia*, and *Chamerion latifolium* may be common. Common mosses include *Sphagnum* spp., *Polytrichum strictum*, and *Hylocomium splendens*. The wet perimeters typically support *Carex aquatilis* and *Eriophorum angustifolium*.
Related Concepts:
- II.C.2.a - Mixed shrub-sedge tussock tundra (Viereck et al. 1992) Intersecting
- II.C.2.b - Mixed shrub-sedge tussock bog (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: Ice-wedge polygons and the thaw-lake cycle dominate the Beaufort Coastal Plain ecoregion. The ice-wedge polygons generally occur on level surfaces (0- to 2-degree slopes), and the ice wedges may be 2 m wide at the top. Polygon diameter ranges from several to more than 30 m. In addition to the Beaufort Coastal Plain, ice-wedge polygons are a common feature on level ground within foothills and mountains, on glacial drift, lacustrine and floodplain terrace surficial deposits. These sites are cold, poorly drained, and underlain by mesic, silty mineral soils with a shallow surface organic layer surrounding the tussocks (Viereck et al. 1992). Permafrost is present. Patch size is small to large.
Vegetation: This tundra ecological system occurs primarily on high-center polygons. Their centers are mesic and dominated by tussocks and shrubs, and their perimeters are commonly wet, supporting wet sedges. *Betula nana* and *Salix pulchra* dominate the shrub layer. Other species include *Ledum palustre ssp. decumbens, Vaccinium vitis-idaea, Vaccinium uliginosum*, and *Empetrum nigrum*. *Eriophorum vaginatum* is the primary tussock-former in most sites, but *Carex bigelowii* may dominate some sites. *Calamagrostis canadensis, Arctagrostis latifolia*, and *Chamerion latifolium* may be common. Common mosses include *Sphagnum* spp., *Polytrichum strictum*, and *Hylocomium splendens*. The wet perimeters typically support *Carex aquatilis* and *Eriophorum angustifolium*.
Dynamics: Ice-wedge polygons are formed by large ice wedges which grow in thermal contraction cracks in permafrost. High-center polygons indicate that erosion, deposition, or thawing are more prevalent than the up-pushing of the sediments along the sides of the wedge. Ice-wedge polygons are typically part of a spatially coarser thaw-lake cycle.

Most of the land on the Beaufort Coastal Plain (Nowacki et al. (2001) ecoregion 1) is polygonal ground and pond complexes. To be able to model and map polygonal ground systems in this region, first mask out lakes, ponds, floodplains and tidal marshes. Then, use only land with less than a 2-degree slope as being polygonal ground.

DISTRIBUTION

Range: This system is typically found in the lowland regions of arctic Alaska, particularly on the Beaufort Coastal Plain in northern Alaska, and the Kotzebue Sound lowlands of west-central Alaska, but it also occurs in other scattered locations of arctic Alaska where there ice-wedge processes occur.
Divisions: 102:C; 104:C
Nations: CA, US
Subnations: AK
Map Zones: 67:C, 68:C, 69:C, 72:?
TNC Ecoregions: 73:C, 75:C, 79:C

SOURCES

References: Nowacki et al. 2001a, Viereck et al. 1992, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818262#references
Description Author: K. Boggs
Version: 09 Oct 2008 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKA ARCTIC SHRUB-TUSSOCK TUNDRA (CES102.180)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Arctic (102)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch, Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Shrubland (Shrub-dominated); Woody-Herbaceous; Polar [Polar Oceanic]; Shallow Soil; Silt Soil Texture; Dwarf-Shrub; Graminoid; Tussock-forming grasses
Non-Diagnostic Classifiers: Eriophorum vaginatum
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Deciduous shrubland
National Mapping Codes: EVT 2693; ESLF 9364; ESP 1693

CONCEPT

Summary: Tussock shrub tundra is common in valleys and slopes throughout arctic Alaska. These sites are cold, poorly drained, and underlain by mesic, silty mineral soils with a shallow surface organic layer surrounding the tussocks. Permafrost is present. Patch size is small to matrix-forming. Tussock shrub tundra has >35% cover of sedges in a tussock growth form, and the combined cover of dwarf- and low shrubs is >25%. *Eriophorum vaginatum* is the primary tussock-former in most stands, but *Carex bigelowii* may dominate some sites. *Betula nana* and *Salix pulchra* dominate the low-shrub layer. Other species include *Ledum palustre ssp. decumbens*, *Vaccinium vitis-idaea*, *Vaccinium uliginosum*, *Empetrum nigrum*, and *Carex* spp. There are also distinctions between acidic and non-acidic tussock tundra. Acidic sites have more ericaceous shrubs and *Sphagnum* and less *Eriophorum* spp., *Betula nana*, and *Carex bigelowii*. Acidic sites also have more organic matter buildup and the tussocks tend to be larger.
Classification Comments: This system is known as Tussock Shrub Tundra by the Alaska Natural Heritage Program.
Similar Ecological Systems:
- Western North American Boreal Low Shrub-Tussock Tundra (CES105.126)

Related Concepts:
- II.C.2.a - Mixed shrub-sedge tussock tundra (Viereck et al. 1992) Intersecting
- II.C.2.b - Mixed shrub-sedge tussock bog (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: Tussock shrub tundra is common in valleys and slopes throughout arctic Alaska. These sites are cold, poorly drained, and underlain by mesic, silty mineral soils with a shallow surface organic layer surrounding the tussocks (Viereck et al. 1992). Permafrost is present. Patch size is small to matrix-forming.
Vegetation: Tussock shrub tundra has >35% cover of sedges in a tussock growth form, and the combined cover of dwarf- and low shrubs is >25%. *Eriophorum vaginatum* is the primary tussock-former in most stands, but *Carex bigelowii* may dominate some sites. *Betula nana* and *Salix pulchra* dominate the low-shrub layer. Other species include *Ledum palustre ssp. decumbens*, *Vaccinium vitis-idaea*, *Vaccinium uliginosum*, *Empetrum nigrum*, and *Carex* spp. There are also distinctions between acidic and non-acidic tussock tundra. Acidic sites have more ericaceous shrubs and *Sphagnum* and less *Eriophorum* spp., *Betula nana*, and *Carex bigelowii*. Acidic sites also have more organic matter buildup and the tussocks tend to be larger.
Dynamics: According to lake-core records, the fire-return interval is approximately 240 years on the Seward Peninsula and 1000+ years on the Beaufort Coastal Plain (J. Allen pers. comm.). These figures may apply to acidic more than non-acidic tussock tundra. Fires typically burn-off the shrub layer resulting in an herbaceous-dominated tussock system, but the shrubs often recover to their pre-fire cover within 15 years.

DISTRIBUTION

Range: This system occurs throughout arctic Alaska, from the Bristol Bay lowlands in southwestern Alaska to the North Slope on the Arctic Ocean.
Divisions: 102:C; 104:C
Nations: CA, US
Subnations: AK
Map Zones: 67:C, 68:C, 69:C, 72:C, 76:C
TNC Ecoregions: 73:C, 74:C, 75:C, 79:C

SOURCES

References: Allen pers. comm., Viereck et al. 1992, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818208#references
Description Author: K. Boggs
Version: 09 Oct 2008 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKAN PACIFIC MARITIME DWARF-SHRUB-SPHAGNUM PEATLAND (CES204.165)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Permafrost; Lowland [Lowland]; Shrubland (Shrub-dominated); Temperate [Temperate Oceanic]; Acidic Soil; Organic Peat (>40 cm); Bog; Dwarf-Shrub; Sphagnum spp.
FGDC Crosswalk: Vegetated, Shrub-dominated, Dwarf-shrubland, Deciduous dwarf-shrubland
National Mapping Codes: EVT 2658; ESLF 9365; ESP 1658

CONCEPT

Summary: This ecological system is a mosaic of dwarf-shrub- and herbaceous-dominated peatlands. It includes well-developed peatlands (bogs and poor fens) in basins or on flat to gently sloping terrain. Soils are acidic and are usually saturated throughout the growing season. *Sphagnum* spp. (especially *Sphagnum fuscum*) dominate the ground layer. Shrub cover is typically low and may include *Ledum* spp., *Andromeda polifolia, Kalmia polifolia, Vaccinium oxycoccos (= Oxycoccus microcarpos), Empetrum nigrum*, and *Vaccinium uliginosum*. Other common species include *Drosera* spp., *Carex livida, Carex pluriflora, Carex pauciflora, Carex aquatilis var. dives (= Carex sitchensis), Trichophorum caespitosum*, and *Eriophorum angustifolium*. This system includes raised bogs.
Classification Comments: This system is known as Dwarf-Shrub-Sphagnum Peatland by the Alaska Natural Heritage Program. Need criteria to differentiate from fen/wet meadow for mapping.
Similar Ecological Systems:
- North Pacific Bog and Fen (CES204.063)

Related Concepts:
- *Carex livida - Trichophorum caespitosum* (Shephard 1995) Finer
- *Carex pluriflora* (DeVelice et al. 1999) Finer
- *Carex sitchensis / Oxycoccus palustris* (Shephard 1995) Finer. most common type on raised bogs
- *Eriophorum angustifolium - Carex pauciflora* (DeVelice et al. 1999) Finer
- *Eriophorum angustifolium - Carex pluriflora* (DeVelice et al. 1999) Finer
- *Eriophorum angustifolium - Trichophorum caespitosum* (DeVelice et al. 1999) Finer
- II.C.2.e - Ericaceous shrub bog (Viereck et al. 1992) Intersecting
- III.A.3.g - Subarctic lowland sedge-shrub wet meadow (Viereck et al. 1992) Intersecting
- III.A.3.j - Subarctic lowland sedge bog meadow (Viereck et al. 1992) Intersecting
- III.A.3.k - Subarctic lowland sedge-moss bog meadow (Viereck et al. 1992) Intersecting
- III.C.1.a - Wet bryophyte (Viereck et al. 1992) Intersecting

DISTRIBUTION

Range: This system occurs from Kodiak Island through southeastern Alaska.
Divisions: 204:C
Nations: US
Subnations: AK
Map Zones: 77:C, 78:C
TNC Ecoregions: 69:C, 70:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817793#references
Description Author: T. Boucher
Version: 10 Dec 2008
Concept Author: Western Ecology Group and Alaska Natural Heritage Program
Stakeholders: West
ClassifResp: West

ALASKAN PACIFIC MARITIME FLOODPLAIN FOREST AND SHRUBLAND (CES204.154)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Riparian Mosaic; Floodplain; Temperate [Temperate Oceanic]
Non-Diagnostic Classifiers: Montane; Lowland; Alluvial plain; Alluvial terrace; Bank; Broad-Leaved Deciduous Tree; Braided channel or stream; Broad-Leaved Deciduous Shrub
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Mixed evergreen-deciduous open tree canopy
National Mapping Codes: EVT 2655; ESLF 9366; ESP 1655

CONCEPT

Summary: This system includes glacially- and non-glacially-fed rivers and streams along the Gulf Coast of Alaska. It includes the active and inactive portions of the floodplain but not abandoned floodplains. Frequent flooding, shifting channels, and sediment deposition characterize the system. This system includes large and small channels as well as proximal outwash. Glacially-fed rivers occur primarily on the mainland, while non-glacially-fed rivers occur on both the mainland and large islands in the Gulf of Alaska. Since glacial and non-glacial floodplain types can not be mapped confidently as separate systems, they are considered one ecological system. However, vegetation composition and disturbance cycle vary depending on type of input (glacial vs. non-glacial) and proximity to the glacier, so descriptions that follow retain these distinctions. Two floodplain types are described below: glacial floodplains and non-glacial floodplains. (It may be possible to apply different successional models by region or proximity to glacier terminus.)

Classification Comments: This system is known as Floodplain Forest and Shrub by the Alaska Natural Heritage Program. Add other indicator species if possible. Model is similar to glacial floodplain, but the frequency and severity of flooding are lower. Possibly have higher percent of landscape in late-seral stages. May need different models for systems with red alder (southern vs. mid to northern). On Kodiak Island, floodplains are placed into Aleutian Floodplain Forest and Shrubland (CES105.295).

Similar Ecological Systems:
- North Pacific Lowland Riparian Forest and Shrubland (CES204.869)
- North Pacific Montane Riparian Woodland and Shrubland (CES204.866)

Related Concepts:
- Black Cottonwood - Willow: 222 (Eyre 1980) Broader
- I.A.1.a - Sitka spruce (closed) (Viereck et al. 1992) Intersecting
- I.A.2.a - Sitka spruce (open) (Viereck et al. 1992) Intersecting
- I.B.1.a - Red alder (Viereck et al. 1992) Finer
- I.B.1.b - Black cottonwood (Viereck et al. 1992) Intersecting
- I.B.2.c - Balsam poplar (black cottonwood) (Viereck et al. 1992) Intersecting
- II.B.1.a - Willow (closed) (Viereck et al. 1992) Intersecting
- II.B.1.b - Alder (closed) (Viereck et al. 1992) Intersecting
- II.B.1.d - Alder-willow (closed) (Viereck et al. 1992) Intersecting
- II.B.2.a - Willow (open) (Viereck et al. 1992) Intersecting
- II.B.2.b - Alder (open) (Viereck et al. 1992) Intersecting
- II.B.2.d - Alder-willow (open) (Viereck et al. 1992) Intersecting
- Red Alder: 221 (Eyre 1980) Intersecting

DESCRIPTION

Environment: Glacial Floodplains: These are glacially-fed rivers and streams along the Gulf Coast of Alaska; this type is uncommon on islands in the Gulf of Alaska. Frequent flooding, shifting channels, and sediment deposition characterize this type. Both large and small channels and short and long (such as the Copper River) rivers are included. Glacial outwash occurs near the terminus of the glacier. This is active proximal outwash with high flood frequency and high sediment input. Channels are scoured and braided, and the substrate is well-drained to excessively well-drained gravel or cobble.

Non-glacial Floodplains: These are non-glacially-fed floodplains occurring along the Gulf Coast of Alaska. They are common on the Alexander Archipelago but also occur on the mainland of southeast Alaska. *Picea sitchensis* is the dominant conifer. These floodplains tend to be smaller than the glacially-fed systems.

Vegetation: Glacial Floodplains: Vegetation classes are the same as early- to mid-seral floodplains, but with a lower proportion in mature forest and a higher proportion in barren and early-seral stages. Wetland development is minimal. Further downstream (distal outwash), vegetation dominance on the floodplain depends on seral stage and frequency of flooding. Low benches are dominated by shrub, seedling, and herbaceous species such as *Alnus viridis ssp. sinuata, Salix alaxensis,* and *Salix* spp. Mid-bench vegetation features shrub types and early-seral forests (*Picea sitchensis, Alnus rubra, Populus balsamifera*). High bench types include mature forests with a more diverse shrub understory (*Picea sitchensis, Tsuga heterophylla, Oplopanax horridus, Rubus spectabilis,*

Vaccinium ovalifolium, Menziesia ferruginea, and *Lysichiton americanus* (in poorly drained inclusions)). Extensive wetlands may develop on the low-angle floodplains. *Populus balsamifera* does not occur commonly on the islands of southeast Alaska, and is more closely linked with larger rivers with at least some glacial input.

Non-glacial Floodplains: *Populus balsamifera* is not common (as it is on the glacially-fed systems). *Alnus rubra* or *Alnus viridis ssp. sinuata* may be common in early-seral stands. Floodplain wetlands are common, but small patch compared to those on large, distal outwash plains. *Alnus rubra* is more common on the outer islands of southeast Alaska than it is on the mainland.

Component Associations:
- *Picea sitchensis - Alnus rubra / Rubus spectabilis* Woodland (CEGL003253, G3)
- *Picea sitchensis - Populus balsamifera ssp. trichocarpa / Oplopanax horridus* Forest (CEGL003278, G3)
- *Picea sitchensis - Populus balsamifera ssp. trichocarpa / Orthilia secunda* Woodland (CEGL003280, G3)
- *Picea sitchensis - Populus balsamifera ssp. trichocarpa* Woodland (CEGL003281, G4Q)
- *Picea sitchensis / Oplopanax horridus - Rubus spectabilis* Forest (CEGL003256, G4)
- *Picea sitchensis / Oplopanax horridus* Temporarily Flooded Forest (CEGL003258, G5)
- *Populus balsamifera ssp. trichocarpa / Oplopanax horridus* Woodland (CEGL003284, G3)
- *Populus balsamifera ssp. trichocarpa / Rubus spectabilis* Woodland (CEGL003283, G3)

DISTRIBUTION

Range: This system occurs from along the Gulf Coast of Alaska, but not on Kodiak Island, south through southeastern Alaska.
Divisions: 204:C
Nations: US
Subnations: AK
Map Zones: 77:C, 78:C
TNC Ecoregions: 69:C, 70:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817700#references
Description Author: T. Boucher
Version: 10 Dec 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKAN PACIFIC MARITIME MOUNTAIN HEMLOCK PEATLAND (CES204.156)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Bog and Fen Mosaic; Sideslope; Temperate [Temperate Oceanic]; Organic Peat (>40 cm); Tsuga mertensiana
Non-Diagnostic Classifiers: Picea sitchensis; Chamaecyparis nootkatensis
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2659; ESLF 9367; ESP 1659

CONCEPT

Summary: This ecological system is a mosaic of dwarf-tree dominated communities (*Tsuga mertensiana* (more common), *Cupressus nootkatensis*, or *Picea sitchensis*), and dwarf-shrub- and herbaceous-dominated peatland communities. It typically occurs on sloping terrain and may develop on fairly steep sideslopes in areas with very high rainfall and low permeability (such as Prince William Sound and Kenai Fjords). Stunted *Tsuga mertensiana* (more common), *Chamaecyparis nootkatensis (= Cupressus nootkatensis)*, or *Picea sitchensis* may be present. Shrubs include *Vaccinium uliginosum, Vaccinium caespitosum*, and *Empetrum nigrum*. Common herbaceous species include *Nephrophyllidium crista-galli, Trichophorum caespitosum, Dodecatheon pulchellum, Geum calthifolium, Cornus canadensis, Carex pauciflora, Carex anthoxanthea*, and *Eriophorum angustifolium*. *Sphagnum* spp. are usually abundant in the ground layer. This system occurs at higher elevations (usually above 500 m) in the southern portion of its range (southeastern Alaska and British Columbia).
Classification Comments: This system is known as Mountain Hemlock Peatland by the Alaska Natural Heritage Program.
Similar Ecological Systems:
- North Pacific Bog and Fen (CES204.063)

Related Concepts:
- *Carex pauciflora* (DeVelice et al. 1999) Finer
- *Nephrophyllidium crista-galli - Trichophorum caespitosum* (DeVelice et al. 1999) Finer
- *Trichophorum caespitosum* (Banner et al. 1986) Finer
- *Tsuga mertensiana / Vaccinium uliginosum* (DeVelice et al. 1999) Finer
- II.A.2.b - Mountain hemlock (open) scrub (Viereck et al. 1992) Intersecting
- II.C.2.e - Ericaceous shrub bog (Viereck et al. 1992) Intersecting
- III.A.3.g - Subarctic lowland sedge-shrub wet meadow (Viereck et al. 1992) Intersecting
- III.A.3.j - Subarctic lowland sedge bog meadow (Viereck et al. 1992) Intersecting
- III.A.3.k - Subarctic lowland sedge-moss bog meadow (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: This ecological system is a mosaic of dwarf-tree dominated communities (*Tsuga mertensiana* (more common), *Cupressus nootkatensis*, or *Picea sitchensis*), and dwarf-shrub- and herbaceous-dominated peatland communities. It typically occurs on sloping terrain and may develop on fairly steep sideslopes in areas with very high rainfall and low permeability (such as Prince William Sound and Kenai Fjords). This system occurs at higher elevations (usually above 500 m) (Banner et al. 1988) in the southern portion of its range (southeastern Alaska and British Columbia).
Vegetation: Stunted *Tsuga mertensiana* (more common), *Chamaecyparis nootkatensis (= Cupressus nootkatensis)*, or *Picea sitchensis* may be present. Shrubs include *Vaccinium uliginosum, Vaccinium caespitosum*, and *Empetrum nigrum*. Common herbaceous species include *Nephrophyllidium crista-galli, Trichophorum caespitosum, Dodecatheon pulchellum, Geum calthifolium, Cornus canadensis, Carex pauciflora, Carex anthoxanthea*, and *Eriophorum angustifolium*. *Sphagnum* spp. are usually abundant in the ground layer (DeVelice et al. 1999, Boggs et al. 2008b).

Component Associations:
- *Trichophorum caespitosum* Saturated Herbaceous Vegetation (CEGL002679, GNR)
- *Tsuga mertensiana / Vaccinium uliginosum / Nephrophyllidium crista-galli* Woodland (CEGL003249, GNR)

DISTRIBUTION

Range: This system occurs from Kenai Fjords through southeastern Alaska and into British Columbia.
Divisions: 204:C
Nations: CA, US
Subnations: AK, BC
Map Zones: 77:C, 78:P
TNC Ecoregions: 69:?, 70:C

SOURCES

References: Banner et al. 1986, Banner et al. 1988, Boggs et al. 2008a, Boggs et al. 2008b, DeVelice et al. 1999, Vitt et al. 1988,

Western Ecology Working Group n.d.

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817706#references

Description Author: T. Boucher

Version: 10 Dec 2008 **Stakeholders:** Canada, West

Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKAN PACIFIC MARITIME POORLY DRAINED CONIFER WOODLAND (CES204.315)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Saturated Soil; Forest and Woodland (Treed); Temperate [Temperate Oceanic]; Organic Peat (>40 cm); Needle-Leaved Tree; Tsuga mertensiana
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2681; ESLF 9368; ESP 1681

CONCEPT

Summary: This ecological system occurs on low to mid elevations on rolling terrain, benches, and gentle slopes with restricted drainage from Kenai Fjords through southeast Alaska. Soils may be shallow to deep, are poorly drained, and usually have a thick organic layer or some peat development. In some places, stands are often a fine mosaic of peatlands and better-drained inclusions. These are low-productivity sites that are intermediate between shore pine or mountain hemlock peatland sites and productive forest systems. The forest canopy is open (less than 45% cover), and trees often show signs of stress such as spike-top (especially cedar) or chlorotic foliage (especially spruce). Standing dead trees are common. In the north, paludification on these sites may lead to conversion from mountain hemlock to mountain hemlock peatland over long time scales. Overstory trees may include several of the following species: *Tsuga heterophylla, Tsuga mertensiana* (often alone or with *Picea sitchensis* in the subpolar rainforest zone), *Thuja plicata* (southern portion of the Alaska distribution only), and *Chamaecyparis nootkatensis (= Cupressus nootkatensis). Picea sitchensis* and *Pinus contorta* may also be present but are not dominant. Common shrubs include *Vaccinium ovalifolium, Gaultheria shallon* (southern portion of the Alaska distribution only), and *Elliottia pyroliflorus*. Common understory species include *Nephrophyllidium crista-galli, Thelypteris quelpaertensis, Phegopteris connectilis, Trichophorum caespitosum, Carex anthoxanthea, Carex pluriflora, Carex stylosa, Eriophorum* spp., *Lysichiton americanus*, and *Sphagnum* spp.
Classification Comments: This system combines those known as Poorly Drained Mountain Hemlock and Poorly Drained Conifer by the Alaska Natural Heritage Program. This system includes all mixed conifer types and low-productivity forests in the Western Hemlock - Redcedar and Western Hemlock - Alaska Cedar types. We combined open-canopied *Tsuga mertensiana - Cupressus nootkatensis* in this system. This system may be a good fit for both red-cedar and yellow-cedar types that are classified as "unproductive; volume class 4 and under."
Similar Ecological Systems:
- North Pacific Hardwood-Conifer Swamp (CES204.090)

Related Concepts:
- I.A.1.c - Sitka spruce-western hemlock (Viereck et al. 1992) Intersecting
- I.A.2.c - Mountain hemlock (open) (Viereck et al. 1992) Intersecting
- I.A.2.d - Mixed conifer (Viereck et al. 1992) Finer

DESCRIPTION

Environment: This system is common on rolling terrain, benches, and gentle slopes with restricted drainage. Soils are poorly drained and usually have a thick organic layer.
Dynamics: This system represents a topoedaphic climax which is relatively stable over time. Short-term succession occurs from single tree mortality from a variety of causes. Tree regeneration frequently occurs on raised organic microsites on the remains of previous trees. Tree growth is generally very slow. Longer term succession is probably influenced by climatic patterns that dictate drainage, either favoring poorer drainage, increased tree mortality, and more open canopy; or, improved drainage, greater tree growth, and a more closed canopy. These patterns can also favor individual tree species based on their tolerance or intolerance of wet soils. The widespread yellow-cedar decline, which covers 200,000 ha of this system in southeastern Alaska, is an example of a climate-induced tree death that has resulted in a composition shift away from yellow-cedar due to this mortality (Hennon et al. 2008).

Component Associations:
- *Tsuga heterophylla - Chamaecyparis nootkatensis / Vaccinium ovalifolium / Lysichiton americanus* Forest (CEGL003240, G3)
- *Tsuga heterophylla - Thuja plicata / Vaccinium ovalifolium / Lysichiton americanus* Forest (CEGL003223, G5)
- *Tsuga heterophylla / Oplopanax horridus / Lysichiton americanus* Forest (CEGL003235, G4G5)
- *Tsuga mertensiana - Chamaecyparis nootkatensis / Elliottia pyroliflorus / Nephrophyllidium crista-galli* Woodland (CEGL003215, G4)
- *Tsuga mertensiana - Chamaecyparis nootkatensis / Gaultheria shallon / Lysichiton americanus* Woodland (CEGL003213, G3)
- *Tsuga mertensiana - Chamaecyparis nootkatensis / Lysichiton americanus - Athyrium filix-femina* Forest (CEGL003216, G3)
- *Tsuga mertensiana - Chamaecyparis nootkatensis / Vaccinium ovalifolium - Gaultheria shallon / Nephrophyllidium crista-galli* Woodland (CEGL003212, G3)
- *Tsuga mertensiana - Chamaecyparis nootkatensis / Vaccinium ovalifolium / Lysichiton americanus* Forest (CEGL003209, G5)
- *Tsuga mertensiana - Chamaecyparis nootkatensis / Vaccinium ovalifolium / Nephrophyllidium crista-galli* Woodland

(CEGL003210, G5)
- *Tsuga mertensiana - Tsuga heterophylla / Vaccinium ovalifolium / Lysichiton americanus* Forest (CEGL003220, G5)
- *Tsuga mertensiana - Tsuga heterophylla / Vaccinium ovalifolium / Nephrophyllidium crista-galli* Forest (CEGL003221, GNR)
- *Tsuga mertensiana / Vaccinium ovalifolium / Caltha leptosepala ssp. howellii* Woodland (CEGL003247, G5)
- *Tsuga mertensiana / Vaccinium ovalifolium / Nephrophyllidium crista-galli* Woodland (CEGL003245, G5)
- *Tsuga mertensiana / Vaccinium uliginosum / Nephrophyllidium crista-galli* Woodland (CEGL003249, GNR)

DISTRIBUTION

Range: This system occurs from Kenai Fjords through southeastern Alaska.
Divisions: 204:C
Nations: US
Subnations: AK
Map Zones: 77:P, 78:C
TNC Ecoregions: 69:C, 70:C

SOURCES

References: Boggs et al. 2008b, DeMeo et al. 1992, DeVelice et al. 1999, Hennon et al. 2008, Martin et al. 1995, Shephard 1995, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818677#references
Description Author: T. Boucher and P. Hennon
Version: 10 Dec 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKAN PACIFIC MARITIME SHORE PINE PEATLAND (CES204.164)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Bog and Fen Mosaic; Temperate [Temperate Oceanic]; Deep Soil; Organic Peat (>40 cm); Pinus contorta
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2657; ESLF 9369; ESP 1657

CONCEPT

Summary: This ecological system is a mosaic of shore pine-, dwarf-shrub- and herbaceous-dominated peatland communities. It includes well-developed peatlands on flat, rolling, or sloping terrain. Soils are poorly drained with deep organic layers. Trees are usually stunted and the tree canopy typically has less than <30% cover. Common species include *Pinus contorta, Chamaecyparis nootkatensis (= Cupressus nootkatensis), Empetrum nigrum, Kalmia, Ledum* spp., *Vaccinium uliginosum, Carex aquatilis var. dives (= Carex sitchensis), Carex pluriflora, Carex pauciflora, Carex livida, Trichophorum caespitosum, Eriophorum angustifolium, Sanguisorba menziesii*, and *Cornus canadensis*. *Sphagnum* spp. dominate the moss layer. This system includes a range of canopy structures and compositions from mixed conifer peatlands on sideslopes and benches with *Chamaecyparis nootkatensis, Tsuga mertensiana, Tsuga heterophylla*, and *Pinus contorta*, to peatlands on level ground with scrub *Pinus contorta*.
Classification Comments: This system is known as Shore Pine Peatland by the Alaska Natural Heritage Program. We discussed splitting out forest and non-forest phases in Juneau, but decided to keep as one type. Do we still need to describe a sedge bog for southeast (we have one in north)? Use 10% trees to get here, but can have non-forested inclusions. Banner et al. (1988) describe this *Pinus contorta* peatland type as a "slope bog."
Similar Ecological Systems:
- North Pacific Bog and Fen (CES204.063)

Related Concepts:
- I.A.3.a - Lodgepole pine (Viereck et al. 1992) Finer
- II.C.2.e - Ericaceous shrub bog (Viereck et al. 1992) Intersecting
- III.A.3.g - Subarctic lowland sedge-shrub wet meadow (Viereck et al. 1992) Intersecting
- III.A.3.j - Subarctic lowland sedge bog meadow (Viereck et al. 1992) Intersecting
- III.A.3.k - Subarctic lowland sedge-moss bog meadow (Viereck et al. 1992) Intersecting
- III.C.1.a - Wet bryophyte (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: This ecological system includes well-developed peatlands on flat, rolling, or sloping terrain. Soils are poorly drained with deep organic layers.
Vegetation: Trees are usually stunted and the tree canopy typically has less than <30% cover. Common species include *Pinus contorta, Chamaecyparis nootkatensis (= Cupressus nootkatensis), Empetrum nigrum, Kalmia, Ledum* spp., *Vaccinium uliginosum, Carex aquatilis var. dives (= Carex sitchensis), Carex pluriflora, Carex pauciflora, Carex livida, Trichophorum caespitosum, Eriophorum angustifolium, Sanguisorba menziesii*, and *Cornus canadensis*. *Sphagnum* spp. dominate the moss layer. This system includes a range of canopy structures and compositions from mixed conifer peatlands on sideslopes and benches with *Chamaecyparis nootkatensis, Tsuga mertensiana, Tsuga heterophylla*, and *Pinus contorta*, to peatlands on level ground with scrub *Pinus contorta* (DeMeo et al. 1992 (forest only), Martin et al. 1995 (forest only), Shephard 1995 (forest and nonforest). Banner et al. (1988) describe this *Pinus contorta* peatland type as a "slope bog."

Component Associations:
- *Pinus contorta / Carex aquatilis var. dives* Woodland (CEGL003203, G3)
- *Pinus contorta / Empetrum nigrum* Woodland (CEGL003202, G5)
- *Pinus contorta / Sphagnum* spp. Woodland (CEGL003201, G3)
- *Pinus contorta / Trichophorum caespitosum* Woodland (CEGL003204, G4G5)
- *Trichophorum caespitosum* Saturated Herbaceous Vegetation (CEGL002679, GNR)

DISTRIBUTION

Range: This system occurs from Yakutat south through southeastern Alaska. *Pinus contorta* does not occur north or west of Yakutat.
Divisions: 204:C
Nations: US
Subnations: AK
Map Zones: 77:P, 78:C
TNC Ecoregions: 69:C, 70:C

SOURCES

References: Banner et al. 1988, DeMeo et al. 1992, Martin et al. 1995, Shephard 1995, Western Ecology Working Group n.d.

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817792#references

Description Author: T. Boucher

Version: 10 Dec 2008 **Stakeholders:** West

Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKAN PACIFIC MARITIME SHRUB AND HERBACEOUS FLOODPLAIN WETLAND (CES204.155)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Saturated Soil; Bog and Fen Mosaic; Floodplain; Temperate [Temperate Oceanic]
Non-Diagnostic Classifiers: Montane; Lowland; Alluvial plain; Alluvial terrace; Bank; Braided channel or stream; Broad-Leaved Deciduous Shrub
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Deciduous shrubland
National Mapping Codes: EVT 2656; ESLF 9370; ESP 1656

CONCEPT

Summary: Floodplain wetlands occur within the active and inactive portions of floodplain systems. Wetlands develop on poorly drained deposits, oxbows, and abandoned channels and are often mosaiced with well-drained floodplain vegetation. Frequent river channel migration and associated flooding and fluvial processes constitute the major disturbances. Wetland succession and species composition are variable due to diverse environmental conditions such as water depth, substrate, and nutrient input. Floodplain wetland vegetation includes the following classes: aquatic bed, freshwater marsh, fen, wet low shrub, and tall-shrub swamp. These have been described as unique systems in this classification, but because floodplain wetland dynamics are different from wetland dynamics outside the floodplain, we will consider floodplain wetlands a distinct system, and model succession accordingly.
Classification Comments: This system is known as Floodplain Wetland by the Alaska Natural Heritage Program.
Related Concepts:

- II.B.2.f - Shrub swamp (open) (Viereck et al. 1992) Intersecting
- II.C.2.e - Ericaceous shrub bog (Viereck et al. 1992) Intersecting
- III.A.3.d - Fresh sedge marsh (Viereck et al. 1992) Intersecting
- III.A.3.f - Subarctic lowland sedge wet meadow (Viereck et al. 1992) Intersecting
- III.A.3.g - Subarctic lowland sedge-shrub wet meadow (Viereck et al. 1992) Intersecting
- III.A.3.j - Subarctic lowland sedge bog meadow (Viereck et al. 1992) Intersecting
- III.A.3.k - Subarctic lowland sedge-moss bog meadow (Viereck et al. 1992) Intersecting
- III.B.3.a - Fresh herb marsh (Viereck et al. 1992) Intersecting
- III.B.3.b - Subarctic lowland herb wet meadow (Viereck et al. 1992) Intersecting
- III.B.3.c - Subarctic lowland herb bog meadow (Viereck et al. 1992) Intersecting
- III.D.1.a - Pondlily (Viereck et al. 1992) Intersecting
- III.D.1.b - Common marestail (Viereck et al. 1992) Intersecting
- III.D.1.c - Aquatic buttercup (Viereck et al. 1992) Intersecting
- III.D.1.d - Burreed (Viereck et al. 1992) Intersecting
- III.D.1.f - Fresh pondweed (Viereck et al. 1992) Intersecting
- III.D.1.h - Cryptogam (Viereck et al. 1992) Intersecting

DISTRIBUTION

Range: This system includes glacially- and non-glacially-fed rivers and streams along the Gulf Coast of Alaska, from Kodiak Island through southeastern Alaska.
Divisions: 204:C
Nations: US
Subnations: AK
Map Zones: 77:C, 78:C
TNC Ecoregions: 69:C, 70:C

SOURCES

References: Viereck 1979, Viereck et al. 1992, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817703#references
Description Author: T. Boucher
Version: 29 Aug 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKAN PACIFIC MARITIME WET LOW SHRUBLAND (CES204.157)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Saturated Soil; Lowland; Shrubland (Shrub-dominated); Temperate [Temperate Oceanic]; Organic Peat (>40 cm); Muck; Myrica gale, Vaccinium uliginosum
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Deciduous shrubland
National Mapping Codes: EVT 2660; ESLF 9371; ESP 1660

CONCEPT

Summary: This wetland system typically occurs as a ring on the outer edge of peatlands or on uplifted tidal marshes that are relatively wet but no longer tidally influenced. It is a minor yet widespread system wherever mature peatlands and uplifted tidal marshes occur, such as the Copper River Delta and Yakutat Forelands. It also occurs on old lakebeds, drained beaver ponds, wet depressions, and the edge of tidal marshes. Soils are saturated for at least a portion of the growing season, and generally have a wet organic layer of variable depth (8 cm to 1 m deep) over silt, sand or gravel. The shrub layer is dominated by *Myrica gale* and/or *Vaccinium uliginosum*. In Katmai National Park and Preserve, *Myrica gale* is the dominant shrub, but *Betula nana* or *Salix barclayi* may also codominate. Species richness is often high and composition is variable. Common associated species may include *Alnus viridis ssp. sinuata, Kalmia microphylla, Carex pauciflora, Carex livida, Carex aquatilis var. dives (= Carex sitchensis), Carex pluriflora, Carex viridula ssp. viridula, Trichophorum caespitosum, Eriophorum angustifolium, Equisetum variegatum, Drosera rotundifolia, Sanguisorba canadensis, Sanguisorba officinalis, Calamagrostis canadensis*, and *Rubus arcticus*. *Sphagnum* spp. may be abundant in the ground layer.
Classification Comments: This system is known as Wet Low Shrub by the Alaska Natural Heritage Program. Not seen in the Stikine valley, not in Kenai Fjords.
Related Concepts:
- *Myrica gale* (Boggs et al. 2003) Finer
- II.C.2.e - Ericaceous shrub bog (Viereck et al. 1992) Intersecting
- II.C.2.i - Willow-graminoid shrub bog (Viereck et al. 1992) Intersecting
- II.C.2.j - Sweetgale-graminoid bog (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: This wetland system typically occurs as a ring on the outer edge of peatlands or on uplifted tidal marshes that are relatively wet but no longer tidally influenced. It is a minor yet widespread system wherever mature peatlands and uplifted tidal marshes occur, such as the Copper River Delta and Yakutat Forelands. It also occurs on old lakebeds, drained beaver ponds, wet depressions, and the edge of tidal marshes. Soils are saturated for at least a portion of the growing season, and generally have a wet organic layer of variable depth (8 cm to 1 m deep) over silt, sand or gravel.
Vegetation: The shrub layer is dominated by *Myrica gale* and/or *Vaccinium uliginosum*. In Katmai National Park and Preserve, *Myrica gale* is the dominant shrub, but *Betula nana* or *Salix barclayi* may also codominate. Species richness is often high and composition is variable. Common associated species may include *Alnus viridis ssp. sinuata, Kalmia microphylla, Carex pauciflora, Carex livida, Carex aquatilis var. dives (= Carex sitchensis), Carex pluriflora, Carex viridula ssp. viridula, Trichophorum caespitosum, Eriophorum angustifolium, Equisetum variegatum, Drosera rotundifolia, Sanguisorba canadensis, Sanguisorba officinalis, Calamagrostis canadensis*, and *Rubus arcticus*. *Sphagnum* spp. may be abundant in the ground layer.

Component Associations:
- *Myrica gale / Carex (aquatilis var. dives, utriculata)* Shrubland (CEGL003376, G3)

DISTRIBUTION

Range: This system occurs from the region of the eastern Alaska Peninsula, Katmai National Park and Preserve, east and south throughout southeastern Alaska. However it does not occur on Kodiak Island.
Divisions: 204:C
Nations: US
Subnations: AK
Map Zones: 76:C, 77:C, 78:C
TNC Ecoregions: 69:C, 70:C, 72:C

SOURCES

References: Boggs 2000, Boggs et al. 2003, Fleming and Spencer 2007, Shephard 1995, Viereck et al. 1992, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817711#references

Description Author: T. Boucher
Version: 29 Aug 2008
Concept Author: Western Ecology Group and Alaska Natural Heritage Program

Stakeholders: West
ClassifResp: West

ALEUTIAN FLOODPLAIN FOREST AND SHRUBLAND (CES105.295)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch, Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Riparian Mosaic [Trees, shrublands, meadows]; Boreal [Boreal Oceanic]; Unconsolidated; Populus balsamifera
Non-Diagnostic Classifiers: Very Short Flooding Interval [Short interval, Spring Flooding]; Floodplain; Outwash plain
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Deciduous open tree canopy
National Mapping Codes: EVT 2728; ESLF 9372; ESP 1728

CONCEPT

Summary: This floodplain system includes active and inactive forested floodplains and outwash plains, and is mosaiced with Aleutian Floodplain Wetland (CES105.296). Forested floodplains and outwash plains are widespread on Kodiak Island and the eastern Alaska Peninsula, but absent from the Aleutian Islands. The substrate is typically well-drained sand or cobble alluvium, although finer silts and clays are found on higher terraces, on distal floodplains, and in lower energy systems. Permafrost is absent. Patch size is small to large and often linear. These are rivers that always have a tree-dominated component. The primary existing vegetation types are: tall willow, alder (*Alnus viridis ssp. sinuata*), mesic herbaceous meadows on the younger deposits, and cottonwood-poplar (*Populus balsamifera* or *Populus balsamifera ssp. trichocarpa*) on the older sites. The cottonwood-poplar stands often have an understory of tall willow, *Calamagrostis canadensis*, ferns and scattered forbs. Floodplains dominated by volcanic ash deposits, the largest being the Katmai River floodplain, are included.
Classification Comments: This system is known as Floodplain Forest and Shrub by the Alaska Natural Heritage Program. This system does not go much farther west than Katmai National Park and Preserve which is about 75 miles into ecoregion 27 (Nowacki et al. 2001). Smaller rivers and streams farther west where the trees are no longer found are classified into Aleutian Shrub and Herbaceous Meadow Floodplain (CES105.283). Consider merging into maritime floodplain system.
Similar Ecological Systems:
- Aleutian Shrub and Herbaceous Meadow Floodplain (CES105.283)

Related Concepts:
- I.B.1.b - Black cottonwood (Viereck et al. 1992) Intersecting
- I.B.1.c - Balsam poplar (forest) (Viereck et al. 1992) Intersecting
- I.B.2.c - Balsam poplar (black cottonwood) (Viereck et al. 1992) Intersecting
- I.B.3.b - Balsam poplar (woodland) (Viereck et al. 1992) Intersecting
- II.B.1.a - Willow (closed) (Viereck et al. 1992) Intersecting
- II.B.1.b - Alder (closed) (Viereck et al. 1992) Intersecting
- II.B.1.d - Alder-willow (closed) (Viereck et al. 1992) Intersecting
- II.B.2.a - Willow (open) (Viereck et al. 1992) Intersecting
- II.B.2.b - Alder (open) (Viereck et al. 1992) Intersecting
- II.B.2.d - Alder-willow (open) (Viereck et al. 1992) Intersecting
- II.C.1.b - Low willow (Viereck et al. 1992) Intersecting
- II.C.1.e - Low alder-willow (closed) (Viereck et al. 1992) Intersecting
- II.C.2.g - Willow low (open) (Viereck et al. 1992) Intersecting
- II.C.2.k - Low alder-willow (open) (Viereck et al. 1992) Intersecting
- II.C.2.l - Low alder (Viereck et al. 1992) Intersecting
- III.A.1.a - Elymus (Viereck et al. 1992) Intersecting
- III.A.1.d - Midgrass-herb (Viereck et al. 1992) Intersecting
- III.A.2.a - Bluejoint meadow (Viereck et al. 1992) Intersecting
- III.A.2.b - Bluejoint-herb (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: This floodplain system includes active and inactive forested floodplains and outwash plains, and is mosaiced with Aleutian Floodplain Wetland (CES105.296). Forested floodplains and outwash plains are widespread on Kodiak Island and the eastern Alaska Peninsula, but absent from the Aleutian Islands. The substrate is typically well-drained sand or cobble alluvium, although finer silts and clays are found on higher terraces, on distal floodplains, and in lower energy systems. Permafrost is absent. Patch size is small to large and often linear. These are rivers that always have a tree-dominated component. Floodplains dominated by volcanic ash deposits, the largest being the Katmai River floodplain, are included.
Vegetation: The primary existing vegetation types are: tall willow, alder (*Alnus viridis ssp. sinuata*), mesic herbaceous meadows on the younger deposits, and cottonwood-poplar (*Populus balsamifera* or *Populus balsamifera ssp. trichocarpa*) on the older sites. The cottonwood-poplar stands often have an understory of tall willow, *Calamagrostis canadensis*, ferns and scattered forbs.

Dynamics: River channel migration, flooding and other fluvial processes constitute the major disturbance in this system.

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Aleutian Floodplain Wetland (CES105.296)

DISTRIBUTION

Range: This system occurs on the Alaska Peninsula and Kodiak Island.
Divisions: 102:C; 105:C
Nations: US
Subnations: AK
Map Zones: 76:C
TNC Ecoregions: 70:C, 72:C

SOURCES

References: Boggs et al. 2003, Viereck et al. 1992, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818600#references
Description Author: K. Boggs
Version: 16 Oct 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALEUTIAN FLOODPLAIN WETLAND (CES105.296)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Bog and Fen Mosaic; Boreal [Boreal Oceanic]
Non-Diagnostic Classifiers: Very Short Flooding Interval [Short interval, Spring Flooding]; Floodplain; Oxbow; Pond; Backswamp; Broad-Leaved Deciduous Shrub; Forb; Aquatic Herb; Graminoid
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Deciduous shrubland
National Mapping Codes: EVT 2729; ESLF 9373; ESP 1729

CONCEPT

Summary: Floodplain wetlands occur within the active and inactive portions of the floodplain systems ("floodplain forest and shrub" and "floodplain herbaceous meadow and shrub"). Wetlands develop on poorly drained deposits, oxbows, and abandoned channels, and are often mosaiced with well-drained floodplain vegetation. River channel migration, flooding and other fluvial processes constitute the major disturbance in this system. Wetland succession and species composition is variable due to diverse environmental conditions such as water depth, substrate, and nutrient input. This floodplain wetland system includes the following existing vegetation types: freshwater aquatic beds, freshwater marshes, wet meadow and herbaceous peatland - complex, and Aleutian Mesic-Wet Willow Shrubland (CES105.148). These have been described as unique systems in this classification, but because floodplain wetland dynamics are different from wetland dynamics outside the floodplain, floodplain wetlands are considered a distinct system, and model succession accordingly. Each type, however, has the same species composition as its correspondingly named system.
Classification Comments: This system is known as Floodplain Wetland by the Alaska Natural Heritage Program.
Related Concepts:
- II.C.1.b - Low willow (Viereck et al. 1992) Intersecting
- II.C.2.g - Willow low (open) (Viereck et al. 1992) Intersecting
- III.A.3.c - Wet sedge-herb meadow tundra (Viereck et al. 1992) Intersecting
- III.A.3.d - Fresh sedge marsh (Viereck et al. 1992) Intersecting
- III.A.3.e - Fresh grass marsh (Viereck et al. 1992) Intersecting
- III.B.3.a - Fresh herb marsh (Viereck et al. 1992) Intersecting
- III.D.1.a - Pondlily (Viereck et al. 1992) Intersecting
- III.D.1.b - Common marestail (Viereck et al. 1992) Intersecting
- III.D.1.c - Aquatic buttercup (Viereck et al. 1992) Intersecting
- III.D.1.d - Burreed (Viereck et al. 1992) Intersecting
- III.D.1.e - Water milfoil (Viereck et al. 1992) Intersecting
- III.D.1.f - Fresh pondweed (Viereck et al. 1992) Intersecting
- III.D.1.g - Water star-wort (Viereck et al. 1992) Intersecting
- III.D.1.h - Cryptogam (Viereck et al. 1992) Intersecting

DESCRIPTION

Dynamics: River channel migration, flooding and other fluvial processes constitute the major disturbance in this system. Wetland succession and species composition is variable due to diverse environmental conditions such as water depth, substrate, and nutrient input.

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Aleutian Floodplain Forest and Shrubland (CES105.295)
- Aleutian Shrub and Herbaceous Meadow Floodplain (CES105.283)

DISTRIBUTION

Range: This system occurs on the Alaska Peninsula, Aleutian Islands and Kodiak Island.
Divisions: 102:C; 105:C
Nations: US
Subnations: AK
Map Zones: 76:C
TNC Ecoregions: 70:C, 72:C, 73:C

SOURCES

References: Viereck et al. 1992, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818603#references

Description Author: K. Boggs
Version: 10 Dec 2008
Concept Author: Western Ecology Group and Alaska Natural Heritage Program

Stakeholders: West
ClassifResp: West

ALEUTIAN SHRUB AND HERBACEOUS MEADOW FLOODPLAIN (CES105.283)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch, Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Riparian Mosaic; Boreal [Boreal Oceanic]
Non-Diagnostic Classifiers: Floodplain; Outwash plain
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Deciduous shrubland
National Mapping Codes: EVT 2727; ESLF 9374; ESP 1727

CONCEPT

Summary: This ecological system includes active and inactive unforested floodplains and outwash plains, and is mosaiced with Aleutian Floodplain Wetland (CES105.296). Small unforested floodplains and outwash plains are widespread in the Aleutian Islands and Alaska Peninsula. The substrate is typically well-drained sand or cobble alluvium, although finer silts and clays are found on higher terraces, on distal floodplains, and in lower energy systems (capped by an organic mat). Permafrost is absent. Patch size is small to large and often linear. These floodplains have several different kinds of plant communities, including shrublands dominated by tall or low willow, or alder (*Alnus viridis ssp. sinuata*), and mesic herbaceous meadows, or *Leymus mollis* grasslands. The tall willow, alder and mesic herbaceous types tend to dominate low-elevation floodplains on Kodiak Island and the Alaska Peninsula. The mesic herbaceous and *Leymus mollis* existing vegetation types dominate the Aleutian Island floodplains. *Calamagrostis* spp. is the dominant mesic herbaceous species, and others include *Athyrium filix-femina, Leymus mollis, Gymnocarpium dryopteris, Geranium richardsonii, Fritillaria camschatcensis, Heracleum maximum,* and *Chamerion angustifolium ssp. angustifolium*. Floodplains dominated by volcanic ash deposits are included.
Classification Comments: This system is known as Floodplain Herbaceous Meadow and Shrub by the Alaska Natural Heritage Program.
Similar Ecological Systems:
- Aleutian Floodplain Forest and Shrubland (CES105.295)

Related Concepts:
- II.B.1.a - Willow (closed) (Viereck et al. 1992) Intersecting
- II.B.1.b - Alder (closed) (Viereck et al. 1992) Intersecting
- II.B.1.d - Alder-willow (closed) (Viereck et al. 1992) Intersecting
- II.B.2.a - Willow (open) (Viereck et al. 1992) Intersecting
- II.B.2.b - Alder (open) (Viereck et al. 1992) Intersecting
- II.B.2.d - Alder-willow (open) (Viereck et al. 1992) Intersecting
- II.C.1.b - Low willow (Viereck et al. 1992) Intersecting
- II.C.1.e - Low alder-willow (closed) (Viereck et al. 1992) Intersecting
- II.C.2.g - Willow low (open) (Viereck et al. 1992) Intersecting
- II.C.2.k - Low alder-willow (open) (Viereck et al. 1992) Intersecting
- II.C.2.l - Low alder (Viereck et al. 1992) Intersecting
- III.A.1.a - Elymus (Viereck et al. 1992) Intersecting
- III.A.1.d - Midgrass-herb (Viereck et al. 1992) Intersecting
- III.A.2.a - Bluejoint meadow (Viereck et al. 1992) Intersecting
- III.A.2.b - Bluejoint-herb (Viereck et al. 1992) Intersecting

DESCRIPTION

Dynamics: River channel migration, flooding and other fluvial processes constitute the major disturbance in this system.

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Aleutian Floodplain Wetland (CES105.296)

DISTRIBUTION

Range: This system occurs on the Alaska Peninsula and Aleutian Islands and possibly Kodiak Island.
Divisions: 102:C; 105:C
Nations: US
Subnations: AK
Map Zones: 76:C
TNC Ecoregions: 70:?, 72:C, 73:C

SOURCES

References: Western Ecology Working Group n.d.

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818597#references
Description Author: K. Boggs
Version: 16 Oct 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALEUTIAN SHRUB-SEDGE PEATLAND (CES105.238)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Saturated Soil; Shrubland (Shrub-dominated); Organic Peat (>40 cm); Mineral: W/ A-Horizon >10 cm
Non-Diagnostic Classifiers: Seepage-Fed Sloping [Mineral]; Seepage-Fed Sloping [Peaty]; Depressional [Lakeshore]; Depressional [Pond]; Riverine / Alluvial; Floating Organic Mats
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Deciduous shrubland
National Mapping Codes: EVT 2647; ESLF 9375; ESP 1647

CONCEPT

Summary: This ecological system occurs in shallow depressions, seepage channels on gentle slopes, and pond margins. It is often mosaiced with the wet meadow and other wetland ecological systems. It occurs on peat, floating organic mats or mineral soil. The sites are wet, and patch size is small. This system has >25% shrub cover. Common shrubs include *Andromeda polifolia, Betula nana, Empetrum nigrum, Ledum palustre ssp. decumbens, Salix pulchra, Vaccinium oxycoccos*, and *Vaccinium uliginosum*. Common herbaceous species include *Carex pluriflora, Cornus suecica, Comarum palustre, Rubus chamaemorus, Carex* spp., and *Eriophorum* spp. Fruticose lichens may occur on the hummocks.
Classification Comments: This system is known as Shrub-Sedge Peatland by the Alaska Natural Heritage Program.
Related Concepts:
- II.C.2.e - Ericaceous shrub bog (Viereck et al. 1992) Intersecting
- III.A.3.g - Subarctic lowland sedge-shrub wet meadow (Viereck et al. 1992) Intersecting
- III.A.3.j - Subarctic lowland sedge bog meadow (Viereck et al. 1992) Intersecting
- III.A.3.k - Subarctic lowland sedge-moss bog meadow (Viereck et al. 1992) Intersecting
- III.C.1.a - Wet bryophyte (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: This ecological system occurs in shallow depressions, seepage channels on gentle slopes, and pond margins. It is often mosaiced with the wet meadow and other wetland ecological systems. It occurs on peat, floating organic mats or mineral soil. The sites are wet, and patch size is small.
Vegetation: This system has >25% shrub cover. Common shrubs include *Andromeda polifolia, Betula nana, Empetrum nigrum, Ledum palustre ssp. decumbens, Salix pulchra, Vaccinium oxycoccos*, and *Vaccinium uliginosum*. Common herbaceous species include *Carex pluriflora, Cornus suecica, Comarum palustre, Rubus chamaemorus, Carex* spp., and *Eriophorum* spp. Fruticose lichens may occur on the hummocks.

DISTRIBUTION

Range: This system occurs on the Alaska Peninsula, Aleutian Islands and Kodiak Island.
Divisions: 102:C; 105:C
Nations: US
Subnations: AK
Map Zones: 76:C
TNC Ecoregions: 70:C, 72:C, 73:C

SOURCES

References: Boggs et al. 2003, Fleming and Spencer 2007, Talbot and Talbot 1994, Viereck et al. 1992, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818582#references
Description Author: K. Boggs
Version: 16 Oct 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ATLANTIC COASTAL PLAIN BLACKWATER STREAM FLOODPLAIN FOREST (CES203.247)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Riverine / Alluvial [Blackwater]
Non-Diagnostic Classifiers: Forest and Woodland (Treed)
National Mapping Codes: ESLF 9322

CONCEPT

Summary: This Atlantic Coastal Plain system, which is apparently most abundant in the Carolinas, occurs in floodplains of small streams that carry little mineral sediment (blackwater streams). These streams have their headwaters in sandy portions of the Coastal Plain. The water is usually strongly stained by tannins but has little suspended clay and is not turbid. Depositional landforms may be absent or present only in limited variety and of small size. Soils are usually strongly acidic. Periodicity of flooding ranges from long (semipermanent) in the wettest portions to short in higher gradient streams. Some small blackwater streams have most of their flow from sandhill seepage and have limited fluctuation in water levels. Vegetation varies from north to south, but generally consists almost entirely of forests of wetland trees, but occasional, small shrubby sloughs may also be present. A variety of tree species may be present; wetter examples (especially toward the northern range limits of this system) are often strongly dominated by *Taxodium distichum* and *Nyssa biflora*. Other examples have mixtures of these species with *Quercus* spp. and other bottomland hardwoods tolerant of blackwater conditions. Species richness ranges from low to moderate, but is lower than in comparable brownwater systems. Flooding is an important ecological factor in this system and may be the most important factor separating it from adjacent systems. Flooding brings nutrients and excludes non-flood-tolerant species. Unlike river systems, flooding tends to be variable and of shorter duration.

Classification Comments: The distinction between brownwater and blackwater streams is sometimes problematic. A number of plant species are characteristic of brownwater floodplains and not blackwater. Well-developed blackwater streams may be confined to areas with primarily sandy soils. The boundary between systems based on river/stream size is necessarily somewhat arbitrary, but is based on significant differences which correspond with river size. Small streams have small watersheds, which tend to lead to more irregular flooding. Depositional landforms are small enough that they do not differentiate communities well, and communities tend to have more of a mixture of species that are segregated on the larger floodplains. The boundary between this system and Atlantic Coastal Plain Streamhead Seepage Swamp, Pocosin and Baygall (CES203.252) may be somewhat gradual. It should be based on the predominance of seepage influence over flooding influence, but vegetational differences may also be partly determined by fire regime. Southern Coastal Plain Spring-run Stream Aquatic Vegetation (CES203.275) shares many characteristics with this system, but differs in having calcareous water and more steady flows.

Similar Ecological Systems:
- Atlantic Coastal Plain Streamhead Seepage Swamp, Pocosin and Baygall (CES203.252)
- Northern Atlantic Coastal Plain Riverine Peat Swamp (CES203.070)
- Southern Atlantic Coastal Plain Large River Floodplain Forest (CES203.066)
- Southern Coastal Plain Spring-run Stream Aquatic Vegetation (CES203.275)

Related Concepts:
- Atlantic White-Cedar: 97 (Eyre 1980) Finer
- Baldcypress - Tupelo: 102 (Eyre 1980) Finer
- Live Oak: 89 (Eyre 1980) Finer
- Pondcypress: 100 (Eyre 1980) Finer
- Sweetbay - Swamp Tupelo - Redbay: 104 (Eyre 1980) Finer
- Sweetgum - Willow Oak: 92 (Eyre 1980) Finer
- Water Tupelo - Swamp Tupelo: 103 (Eyre 1980) Finer
- Willow Oak - Water Oak - Diamondleaf (Laurel) Oak: 88 (Eyre 1980) Finer

DESCRIPTION

Environment: Examples of this system occur in floodplains of small streams of the Atlantic Coastal Plain that carry little mineral sediment (blackwater streams). These streams occur in low areas within sandy portions of the Coastal Plain (Smock and Gilinsky 1992). The water is usually strongly stained by tannins but has little suspended clay and is not turbid. Depositional landforms may be absent or may be present in limited variety and of small size. Soils are generally sandy in drier portions of the floodplain, mucky in wetter portions, or may be uniform organic soils. Soils are usually strongly acidic, but spring-fed rivers or streams may have local components with calcareous water and non-acidic soils. Flooding ranges from semipermanent in the wettest floodplains to intermittent and short in slightly higher areas and along higher gradient streams. Some small blackwater streams near the Fall-line Sandhills have most of their flow from sandhill seepage and have limited fluctuation in water levels, but other blackwater stream channels may dry out during the late summer. In these cases, water tables are not far below the channel, and are high enough that the deeper depressions

may still hold water (Smock and Gilinsky 1992). Sediment oxygen demand is high in blackwater swamp areas which have long-duration flooding and high amounts of total organic carbon in the soil and sediments. Evidence suggests that blackwater streams may naturally be low in dissolved oxygen (Todd et al. 2010).

The fluvial features of riverine floodplains occur less frequently along small streams. These features, such as river terraces, oxbows, alluvial flats, point bars, and streamside levees, may occur but on a smaller scale and sometimes poorly developed. Fine-scale alluvial floodplain features may be abundant. In pre-European settlement forests, community diversity in these streamside systems was much more complex than in the modified landscapes of today. Fire and beaver activity created a mosaic whose elements included canebrakes, beaver ponds and grass-sedge meadows in abandoned beaver clearings, as well as the streamside zones and mixed hardwood and/or *Pinus* spp. forests that make up more than 95% of the cover that exists today. The most prominent evergreen south of Virginia is the shade-intolerant *Pinus taeda*, which manages to maintain itself by reproducing in larger (multi-tree) treefall gaps.
Vegetation: Vegetation consists almost entirely of forests of wetland trees. Wetter examples are strongly dominated by *Taxodium distichum* and *Nyssa biflora*. Other examples have mixtures of these species with *Quercus* spp. and other bottomland hardwoods tolerant of blackwater conditions. Except in the very wet examples, understory, shrub, and herb layers are generally well-developed, and woody vines are also prominent. Species richness ranges from low to moderate but is lower than in comparable brownwater systems.
Dynamics: Flooding is an important ecological factor in this system and may be the most important factor separating it from adjacent systems. Flooding brings nutrients and excludes non-flood-tolerant species. Unlike river systems, flooding tends to be variable and of shorter duration. It is unclear how important aquatic fauna are when the system is flooded, but they may be important. The small flows, low gradient, and binding of sediment by vegetation limit channel shifts and sediment movement, but floods may cause local disturbance by scouring. The areas flooded for the longest durations tend to have accumulations of organic sediments which deplete levels of aquatic dissolved oxygen (Todd et al. 2010). Most of these forests would exist naturally as multi-aged old-growth forests driven by gap-phase regeneration. Windthrow is probably the most important cause of canopy gaps. Fire is probably more important than in larger river systems, because distances to uplands are short and because stream channels and sloughs are smaller and less effective as firebreaks. However, most of the vegetation is not very flammable and usually will not carry fire. Some of these areas apparently were once canebrakes, which presumably were maintained by periodic fire.

Fire-return interval varied highly in this system. Except in canebrakes, most fires were very light surface fires, creeping in hardwood or pine litter with some thin, patchy cover of bottomland grasses such as *Chasmanthium laxum* and *Chasmanthium latifolium*. Flame lengths are typically 15 to 30 cm (6-12 inches) (Landfire 2007a). Even so, fire-scarred trees can be found in most small stream sites except in the wettest microsites. Stand-replacement fires are unknown in this type. Except where Native American burning was involved, fires likely occurred primarily during drought conditions and then often only when fire spread into bottomlands from more pyrophytic uplands. Trees may be partially girdled by fire in duff, followed by bark sloughing. While fire rarely killed the tree, this allowed entry of rot, which, in the moist environment, often resulted in hollow trees, providing nesting and denning habitat for many species of birds and animals. Surface fires occurred on a frequency ranging from about 3 to 8 years in streamside canebrake, streamside hardwood/canebrake, or pine, to 25 years or more in hardwood litter. Low areas having a long hydroperiod, islands, and areas protected from fire by backswamps and oxbows were virtually fire-free. Fire effects were largely limited to top-kill of shrubs and tree saplings less than 5 cm (2 inches) diameter, and the formation of hollow trees.

The distinctive dynamics of stream flooding and protected topographic position dominate the distinctive vegetation of this system. The small watersheds and sometimes higher gradients on these streams may limit floods to fairly short duration. Flooding is most common in the winter, but may occur in other seasons. The sorting of plants by depositional landforms of different heights suggest that wetness or depth of flood waters has significance. In higher gradient streams, flood waters have significant energy. Scouring and reworking of sediment make up an important factor on the streambanks, and channels may occasionally change course. In addition to disturbance, floods bring nutrient input, deposit sediment and disperse plant seeds. However, because of the limited sediment transport, nutrient input is less in blackwater stream systems than in other floodplains. Stream flooding rarely leads to canopy tree mortality.

Component Associations:
- *Betula nigra - Quercus laurifolia - Taxodium (distichum, ascendens) / Crataegus aestivalis* Forest (CEGL004282, G2G3)
- *Chamaecyparis thyoides - (Liriodendron tulipifera) / Lyonia lucida* Forest (CEGL007563, G2)
- *Decodon verticillatus* Seasonally Flooded Shrubland (CEGL003905, G4)
- *Magnolia virginiana - Nyssa biflora / Carpinus caroliniana / Thelypteris noveboracensis - Athyrium filix-femina* Forest (CEGL004722, G3G4)
- *Nuphar sagittifolia* Herbaceous Vegetation (CEGL004328, G3?)
- *Nyssa biflora - (Taxodium distichum) / Clethra alnifolia - Viburnum nudum / Woodwardia areolata* Forest (CEGL007054, G3)
- *Nyssa biflora - Liriodendron tulipifera - Pinus (serotina, taeda) / Lyonia lucida - Ilex glabra* Forest (CEGL004734, G3?)
- *Nyssa biflora - Quercus nigra - Quercus laurifolia - Pinus taeda / Ilex opaca - Carpinus caroliniana* Forest (CEGL007350, G4?)
- *Orontium aquaticum - Schoenoplectus (etuberculatus, subterminalis) - Eriocaulon decangulare - Juncus trigonocarpus* Herbaceous Vegetation (CEGL007860, G2?)
- *Quercus laurifolia / Carpinus caroliniana / Justicia ovata* Forest (CEGL007348, G4?)
- *Quercus phellos - Quercus laurifolia - Nyssa biflora - Liquidambar styraciflua / Arundinaria gigantea ssp. tecta - Sabal minor* Forest (CEGL007846, G4?)
- *Quercus virginiana - (Pinus taeda) / (Sabal minor, Serenoa repens)* Forest (CEGL007039, G3G4)
- *Taxodium ascendens / (Nyssa biflora) / Leucothoe racemosa - Lyonia lucida - Morella cerifera* Depression Forest (CEGL007420, G3)

- *Taxodium distichum - Nyssa aquatica - Nyssa biflora / Fraxinus caroliniana / Itea virginica* Forest (CEGL007432, G3G4)
- *Taxodium distichum - Nyssa biflora - Acer rubrum - Magnolia virginiana* Saturated Forest (CEGL003804, G2G3)
- *Taxodium distichum - Nyssa biflora / Fraxinus caroliniana / Lyonia lucida* Forest (CEGL004733, G3G4)
- *Taxodium distichum - Nyssa ogeche* Forest (CEGL003841, G3G4)

Spatial Characteristics

Spatial Summary: Generally a small-patch system, with narrow bands or dendritic patches interspersed with other systems.
Size: Occurs in narrow bands, from a few hundred feet to possibly as much as a mile in width, and often several to many miles long. Natural limitations on development and conversion often result in contiguous patches that may be hundreds or even thousands of acres. However, because of relatively easy accessibility compared to larger floodplains, patches of mature vegetation are often small.
Adjacent Ecological Systems:
- Atlantic Coastal Plain Small Brownwater River Floodplain Forest (CES203.250)
- Atlantic Coastal Plain Streamhead Seepage Swamp, Pocosin and Baygall (CES203.252)
- Southeastern Coastal Plain Cliff (CES203.398)
- Southern Atlantic Coastal Plain Tidal Wooded Swamp (CES203.240)

Adjacent Ecological System Comments: May be associated with a variety of systems, especially upland or wetland longleaf pine systems and Atlantic Coastal Plain Streamhead Seepage Swamp, Pocosin and Baygall (CES203.252). Most naturally connect downstream to Atlantic Coastal Plain Small Brownwater River Floodplain Forest (CES203.250) or to Southern Atlantic Coastal Plain Tidal Wooded Swamp (CES203.240).

Distribution

Range: This system is potentially found throughout the Atlantic Coastal Plain north to about the James River in Virginia, but it is most abundant in North Carolina and South Carolina.
Divisions: 203:C
Nations: US
Subnations: FL, GA, NC, SC, VA
Map Zones: 55:C, 58:C, 60:C
USFS Ecomap Regions: 232A:CC, 232C:CC, 232H:CC, 232I:CC, 232J:CC
TNC Ecoregions: 55:C, 56:C, 57:C

Sources

References: Burke et al. 2003, Comer et al. 2003, Devall 1998, Engeman et al. 2007, Eyre 1980, Harris 1989, Landfire 2007a, Schafale pers. comm., Schuster 1974, Sharitz and Mitsch 1993, Smock and Gilinsky 1992, Todd et al. 2010
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723238#references
Description Author: M. Schafale and R. Evans, mod. M. Pyne
Version: 14 Jan 2014 **Stakeholders:** East, Southeast
Concept Author: M. Schafale and R. Evans **ClassifResp:** Southeast

ATLANTIC COASTAL PLAIN BROWNWATER STREAM FLOODPLAIN FOREST (CES203.248)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Riverine / Alluvial [Brownwater]
Non-Diagnostic Classifiers: Forest and Woodland (Treed)
National Mapping Codes: ESLF 9320

CONCEPT

Summary: This Atlantic Coastal Plain ecological system ranges from southern Virginia (south of the James River) to Georgia on floodplains of smaller streams that carry significant mineral sediment (brownwater or redwater streams). These streams have their headwaters in the Piedmont, Blue Ridge, or other interior regions, or in portions of the Coastal Plain where fine-textured sediment predominates. The water generally carries substantial amounts of silt and clay. Depositional landforms, at least a natural levee, are often distinctly present but are fairly small relative to the scale of communities and help create some variation in duration of flooding and nutrient input. Soils are generally fertile and not strongly acidic. Flooding is generally seasonal but may range to nearly semipermanent. Vegetation consists almost entirely of forests of wetland trees. Wetter examples are strongly dominated by *Taxodium distichum* and *Nyssa* spp. Other examples have mixtures of these species with *Quercus* spp. and other bottomland hardwoods. Except in the very wet examples, understory, shrub and herb layers are generally well-developed and woody vines are also prominent. Flooding is an important ecological factor in this system and may be the most important factor separating it from adjacent systems. Flooding brings nutrients and excludes non-flood-tolerant species. In contrast to larger river systems, the flooding in this system tends to be variable and of shorter duration.
Classification Comments: The distinction between brownwater and blackwater streams is sometimes problematic. A number of plant species are characteristic of brownwater floodplains and not blackwater. Well-developed blackwater streams may be confined to areas with primarily sandy soils. The boundary between systems based on river/stream size is necessarily somewhat arbitrary, but is based on significant differences which correspond with river size. Small streams have small watersheds, which tend to lead to more irregular flooding. Depositional landforms are small enough that they do not differentiate communities well, and communities tend to have more of a mixture of species that are segregated on the larger floodplains.

This system as defined covers a large geographic range. There are some significant biogeographic differences across this range, leading to a large number of associations. However, more plant species are shared across the region in this system than in most other systems in the region.
Similar Ecological Systems:
- Northern Atlantic Coastal Plain Riverine Peat Swamp (CES203.070)
- Southern Atlantic Coastal Plain Large River Floodplain Forest (CES203.066)
- Southern Atlantic Coastal Plain Mesic Hardwood Forest (CES203.242)

Related Concepts:
- Baldcypress - Tupelo: 102 (Eyre 1980) Finer
- Cottonwood: 63 (Eyre 1980) Finer
- Live Oak: 89 (Eyre 1980) Finer
- River Birch - Sycamore: 61 (Eyre 1980) Finer
- Silver Maple - American Elm: 62 (Eyre 1980) Finer
- Swamp Chestnut Oak - Cherrybark Oak: 91 (Eyre 1980) Finer
- Sweetgum - Willow Oak: 92 (Eyre 1980) Finer
- Water Tupelo - Swamp Tupelo: 103 (Eyre 1980) Finer
- Willow Oak - Water Oak - Diamondleaf (Laurel) Oak: 88 (Eyre 1980) Finer

DESCRIPTION

Environment: Occurs on floodplains of smaller streams that carry significant mineral sediment (brownwater or redwater streams). These streams have their headwaters in the Piedmont, Blue Ridge, Interior Plateaus, or in portions of the Coastal Plain where fine-textured sediment predominates. The water generally carries substantial amounts of silt and clay. Depositional landforms, at least a natural levee, are often distinctly present but are fairly small relative to the scale of communities. They create some variation in duration of flooding and nutrient input. Soil texture varies from sandy to clayey, often in a fine mosaic. Soils are generally fertile and not strongly acidic. Flooding is generally seasonal, but may range to nearly semipermanent.
Vegetation: Vegetation consists almost entirely of forests of wetland trees. Wetter examples are strongly dominated by *Taxodium distichum* and *Nyssa* spp. Other examples have mixtures of these species with *Quercus* spp. and other bottomland hardwoods. Except in the very wet examples, understory, shrub, and herb layers are generally well-developed, and woody vines are also prominent. Some canopy trees may include *Acer rubrum, Acer saccharinum, Betula nigra, Carya illinoinensis, Celtis laevigata, Liquidambar styraciflua, Liriodendron tulipifera, Nyssa aquatica, Nyssa biflora, Pinus taeda, Platanus occidentalis, Quercus laurifolia, Quercus*

michauxii, Quercus phellos, Salix caroliniana, and *Taxodium distichum*. Some shrubs and small trees may include *Alnus serrulata, Arundinaria gigantea ssp. tecta, Carpinus caroliniana, Fraxinus caroliniana, Ilex opaca, Itea virginica, Leucothoe racemosa, Sabal minor*, and *Serenoa repens*. Herbs may include *Boehmeria cylindrica, Commelina virginica, Leersia lenticularis*, and *Onoclea sensibilis*.

Dynamics: Flooding is the most important ecological factor in this system. Frequency and duration of flooding determines the occurrences of different associations and separates the system from other kinds of wetlands. Flooding brings nutrients and excludes non-flood-tolerant species. When flooded, the system has a substantial aquatic faunal component, with high densities of invertebrates, and may play an important role in the life cycle of fish in the associated river. Unusually long or deep floods may stress vegetation or act as a disturbance for some species. Larger floods cause local disturbance by scouring and depositing sediment along channels, and occasionally causing channel shifts. However, the low gradient and binding of sediment by vegetation generally makes these processes much slower and less frequent than in river systems of most other regions. Except for primary successional communities such as bars, most forests exist naturally as multi-aged old-growth forests driven by gap-phase regeneration. Windthrow is probably the most important cause of gaps. Fire is probably more important than in larger river systems, because distances to uplands are short and because stream channels and sloughs are smaller and less effective as firebreaks. However, most of the vegetation is not very flammable and usually will not carry fire. Some of these areas apparently were once canebrakes, which presumably were maintained by periodic fire.

Component Associations:

- *Acer saccharinum / Leersia lenticularis - Commelina virginica* Forest (CEGL007727, G3?)
- *Betula nigra - Platanus occidentalis / Alnus serrulata / Boehmeria cylindrica* Forest (CEGL007312, G4G5)
- *Liquidambar styraciflua - Liriodendron tulipifera / Onoclea sensibilis* Forest (CEGL007329, G4)
- *Nyssa aquatica* Forest (CEGL002419, G4G5)
- *Pinus taeda - Quercus hemisphaerica / Osmanthus americanus / Ilex glabra* Woodland (CEGL003619, G2)
- *Quercus (phellos, palustris, michauxii) - Liquidambar styraciflua / Cinna arundinacea* Forest (CEGL006605, G3G4)
- *Quercus michauxii / Carpinus caroliniana - Ilex opaca / Leucothoe racemosa* Forest (CEGL007737, G2G3)
- *Quercus pagoda - Quercus nigra / Halesia diptera - Ilex decidua / Chasmanthium sessiliflorum - Dicliptera brachiata* Forest (CEGL007354, G4?)
- *Quercus phellos - Quercus laurifolia - Nyssa biflora - Liquidambar styraciflua / Arundinaria gigantea ssp. tecta - Sabal minor* Forest (CEGL007846, G4?)
- *Quercus virginiana - (Pinus taeda) / (Sabal minor, Serenoa repens)* Forest (CEGL007039, G3G4)
- *Salix caroliniana* Temporarily Flooded Forest (CEGL007373, G4)
- *Taxodium distichum - Nyssa aquatica - Nyssa biflora / Fraxinus caroliniana / Itea virginica* Forest (CEGL007432, G3G4)
- *Taxodium distichum - Nyssa aquatica / Fraxinus caroliniana* Forest (CEGL007431, G5?)

Spatial Characteristics

Spatial Summary: Generally a linear system, with narrow bands or dendritic patches interspersed with other systems.

Size: Occurs in narrow bands, from a few hundred feet to possibly as much as a mile in width, and often several to many miles long. Natural limitations on development and conversion often result in contiguous patches that may be hundreds or even thousands of acres. However, because of relatively easy accessibility compared to larger floodplains, patches of mature vegetation are often small.

Adjacent Ecological Systems:

- Atlantic Coastal Plain Small Brownwater River Floodplain Forest (CES203.250)
- East Gulf Coastal Plain Freshwater Tidal Wooded Swamp (CES203.299)
- Southeastern Coastal Plain Cliff (CES203.398)

Adjacent Ecological System Comments: May be associated with a variety of systems, especially upland hardwood forests and upland or wetland longleaf pine systems. Most naturally connect downstream to Atlantic Coastal Plain Small Brownwater River Floodplain Forest (CES203.250) or to Southern Atlantic Coastal Plain Tidal Wooded Swamp (CES203.240).

Distribution

Range: This system is found throughout the Atlantic Coastal Plain, from southeastern Virginia to southeastern Georgia.
Divisions: 203:C
Nations: US
Subnations: GA, NC, SC, VA
Map Zones: 55:C, 58:C, 60:C
USFS Ecomap Regions: 232A:CC, 232C:CC, 232H:CC, 232I:CC, 232J:CC
TNC Ecoregions: 56:C, 57:C

Sources

References: Comer et al. 2003, Devall 1998, Eyre 1980, Harris 1989, Landfire 2007a, Sharitz and Mitsch 1993, Smock and Gilinsky 1992, Wharton 1978

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723237#references

Description Author: M. Schafale and R. Evans, mod. M. Pyne
Version: 14 Jan 2014
Concept Author: M. Schafale and R. Evans
Stakeholders: East, Southeast
ClassifResp: Southeast

ATLANTIC COASTAL PLAIN CLAY-BASED CAROLINA BAY WETLAND (CES203.245)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Forest and Woodland (Treed); Depressional; Graminoid
Non-Diagnostic Classifiers: Isolated Wetland [Partially Isolated]
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Mixed evergreen-deciduous open tree canopy
National Mapping Codes: EVT 2459; ESLF 9128; ESP 1459

CONCEPT

Summary: This system consists of mineral soil wetlands associated with ovoid, shallow depressions with nearly flat bottoms in parts of the Atlantic Coastal Plain. Often called clay-based Carolina bays, these areas are most numerous and extensive in South Carolina but are also present in adjacent Georgia and the Inner Coastal Plain of North Carolina. The depressions have mineral soils with a clay hardpan or some other layer in the soil that traps and retains water from a combination of rainfall and the exposure of a high regional water table. Some examples are essentially permanently flooded, while others are seasonally flooded but have water levels that vary substantially from year to year and over longer climatic cycles. Vegetation includes a series of primarily herbaceous and woodland associations, which have high herbaceous plant diversity. The wettest sites have open water and floating-leaved aquatic vegetation, or marsh vegetation of tall graminoids. Drier sites often have an open canopy of *Taxodium ascendens*, with a dense, often fairly species-rich herbaceous layer beneath. A few occurrences are shrubby, but none contain the dense shrub layers of characteristic pocosin species that occur in the bays with organic rather than mineral soils. Vegetation composition often varies substantially from year to year, in response to differences in water levels and drawdown times. Variation in hydroperiod is the most important dynamic, causing rapid major changes in the herbaceous vegetation. Unlike the steeper-sided solution depressions, where many different hydroperiods are present within a short distance and vegetation zones simply shift, the flat-bottomed Carolina bays experience drastic yearly changes in hydroperiod over most of their extent. Fire periodically spreads into the bays from adjacent uplands when conditions are dry, helping prevent invasion by less water-tolerant trees during dry periods, and this interacts with flooding to affect vegetation composition. In the absence of fire, *Pinus taeda* often invades the bays. Fire may also be important in preventing buildup of organic matter on the soil surface.

Classification Comments: The distinction between the central concepts of this system and Southern Atlantic Coastal Plain Depression Pondshore (CES203.262) is well marked, with basin morphology, geographic range, and prevailing communities differing. However, there is a common set of plant species, including some rare ones, that occur in both systems. Thus, there may be difficulty in defining the local boundary, and some atypical depressions may have to be placed in one system or the other based on the preponderance of evidence. This system is related to Northern Atlantic Coastal Plain Pond (CES203.518) which occurs farther north in the Coastal Plain, and to some of the flat-bottomed basin wetlands of Florida which occur outside the range of this system to the south.

Similar Ecological Systems:
- East Gulf Coastal Plain Depression Pond (CES203.558)
- Northern Atlantic Coastal Plain Pond (CES203.518)
- Southeastern Coastal Plain Natural Lakeshore (CES203.044)
- Southern Atlantic Coastal Plain Depression Pond (CES203.262)

Related Concepts:
- Cypress Savanna (Schafale and Weakley 1990) Intersecting
- Depression Meadows (Bennett and Nelson 1991) Finer
- Non-Alluvial Swamp (Bennett and Nelson 1991) Finer
- Pond Cypress Pond (Bennett and Nelson 1991) Finer
- Pond Cypress Savanna (Bennett and Nelson 1991) Finer
- Pondcypress: 100 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs in Carolina bays with mineral soils and with seasonal to permanent standing water. Carolina bays are oriented, oval, shallow depressions with nearly flat bottoms, which range from North Carolina through South Carolina, and into adjacent Georgia. Most Carolina bays in the Outer Coastal Plain occur in sandy sediments and are filled with peat, while most Carolina bays in the Inner Coastal Plain occur in loamy sediments and have mineral soils with a clay hardpan or some other layer in the soil that traps water. These depressions hold water, due to a combination of rainfall and exposure of a high regional water table. Some are essentially permanently flooded. Others contain water well into the growing season in most years, but water levels vary substantially from year to year and over longer climatic cycles. Fire is an important natural influence in dry times.

Vegetation: Vegetation includes a series of primarily herbaceous and woodland associations. The wettest sites have open water and floating-leaved aquatic vegetation, or marsh vegetation of tall graminoids. Drier sites often have an open canopy of *Taxodium*

ascendens, with a dense, often fairly species-rich herbaceous layer beneath. A large number of annual species are present. Showy, characteristic plants include species of *Symphiotrichum, Boltonia, Xyris, Ludwiga*, and *Solidago* (Bennett and Nelson 1991). Some sites have similar herbaceous vegetation without trees. A few occurrences are shrubby, but none contain the dense shrub layers of characteristic pocosin species that occur in the bays with organic soils. Vegetational composition often varies substantially from year to year, in response to differences in water levels and drawdown times. Seed banking plays an important role in component communities. The system is also important as amphibian breeding habitat and may support a distinctive aquatic invertebrate community.

Dynamics: Variation in hydroperiod is the most important dynamic, causing rapid major changes in the herbaceous vegetation. Unlike the steeper-sided solution depressions, where many different hydroperiods are present within a short distance and vegetation zones simply shift, the flat-bottomed Carolina bays experience drastic yearly changes in hydroperiod over most of their extent. Many plants persist in seed banks for periods of years when conditions are not suitable. Fire is also an important process, spreading into the bays from adjacent uplands when conditions are dry. Fire prevents invasion by less water-tolerant trees during dry periods, and interacts with flooding to affect vegetational composition. In the absence of fire, *Pinus taeda* often invades the bays. Fire may also be important in preventing buildup of organic matter on the soil surface. Seed banking is a very important process in this system. The drastic variation in species composition in response to varying water levels is made possible by a long-persistent seed bank for most of the herbaceous species. Species can be unseen for many years, but reappear quickly when conditions are favorable for them.

Animal migration is also potentially an important dynamic. These wetlands are often important breeding sites for frogs and salamanders, including a number of rare species. Movement of these amphibians transfers nutrients to and from the system, and ties it closely to the surrounding upland systems, and locally in some cases to connected riparian wetlands.

Component Associations:
- *Leersia hexandra - (Panicum verrucosum, Scleria reticularis)* Herbaceous Vegetation (CEGL004047, G2G3)
- *Taxodium ascendens / Cyrilla racemiflora - Zenobia pulverulenta* Woodland (CEGL003734, G2)
- *Taxodium ascendens / Panicum hemitomon - Polygala cymosa* Woodland (CEGL003733, G2G3)
- *Taxodium ascendens / Woodwardia virginica* Woodland (CEGL004441, G2?)

Spatial Characteristics

Spatial Summary: Small-patch system, occurring alone or in closely associated complexes.

Size: Most clay-based Carolina bays are Â½ mile or less long. Some are isolated, while in places several bays may be close enough together to be considered part of the same occurrence.

Adjacent Ecological Systems:
- Atlantic Coastal Plain Upland Longleaf Pine Woodland (CES203.281)
- Central Atlantic Coastal Plain Wet Longleaf Pine Savanna and Flatwoods (CES203.265)

Adjacent Ecological System Comments: Most occurrences were naturally associated with or embedded within Central Atlantic Coastal Plain Wet Longleaf Pine Savanna and Flatwoods (CES203.265) and Atlantic Coastal Plain Upland Longleaf Pine Woodland (CES203.281). Most are now surrounded by heavily altered systems.

Distribution

Range: This system is found in the Inner to Middle Coastal Plain, from southern North Carolina, through South Carolina, and into adjacent Georgia. It is most numerous and extensive in South Carolina.

Divisions: 203:C

Nations: US

Subnations: GA, NC, SC

Map Zones: 55:C, 58:C

USFS Ecomap Regions: 232C:CC, 232I:CC, 232J:CC

TNC Ecoregions: 56:C, 57:C

Sources

References: Bennett and Nelson 1991, Comer et al. 2003, Elliott, M. pers. comm., EPA 2004, Eyre 1980, Harrison 1983, Kirkman et al. 2012, Prouty 1952, Richardson and Gibbons 1993, Schafale and Weakley 1990, Sharitz 2003, Turner 2010, Van De Genachte and Cammack 2002, Wharton 1978

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723240#references

Description Author: M. Schafale and R. Evans

Version: 10 Jan 2014

Concept Author: M. Schafale and R. Evans

Stakeholders: Southeast

ClassifResp: Southeast

ATLANTIC COASTAL PLAIN NORTHERN BOG (CES203.893)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Non-Diagnostic Classifiers: Acidic Water; Shrubland (Shrub-dominated); Depressional; Isolated Wetland [Partially Isolated]
National Mapping Codes: ESLF 9189

CONCEPT

Summary: This system is comprised of dwarf-shrub sphagnum bogs dominated by *Chamaedaphne calyculata* occurring on Cape Cod (Massachusetts), Long Island (New York), and the Coastal Plain and near-coastal areas of northern New Jersey. North of the glacial border, this system typically occurs in isolated glacial kettleholes and in New Jersey in similar isolated basins, generally in regions of deep sands. The system is characterized by acidic, tannic water supporting a floating or grounded *Sphagnum* mat over which *Chamaedaphne calyculata, Gaylussacia dumosa*, and other dwarf-shrubs have rooted. Taller shrubs such as *Vaccinium corymbosum* may occur at the periphery of the bog, and *Decodon verticillatus* often forms a distinct zone adjacent to open water. Scattered individuals of *Pinus rigida, Pinus strobus*, or less often *Chamaecyparis thyoides* or *Picea mariana* may form a partial and stunted tree layer. Rooted hydromorphic plants such as *Nymphaea odorata* occur in open water.
Classification Comments: This system is separated from Northern Atlantic Coastal Plain Pitch Pine Lowland (CES203.374) based on the different landscape setting of the latter (pine barrens) and the implications for a different fire regime.
Similar Ecological Systems:
- North-Central Interior and Appalachian Acidic Peatland (CES202.606)--occurs inland from the Coastal Plain.
- Northern Atlantic Coastal Plain Pitch Pine Lowland (CES203.374)--may be similar in some instances, but is restricted to the New Jersey Pine Barrens region southward to Maryland, where the bogs occur in a contiguous pine barrens landscape.

Related Concepts:
- Pitch Pine Bog (Gawler and Cutko 2010) Finer
- Pitch Pine: 45 (Eyre 1980) Finer

Component Associations:
- *Chamaecyparis thyoides / Chamaedaphne calyculata* Woodland (CEGL006321, G3G4)
- *Chamaedaphne calyculata - (Gaylussacia dumosa) - Decodon verticillatus / Woodwardia virginica* Dwarf-shrubland (CEGL006008, G5)
- *Myrica gale - Chamaedaphne calyculata / Carex exilis* Shrub Herbaceous Vegetation (CEGL006392, GNR)
- *Nuphar advena - Nymphaea odorata* Herbaceous Vegetation (CEGL002386, G4G5)
- *Pinus rigida / Chamaedaphne calyculata / Sphagnum* spp. Woodland (CEGL006194, G3G5)
- *Sphagnum cuspidatum* Nonvascular Vegetation (CEGL004384, G2?)

DISTRIBUTION

Range: This system occurs on Cape Cod (Massachusetts), Long Island (New York), and possibly on the Coastal Plain of New Jersey north of the Pine Barrens region.
Divisions: 203:C
Nations: US
Subnations: MA, NJ, NY
Map Zones: 60:C, 65:C, 66:C
TNC Ecoregions: 62:C

SOURCES

References: Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722787#references
Description Author: L. Sneddon, mod. S.C. Gawler
Version: 05 May 2008
Concept Author: L. Sneddon
Stakeholders: East
ClassifResp: East

ATLANTIC COASTAL PLAIN PEATLAND POCOSIN AND CANEBRAKE (CES203.267)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Forest and Woodland (Treed); Shrubland (Shrub-dominated); Extensive Wet Flat
Non-Diagnostic Classifiers: Organic Peat (>40 cm)
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Mixed evergreen-deciduous shrubland
National Mapping Codes: EVT 2452; ESLF 9121; ESP 1452

CONCEPT

Summary: This system includes wetlands of organic soils, occurring on broad flats or gentle basins, primarily on the outer terraces of the Atlantic Coastal Plain of the Carolinas and southeastern Virginia. Under current conditions, the vegetation is predominantly dense shrubland and very shrubby open woodlands. A characteristic suite of primarily evergreen shrubs, greenbriars, and *Pinus serotina* dominates. These shrubs include *Cyrilla racemiflora, Ilex coriacea, Ilex glabra, Lyonia lucida,* and *Zenobia pulverulenta,* along with *Smilax laurifolia*. *Pinus serotina* is the characteristic tree, along with *Gordonia lasianthus, Magnolia virginiana,* and *Persea palustris*. Herbs are scarce and largely limited to small open patches. Under pre-European settlement fire regimes, stands of *Arundinaria gigantea ssp. tecta* (canebrakes) would have been more common and extensive. Soil saturation, sheet flow, and peat depth create a distinct zonation, with the highest stature woody vegetation on the edges and lowest in the center. Catastrophic fires are important in this system, naturally occurring at moderate frequency. Fires generally kill all above-ground shrubs in large patches. Mortality of *Pinus serotina* varies, creating a shifting mosaic. Vegetation structure and biomass recover rapidly in most of the burned areas, primarily by sprouting. *Pinus serotina* can regenerate from serotinous cones if killed.
Classification Comments: Related vegetation occurs in Atlantic Coastal Plain Streamhead Seepage Swamp, Pocosin and Baygall (CES203.252), which may share many plant species but which has hydrology driven by seepage. This system ((CES203.267) has three recognizable landscape patterns within it: domed peatlands, peat-filled Carolina bays, and small swales. Vegetational and ecological differences between these have not been demonstrated but may warrant further investigation. There are differences in landscape pattern among them. The "small swale" manifestation of this exists in smaller patches.
Similar Ecological Systems:
- Atlantic Coastal Plain Streamhead Seepage Swamp, Pocosin and Baygall (CES203.252)
- Southern Atlantic Coastal Plain Nonriverine Swamp and Wet Hardwood Forest (CES203.304)

Related Concepts:
- Bay Forest (Bennett and Nelson 1991) Finer
- Pocosin (Bennett and Nelson 1991) Finer
- Pond Pine Woodland (Bennett and Nelson 1991) Finer
- Pond Pine: 98 (Eyre 1980) Finer
- Sweetbay - Swamp Tupelo - Redbay: 104 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs on broad interfluvial flats and in small to large, very gentle basins and swales, largely on the outermost terraces of the Outer Coastal Plain. Some occurrences are in large to small peat-filled Carolina bays (Bennett and Nelson 1991, Nifong 1998). Smaller patches occur in shallow swales associated with relict coastal dune system or other irregular sandy surfaces. Soils range from wet mineral soils with mucky surface layers to peats several meters deep. Most of the largest occurrences are domed peatlands with the deepest peat associated with topographic highs in the center, but deep peats are also associated with buried drainage channels. Hydrology is driven by rainfall and sheet flow. The low hydraulic conductivity of the organic material limits interaction with the groundwater. The raised center of domed peatlands is fed only by rainwater and is therefore a true ombrotrophic bog. More peripheral portions are fed by sheet flow from the center, and so receive only acidic water low in nutrients. Occurrences in Carolina bays and other basins appear to be similarly isolated from surface or groundwater inflow from adjacent areas. Soils are normally saturated throughout the winter and well into the growing season, though the organic material may dry enough to burn during droughts. Standing water is limited to local depressions and disturbed areas. Soil saturation and peat depth, with its corresponding nutrient limitation, are the primary drivers of vegetational zonation as well as the distinction between this system and adjacent ones, but their effect may be modified by drainage patterns.
Vegetation: Vegetation is a series of distinctive associations known as pocosins. Under current conditions, the vegetation is predominantly dense shrubland and very shrubby open woodlands, ranging to nearly closed forests. Herbaceous associations are present only as small patches. Vegetation is typically zoned. The lowest stature vegetation occurs in the center of the system, with woodlands on the edges and in the smaller occurrences. The communities have in common a dense shrub layer of wetland shrubs tolerant of the organic soils, low nutrient conditions, and fire. *Ilex glabra, Lyonia lucida, Lyonia mariana, Cyrilla racemiflora, Ilex coriacea,* and *Zenobia pulverulenta* are characteristic and usually dominant in some combination, along with *Smilax laurifolia*. *Pinus serotina* is the characteristic tree, and it along with a set of evergreen hardwoods, including *Gordonia lasianthus, Magnolia*

, and *Persea palustris*, are generally the only trees present. Under pre-European settlement fire regimes, stands of *Arundinaria gigantea ssp. tecta* (canebrakes) would have been more common and extensive. Component communities tend to be low in plant species richness, and woody species richness exceeds herbaceous in most associations, with herbs being limited to small open patches. These areas would have formerly been more extensive under pre-European settlement fire regimes. The dominance of pond pine and evergreen shrubs as opposed to a canopy of deciduous hardwoods distinguishes this system from nonriverine swamp forests (CES203.304).

Dynamics: Fire is an important factor in these systems, with the pre-settlement fire regime probably being very different from that observed under current conditions. Natural fire-return intervals are not well known, but are probably on the order of a decade or two in the wettest areas. Peripheral areas may be subject to fire as often as the surrounding vegetation burns, which may naturally have been an average of 3 years. Fires are typically intense due to density and flammability of the vegetation; all above-ground vegetation is often killed, though *Pinus serotina* are resilient to fire and may survive. Fires are followed by vigorous root sprouting by shrubs and hardwoods, leading to recovery of standing biomass within a few years. *Pinus serotina* recovers by epicormic sprouting or by regeneration from seeds released from serotinous cones. Fires during droughts may ignite peat, forming holes that take longer to recover. Herb-dominated openings in pocosins may depend on peat fires for their creation, though this is not well documented. Natural fires occur in large patches, creating a shifting patch structure in the system that interacts with the vegetational zonation created by peat depth. The intensity of fire in these systems makes fire control difficult; prescribed burning is seldom done, and wild fires during drought continue to be a significant influence. The larger peatlands are believed to have been created by paludification following natural blocking of drainage (Otte 1981). Peat buildup raises the water table in the center, creating the domed structure of the largest peatlands and allowing the wetland to spread out as wetness is increased at the edges. Many of the deeper pocosin peats contain fossil logs that indicate dominance by a swamp forest in past millennia. Otte (1981) noted that peat fires likely limit the height to which the peat can accumulate, in proportion to how high it can raise the local water table.

Component Associations:
- *Arundinaria gigantea ssp. tecta* Shrubland (CEGL003843, G1)
- *Chamaedaphne calyculata - Vaccinium macrocarpon / Carex striata var. striata - Woodwardia areolata* Dwarf-shrubland (CEGL004165, G1)
- *Chamaedaphne calyculata / Carex striata var. striata - Sarracenia (flava, purpurea, rubra ssp. rubra)* Dwarf-shrubland (CEGL004164, G1)
- *Chamaedaphne calyculata / Carex striata var. striata - Woodwardia virginica* Dwarf-shrubland (CEGL004163, G1G2)
- *Cyrilla racemiflora - Persea palustris - Magnolia virginiana* Shrubland (CEGL004449, G2)
- *Cyrilla racemiflora - Zenobia pulverulenta* Shrubland (CEGL003943, G2G3)
- *Gordonia lasianthus - Magnolia virginiana - Persea palustris / Sphagnum* spp. Forest (CEGL007044, G4)
- *Ilex glabra - Lyonia lucida - Zenobia pulverulenta* Shrubland (CEGL003944, G2)
- *Magnolia virginiana - Persea palustris / Lyonia lucida* Forest (CEGL007049, G3?)
- *Pinus serotina - Gordonia lasianthus / Lyonia lucida* Woodland (CEGL003671, G3)
- *Pinus serotina / Arundinaria gigantea ssp. tecta* Wooded Shrubland (CEGL003851, G1)
- *Pinus serotina / Arundinaria gigantea ssp. tecta* Woodland (CEGL004433, G1)
- *Pinus serotina / Cyrilla racemiflora - Lyonia lucida - Ilex glabra* Woodland (CEGL003670, G3)
- *Pinus serotina / Ilex glabra / Woodwardia virginica* Woodland (CEGL004652, G2?)
- *Pinus serotina / Lyonia lucida - Ilex glabra - (Cyrilla racemiflora)* Shrubland (CEGL003846, G3)
- *Pinus serotina / Morella cerifera / Osmunda regalis var. spectabilis* Woodland (CEGL003669, G2?)
- *Pinus serotina / Zenobia pulverulenta - Cyrilla racemiflora - Lyonia lucida* Wooded Shrubland (CEGL004458, G2?)

Spatial Characteristics

Spatial Summary: This system occurs both as large patches in domed peatlands and large Carolina bays, and as complexes or isolated individual small patches in swales. Large patches tend to be homogeneous systems, while small patches often occur in mosaics with other systems. Large patches are usually zoned, with large patches of different associations.

Size: Occurs as both large patches, a few up to 10,000 acres or more, and also as small patches. Small patches are often in complexes, with many in close proximity.

Adjacent Ecological Systems:
- Atlantic Coastal Plain Small Blackwater River Floodplain Forest (CES203.249)
- Atlantic Coastal Plain Upland Longleaf Pine Woodland (CES203.281)
- Central Atlantic Coastal Plain Wet Longleaf Pine Savanna and Flatwoods (CES203.265)
- Southern Atlantic Coastal Plain Nonriverine Swamp and Wet Hardwood Forest (CES203.304)
- Southern Atlantic Coastal Plain Wet Pine Savanna and Flatwoods (CES203.536)
- Southern Atlantic White-cedar Peatland Forest (CES203.068)

Adjacent Ecological System Comments: Atlantic Coastal Plain Upland Longleaf Pine Woodland (CES203.281) and Southern Atlantic Coastal Plain Wet Pine Savanna and Flatwoods (CES203.536) may be the most adjacent systems in the southern part of the range, and in swale and Carolina bay occurrences. Nonriverine swamp systems are the most frequently associated in the northern half of the range.

Distribution

Range: This system is found primarily in North Carolina, extending into Georgia and southeastern Virginia.

Divisions: 203:C

Nations: US
Subnations: GA, NC, SC, VA
Map Zones: 58:C, 60:C
USFS Ecomap Regions: 232C:CC, 232I:CC
TNC Ecoregions: 56:C, 57:C

SOURCES

References: Bennett and Nelson 1991, Christensen et al. 1981, Comer et al. 2003, Eyre 1980, Nifong 1998, Otte 1981, Richardson 2003, Sharitz and Gibbons 1982, Weakley and Schafale 1991

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723219#references

Description Author: M. Schafale and R. Evans, mod. M. Pyne and C. Nordman
Version: 14 Jan 2014
Concept Author: M. Schafale and R. Evans
Stakeholders: East, Southeast
ClassifResp: Southeast

ATLANTIC COASTAL PLAIN SMALL BLACKWATER RIVER FLOODPLAIN FOREST (CES203.249)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Riverine / Alluvial [Blackwater]
Non-Diagnostic Classifiers: Forest and Woodland (Treed)
National Mapping Codes: ESLF 9318

CONCEPT

Summary: This ecological system encompasses the floodplains of small to medium blackwater rivers in the Atlantic Coastal Plain which are intermediate in size between the smaller streams and the largest rivers. Blackwater rivers originate in the sandy areas of the Coastal Plain, carry little sediment, and have less well-developed depositional alluvial landforms. The water is usually strongly stained by tannins but has little suspended clay and is not turbid. Soils are sandy or mucky, acidic, and infertile. Vegetation is a mosaic of cypress and gum swamps and bottomland hardwoods dominated by a limited set of oaks and other species. The lowest, wettest areas have some combination of *Taxodium distichum*, *Taxodium ascendens*, and *Nyssa biflora*. *Nyssa aquatica* is generally scarce or absent. Higher portions of the floodplain have forests with combinations of a small set of wetland oaks and other species, including *Quercus laurifolia*, *Quercus lyrata*, *Quercus nigra*, *Liquidambar styraciflua*, *Pinus taeda*, *Magnolia virginiana*, and other species. In general, vegetation is low in species richness.

Classification Comments: The distinction between brownwater and blackwater rivers is sometimes problematic. A number of plant species are characteristic of brownwater floodplains and not blackwater. Well-developed blackwater rivers may be confined to areas with primarily sandy soils. The boundary between systems based on river/stream size is necessarily somewhat arbitrary, but is based on significant differences which correspond with river size. Smaller streams have smaller watersheds, which tend to lead to more variable water levels and irregular flooding. Depositional landforms are small enough that they do not differentiate communities well, and communities tend to have more of a mixture of species that are segregated on the larger floodplains. Large rivers have greater variation in water levels and have flood regimes that integrate the effects of very large watersheds. Depositional landforms are larger, and communities can be more segregated.

Similar Ecological Systems:
- Northern Atlantic Coastal Plain Riverine Peat Swamp (CES203.070)
- Southern Atlantic Coastal Plain Large River Floodplain Forest (CES203.066)

Related Concepts:
- Baldcypress - Tupelo: 102 (Eyre 1980) Finer
- Bottomland Forest (FNAI 1990) Intersecting
- Floodplain Forest (FNAI 1990) Intersecting
- Floodplain Swamp (FNAI 1990) Intersecting
- Live Oak: 89 (Eyre 1980) Finer
- Loblolly Pine - Hardwood: 82 (Eyre 1980) Finer
- Loblolly Pine: 81 (Eyre 1980) Finer
- Overcup Oak - Water Hickory: 96 (Eyre 1980) Finer
- Pondcypress: 100 (Eyre 1980) Finer
- River Birch - Sycamore: 61 (Eyre 1980) Finer
- Silver Maple - American Elm: 62 (Eyre 1980) Finer
- Sugarberry - American Elm - Green Ash: 93 (Eyre 1980) Finer
- Sweetgum - Willow Oak: 92 (Eyre 1980) Finer
- Water Tupelo - Swamp Tupelo: 103 (Eyre 1980) Finer
- Willow Oak - Water Oak - Diamondleaf (Laurel) Oak: 88 (Eyre 1980) Finer

DESCRIPTION

Environment: Examples of this system occur in floodplains of medium to small coastal plain rivers that carry little mineral sediment (blackwater rivers). These rivers have their headwaters in sandy portions of the Atlantic Coastal Plain. The water is usually strongly stained by tannins but has little suspended clay and is not turbid. Depositional landforms such as natural levees and backswamps are usually not well-developed, but point bars, ridge-and-swale systems (scrollwork), and sloughs caused by river meandering may be prominent. Soils are generally sandy in drier portions of the floodplain, mucky in wetter portions, and are very acidic (Smock and Gilinsky 1992). Spring-fed rivers may have calcareous water and non-acidic soils. Flooding ranges from semipermanent in the wettest areas to intermittent and short on the higher portions of the floodplain. Sediment oxygen demand is high in blackwater swamp areas which have long duration flooding and high amounts of total organic carbon in the soil and sediments. Evidence suggests that blackwater streams may naturally be low in dissolved oxygen (Todd et al. 2010). The sandy soils may make some higher areas within the floodplain well-drained and dry when not flooded.

Saturation and flooding by acidic water, high in tannins is a key process. These waters carry very little sediment and are the color of dark tea (Wharton 1978). This is a linear to large-patch ecological system; stands may be contiguous over thousands of acres. Examples are by nature linear and most tend to be narrow The largest ones, such as the Satilla River of Georgia, could be called matrix examples. The Satilla could be the largest example; it is about 375 km in length. Its lower floodplain is about 2 km across, so in its entirety it could be up to 750 square km in size. Stands that have not had extensive timber removal will probably have more woody debris and constitute better habitat for component animal and plant species (Wharton 1978).

Vegetation: Vegetation consists largely of forests dominated by wetland trees species. Non-forested vegetation is present only on recently deposited bars and in oxbow lakes. The lowest, wettest areas have some combination of *Taxodium distichum, Taxodium ascendens*, and *Nyssa biflora*. *Nyssa aquatica* is generally scarce or absent. Higher portions of the floodplain have forests with combinations of a small set of wetland oaks and other species, including *Quercus laurifolia, Quercus lyrata, Quercus nigra, Liquidambar styraciflua, Pinus taeda, Magnolia virginiana*, and other species. Overall canopy species richness in a given site and over the system as a whole is lower than in comparable brownwater river systems. The distinctive levee assemblage of trees in brownwater river systems is largely lacking, though *Betula nigra, Salix nigra, Salix caroliniana*, and *Planera aquatica* may dominate banks and bars. The wettest forests are sometimes simple in structure, with an understory but little shrub or herb layer, but the other communities tend to have well-developed understories, shrub, and herb layers. Woody vines are usually prominent.

Dynamics: Flooding is the most important ecological factor in this system. Frequency and duration of flooding determine the occurrences of different associations and separate the system from other kinds of wetlands. Flooding brings nutrients and excludes non-flood-tolerant species. When flooded, the system may have a substantial aquatic faunal component, with high densities of invertebrates, and may play an important role in the life cycle of fish in the associated river. Unusually long or deep floods may stress vegetation or act as a disturbance for some species. Larger floods cause local disturbance by scouring and depositing sediment along channels, and occasionally causing channel shifts. However, the low gradient and binding of sediment by vegetation generally makes these processes much slower and less frequent than in river systems of most other regions. The areas flooded for the longest durations tend to have high amounts of total organic carbon in the soil and sediments which deplete levels of aquatic dissolved oxygen (Todd et al. 2010).

Except for primary successional communities such as bars, most forests exist naturally as multi-aged old-growth forests driven by gap-phase regeneration. In addition to periodic flooding, the formation of windfall gaps is a dominant ecological process in bottomland hardwood forests. Windfall gaps range from small (a single mature canopy tree) to patches up to a hectare or occasionally more, due to the effects of tornadoes and hurricanes. When canopy trees fall, seedlings in the understory are released and compete for a spot in the canopy. This leads to dense areas of herbaceous and woody vegetation in windfall gaps of all sizes. This is the major process in forest regeneration in bottomland hardwood forests.

Flooding is more frequent on the lower terraces but frequently floods higher terraces (Wharton et al. (1982) zones IV and V). Duration of flooding varies with the placement of a site in the landscape and is a dominant process affecting vegetation on a given site. Flooding can deposit alluvium or scour the ground, depending on the landscape position of a site and the severity of the flood event.

Fire is not believed to be important, due to low flammability of much of the vegetation, wetness, and abundance of natural firebreaks. Some areas of bottomlands apparently were once occupied by canebrakes, which presumably were maintained through deliberate fall burning by Native Americans. Infrequent, mild surface fires would occur in the system; however, they would not alter species composition or structure.

Component Associations:

- *Betula nigra - Quercus laurifolia - Taxodium (distichum, ascendens) / Crataegus aestivalis* Forest (CEGL004282, G2G3)
- *Eragrostis hypnoides - Micranthemum umbrosum - Lipocarpha micrantha - (Juncus repens)* Herbaceous Vegetation (CEGL004341, G2)
- *Fraxinus caroliniana - Sabal palmetto - Ulmus americana / Cephalanthus occidentalis* Forest (CEGL008592, G3?)
- *Fraxinus pennsylvanica - Ulmus americana - Celtis laevigata / Ilex decidua* Forest (CEGL002427, G4G5)
- *Nuphar sagittifolia* Herbaceous Vegetation (CEGL004328, G3?)
- *Panicum rigidulum - Hibiscus moscheutos* Herbaceous Vegetation (CEGL004273, G2G3)
- *Pinus glabra - Quercus virginiana - Carya glabra / Carpinus caroliniana / Serenoa repens* Forest (CEGL004676, G2G3)
- *Pinus taeda - Quercus laurifolia - Chamaecyparis thyoides - (Quercus virginiana) / Vaccinium elliottii* Forest (CEGL007548, G2?)
- *Pinus taeda - Quercus laurifolia / Vaccinium elliottii - Arundinaria gigantea* Forest (CEGL004736, G3G4)
- *Planera aquatica* Forest (CEGL007394, G4?)
- *Quercus laurifolia - Quercus lyrata / Carpinus caroliniana - Persea palustris / Vaccinium elliottii* Forest (CEGL004737, G4?)
- *Quercus lyrata - Quercus laurifolia - Taxodium distichum / Saururus cernuus* Forest (CEGL004735, G3G5)
- *Quercus virginiana - (Pinus taeda) / (Sabal minor, Serenoa repens)* Forest (CEGL007039, G3G4)
- *Salix caroliniana* Temporarily Flooded Coastal Plain Shrubland (CEGL007052, G4?)
- *Taxodium ascendens / Fraxinus caroliniana - Cephalanthus occidentalis - (Planera aquatica)* Woodland (CEGL004289, G2G3)
- *Taxodium distichum - Nyssa aquatica - Nyssa biflora / Fraxinus caroliniana / Itea virginica* Forest (CEGL007432, G3G4)
- *Taxodium distichum - Nyssa biflora / Fraxinus caroliniana / Lyonia lucida* Forest (CEGL004733, G3G4)

SPATIAL CHARACTERISTICS

Spatial Summary: Large-patch system, often contiguous over thousands of acres. Could potentially be regarded as matrix.

Size: This system occurs in broad linear bodies that are usually at least a mile wide, sometimes several miles wide, and may be dozens of miles long. The natural limitations on development and conversion often result in contiguous patches of tens of thousands of

acres in natural or semi-natural condition. Areas of vegetation in good condition are more likely to be hundreds of acres, bordered by young forests, clearcut areas, or pine plantations.

Adjacent Ecological Systems:

- Atlantic Coastal Plain Fall-line Sandhills Longleaf Pine Woodland (CES203.254)
- Atlantic Coastal Plain Peatland Pocosin and Canebrake (CES203.267)
- Central Atlantic Coastal Plain Wet Longleaf Pine Savanna and Flatwoods (CES203.265)
- Southeastern Coastal Plain Cliff (CES203.398)
- Southern Atlantic Coastal Plain Nonriverine Swamp and Wet Hardwood Forest (CES203.304)
- Southern Atlantic White-cedar Peatland Forest (CES203.068)

Adjacent Ecological System Comments: Generally bordered by upland hardwood systems on bluffs, by longleaf pine or Atlantic Coastal Plain Peatland Pocosin and Canebrake (CES203.267). Riverine aquatic systems are closely associated.

DISTRIBUTION

Range: This system is potentially found throughout the Atlantic Coastal Plain from Georgia north to about the James River in Virginia, but it is most abundant in North Carolina and South Carolina.
Divisions: 203:C
Nations: US
Subnations: FL, GA, NC, SC
Map Zones: 55:C, 58:C, 60:P
USFS Ecomap Regions: 232A:CC, 232C:CC, 232H:CC, 232I:CC, 232J:CC
TNC Ecoregions: 56:C, 57:C

SOURCES

References: Burke et al. 2003, Comer et al. 2003, Eyre 1980, FNAI 1990, Harris 1989, Landfire 2007a, Putnam 1951, Rosen et al. 2006, Schuster 1974, Sharitz and Mitsch 1993, Smock and Gilinsky 1992, Todd et al. 2010, Wharton 1978, Wharton et al. 1982
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723236#references
Description Author: M. Schafale and R. Evans, mod. M. Pyne
Version: 14 Jan 2014 **Stakeholders:** East, Southeast
Concept Author: M. Schafale and R. Evans **ClassifResp:** Southeast

ATLANTIC COASTAL PLAIN SMALL BROWNWATER RIVER FLOODPLAIN FOREST (CES203.250)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Riverine / Alluvial [Brownwater]
Non-Diagnostic Classifiers: Forest and Woodland (Treed)
National Mapping Codes: ESLF 9315

CONCEPT

Summary: This ecological system encompasses the floodplains of small to medium brownwater rivers of the Atlantic Coastal Plain which are intermediate in size between the smaller streams and the largest rivers. Brownwater rivers originate in clayey areas and carry substantial amounts of mineral sediment, creating well-developed deposition alluvial landforms and fertile soils. These rivers have their headwaters in the Piedmont, Blue Ridge, Interior Plateaus, or in portions of the Coastal Plain where fine-textured sediment predominates. Vegetation is a mosaic of cypress and gum swamps, oak-dominated bottomland hardwoods, and mixed levee forests, with only local examples of embedded non-forested communities. The lowest, wettest areas are dominated by a combination of *Taxodium distichum* and *Nyssa aquatica*. Natural levees and riverfronts have a diverse mixture of trees, including *Platanus occidentalis, Celtis laevigata, Fraxinus pennsylvanica, Acer negundo,* and others. Moderate to high parts of the floodplain away from the levee are usually dominated by bottomland hardwoods, including wetland oaks such as *Quercus laurifolia, Quercus michauxii, Quercus pagoda,* and sometimes a number of other species including *Liquidambar styraciflua*.
Classification Comments: The distinction between brownwater and blackwater rivers is sometimes problematic. A number of plant species are characteristic of brownwater floodplains and not blackwater. Well-developed blackwater rivers may be confined to areas with primarily sandy soils. The boundary between systems based on river/stream size is necessarily somewhat arbitrary, but is based on significant differences which correspond with river size. Smaller streams have smaller watersheds, which tend to lead to more variable water levels and irregular flooding. Depositional landforms are small enough that they don't differentiate communities well, and communities tend to have more of a mixture of species that are segregated on the larger floodplains. Large rivers have greater variation in water levels and have flood regimes that integrate the effects of very large watersheds. Depositional landforms are larger, and communities can be more segregated.

This system as defined covers a large geographic range. There are some significant biogeographic differences across this range, leading to a large number of associations. However, more plant species are shared across the region in this system than in most other systems in the region.

Similar Ecological Systems:
- Northern Atlantic Coastal Plain Riverine Peat Swamp (CES203.070)
- Southern Atlantic Coastal Plain Large River Floodplain Forest (CES203.066)

Related Concepts:
- Baldcypress - Tupelo: 102 (Eyre 1980) Finer
- Black Willow: 95 (Eyre 1980) Finer
- Cottonwood: 63 (Eyre 1980) Finer
- Live Oak: 89 (Eyre 1980) Finer
- Overcup Oak - Water Hickory: 96 (Eyre 1980) Finer
- River Birch - Sycamore: 61 (Eyre 1980) Finer
- Silver Maple - American Elm: 62 (Eyre 1980) Finer
- Sugarberry - American Elm - Green Ash: 93 (Eyre 1980) Finer
- Swamp Chestnut Oak - Cherrybark Oak: 91 (Eyre 1980) Finer
- Sycamore - Sweetgum - American Elm: 94 (Eyre 1980) Finer
- Water Tupelo - Swamp Tupelo: 103 (Eyre 1980) Finer

DESCRIPTION

Environment: Examples of this system occur in floodplains of medium to small Coastal Plain rivers that carry significant mineral sediment (brownwater or redwater rivers). These rivers have their headwaters in the Piedmont, Blue Ridge, Interior Plateaus, or in portions of the Coastal Plain where fine-textured sediment predominates. The water generally carries substantial amounts of silt, clay, and sometimes sand. Depositional landforms such as point bars, natural levees, backswamps, and ridge-and-swale systems (scrollwork) are well-developed and form patterns of significant variation in flooding duration and nutrient input. Soil texture varies from sandy to clayey. Soils are generally fertile and not strongly acidic. Flooding ranges from semipermanent in the wettest areas to intermittent and short on the higher portions of the floodplain. The highest terraces may no longer flood at all and belong to a different system.

Vegetation: Vegetation consists largely of forests dominated by wetland tree species. Non-forested vegetation is present only on recently deposited bars and in oxbow lakes. Three distinct groups of associations can be recognized. The lowest, wettest areas have

some combination of *Taxodium distichum* and *Nyssa aquatica* dominating. Natural levees and riverfronts have a diverse mixture of trees that typically includes *Platanus occidentalis, Celtis laevigata, Fraxinus pennsylvanica, Acer negundo*, and other species that benefit from the high light levels and heavy alluvial deposition of these sites. Moderate to high parts of the floodplain away from the levee are usually dominated by bottomland hardwoods, various mixtures of wetland oaks, including *Quercus laurifolia, Quercus michauxii, Quercus pagoda*, and sometimes a number of other oak species, along with *Liquidambar styraciflua*, but other species are sometimes codominant. The wettest forests are sometimes simple in structure, with an understory but little shrub or herb layer, but the other communities tend to have well-developed understories, shrub, and herb layers. Woody vines are usually prominent.
Dynamics: Flooding is the most important ecological factor in this system. Frequency and duration of flooding determines the occurrences of different associations and separates the system from other kinds of wetlands. Flooding brings nutrients and excludes non-flood-tolerant species. When flooded, the system has a substantial aquatic faunal component, with high densities of invertebrates, and may play an important role in the life cycle of fish in the associated river. Unusually long or deep floods may stress vegetation or act as a disturbance for some species. Larger floods cause local disturbance by scouring and depositing sediment along channels, and occasionally causing channel shifts. However, the low gradient and binding of sediment by vegetation generally makes these processes much slower and less frequent than in river systems of most other regions. Except for primary successional communities such as bars, most forests exist naturally as multi-aged old-growth forests driven by gap-phase regeneration. Windthrow is probably the most important cause of gaps. Fire is not believed to be important, due to low flammability of much of the vegetation, wetness, and abundance of natural firebreaks. However, some areas of bottomlands apparently were once canebrakes, which presumably were maintained by periodic fire.

Component Associations:
- *Betula nigra - Platanus occidentalis / Alnus serrulata / Boehmeria cylindrica* Forest (CEGL007312, G4G5)
- *Celtis laevigata - Fraxinus pennsylvanica - Acer negundo - (Juglans nigra) / Asimina triloba / Carex grayi* Forest (CEGL004740, G3G5)
- *Cephalanthus occidentalis - Decodon verticillatus* Shrubland (CEGL006069, G4G5)
- *Fagus grandifolia - Liquidambar styraciflua - Quercus (michauxii, nigra)* Forest (CEGL007866, G3?)
- *Fraxinus pennsylvanica - Quercus laurifolia - Quercus lyrata - Carya aquatica* Forest (CEGL004695, G3G4)
- *Fraxinus pennsylvanica - Ulmus americana / Carpinus caroliniana / Boehmeria cylindrica* Forest (CEGL007806, G4?)
- *Liquidambar styraciflua - Liriodendron tulipifera / Onoclea sensibilis* Forest (CEGL007329, G4)
- *Nyssa aquatica* Forest (CEGL002419, G4G5)
- *Pinus glabra - Quercus (laurifolia, michauxii, nigra) / Carpinus caroliniana ssp. caroliniana / Sabal minor* Forest (CEGL007544, G3G4)
- *Pinus glabra - Quercus virginiana - Carya glabra / Carpinus caroliniana / Serenoa repens* Forest (CEGL004676, G2G3)
- *Planera aquatica* Forest (CEGL007394, G4?)
- *Platanus occidentalis - Celtis laevigata - Fraxinus pennsylvanica / Lindera benzoin - Ilex decidua / Carex retroflexa* Forest (CEGL007730, G4?)
- *Populus deltoides - Salix caroliniana* Forest (CEGL007343, G4G5)
- *Populus deltoides - Salix nigra / Mikania scandens* Forest (CEGL007346, G4G5)
- *Populus deltoides / Acer negundo / Boehmeria cylindrica* Forest (CEGL007731, G3G5)
- *Quercus (phellos, palustris, michauxii) - Liquidambar styraciflua / Cinna arundinacea* Forest (CEGL006605, G3G4)
- *Quercus laurifolia - Quercus michauxii - Liquidambar styraciflua / Carpinus caroliniana* Forest (CEGL004678, G3G4)
- *Quercus lyrata - Carya aquatica* Forest (CEGL007397, G4G5)
- *Quercus pagoda - Quercus nigra / Halesia diptera - Ilex decidua / Chasmanthium sessiliflorum - Dicliptera brachiata* Forest (CEGL007354, G4?)
- *Quercus virginiana - (Pinus taeda) / (Sabal minor, Serenoa repens)* Forest (CEGL007039, G3G4)
- *Salix nigra - Fraxinus pennsylvanica* Forest (CEGL007734, G3G4)
- *Taxodium distichum - Fraxinus pennsylvanica - Quercus laurifolia / Acer rubrum / Saururus cernuus* Forest (CEGL007719, G3G4)
- *Taxodium distichum - Nyssa aquatica - Nyssa biflora / Fraxinus caroliniana / Itea virginica* Forest (CEGL007432, G3G4)
- *Taxodium distichum - Nyssa aquatica / Fraxinus caroliniana* Forest (CEGL007431, G5?)

SPATIAL CHARACTERISTICS

Spatial Summary: Linear system, often contiguous over thousands of acres. Could potentially be regarded as matrix.
Size: This system occurs in broad linear bodies that are usually several miles wide and may be hundreds of miles long. The natural limitations on development and conversion often result in contiguous patches of tens of thousands of acres in natural or semi-natural condition. Areas of vegetation in good condition are more likely to be hundreds to possibly thousands of acres, bordered by young forests, clearcut areas, or pine plantations.
Adjacent Ecological Systems:
- Atlantic Coastal Plain Blackwater Stream Floodplain Forest (CES203.247)
- Atlantic Coastal Plain Brownwater Stream Floodplain Forest (CES203.248)
- Central Atlantic Coastal Plain Wet Longleaf Pine Savanna and Flatwoods (CES203.265)

Adjacent Ecological System Comments: Generally bordered by upland hardwood systems on bluffs or adjacent high terraces. Riverine aquatic systems are closely associated.

DISTRIBUTION

Range: This ranges throughout the Atlantic Coastal Plain from Georgia, north to about the James River in Virginia.
Divisions: 203:C
Nations: US
Subnations: GA, NC, SC, VA
Map Zones: 55:C, 58:C, 60:C
USFS Ecomap Regions: 232A:CC, 232C:CC, 232H:CC, 232I:CC, 232J:CC
TNC Ecoregions: 56:C, 57:C

SOURCES

References: Comer et al. 2003, Eyre 1980, Harris 1989, Schuster 1974, Sharitz and Mitsch 1993, Smock and Gilinsky 1992, Wharton 1978, Wharton et al. 1982
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723235#references
Description Author: M. Schafale and R. Evans, mod. M. Pyne
Version: 14 Jan 2014 **Stakeholders:** East, Southeast
Concept Author: M. Schafale and R. Evans **ClassifResp:** Southeast

ATLANTIC COASTAL PLAIN STREAMHEAD SEEPAGE SWAMP, POCOSIN AND BAYGALL (CES203.252)

CLASSIFIERS

Conf.: 3 - Weak **Classification Status:** Standard
Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Forest and Woodland (Treed); Mid and Southern Atlantic Coastal Plain; Seepage-Fed Sloping
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Mixed evergreen-deciduous open tree canopy
National Mapping Codes: EVT 2468; ESLF 9137; ESP 1468

CONCEPT

Summary: This ecological system encompasses seepage-fed wetlands in dissected landscapes of the Atlantic Coastal Plain, from southeastern Virginia south through South Carolina and into the Inner Coastal Plain of Georgia. Examples are usually associated with ravines or along headwater streams. Overbank flooding is a negligible influence. Fire may be an important force in some associations and not in others. Vegetation consists of open to closed forests or woodlands of acid-tolerant wetland hardwoods or pine. Generally there is a dense shrub layer consisting primarily of species shared with Atlantic Coastal Plain Peatland Pocosin and Canebrake (CES203.267).

Classification Comments: This system is very heterogeneous in vegetation and in the role of fire, as well as extensive in geographic range. It might be appropriate to split it into two or even three systems. The streamhead pocosins of the Fall-line Sandhills region of North Carolina and northern South Carolina (EPA 65c), as well as related areas of Georgia and southern Virginia are distinctive in being strongly fire-dominated, having pine as a major canopy dominant, and having a flora consisting largely of pocosin species. The closely related white-cedar- and cane-dominated associations would also fit into this system. A second set of associations ranging from South Carolina through the Gulf Coastal Plain has vegetation that suggests less influence by fire, including hardwood canopies and shrub layers that are primarily pocosin species but share some other wetland species. A third set, from a wider variety of topographic settings throughout the region, has hardwood canopies and shrub and herb layers with less peatland affinities, more closely related to floodplain communities. Their flora suggests a minor role for fire.

This system is distinguished from Atlantic Coastal Plain Sandhill Seep (CES203.253) by the predominance of woody vegetation indicative of less frequent fire. Where the two co-occur, it occurs in larger and topographically lower patches. This system is distinguished from Atlantic Coastal Plain Peatland Pocosin and Canebrake (CES203.267), which may have fairly similar flora, by having seepage-dominated hydrology and occurring in dissected landscapes.

Similar Ecological Systems:
- Atlantic Coastal Plain Blackwater Stream Floodplain Forest (CES203.247)
- Atlantic Coastal Plain Peatland Pocosin and Canebrake (CES203.267)
- Atlantic Coastal Plain Sandhill Seep (CES203.253)
- Piedmont Seepage Wetland (CES202.298)
- Southern Coastal Plain Seepage Swamp and Baygall (CES203.505)

Related Concepts:
- Atlantic White-Cedar: 97 (Eyre 1980) Finer
- Baygall (FNAI 1990) Undetermined
- Pond Pine: 98 (Eyre 1980) Finer
- Streamhead pocosins (Fleming et al. 2005) Finer
- Sweetbay - Swamp Tupelo - Redbay: 104 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs in dissected Coastal Plain terrain on sites saturated by seepage of shallow groundwater. Seasonal to permanent saturation combined with fire of only moderate to low frequency and woody vegetation are the unifying characteristics of this system. A stream is often present draining the site, but it is small, and overbank flooding is a negligible influence. Most examples are in bottoms of ravines, but some are on sideslopes or flats at the base of slopes. Most examples are in sandy areas where rapid soil drainage in the surrounding landscape supplies the seepage. Soils within the system itself are generally mucky sands or clays, or deeper organic soils. This system occurs in landscapes that had frequent fire under natural conditions.

Vegetation: Vegetation is dominated by woody plants. An open to closed tree canopy is usually present and consists of a mixture of acidic-tolerant wetland trees such as *Nyssa biflora, Acer rubrum, Pinus serotina, Magnolia virginiana, Liriodendron tulipifera,* and *Chamaecyparis thyoides*. There is generally a dense shrub layer that is dominated by species shared with pocosins or baygalls, such as *Cyrilla racemiflora, Leucothoe axillaris, Lyonia lucida, Lyonia ligustrina, Clethra alnifolia, Cliftonia monophylla, Ilex glabra,* and *Arundinaria gigantea ssp. tecta,* but includes some species of other saturated wetlands, such as *Toxicodendron vernix, Morella caroliniensis, Persea palustris,* and *Viburnum nudum*. *Smilax laurifolia* may be abundant. The herb layer, if well-developed at all, generally consists of large wetland ferns, such as *Osmunda cinnamomea, Osmunda regalis var. spectabilis, Woodwardia virginica,* and *Woodwardia areolata*, with *Carex* spp. Some examples (canebrakes) are dominated by *Arundinaria gigantea ssp. tecta*.

Dynamics: Seepage is the most important ecological factor determining where this system occurs. Seepage provides a steady source

of water, so that soils remain saturated but seldom have surface flooding. The importance of fire varies widely in this system. Fire is the most important dynamic process in many examples, but is of minor importance in others, and is probably an important driver of the different vegetation associations. Fire frequency and intensity vary among associations, from moderately frequent intense fires to infrequent low-intensity fires. This system occurs within larger upland landscapes that had frequent fire in the past, but the wetness of these headwater wetlands often limits fire spread into them. Associations dominated by *Pinus serotina* and evergreen shrubs such as *Ilex, Lyonia, Gaylussacia, Persea, Morella, Arundinaria gigantea ssp. tecta* and *Cyrilla*, or canebrakes dominated by *Arundinaria gigantea ssp. tecta* can have intense canopy fires that are the dominant influence on vegetation structure. Those dominated by *Chamaecyparis thyoides* have infrequent fire that may catastrophically kill the canopy trees, while also promoting *Chamaecyparis thyoides* regeneration. Associations with hardwood canopies, such as *Acer rubrum, Liriodendron tulipifera*, or *Nyssa biflora*, especially those with limited shrub abundance, are not very flammable and usually burn with low intensity and limited effect. Wind can be an important natural disturbance. Forests of *Chamaecyparis thyoides* are susceptible to heavy windthrow that can affect a substantial part of the canopy. Wind damage in hardwood and pine forests tends to consist mainly of small to medium-sized canopy gaps. In ravine bottom sites that have some streamflow, beavers can be an important influence. Beaver ponds convert the forested vegetation to open water. Upon abandonment, beaver pond sites go through a succession that may lead to a long-lasting mire community, or to regeneration of a swamp canopy and lower strata.

Component Associations:
- *Arundinaria gigantea ssp. tecta* Shrubland (CEGL003843, G1)
- *Chamaecyparis thyoides - (Liriodendron tulipifera) / Lyonia lucida* Forest (CEGL007563, G2)
- *Cyrilla racemiflora - Cliftonia monophylla* Scrub (CEGL003847, G4)
- *Gordonia lasianthus - Magnolia virginiana - Persea palustris / Sphagnum* spp. Forest (CEGL007044, G4)
- *Gordonia lasianthus / Woodwardia virginica - Osmunda regalis var. spectabilis* Forest (CEGL004410, G2G3)
- *Ilex coriacea - Lyonia lucida - Smilax laurifolia* Shrubland (CEGL004666, G3G4)
- *Magnolia virginiana - Nyssa biflora / Carpinus caroliniana / Thelypteris noveboracensis - Athyrium filix-femina* Forest (CEGL004722, G3G4)
- *Nyssa biflora - (Acer rubrum) / Ilex opaca / Leucothoe axillaris / Carex atlantica ssp. capillacea* Forest (CEGL004427, G2G3)
- *Nyssa biflora - Acer rubrum var. trilobum - Liriodendron tulipifera / Ilex coriacea - Lyonia lucida* Forest (CEGL004645, G3)
- *Pinus serotina - (Liriodendron tulipifera) / Lyonia lucida - Clethra alnifolia - Ilex glabra* Woodland (CEGL004435, G4)
- *Pinus serotina / Gordonia lasianthus - Persea palustris* Saturated Woodland (CEGL007996, G3?Q)

SPATIAL CHARACTERISTICS

Spatial Summary: Occurs as large patches or as long narrow bodies following ravines, often in dendritic networks interfingered with upland systems.
Size: Most occurrences are in narrow bodies that may be very local or may be long and connected in dendritic networks. Networks may contain hundreds of contiguous acres but with few areas very far from an edge.
Adjacent Ecological Systems:
- Atlantic Coastal Plain Blackwater Stream Floodplain Forest (CES203.247)
- Atlantic Coastal Plain Fall-line Sandhills Longleaf Pine Woodland (CES203.254)
- Atlantic Coastal Plain Sandhill Seep (CES203.253)

Adjacent Ecological System Comments: Most frequently associated with Atlantic Coastal Plain Fall-line Sandhills Longleaf Pine Woodland (CES203.254) in the northern part of the range. Potentially associated with a variety of upland systems in the southern part of the range. Many examples will grade downstream to small or large floodplain systems.

DISTRIBUTION

Range: This ecological system is found in the Atlantic Coastal Plain, from southeastern Virginia south through South Carolina and into the Inner Coastal Plain of Georgia, primarily in the Fall-line Sandhills region; rarely in dissected terrain in the Outer Coastal Plain.
Divisions: 203:C
Nations: US
Subnations: GA, NC, SC, VA
Map Zones: 55:C, 58:C, 59:C, 60:C
USFS Ecomap Regions: 232C:CC, 232H:CC, 232I:CC, 232Ja:CCC
TNC Ecoregions: 56:C, 57:C

SOURCES

References: Comer et al. 2003, Engeman et al. 2007, Eyre 1980, Fleming et al. 2005, FNAI 1990, Landfire 2007a
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723233#references
Description Author: M. Schafale and R. Evans, mod. C. Nordman
Version: 14 Jan 2014 **Stakeholders:** East, Southeast
Concept Author: M. Schafale and R. Evans **ClassifResp:** Southeast

BOREAL BLACK SPRUCE SWAMP (CES103.335)

CLASSIFIERS

Classification Status: Standard

Primary Division: Boreal (103)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Swamp; Boreal
National Mapping Codes: ESLF 9394

CONCEPT

Summary: This ecological system encompasses lower-slope, level and depressional wetlands on morainal, lacustrine sites, often on organic soils. It also occurs on the edges of small lakes and ponds. Typically these sites are transitional from peatland to upland. Soils are saturated to subhydric, medium to very rich, and nutrient levels are poor. Swamps are distinguished from other wetland types in that they are wooded (treed or shrub) wetlands that are in contact with minerotrophic water in either mineral or peatland soils. An abundance of woody material in swamps provides another important distinction in that the peat is primarily composed of decomposing wooded material (shrub and tree) rather than the *Sphagnum* or sedge-dominated peat types that comprise the organic layer in poor fens and bogs. Further, peat soils in swamps are fairly well decomposed compared to peat in peatlands, which is caused by fluctuating water tables that allow for oxygen and decomposition. Tree cover is low, approximately 30-50%, predominantly *Picea mariana* with some *Picea glauca X engelmannii* (hybrid white spruce) or sometimes *Larix laricina* Shrub cover is also low, about 35% cover, with *Betula glandulosa, Betula neoalaskana, Betula pumila, Salix barclayi, Ledum groenlandicum, Rosa acicularis, Alnus incana ssp. tenuifolia (= Alnus tenuifolia),* and regenerating canopy trees. Herbaceous cover is high, 40-75%, with *Carex disperma, Caltha palustris, Equisetum arvense, Equisetum fluviatile, Cornus canadensis, Vaccinium vitis-idaea, Rubus chamaemorus, Orthilia secunda, Petasites frigidus var. palmatus (= Petasites palmatus),* and *Comarum palustre (= Potentilla palustris)*. Moss cover is also high at 75-90%; typical species include *Tomentypnum nitens, Pleurozium schreberi, Sphagnum* spp., and *Hylocomium splendens*, among others.

Classification Comments: We are splitting black spruce swamps from black spruce bogs. Black spruce bogs in Alaska are placed into Western North American Boreal Black Spruce Dwarf-tree Peatland (CES105.139) or Western Canadian Boreal Black Spruce Bog and Dwarf-tree Peatland (CES103.799). This system is probably not mappable, except at very fine, local scales. This ecological system was developed for the purpose of capturing the coarse filter of terrestrial biodiversity in the interior of British Columbia Ecoregional Assessment, conducted by The Nature Conservancy of Canada, with NatureServe's assistance. This system was designed to be equivalent to those developed for neighboring ecoregions: Canadian Rocky Mountains (7), Okanagan (68), Alaska Coastal Forest and Mountains (69), and the North Cascades (3).

Related Concepts:

- $At - Hardhack (SBSdk/10) (Steen and Coupe 1997) Intersecting
- $At - Hardhack (SBSdk/10) (Banner et al. 1993) Intersecting
- $At - Hardhack (SBSdk/10) (DeLong et al. 1993) Intersecting
- Lt - Horsetail (BWBSmw2/07) (DeLong et al. 1990) Intersecting
- Lt - Water sedge - Fen Moss (BWBSwk1/09) (DeLong et al. 1990) Intersecting
- PlSb - Sedge - Sphagnum (ICHwk3/08) (Meidinger et al. 1988) Intersecting
- Sb - Creeping-snowberry - Peat-moss (SBPSmc/08) (Banner et al. 1993) Intersecting
- Sb - Creeping-snowberry - Peat-moss (SBPSmc/08) (Steen and Coupe 1997) Intersecting
- Sb - Creeping-snowberry - Peat-moss (SBSmw/14) (Steen and Coupe 1997) Intersecting
- Sb - Creeping-snowberry - Peat-moss (SBSmw/14) (DeLong 2003) Intersecting
- Sb - Buckbean - Peat-moss (ICHmc2/11) (Banner et al. 1993) Intersecting
- Sb - Buckbean - Peat-moss (ICHmw3/10) (Steen and Coupe 1997) Intersecting
- Sb - Buckbean - Peat-moss (ICHvk2/09) (DeLong 2003) Intersecting
- Sb - Buckbean - Peat-moss (ICHwk3/11) (Meidinger et al. 1988) Intersecting
- Sb - Buckbean - Peat-moss (SBSdw2/12) (DeLong et al. 1993) Intersecting
- Sb - Buckbean - Peat-moss (SBSdw2/12) (Steen and Coupe 1997) Intersecting
- Sb - Buckbean - Peat-moss (SBSmc2/16) (DeLong et al. 1993) Intersecting
- Sb - Buckbean - Peat-moss (SBSmc2/16) (Banner et al. 1993) Intersecting
- Sb - Buckbean - Peat-moss (SBSwk1/16) (DeLong 2003) Intersecting
- Sb - Buckbean - Peat-moss (SBSwk1/16) (Steen and Coupe 1997) Intersecting
- Sb - Cloudberry - Sphagnum (BWBSmw2/08) (DeLong et al. 1990) Intersecting
- Sb - Common horsetail - Peat-moss (BWBSmw1/11) (DeLong et al. 1990) Intersecting
- Sb - Common horsetail - Peat-moss (BWBSmw2/12) (DeLong et al. 1990) Intersecting
- Sb - Common horsetail - Peat-moss (SBSdw3/12) (DeLong et al. 1993) Intersecting
- Sb - Common horsetail - Peat-moss (SBSdw3/12) (Banner et al. 1993) Intersecting
- Sb - Common horsetail - Peat-moss (SBSmc2/14) (DeLong et al. 1993) Intersecting

- Sb - Common horsetail - Peat-moss (SBSmc2/14) (Banner et al. 1993) Intersecting
- Sb - Common horsetail - Peat-moss (SBSmw/16) (DeLong 2003) Intersecting
- Sb - Common horsetail - Peat-moss (SBSmw/16) (Steen and Coupe 1997) Intersecting
- Sb - Common horsetail - Peat-moss (SBSwk1/15) (DeLong 2003) Intersecting
- Sb - Common horsetail - Peat-moss (SBSwk1/15) (Steen and Coupe 1997) Intersecting
- Sb - Creeping-snowberry - Sphagnum (SBSdk/09) (Steen and Coupe 1997) Intersecting
- Sb - Creeping-snowberry - Sphagnum (SBSdk/09) (Banner et al. 1993) Intersecting
- Sb - Creeping-snowberry - Sphagnum (SBSdk/09) (DeLong et al. 1993) Intersecting
- Sb - Feathermoss - Bluebells (BWBSmw2/06) (DeLong et al. 1990) Intersecting
- Sb - Horsetail - Sphagnum (BWBSdk1/09) (Banner et al. 1993) Intersecting
- Sb - Horsetail - Sphagnum (BWBSdk1/09) (MacKinnon et al. 1990) Intersecting
- Sb - Horsetail - Sphagnum (BWBSwk1/07) (DeLong et al. 1990) Intersecting
- Sb - Labrador tea (SBSwk3a/05) (DeLong 2004) Intersecting
- Sb - Labrador tea - Sphagnum (BWBSdk1/10) (Banner et al. 1993) Intersecting
- Sb - Labrador tea - Sphagnum (BWBSdk1/10) (MacKinnon et al. 1990) Intersecting
- Sb - Labrador tea - Sphagnum (BWBSdk2/07) (Banner et al. 1993) Intersecting
- Sb - Labrador tea - Sphagnum (BWBSmw1/08) (DeLong et al. 1990) Intersecting
- Sb - Lingonberry - Coltsfoot (BWBSdk1/07) (Banner et al. 1993) Intersecting
- Sb - Lingonberry - Coltsfoot (BWBSdk1/07) (MacKinnon et al. 1990) Intersecting
- Sb - Lingonberry - Coltsfoot (BWBSmw1/04) (DeLong et al. 1990) Intersecting
- Sb - Scrub birch - Sedge (SBPSdc/07) (Steen and Coupe 1997) Intersecting
- Sb - Scrub birch - Sedge (SBSdh1/08) (DeLong 1996) Intersecting
- Sb - Scrub birch - Sedge (SBSmk1/10) (DeLong et al. 1993) Intersecting
- Sb - Skunk cabbage - Peat-moss (ICHmc2/12) (Banner et al. 1993) Intersecting
- Sb - Skunk cabbage - Peat-moss (ICHvk2/10) (DeLong 2003) Intersecting
- Sb - Skunk cabbage - Peat-moss (SBSvk/13) (DeLong 2003) Intersecting
- Sb - Skunk cabbage - Peat-moss (SBSwk1/17) (DeLong 2003) Intersecting
- Sb - Skunk cabbage - Peat-moss (SBSwk1/17) (Steen and Coupe 1997) Intersecting
- Sb - Soft-leaved sedge - Peat-moss (ICHmc2/10) (Banner et al. 1993) Intersecting
- Sb - Soft-leaved sedge - Peat-moss (MSxv/10) (Steen and Coupe 1997) Intersecting
- Sb - Soft-leaved sedge - Peat-moss (SBSmc2/13) (Banner et al. 1993) Intersecting
- Sb - Soft-leaved sedge - Peat-moss (SBSmc2/13) (DeLong et al. 1993) Intersecting
- Sb - Soft-leaved sedge - Peat-moss (SBSmw/15) (DeLong 2003) Intersecting
- Sb - Soft-leaved sedge - Peat-moss (SBSmw/15) (Steen and Coupe 1997) Intersecting
- Sb - Soft-leaved sedge - Sphagnum (SBSdk/10) (Steen and Coupe 1997) Intersecting
- Sb - Soft-leaved sedge - Sphagnum (SBSdk/10) (DeLong et al. 1993) Intersecting
- Sb - Soft-leaved sedge - Sphagnum (SBSdk/10) (Banner et al. 1993) Intersecting
- Sb - Soft-leaved sedge - Sphagnum (SBSdw2/11) (DeLong et al. 1993) Intersecting
- Sb - Soft-leaved sedge - Sphagnum (SBSdw2/11) (Steen and Coupe 1997) Intersecting
- Sb - Soft-leaved sedge - Sphagnum (SBSdw3/10) (Banner et al. 1993) Intersecting
- Sb - Soft-leaved sedge - Sphagnum (SBSdw3/10) (DeLong et al. 1993) Intersecting
- Sb - Sphagnum (ICHvk2/07) (DeLong 2003) Intersecting
- Sb - Water sedge - Peat-moss (BWBSdk1/13) (MacKinnon et al. 1990) Intersecting
- Sb - Water sedge - Peat-moss (BWBSdk1/13) (Banner et al. 1993) Intersecting
- Sb - Water sedge - Peat-moss (SBSdw3/11) (Banner et al. 1993) Intersecting
- Sb - Water sedge - Peat-moss (SBSdw3/11) (DeLong et al. 1993) Intersecting
- Sb - Water sedge - Peat-moss (SBSmk2/07) (MacKinnon et al. 1990) Intersecting
- Sb - Water sedge - Peat-moss (SBSmm/10) (Steen and Coupe 1997) Intersecting
- Sb - Willow (BWBSmw2/09) (DeLong et al. 1990) Intersecting
- Sb - Willow - Glow moss (BWBSwk1/08) (DeLong et al. 1990) Intersecting
- Sb - Willow - Glow moss (BWBSwk2/08) (DeLong et al. 1990) Intersecting
- SbPl - Bog-laurel - Sphagnum (ICHmm/07) (DeLong 1996) Intersecting
- SbPl - Bog-laurel - Sphagnum (SBSvk/08) (DeLong 2003) Intersecting
- SbPl - Feathermoss (SBSmc3/06) (Steen and Coupe 1997) Intersecting
- SbPl - Feathermoss (SBSwk1/12) (DeLong 2003) Intersecting
- SbSxw - Scrub birch - Sedge (SBPSmc/07) (Steen and Coupe 1997) Intersecting
- SbSxw - Scrub birch - Sedge (SBPSmc/07) (DeLong et al. 1993) Intersecting
- SbSxw - Scrub birch - Sedge (SBPSmc/07) (Banner et al. 1993) Intersecting
- SbSxw - Scrub birch - Sedge (SBPSmk/08) (Steen and Coupe 1997) Intersecting
- SbSxw - Scrub birch - Sedge (SBSmc2/12) (DeLong et al. 1993) Intersecting
- SbSxw - Scrub birch - Sedge (SBSmc2/12) (Banner et al. 1993) Intersecting
- SbSxw - Scrub birch - Sedge (SBSmc3/09) (Steen and Coupe 1997) Intersecting

- SbSxw - Scrub birch - Sedge (SBSmc3/09) (DeLong et al. 1993) Intersecting
- SbSxw - Scrub birch - Sedge (SBSmw/10) (Steen and Coupe 1997) Intersecting
- SbSxw - Scrub birch - Sedge (SBSwk1/11) (Steen and Coupe 1997) Intersecting
- SbSxw - Scrub birch - Sedge (SBSwk1/11) (DeLong 2003) Intersecting
- Sw - Forested wetland (SWBmk/09) (DeLong 2000) Intersecting
- Sw - Forested wetland (SWBmk/09) (Banner et al. 1993) Intersecting
- Sxw - Devil's club - Lady fern (ICHwk4/08) (Steen and Coupe 1997) Intersecting
- Sxw - Horsetail - Leafy moss (MSdv/09) (Steen and Coupe 1997) Intersecting
- Sxw - Huckleberry - Highbush-cranberry (ESSFmv3/06) (Banner et al. 1993) Intersecting

DISTRIBUTION

Range: This ecological system is found in northern boreal British Columbia and fingers down into the interior regions of British Columbia. Black spruce swamps can be expected to occur throughout boreal North America.
Divisions: 103:C; 105:C; 207:C
Nations: CA
Subnations: AB, BC, MB, NT, ON, QC, SK
TNC Ecoregions: 139:C, 144:C

SOURCES

References: Banner et al. 1993, DeLong 1996, DeLong 2000, DeLong 2003, DeLong 2004, DeLong et al. 1990, DeLong et al. 1993, Lawrence et al. 2005, MacKinnon et al. 1990, Meidinger et al. 1988, Smith et al. 2007, Steen and Coupe 1997, Stone et al. 2007, Western Ecology Working Group n.d., Willoughby 2007, Willoughby et al. 2006
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.820936#references
Description Author: G. Kittel, mod. M.S. Reid
Version: 31 Mar 2010 **Stakeholders:** Canada, West
Concept Author: G. Kittel, mod. M.S. Reid **ClassifResp:** West

BOREAL BLANKET BOG (CES103.870)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Primary Division: Boreal (103)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Boreal [Boreal Continental]; Seepage-Fed Sloping; Depressional; Sphagnum spp.
Non-Diagnostic Classifiers: Montane [Lower Montane]; Lowland [Foothill]; Lowland [Lowland]; Shrubland (Shrub-dominated)
National Mapping Codes: ESLF 9174

CONCEPT

Summary: This ecological system extends across the western boreal regions of North America with occurrences in inland British Columbia. These are peatlands that occur on expansive, flat landscapes in areas of high rainfall and low temperatures. They are thought to have developed under cool, moist climatic regimes of the past 2500 to 3000 years, where the paludification process results in previously forested landscapes being blanketed by expanding peat from adjacent low-lying areas, hence the term "blanket" bog. Trees are generally quite stunted. Dominant tree species include *Picea mariana, Picea glauca, Picea sitchensis*, and *Larix laricina*. Low ericaceous shrubs, including *Kalmia* spp., *Ledum groenlandicum*, *Chamaedaphne calyculata*, and *Betula glandulosa*, occur with patches of graminoids and bryophyte lawns. *Sphagnum* species, including *Sphagnum magellanicum*, *Sphagnum fuscum*, and *Sphagnum cuspidatum*, may be characteristic.
Classification Comments: It's unclear where this system occurs, but for now it is assumed to not occur in Alaska. More information is needed to solidify its concept and distribution.
Related Concepts:
- Sitka Spruce: 223 (Eyre 1980) Intersecting

DISTRIBUTION

Range: This system occurs in the western boreal regions of North America with occurrences in inland British Columbia.
Divisions: 103:C; 105:P; 204:P; 306:C
Nations: CA, US
Subnations: AB, AK, BC, NT, YT?
TNC Ecoregions: 7:C, 69:?

SOURCES

References: Banner et al. 1993, Comer et al. 2003, Green and Klinka 1994, NCC 2002
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722805#references
Description Author: G. Kittel, mod. M.S. Reid
Version: 08 Dec 2008
Stakeholders: Canada, West
Concept Author: G. Kittel
ClassifResp: West

BOREAL DEPRESSIONAL SHRUB BOG (CES103.871)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Boreal (103)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Shrubland (Shrub-dominated); Depressional [Lakeshore]; Depressional [Sinkhole]; Organic Peat (>40 cm); Sphagnum spp.
Non-Diagnostic Classifiers: Boreal Fen; Boreal [Boreal Continental]; Isolated Wetland [Partially Isolated]
National Mapping Codes: ESLF 9175

CONCEPT

Summary: These wetlands are found at higher temperate and boreal latitudes of Canada, extending south into the Pacific Maritime and Rocky Mountain divisions. They form where the rate of sphagnum peat accumulation exceeds its decomposition, resulting in ombrotrophic and acidic peatlands in which the bog surface is raised above the water table. These peatlands are typically formed as lake-filled basins or depressions. The surface morphology of the peatland may be more-or-less level, domed, or eccentric. Secondary bog pools may be present. While the raised portion defines these bogs, boreal fen systems may occupy some portion of the same basin, due to localized groundwater input. Soils are saturated throughout the growing season from groundwater upwelling. The vegetation is dominated by low ericaceous shrubs (including *Kalmia polifolia*, *Andromeda polifolia*, *Ledum groenlandicum*, *Rubus chamaemorus*, *Vaccinium oxycoccos*, *Betula glandulosa*, *Empetrum nigrum*, and *Chamaedaphne calyculata*), and with patches of graminoids and bryophyte lawns. *Sphagnum* species are characteristic, including *Sphagnum capillifolium*, *Sphagnum magellanicum*, *Sphagnum fuscum*, *Sphagnum papillosum*, and *Sphagnum cuspidatum*. Conifers sometimes occur (*Picea mariana* or *Larix laricina*), especially late in succession.
Classification Comments: It's somewhat unclear where this system occurs, but for now it is assumed to not occur in Alaska. More information is needed to solidify its concept and distribution differences from the several peatland systems defined for Alaska. Where this system occurs in Idaho, Montana and eastern Oregon, it is very uncommon, and is disjunct from the true boreal distribution of the system. Bogs and fens in the maritime climate regions of Oregon, Washington and British Columbia are placed into North Pacific Bog and Fen (CES204.063).
Similar Ecological Systems:
- North Pacific Bog and Fen (CES204.063)

Related Concepts:
- Lodgepole Pine: 218 (Eyre 1980) Intersecting
- Non-forested bog (BWBSdk1/31) (Banner et al. 1993) Intersecting
- Non-forested bog (BWBSdk1/31) (MacKinnon et al. 1990) Intersecting
- Non-forested bog (BWBSdk2/31) (Banner et al. 1993) Intersecting
- Scheuchzeria - Peat-moss (ICHmc2/Wb12) (Banner et al. 1993) Intersecting
- Scheuchzeria - Peat-moss (ICHmk3/Wb12) (Steen and Coupe 1997) Intersecting
- Scheuchzeria - Peat-moss (SBSdw3/Wb12) (DeLong et al. 1993) Intersecting
- Scheuchzeria - Peat-moss (SBSdw3/Wb12) (Banner et al. 1993) Intersecting
- Scheuchzeria - Peat-moss (SBSmc2/Wb12) (Banner et al. 1993) Intersecting
- Scheuchzeria - Peat-moss (SBSmc2/Wb12) (DeLong et al. 1993) Intersecting
- Scheuchzeria - Peat-moss (SBSvk/Wb12) (DeLong 2003) Intersecting
- Shore sedge - Buckbean - Peat-moss (CWHws1/Wb13) (Banner et al. 1993) Intersecting
- Shore sedge - Buckbean - Peat-moss (CWHws2/Wb13) (Banner et al. 1993) Intersecting
- Shore sedge - Buckbean - Peat-moss (ICHmc1/Wb13) (Meidinger et al. 1988) Intersecting
- Shore sedge - Buckbean - Peat-moss (ICHmc1/Wb13) (Banner et al. 1993) Intersecting
- Shore sedge - Buckbean - Peat-moss (ICHvc/Wb13) (Banner et al. 1993) Intersecting
- Shore sedge - Buckbean - Peat-moss (ICHwk2/Wb13) (Steen and Coupe 1997) Intersecting
- Shore sedge - Buckbean - Peat-moss (SBSmk1/Wb13) (DeLong et al. 1993) Intersecting

Component Associations:
- *Carex exsiccata* Herbaceous Vegetation (CEGL003312, G2G3)
- *Eriophorum chamissonis / Sphagnum* spp. Herbaceous Vegetation (CEGL003333, G4)
- *Ledum groenlandicum - Kalmia microphylla / Sphagnum* spp. Shrubland (CEGL003414, G4)
- *Ledum groenlandicum - Myrica gale / Sphagnum* spp. Shrubland (CEGL003335, G2)
- *Rhynchospora alba - (Vaccinium oxycoccos) / Sphagnum tenellum* Herbaceous Vegetation (CEGL003338, G3)
- *Spiraea douglasii / Sphagnum* spp. Shrubland (CEGL003416, G3)

DISTRIBUTION

Range: This system is found at higher temperate and boreal latitudes of Canada, extending south into the Pacific Maritime and Rocky

Mountain divisions, but not west of the coastal mountain ranges of Alaska, British Columbia and Washington.
Divisions: 103:C; 105:C; 306:C
Nations: CA, US
Subnations: AB, AK, BC, ID, MT, OR, WA?, YT
Map Zones: 10:P, 19:C
USFS Ecomap Regions: M242D:??, M333A:??, M333B:??

SOURCES

References: Banner et al. 1993, Bursik and Moseley 1995, Comer et al. 2003, DeLong 2003, DeLong et al. 1993, Eyre 1980, Green and Klinka 1994, Lawrence et al. 2005, MacKinnon et al. 1990, Meidinger et al. 1988, Smith et al. 2007, Steen and Coupe 1997, Stone et al. 2007, Willoughby 2007, Willoughby et al. 2006
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722804#references
Description Author: G. Kittel and P. Comer, mod. M.S. Reid
Version: 31 Mar 2010 **Stakeholders:** Canada, West
Concept Author: G. Kittel and P. Comer **ClassifResp:** West

BOREAL WHITE SPRUCE SWAMP AND BOG (CES105.340)

CLASSIFIERS

Classification Status: Standard

Primary Division: Montane Boreal (105)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Boreal; Bog
National Mapping Codes: ESLF 9399

CONCEPT

Summary: This ecological system encompasses moist lower and toeslope seepage sites, often near stream channels, with subhydric soils with medium to very rich nutrients. Some sites are not near the groundwater; at others, the groundwater table is within 50 cm of the surface. Soils are loamy sands, silt, or organics with up to 40 cm Hemimor or Humimor humus. Occurrences are small in size and widely distributed. Forest canopy ranges from very open to moderately closed and dominated by *Picea galuca X engelmannii* (hybrid white spruce) with *Picea mariana*, other species often include *Pinus contorta, Populus tremuloides*, and scattered *Abies lasiocarpa* in colder sites or *Pseudotsuga menziesii* in warmer pockets. The shrub layer can be absent to abundant with *Lonicera involucrata, Rosa acicularis*, and *Vaccinium membranaceum*. The undergrowth has abundant *Equisetum scirpoides, Equisetum arvense, Calamagrostis rubescens, Petasites frigidus var. palmatus (= Petasites palmatus)*, and *Maianthemum stellatum (= Smilacina stellata)*. Moss cover is abundant and generally dominated by leafy mosses.
Classification Comments: This ecological system was developed for the purpose of capturing the coarse filter of terrestrial biodiversity in the interior of British Columbia Ecoregional Assessment, conducted by The Nature Conservancy of Canada, with NatureServe's assistance. This system was designed to be equivalent to those developed for neighboring ecoregions: Canadian Rocky Mountains (7), Okanagan (68), Alaska Coastal Forest and Mountains (69), and the North Cascades (3).
Related Concepts:
- Sb - Horsetail - Sphagnum (BWBSwk2/07) (DeLong et al. 1990) Intersecting
- Sw - Devil's club (BWBSmw2/11) (DeLong et al. 1990) Intersecting
- Sw - Willow - Glow moss (BWBSdk1/11) (MacKinnon et al. 1990) Intersecting
- Sw - Willow - Glow moss (BWBSdk1/11) (Banner et al. 1993) Intersecting
- Sxw - Feathermoss - Brachythecium (IDFdk4/09) (Steen and Coupe 1997) Intersecting
- Sxw - Horsetail - Glow moss (IDFdk3/09) (Steen and Coupe 1997) Intersecting
- Sxw - Horsetail - Glow moss (IDFdk4/10) (Steen and Coupe 1997) Intersecting
- Sxw - Horsetail - Glow moss (SBPSdc/08) (Steen and Coupe 1997) Intersecting
- Sxw - Horsetail - Glow moss (SBPSmc/06) (Banner et al. 1993) Intersecting
- Sxw - Horsetail - Glow moss (SBPSmc/06) (DeLong et al. 1993) Intersecting
- Sxw - Horsetail - Glow moss (SBPSmc/06) (Steen and Coupe 1997) Intersecting
- Sxw - Horsetail - Glow moss (SBPSmk/07) (Steen and Coupe 1997) Intersecting
- Sxw - Horsetail - Glow moss (SBPSxc/05) (Steen and Coupe 1997) Intersecting
- Sxw - Horsetail - Glow moss (SBSdw1/09) (Steen and Coupe 1997) Intersecting
- Sxw - Horsetail - Glow moss (SBSdw1/09) (DeLong 2003) Intersecting
- Sxw - Horsetail - Glow moss (SBSdw3/09) (DeLong et al. 1993) Intersecting
- Sxw - Horsetail - Glow moss (SBSdw3/09) (Banner et al. 1993) Intersecting
- Sxw - Horsetail - Glow moss (SBSmc1/08) (Steen and Coupe 1997) Intersecting
- Sxw - Horsetail - Glow moss (SBSmc2/11) (DeLong et al. 1993) Intersecting
- Sxw - Horsetail - Glow moss (SBSmh/09) (Steen and Coupe 1997) Intersecting
- Sxw - Horsetail - Glow moss (SBSmh/09) (DeLong 2003) Intersecting
- Sxw - Labrador tea - Willow (MSxv/09) (Steen and Coupe 1997) Intersecting

DISTRIBUTION

Range: This ecological system is found in northern boreal British Columbia and fingers down into the interior regions of British Columbia.
Divisions: 105:C; 207:C
Nations: CA
Subnations: BC
TNC Ecoregions: 139:C, 144:C

SOURCES

References: Banner et al. 1993, DeLong 2003, DeLong et al. 1990, DeLong et al. 1993, MacKinnon et al. 1990, Steen and Coupe 1997, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.820941#references

Description Author: G. Kittel
Version: 25 Jan 2009
Concept Author: G. Kittel

Stakeholders: Canada, West
ClassifResp: West

BOREAL WILLOW-ALDER SWAMP THICKET (CES103.524)

CLASSIFIERS

Classification Status: Standard

Primary Division: Boreal (103)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Saturated Soil; Shrubland (Shrub-dominated); Muck; Broad-Leaved Deciduous Shrub
National Mapping Codes: ESLF 9397

CONCEPT

Summary: These are deciduous tall-shrub swamps found throughout boreal Canada. They include medium-tall to short shrublands of slow-moving streams and rivers, around beaver ponds in the peripheral zones of wetlands and lakeshores, where there is early-season flooding, continuous seepage near the surface and poor drainage. These shrub swamps are related to both mineral and peatland wetland types, and can occur in widely different landscape settings from mineral-soil floodplains to peatland soil. For this reason swamps have traditionally been harder to identify than other wetland types and are often confused or grouped with other wetland classes. Swamps are distinguished from other wetland types in that they are wooded (treed or shrub) wetlands that are in contact with minerotrophic water in either mineral or peatland soils. An important distinction is that the woody vegetation dominates swamp areas (often in percentages greater than 30% and up to 100% of the canopy) as a result of greater contact with nutrients, aerated soils, and high water availability. The majority of swamps have closed canopies (greater than 50%). This abundance of woody material in swamps provides another important distinction in that the peat is primarily composed of decomposing wooded material (shrub and tree) rather than the *Sphagnum* or sedge-dominated peat types that comprise the organic layer in poor fens and bogs. Further, peat soils in swamps are fairly well-decomposed as a result of fluctuating water tables that allow for oxygen and decomposition. Shrubs, generally >2 m in height, dominate the cover of these swamps. These are deciduous shrubs, predominantly willows (*Salix* spp.) and alders (*Alnus incana ssp. tenuifolia, Alnus incana ssp. rugosa*). They are typically dense thickets, or patches of shrubs intermingled with patches of wet meadows. Common shrub species include *Alnus incana ssp. tenuifolia, Alnus incana ssp. rugosa (= Alnus rugosa), Alnus viridis, Cornus sericea (= Cornus sericea*), and a number of species of *Salix*. A shorter shrub layer can be present, including *Betula glandulosa, Betula nana, Betula pumila, Rosa* spp., *Vaccinium* spp., as well as a number of forbs, ferns, sedges, and mosses.
Classification Comments: This system is similar to Western North American Boreal Deciduous Shrub Swamp (CES105.122) of Alaska, and exactly where one transitions to the other is not yet determined. They could possibly be merged into one boreal willow-alder swamp system, but this needs review. Certainly there is a lot of similar composition in these swamps across boreal North America, with some shifts in the willows found in Alaska versus those found in eastern Canada. This system is also similar to North Pacific Interior Shrub Swamp (CES207.397) of interior British Columbia. That system should probably be merged into this one.
Similar Ecological Systems:
- North Pacific Interior Shrub Swamp (CES207.397)--of interior British Columbia.
- Western North American Boreal Deciduous Shrub Swamp (CES105.122)--of Alaska.

DESCRIPTION

Environment: *Hydrology/Moisture Regime*: Water regime (fluctuating water table) and availability play a significant role in swamps. The water table in swamps fluctuates seasonally, or in some systems bi-yearly, but pools of water are often visible in the hummocky ground surface. Thus, for most of the growing season, the majority of the soil layer is aerated, but water availability is still high in the continually saturated lower portions of the rooting zone. Treed swamps (such as hardwood or mixedwood swamps) in mineral soils are often drier, while swamps that grade into treed fens (tamarack swamps) are wetter. Shrub swamps are almost always wetter than most of the treed swamps, except in some riparian floodplain-associated areas on mineral soils. Moisture regimes for swamps range from hygric to hydric. Flow through swamps is fairly dynamic with good lateral flow through the ground water layer, and fluctuations of this water table allow for aeration of the rooting zone during the growing season. *Soils*: Swamps exist in both peat and mineral soils. Swamps are sometimes termed peatlands but the substrate is from woody (silvic) peat and is well-decomposed. Decomposition is driven by the fluctuating water levels which are absent in *Sphagnum*-derived peatlands. Swamp soils are typically composed of gleysols with mottling in the upper horizons and gleying in the lower horizons. Mottling occurs in a soil that has been inundated with water intermittently (the mottles are iron and manganese oxides). Gleization occurs during the chemical reduction of iron, thus changing the soil colors. Soils with low chromas are indicative of hydric conditions. *Nutrient Regime*: The nutrient regime in swamp wetlands ranges from poor to rich, depending on the amount of contact with dissolved mineral water. Most shrub swamps range from medium to rich.

DISTRIBUTION

Range: This system is found throughout boreal Canada, from Yukon Territory east and south into Alberta, Saskatchewan and further east.
Divisions: 103:C; 105:C
Nations: CA
Subnations: AB, MB, ON?, QC?, SK, YT

SOURCES

References: Lawrence et al. 2005, Smith et al. 2007, Stone et al. 2007, Thompson and Hansen 2003, Western Ecology Working Group n.d., Willoughby 2007, Willoughby et al. 2006

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.837958#references

Description Author: M.S. Reid

Version: 31 Mar 2010 **Stakeholders:** Canada, West

Concept Author: M.S. Reid **ClassifResp:** West

BOREAL-LAURENTIAN BOG (CES103.581)

CLASSIFIERS

Classification Status: Standard

Primary Division: Boreal (103)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Oligotrophic Water; Organic Peat (>40 cm); Dwarf-Shrub; Graminoid
Non-Diagnostic Classifiers: Saturated Soil; >180-day hydroperiod; Moderate (100-500 yrs) Persistence; Shrubland (Shrub-dominated); Depressional; Isolated Wetland [Partially Isolated]; Bryophyte; Picea mariana - Larix laricina
National Mapping Codes: ESLF 9354

CONCEPT

Summary: These raised peatlands are found at the higher temperate and near-boreal latitudes of the northeastern and north-central United States and adjacent Canada, where climate allows the rate of peat accumulation to exceed its decomposition, resulting in acidic peatlands. Most are ombrotrophic, at least over part of their area, though some examples may be weakly minerotrophic (poor fen), especially around the margins. The surface morphology of the bog may be more-or-less level, domed, or eccentric, but typically is over the water table. The vegetation is either semi-treed and dominated by low ericaceous shrubs (including *Kalmia angustifolia, Kalmia polifolia, Ledum groenlandicum*, and *Chamaedaphne calyculata*), with patches of conifers, graminoids and bryophyte lawns, or more open forest, where trees form a partial to moderate cover over parts of the peatland. In the latter situation, stunted *Picea mariana* and *Larix laricina* are the dominant trees, and dwarf-shrubs (*Chamaedaphne calyculata, Ledum groenlandicum*) and sedges are common in the understory.

Secondary bog pools (schlenke) may be present. While the raised portion defines these bogs, fen vegetation is often present along the perimeter.

This broadly defined peatland system can be subdivided based on the geomorphology of the peatland. A variety of approaches have been taken: in Maine, see Davis and Anderson (2001); in Canada, see National Wetlands Working Group (1988); and in Minnesota, see Glaser (1992). In Canada, bog and fen peatlands each have their own set of forms. In Minnesota, Glaser treats bogs and fens together as part of larger patterned peatland complexes (mire complexes).
Classification Comments: This system corresponds to Glaser and Janssens' (1986) forested and "semi-forested continental bogs," but this system is somewhat broader in scope as it includes both the domed bogs and the flat bogs in the system type. Thus it extends further southward, into the central Great Lakes and northeasternmost United States. Eastward, it extends roughly to the Acadian region, where it is replaced by Acadian Maritime Bog (CES201.580). Northwestward in northern Ontario, continental non-forested bogs are common (Glaser and Janssens 1986, fig. 2).

These bogs may overlap in common terminology with that of "muskeg," a flat bog peatland with scattered trees and a fairly dense shrub layer on hummocky peat. But muskeg could include poor fens and acidic swamps as well as bogs.

Similar Ecological Systems:
- Acadian Maritime Bog (CES201.580)
- Boreal-Laurentian Conifer Acidic Swamp and Treed Poor Fen (CES103.724)
- North-Central Interior and Appalachian Acidic Peatland (CES202.606)

Related Concepts:
- Black Spruce - Tamarack: 13 (Eyre 1980) Finer
- Bog Moss Lawn (Gawler and Cutko 2010) Finer
- Leatherleaf Boggy Fen (Gawler and Cutko 2010) Finer
- Low Sedge - Buckbean Fen Lawn (Gawler and Cutko 2010) Finer
- Muskeg (Kost et al. 2007) Broader
- Sheep Laurel Dwarf Shrub Bog (Gawler and Cutko 2010) Finer
- Spruce - Larch Wooded Bog (Gawler and Cutko 2010) Finer
- Tamarack: 38 (Eyre 1980) Finer

Component Associations:
- *Alnus incana ssp. rugosa - Nemopanthus mucronatus / Sphagnum* spp. Shrubland (CEGL006158, G5)
- *Carex (oligosperma, exilis) - Chamaedaphne calyculata* Shrub Herbaceous Vegetation (CEGL006524, GNR)
- *Carex lasiocarpa - Rhynchospora alba - Scheuchzeria palustris* Herbaceous Vegetation (CEGL002501, G2?)
- *Carex limosa - Rhynchospora alba / Sphagnum pulchrum - Cladopodiella* sp. Herbaceous Vegetation (CEGL006522, GNR)
- *Carex oligosperma - Carex pauciflora - Eriophorum vaginatum / Sphagnum* spp. Herbaceous Vegetation (CEGL005256, G4G5)
- *Chamaedaphne calyculata - Ledum groenlandicum - Kalmia polifolia* Bog Dwarf-shrubland (CEGL005278, G5)
- *Chamaedaphne calyculata / Carex oligosperma / Sphagnum* spp. Poor Fen Dwarf-shrubland (CEGL005277, G5)
- *Kalmia angustifolia - Chamaedaphne calyculata - (Picea mariana) / Cladina* spp. Dwarf-shrubland (CEGL006225, G5)
- *Picea mariana - (Larix laricina) / Ledum groenlandicum / Sphagnum* spp. Forest (CEGL005271, G5)

- *Picea mariana / (Vaccinium corymbosum, Gaylussacia baccata) / Sphagnum* sp. Woodland (CEGL006098, G3G5)
- *Picea mariana / Chamaedaphne calyculata / Sphagnum* spp. Open Bog Woodland (CEGL005218, G4G5)
- *Picea mariana / Ledum groenlandicum / Carex trisperma / Sphagnum* spp. Bog Woodland (CEGL002485, G5)
- *Rhododendron canadense - Chamaedaphne calyculata* Dwarf-shrubland (CEGL006514, GNR)
- *Sphagnum (cuspidatum, torreyanum) - Vaccinium macrocarpon* Nonvascular Vegetation (CEGL006394, GNR)
- *Sphagnum rubellum - Vaccinium oxycoccos* Nonvascular Vegetation (CEGL006135, GNR)

DISTRIBUTION

Range: This system occurs in central and eastern Canada, extending into northern New England and the Great Lakes region, particularly in northern Minnesota. Very few examples occur south of the Laurentian-Acadian Division.
Divisions: 103:C; 201:C; 202:C
Nations: CA, US
Subnations: MB, ME, MI, MN, NB, NS, NY, ON, PE?, QC, VT, WI
Map Zones: 41:C, 50:C, 51:C, 64:C, 66:C
USFS Ecomap Regions: 211Aa:CCC, 211Ab:CCC, 211Ba:CCC, 211Bb:CCC, 211Ca:CCC, 211Cb:CCC, 211Da:CCC, 211Dc:CCC, 212Ha:CCC, 212Hb:CCC, 212Hc:CCC, 212Hd:CCC, 212He:CCC, 212Hf:CCC, 212Hg:CCC, 212Hh:CCC, 212Hi:CCC, 212Hj:CCC, 212Hk:CCC, 212Hl:CCC, 212Hm:CCC, 212Ra:CCC, 212Rb:CCC, 212Rc:CCC, 212Rd:CCC, 212Re:CCC, 221Ai:CCP, 221Ak:CCC, M211Aa:CCC, M211Ab:CCC, M211Ae:CCC, M211Af:CCC, M211Ba:CCP, M211Ca:CCP, M211Da:CCP, M211Dc:CCP
TNC Ecoregions: 47:C, 48:C, 61:C, 63:C

SOURCES

References: Comer et al. 2003, Damman and French 1987, Davis and Anderson 2001, Glaser 1992a, Glaser and Janssens 1986, Harris et al. 1996, National Wetlands Working Group 1988
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723024#references
Description Author: S.C. Gawler and D. Faber-Langendoen
Version: 04 Mar 2004 **Stakeholders:** Canada, East, Midwest
Concept Author: S.C. Gawler and D. Faber-Langendoen **ClassifResp:** East

BOREAL-LAURENTIAN CONIFER ACIDIC SWAMP AND TREED POOR FEN (CES103.724)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Boreal (103)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Non-Diagnostic Classifiers: Forest and Woodland (Treed); Depressional; Isolated Wetland [Partially Isolated]
National Mapping Codes: ESLF 9177

CONCEPT

Summary: This ecological system extends across the boreal regions of central and western Canada, and east and south into northern New England and the Great Lakes region. The system is primarily weakly to moderately minerotrophic (poor fen), though some stands may approach ombrotrophic (bog) conditions. Decomposition is so slow that fibrous or woody peat accumulates, and the water is slightly to very acidic and nutrient-poor (also called mesotrophic). Acidic (also called poor or transitional) fens have organic soils and are dominated by aquatics, emergents, and dwarf-shrubs, or raised peat dominated by shrubs and trees. Groundwater, the primary water source, is nutrient-rich due to its contact with mineral soils, however, acidic fens have less contact with nutrient-rich waters, as the amount of peat has accumulated to raise the level of the fen, but it remains in contact with groundwater (hence "transitional" on its way to becoming a bog). The water is acidic, with a pH generally between 4.0 and 5.8. This is a forested peatland where the trees form partial to full cover over most or all of the peatland. Stunted to well-developed *Picea mariana* and *Larix laricina* are the dominant trees. Heaths and sedges are common in the understory, but the dwarf-shrub layer is less well-developed than in open acidic peatlands, though it may be prominent in more open parts of the system. *Chamaedaphne calyculata, Kalmia polifolia, Ledum groenlandicum, Vaccinium macrocarpon (= Oxycoccus macrocarpus), Vaccinium vitis-idaea*, and *Salix* spp. are the dominant dwarf-shrubs. Other fen indicators also occur, such as *Betula glandulosa* or *Betula pumila*. Other poor fens are graminoid-dominated with herbaceous indicators such as *Drosera* spp., *Equisetum fluviatile, Maianthemum trifolium, Sarracenia purpurea*, and sedges (*Carex* spp.)
Classification Comments: This forested system is most common in poorly drained basins, with some minerotrophic influence. It is sometimes referred to as "muskeg," a flat bog peatland with scattered trees and a fairly dense shrub layer on mounded or hummocky peat, though this system is not, technically, an ombrotrophic bog [see Boreal-Laurentian Bog (CES103.581)]. Muskeg is probably a complex of bogs and acidic swamps. Black spruce swamps in northeastern Vermont, northern New Hampshire, Adirondack region of New York, and Maine are included here. There appears to be no need for a true Boreal alkaline swamp system, but further review is needed. In Acadia and the Northern Appalachian regions, this system is mostly replaced by the sub-boreal Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp (CES201.574). Small kettlehole bogs in the northeastern U.S. are attributed to North-Central Interior and Appalachian Acidic Peatland (CES202.606). In western Canada, this system is uncommon because the substrates are mostly calcareous, resulting in a preponderance of rich, alkaline fens either dominated by *Larix laricina* with some *Picea mariana*, or else shrub-sedge fens lacking trees.
Similar Ecological Systems:
- Boreal-Laurentian Bog (CES103.581)--only partly wooded, if at all.
- Boreal-Laurentian-Acadian Acidic Basin Fen (CES201.583)
- North-Central Interior and Appalachian Acidic Peatland (CES202.606)
- Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp (CES201.574)--characterized by *Picea rubens* rather than *Picea mariana*.

Related Concepts:
- Black Spruce (eastern type): 12 (Eyre 1980) Finer
- Black Spruce - Tamarack: 13 (Eyre 1980) Finer
- Muskeg (Kost et al. 2007) Intersecting
- Poor Conifer Swamp (Kost et al. 2007) Intersecting

Component Associations:
- *Carex lasiocarpa - Carex oligosperma / Sphagnum* spp. Herbaceous Vegetation (CEGL002265, G3G4)
- *Chamaedaphne calyculata / Carex oligosperma / Sphagnum* spp. Poor Fen Dwarf-shrubland (CEGL005277, G5)
- *Larix laricina / Chamaedaphne calyculata / Carex lasiocarpa* Shrubland (CEGL005226, G4G5)
- *Picea mariana - (Larix laricina) / Ledum groenlandicum / Sphagnum* spp. Forest (CEGL005271, G5)
- *Picea mariana / Alnus incana / Sphagnum* spp. Forest (CEGL002452, G5)
- *Picea mariana / Ledum groenlandicum / Carex trisperma / Sphagnum* spp. Bog Woodland (CEGL002485, G5)
- *Pinus banksiana - (Picea mariana)* - Mixed Hardwoods / *Sphagnum* spp. Forest (CEGL005166, GNRQ)

DISTRIBUTION

Range: This system is found in central and eastern Canada, extending into northern New England and the Great Lakes region, particularly in northern Minnesota.
Divisions: 103:C; 201:C
Nations: CA, US

Subnations: AB, MB, ME, MI, MN, NB, NH, NS, NY, ON, PE?, SK, VT, WI
Map Zones: 40:C, 41:C, 50:C, 51:C, 64:C, 66:C
USFS Ecomap Regions: 211A:CC, 211B:CC, 211C:CC, 211D:CC, 212Ha:CCC, 212Hb:CCC, 212Hc:CCC, 212Hd:CCC, 212He:CCC, 212Hf:CCC, 212Hg:CCC, 212Hh:CCC, 212Hi:CCC, 212Hj:CCC, 212Hk:CCC, 212Hl:CCC, 212Hm:CCC, 212K:CC, 212L:CC, 212M:CC, 212N:CC, 212Ra:CCC, 212Rb:CCC, 212Rc:CCC, 212Rd:CCC, 212Re:CCC, M211A:CC, M211B:CC, M211C:CC, M211D:CC
TNC Ecoregions: 47:C, 48:C, 63:C, 137:?, 140:C, 141:C

SOURCES

References: Comer et al. 2003, Glaser and Janssens 1986, Harris et al. 1996, Kost et al. 2007, Smith et al. 2007
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722947#references
Description Author: D. Faber-Langendoen, mod. M.S. Reid
Version: 31 Mar 2010 **Stakeholders:** Canada, East, Midwest
Concept Author: D. Faber-Langendoen **ClassifResp:** Midwest

BOREAL-LAURENTIAN-ACADIAN ACIDIC BASIN FEN (CES201.583)

CLASSIFIERS

Classification Status: Standard

Primary Division: Laurentian-Acadian (201)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Acidic Water; Depressional; Organic Peat (>40 cm); Broad-Leaved Shrub; Dwarf-Shrub; Graminoid; Picea mariana - Larix laricina
Non-Diagnostic Classifiers: Oligotrophic Water; Shallow (<15 cm) Water; Moderate (100-500 yrs) Persistence; Shrubland (Shrub-dominated); Isolated Wetland [Partially Isolated]
National Mapping Codes: ESLF 9353

CONCEPT

Summary: This peatland system ranges over a broad geographic area across the glaciated Northeast to the Great Lakes and upper Midwest. The fens have developed in open or closed, relatively shallow basins with nutrient-poor and acidic conditions. Many occur in association with larger lakes or streams. Some occur as kettlehole fens (usually called kettlehole "bogs") associated with eskers or other glacial deposits. The substrate is *Sphagnum*, and vegetation typically includes areas of graminoid dominance and dwarf-shrub dominance. *Chamaedaphne calyculata* is usually present and often dominant. Scattered stunted trees may be present. These fens often develop adjacent to open water and may form a floating mat over water.

Particularly distinctive are the ribbed bogs or fens in which a pattern of narrow (2- to 3-m wide), low (less than 1 m deep) ridges are oriented at right angles to the direction of the drainage (National Wetlands Working Group 1988). Wet pools or depressions occur between the ridges. These patterned peatlands may include string bog, Atlantic ribbed fen, or northern ribbed fen (National Wetlands Working Group 1988). They develop almost entirely north of 46 degrees N latitude in east-central Canada and the adjacent U.S. They are minerotrophic peatlands in which the vegetation has developed into a pattern of strings (raised, usually linear features) and flarks (wet depressions separating the strings). The substrate chemistry is entirely acidic in some peatlands; in others, where bedrock or other substrate influence creates circumneutral to calcareous conditions, peatland chemistry may be entirely calcareous or vary from acidic to calcareous within the same peatland. In acidic portions, typical bog heaths predominate mixed with sedges. *Dasiphora fruticosa ssp. floribunda* is diagnostic of circumneutral to calcareous conditions. These peatlands usually develop in open basins and flat plains, and the patterned portion may occupy only a fraction of the entire peatland. The edge of the basin may be shallow to deep peat over a sloping substrate, where seepage waters provide nutrients.

Classification Comments: Need to clarify the conceptual boundaries between this and the boreal fens in central and eastern Canada. This system is also similar to acidic peatlands in the southern edge of the glaciated region, which are treated under North-central Interior and Appalachian Acidic Peatland (CES202.606); those often tend to be smaller-patch landscape elements. USFS sections are used to differentiate the ranges.

Similar Ecological Systems:
- Boreal-Laurentian Conifer Acidic Swamp and Treed Poor Fen (CES103.724)
- North-Central Interior and Appalachian Acidic Peatland (CES202.606)

Related Concepts:
- Black Spruce - Tamarack: 13 (Eyre 1980) Finer
- Leatherleaf Boggy Fen (Gawler and Cutko 2010) Finer
- Low Sedge - Buckbean Fen Lawn (Gawler and Cutko 2010) Finer
- Mixed Tall Sedge Fen (Gawler and Cutko 2010) Finer
- Mountain Holly - Alder Woodland Fen (Gawler and Cutko 2010) Finer
- Northern White-Cedar: 37 (Eyre 1980) Finer
- Red Maple: 108 (Eyre 1980) Finer
- Sedge - Leatherleaf Fen Lawn (Gawler and Cutko 2010) Finer
- Sweetgale Mixed Shrub Fen (Gawler and Cutko 2010) Finer

Component Associations:
- *Acer rubrum / Alnus incana - Ilex verticillata / Osmunda regalis* Woodland (CEGL006395, GNR)
- *Betula pumila / Chamaedaphne calyculata / Carex lasiocarpa* Shrubland (CEGL002494, G4G5)
- *Carex (oligosperma, exilis) - Chamaedaphne calyculata* Shrub Herbaceous Vegetation (CEGL006524, GNR)
- *Carex lasiocarpa - Carex oligosperma / Sphagnum* spp. Herbaceous Vegetation (CEGL002265, G3G4)
- *Carex limosa - Rhynchospora alba / Sphagnum pulchrum - Cladopodiella* sp. Herbaceous Vegetation (CEGL006522, GNR)
- *Chamaedaphne calyculata / Carex oligosperma / Sphagnum* spp. Poor Fen Dwarf-shrubland (CEGL005277, G5)
- *Larix laricina / Chamaedaphne calyculata / Carex lasiocarpa* Shrubland (CEGL005226, G4G5)
- *Myrica gale - Chamaedaphne calyculata / Carex (lasiocarpa, utriculata) - Utricularia* spp. Shrub Herbaceous Vegetation (CEGL006302, G4G5)
- *Myrica gale - Spiraea alba - Chamaedaphne calyculata* Shrubland (CEGL006512, GNR)

- *Thuja occidentalis - Abies balsamea / Ledum groenlandicum / Carex trisperma* Woodland (CEGL006507, GNR)
- *Vaccinium corymbosum / Sphagnum* spp. Shrubland (CEGL006190, G4)

DISTRIBUTION

Range: This system is found in New England and adjacent Canada west to the Great Lakes and Minnesota, north of the glacial boundary.
Divisions: 103:C; 201:C; 202:C
Nations: CA, US
Subnations: MA, ME, MI, MN, NB?, NH, NS?, NY, QC, VT, WI
Map Zones: 41:C, 50:C, 51:C, 63:P, 64:C, 65:C, 66:C
USFS Ecomap Regions: 211A:CC, 211B:CC, 211C:CC, 211D:CC, 211E:CC, 212Ha:CCP, 212Hb:CCP, 212Hc:CCP, 212Hd:CCP, 212He:CCP, 212Hf:CCC, 212Hg:CCC, 212Hh:CCP, 212Hi:CCP, 212Hj:CCP, 212Hk:CCC, 212Hl:CCP, 212Hm:CCP, 212J:CP, 212Lb:CCP, 212Ra:CCC, 212Rb:CCC, 212Rc:CCP, 212Rd:CCP, 212Re:CCC, 212S:CP, 212T:CP, 212X:CP, 212Ya:CCP, M211A:CC, M211B:CC, M211C:CC, M211D:CC
TNC Ecoregions: 47:C, 48:P, 61:C, 63:C

SOURCES

References: Comer et al. 2003, Damman and French 1987
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723023#references
Description Author: S.C. Gawler
Version: 05 Jun 2008 **Stakeholders:** Canada, East, Midwest
Concept Author: S.C. Gawler **ClassifResp:** East

CALIFORNIA CENTRAL VALLEY ALKALI SINK (CES206.954)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Playa Mosaic; Lowland [Lowland]; Mediterranean [Mediterranean Xeric-Oceanic]; Depressional
Non-Diagnostic Classifiers: Shrubland (Shrub-dominated); Herbaceous; Isolated Wetland [Partially Isolated]
National Mapping Codes: ESLF 9181

CONCEPT

Summary: These strongly saline/alkaline playa-like depressions are limited to the San Joaquin Valley and typically occur in a matrix of mixed salt desert scrub. These areas are seasonally to intermittently flooded. They are not flooded every year and respond to localized thunderstorms. Soils typically are fine-textured with an impermeable caliche layer or clay pan. Salt encrustations are often deposited on the surface as the playa dries. Species are salt-tolerant and halophytic species such as *Allenrolfea occidentalis, Suaeda moquinii, Distichlis spicata, Cressa truxillensis, Frankenia salina, Arthrocnemum*, and *Hemizonia pungens (= Centromadia pungens)*. During exceptionally wet years, an increase in precipitation can dilute the salt concentration in the soils of some of examples of this system which may allow for less salt-tolerant species to occur.
Related Concepts:
- Wetlands (217) (Shiflet 1994) Broader. Many wetland systems are related to this very broad SRM type.

DESCRIPTION

Environment: These strongly saline/alkaline playa-like depressions typically occur in a matrix of mixed salt desert scrub. Soils typically are fine-textured with an impermeable caliche layer or clay pan. Salt encrustations are often deposited on the surface as the playa dries.
Dynamics: These areas are seasonally to intermittently flooded. They are not flooded every year and respond to localized thunderstorms. During exceptionally wet years, an increase in precipitation can dilute the salt concentration in the soils of some of examples of this system which may allow for less salt-tolerant species to occur.

DISTRIBUTION

Range: Limited to the San Joaquin Valley.
Divisions: 206:C
Nations: US
Subnations: CA
Map Zones: 5:C
USFS Ecomap Regions: 262A:CC, M261C:??, M261F:??
TNC Ecoregions: 13:C

SOURCES

References: Barbour and Major 1988, Brooks and Minnich 2006, Coffman 2007, Comer et al. 2003, Holland and Keil 1995, Keeler-Wolf pers. comm., PRBO Conservation Science 2011, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Shiflet 1994, WNHP 2011
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722727#references
Description Author: P. Comer and T. Keeler-Wolf, mod. G. Kittel
Version: 14 Jan 2014 **Stakeholders:** West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

CENTRAL ATLANTIC COASTAL PLAIN WET LONGLEAF PINE SAVANNA AND FLATWOODS (CES203.265)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Forest and Woodland (Treed); Short Disturbance Interval; Needle-Leaved Tree
Non-Diagnostic Classifiers: Extensive Wet Flat
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2449; ESLF 9118; ESP 1449

CONCEPT

Summary: This ecological system of wet *Pinus palustris*-dominated savannas and flatwoods ranges from southern Virginia to central South Carolina. It was once one of the most extensive systems in the coastward part of its range. Examples and associations share the common features of wet, seasonally saturated, mineral soils and exposure to frequent fire. They occur on a wide range of soil textures, which is an important factor in distinguishing different associations. The vegetation is naturally dominated by *Pinus palustris* or, less frequently, *Pinus serotina*. There is a dense ground cover of herbs and low shrubs; grasses dominate but there is often a large diversity of other herbs. Frequent, low-intensity fire is the dominant natural ecological force.
Classification Comments: This system is distinguished from Southern Atlantic Coastal Plain Wet Pine Savanna and Flatwoods (CES203.536) because of substantial biogeographic differences. The break is placed at the Santee River, which approximates the transition between the ranges of *Aristida stricta* and *Aristida beyrichiana*, which are keystone species in the communities where they occur. This corresponds roughly with the geographic break in the upland longleaf pine systems as well. This system is distinguished from Atlantic Coastal Plain Upland Longleaf Pine Woodland (CES203.281) because of that system's more upland character. However, the two systems have much in common, including frequent fire, the same primary dominant canopy tree, and many herbaceous species. They can also occur in the same landscapes. However, floristic differences are well marked, and no associations are shared. This system occurs primarily in the Outer Coastal Plain, but small patches may occur in atypical landforms in the Fall-line Sandhills. Sandhills examples are not treated as a separate system, as the upland longleaf pine systems are, because they are confined to sites that more resemble the Outer Coastal Plain. They are distinguished in the Sandhills from Atlantic Coastal Plain Sandhill Seep (CES203.253) by landform and apparent hydrology that is driven by seasonal high water table rather than seepage.
Similar Ecological Systems:
- Atlantic Coastal Plain Fall-line Sandhills Longleaf Pine Woodland (CES203.254)
- Atlantic Coastal Plain Sandhill Seep (CES203.253)
- Atlantic Coastal Plain Upland Longleaf Pine Woodland (CES203.281)
- Southern Atlantic Coastal Plain Wet Pine Savanna and Flatwoods (CES203.536)

Related Concepts:
- Longleaf Pine - Slash Pine: 83 (Eyre 1980) Finer
- Longleaf Pine: 70 (Eyre 1980) Finer
- Pond Pine: 98 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs on wet mineral soil sites, primarily in the Middle and Outer Coastal Plain but occasionally in the Fall-line Sandhills. Landforms include low areas in relict beach ridge systems and eolian sand deposits, and poorly drained clayey, loamy, or sandy flats. They occasionally occur on river terraces above current flood levels. Soils range from clayey to sandy, with no accumulated organic surface layer. Soils are seasonally saturated, due to high water table or poor soil drainage. The unifying feature of this system is wet mineral soils associated with a high frequency of fire. Variation in soil texture appears to be a primary driver of differences between associations within the system, with biogeography also important.
Vegetation: Vegetation is a set of associations that are naturally woodlands or savannas dominated by *Pinus palustris* or, less frequently, by *Pinus serotina*, *Pinus elliottii*, or some combination. Hardwoods are present in any abundance only in examples altered by fire suppression. The ground cover is a dense combination of herbs and low shrubs. A variety of ericaceous shrubs and hollies is common, with density determined by fire history. Grasses naturally dominate the ground cover. *Aristida stricta* often dominates within its range, but *Ctenium aromaticum, Sporobolus pinetorum, Sporobolus teretifolius*, or other grasses may dominate. A great diversity of other herbs is often present, including composites, sedges, insectivorous plants, and variety of showy forbs. Communities in this system are often very high in species richness, with some of the highest values measured anywhere at the 1/10-hectare, 1/100-hectare, and 1-square-meter levels. However, some associations are naturally low to moderate in species richness.
Dynamics: Frequent fire is the predominant natural disturbance in this system. Communities naturally burned every few years, many averaging as often as every 3 years. Fires are naturally low to moderate in intensity. They burn above-ground parts of herbs and shrubs but have little effect on the fire-tolerant trees. Vegetation recovers very quickly from fire, with live herbaceous biomass often restored in just a few weeks. Many plants have their flowering triggered by burning, the effects on subsequent establishment are not well-documented. In the absence of fire, the shrubs increase and hardwoods may invade the system. Herb layer density and diversity

decline after a number of years without fire. In time, unburned examples will become nearly indistinguishable from the drier associations of Atlantic Coastal Plain Peatland Pocosin and Canebrake (CES203.267).

Canopies are believed to naturally be multi-aged, consisting of a mosaic of even-aged patches driven by gap-phase regeneration. *Pinus palustris* is shade-intolerant and slow to reach reproductive age but is very long-lived.

Component Associations:
- *Hypericum reductum / Aristida stricta* Dwarf-shrubland (CEGL003954, G1G2Q)
- *Pinus palustris - (Pinus serotina) / Ilex glabra - Gaylussacia frondosa - (Kalmia carolina)* Woodland (CEGL003647, G2)
- *Pinus palustris - Pinus serotina / Ctenium aromaticum - Muhlenbergia expansa - Carphephorus odoratissimus* Woodland (CEGL003658, G3)
- *Pinus palustris - Pinus serotina / Ctenium aromaticum - Muhlenbergia expansa - Rhynchospora latifolia* Woodland (CEGL003660, G1)
- *Pinus palustris - Pinus serotina / Ctenium aromaticum - Scleria pauciflora - Sarracenia flava* Woodland (CEGL004499, G1)
- *Pinus palustris - Pinus serotina / Magnolia virginiana / Sporobolus teretifolius - Carex striata* Woodland (CEGL004500, G1)
- *Pinus palustris - Pinus serotina / Pleea tenuifolia - Aristida stricta* Woodland (CEGL003661, G1)
- *Pinus palustris - Pinus serotina / Sporobolus pinetorum - (Aristida stricta) - Eryngium integrifolium* Woodland (CEGL004501, G2)
- *Pinus palustris - Pinus serotina / Sporobolus pinetorum - Ctenium aromaticum - Eriocaulon decangulare var. decangulare* Woodland (CEGL004502, G1)
- *Pinus palustris - Pinus taeda - Pinus serotina / Quercus marilandica / (Quercus pumila) / Aristida stricta* Woodland (CEGL003664, G1)
- *Pinus palustris / Arundinaria gigantea ssp. tecta - Liquidambar styraciflua / Andropogon glomeratus - Sarracenia minor* Woodland (CEGL004495, G1)
- *Pinus palustris / Ilex glabra / Aristida stricta* Woodland (CEGL003648, G3)
- *Pinus palustris / Leiophyllum buxifolium / Aristida stricta* Woodland (CEGL003649, G1)
- *Pinus palustris / Serenoa repens - Ilex glabra* Woodland (CEGL003653, G2G3)

Spatial Characteristics

Spatial Summary: This system naturally occurs as large to small patches, sometimes part of extensive matrix mosaics with other systems. It was naturally one of the most abundant systems on the lower terraces of the Outer Coastal Plain.
Size: Ranges from large to small patch, which may form a matrix mosaic with other systems. Many remaining examples are naturally bounded islands.
Adjacent Ecological Systems:
- Atlantic Coastal Plain Clay-Based Carolina Bay Wetland (CES203.245)
- Atlantic Coastal Plain Peatland Pocosin and Canebrake (CES203.267)
- Atlantic Coastal Plain Small Blackwater River Floodplain Forest (CES203.249)
- Atlantic Coastal Plain Small Brownwater River Floodplain Forest (CES203.250)
- Atlantic Coastal Plain Upland Longleaf Pine Woodland (CES203.281)
- Southern Atlantic Coastal Plain Depression Pond (CES203.262)
- Southern Atlantic Coastal Plain Mesic Hardwood Forest (CES203.242)

Adjacent Ecological System Comments: Atlantic Coastal Plain Upland Longleaf Pine Woodland (CES203.281) and Atlantic Coastal Plain Peatland Pocosin and Canebrake (CES203.267) are the most frequently associated systems. Southern Atlantic Coastal Plain Depression Pondshore (CES203.262) patches may be embedded, and Atlantic Coastal Plain Small Blackwater River Floodplain Forest (CES203.249), Atlantic Coastal Plain Small Brownwater River Floodplain Forest (CES203.250), and Southern Atlantic Coastal Plain Mesic Hardwood Forest (CES203.242) may adjoin.

Distribution

Range: This system ranges from southern Virginia to central South Carolina. To the south, the equivalent system is Southern Atlantic Coastal Plain Wet Pine Savanna and Flatwoods (CES203.536), the range of which includes Georgia and northern Florida.
Divisions: 203:C
Nations: US
Subnations: NC, SC, VA
Map Zones: 58:C, 60:C
USFS Ecomap Regions: 232C:CC, 232H:CC, 232I:CC, 232J:CC
TNC Ecoregions: 57:C

Sources

References: Brewer 2008, Eyre 1980, NatureServe 2011, Oswalt et al. 2012, Rehn and Hebard 1916, Southeastern Ecology Working Group n.d., Wahlenberg 1946
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723221#references
Description Author: M. Schafale and R. Evans, mod. C. Nordman
Version: 14 Jan 2014 **Stakeholders:** East, Southeast
Concept Author: M. Schafale and R. Evans **ClassifResp:** Southeast

CENTRAL INTERIOR HIGHLANDS AND APPALACHIAN SINKHOLE AND DEPRESSION POND (CES202.018)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Lowland [Lowland]; Depressional [Pond]; Depressional [Sinkhole]; Muck; Mineral: W/ A-Horizon >10 cm
Non-Diagnostic Classifiers: Alkaline Water; Circumneutral Water; Forest and Woodland (Treed); Isolated Wetland [Partially Isolated]
National Mapping Codes: ESLF 9160

CONCEPT

Summary: This system of ponds and wetlands is found in the Interior Highlands of the Ozark, Ouachita, and Interior Low Plateau regions, and ranges north from the Southern and Central Appalachians to the northern Piedmont regions. Stands occur in basins of sinkholes or other isolated depressions on uplands. Soils are very poorly drained, and surface water may be present for extended periods of time, rarely becoming dry. Water depth may vary greatly on a seasonal basis and may be a meter deep or more in the winter. Some examples become dry in the summer. Soils may be deep (100 cm or more), consisting of peat or muck, with parent material of peat, muck or alluvium. Ponds vary from open water to herb-, shrub-, or tree-dominated. Tree-dominated examples typically contain *Quercus* species, *Platanus occidentalis*, *Fraxinus pennsylvanica*, *Acer saccharinum*, or *Nyssa* species, or a combination of these. In addition, *Liquidambar styraciflua* may be present in southern examples. *Cephalanthus occidentalis* is a typical shrub component. The herbaceous layer is widely variable depending on geography.
Classification Comments: Many of these ponds have their geologic origin as a more-or-less complete karst collapse feature. Some of them may display this geologic origin in a more explicit manner, with definite walls and exposed limestone or dolomite at the surface ("sinkholes"). Others are more subtle, and exist as more gentle depressions, with no exposed surface geology ("depression ponds"). This includes the "sagponds" of northwestern Georgia and adjacent Alabama. Rare examples in the Ridge and Valley of Georgia (Coosa Valley) are included here. These occur on limestones or dolomites of the Chickamauga Group. Matt Elliott (pers. comm.): "I would put Ridge and Valley sagponds in with Interior Highlands ponds rather than Piedmont, as they are essentially karst features. R&V sagponds are generally pretty rare but are common in parts of Bartow County, Georgia, and a few other places. The shallower ones are dominated by willow oak, the deeper ones *Nyssa biflora*. On the Cumberland Plateau, the ones I have seen usually have sweetgum and *Nyssa sylvatica*, but I think willow oak and possibly *Nyssa biflora* might occur in some of the deeper ones. A lot of the plateau ponds seem more like swales than deep ponds, but they still may be related to underlying karst features. The Ridge and Valley sagponds may be somewhat different from those on the plateau - often deeper and with even more Coastal Plain elements; it also includes sinkhole ponds of northern New Jersey (K. Strakosch-Walz pers. comm.) and possibly ponds of the Ridge and Valley in Pennsylvania. These are very similar to Shenandoah sinkhole ponds of Virginia and are in Maryland as well (L. Sneddon pers. comm.). The only documented occurrence in Pennsylvania is the Maple Hills sinkhole in Lycoming County; "there are plenty of other sinkholes in Pennsylvania, but they have not been associated with any specific plant community" (G. Podniesinski pers. comm. 2010).
Similar Ecological Systems:
- Piedmont Upland Depression Swamp (CES202.336)

Related Concepts:
- Black Willow: 95 (Eyre 1980) Finer
- Depression Swamp (Evans 1991) Finer
- Overcup Oak - Water Hickory: 96 (Eyre 1980) Finer
- Pin Oak - Sweetgum: 65 (Eyre 1980) Finer
- Sagponds (Wharton 1978) Finer
- Silver Maple - American Elm: 62 (Eyre 1980) Finer
- Sinkhole/Depression Marsh (Evans 1991) Finer
- Sinkhole/Depression Pond (Evans 1991) Finer
- Sugarberry - American Elm - Green Ash: 93 (Eyre 1980) Finer
- Sweetgum - Willow Oak: 92 (Eyre 1980) Finer
- Water Tupelo - Swamp Tupelo: 103 (Eyre 1980) Finer

DESCRIPTION

Environment: Examples of this system occur in basins of sinkholes or other isolated depressions on uplands. Soils are very poorly drained, and surface water may be present for extended periods of time, rarely becoming dry. The watershed of these sites is typically small so water depth may vary greatly on a seasonal basis, and may be a meter deep or more in the winter (Homoya and Hedge 1985). Some examples become dry in the summer. The rate of water level rise and fall may also be related to whether these sites have internal drainage within the karst features or are essentially closed depressions (Wolfe 1996). Soils may be deep (100 cm or more), consisting of peat or muck, with parent material of peat, muck or alluvium. Many of these ponds have their geologic origin as a more-or-less complete karst collapse feature. Some of them may display this geologic origin in a more explicit manner, with definite

walls and exposed limestone or dolomite at the surface ("sinkholes"). Others are more subtle and exist as more gentle depressions, with no exposed surface geology ("depression ponds").
Vegetation: Ponds vary from open water to herb-, shrub-, or tree-dominated types. Tree-dominated examples typically contain *Quercus* species, *Platanus occidentalis, Fraxinus pennsylvanica, Acer saccharinum,* or *Nyssa* species, or a combination of these. In addition, *Liquidambar styraciflua* may be present in southern examples. *Cephalanthus occidentalis* is a typical shrub component. The herbaceous layer is widely variable depending on geography.
Dynamics: Water depth may vary greatly on a seasonal basis, and may be a meter deep or more in the winter. Some examples become dry in the summer.

Component Associations:
- *(Quercus palustris) / Panicum rigidulum var. rigidulum - Panicum verrucosum - Eleocharis acicularis* Herbaceous Vegetation (CEGL007858, G1)
- *Acer (rubrum, saccharinum) - Fraxinus pennsylvanica / Ilex verticillata / Osmunda regalis* Forest (CEGL006630, GNR)
- *Boltonia asteroides var. asteroides - Symphyotrichum racemosum - Mentha arvensis* Herbaceous Vegetation (CEGL006900, G1G2)
- *Brasenia schreberi* Eastern Herbaceous Vegetation (CEGL004527, G4?)
- *Carex aquatilis - Dulichium arundinaceum* Herbaceous Vegetation (CEGL008542, G1?)
- *Carex barrattii* Herbaceous Vegetation (CEGL007857, G1)
- *Carex comosa - Carex decomposita - Dulichium arundinaceum - Lycopus rubellus* Herbaceous Vegetation (CEGL002413, G3G4)
- *Carex joorii - Eleocharis tenuis var. verrucosa - Juncus* spp. *- Panicum rigidulum* Interior Highlands Channel Scar Depression Wooded Herbaceous Vegetation (CEGL007116, G2?)
- *Cephalanthus occidentalis - (Salix nigra, Quercus lyrata)* Karst Depression Shrubland (CEGL008439, G1Q)
- *Cephalanthus occidentalis / Hibiscus moscheutos ssp. moscheutos* Depression Pond Shrubland (CEGL004742, G3?)
- *Ceratophyllum demersum - Stuckenia pectinata* Herbaceous Vegetation (CEGL004528, G4G5)
- *Dasiphora fruticosa ssp. floribunda / Rhynchospora capillacea - Scleria verticillata* Shrub Herbaceous Vegetation (CEGL006356, G1)
- *Eleocharis microcarpa - Juncus repens - Rhynchospora corniculata - (Mecardonia acuminata, Proserpinaca* spp.) Herbaceous Vegetation (CEGL004748, G2G3)
- *Fraxinus pennsylvanica - Acer saccharinum - Quercus bicolor / Boehmeria cylindrica* Forest (CEGL006634, GNR)
- *Liquidambar styraciflua - Acer rubrum / Carex* spp. *- Sphagnum* spp. Forest (CEGL007388, G2G3Q)
- *Ludwigia peploides* Herbaceous Vegetation (CEGL007835, G4G5)
- *Nelumbo lutea* Herbaceous Vegetation (CEGL004323, G4?)
- *Nuphar advena - Nymphaea odorata* Herbaceous Vegetation (CEGL002386, G4G5)
- *Nyssa aquatica / Cephalanthus occidentalis* Pond Forest (CEGL004712, G1?)
- *Nyssa biflora / Cephalanthus occidentalis - Lyonia lucida* Sagpond Forest (CEGL004116, G1G2)
- *Orontium aquaticum - Schoenoplectus subterminalis - Eriocaulon aquaticum* Herbaceous Vegetation (CEGL007859, G1)
- *Panicum hemitomon - Dulichium arundinaceum* Herbaceous Vegetation (CEGL004126, G1)
- *Platanus occidentalis - Fraxinus pennsylvanica - Ulmus americana / Cornus sericea* Forest (CEGL006901, G2G3)
- *Pontederia cordata - Sagittaria graminea - Sagittaria latifolia* Semipermanently Flooded Herbaceous Vegetation (CEGL004986, G1G2Q)
- *Quercus alba - Nyssa sylvatica* Sandstone Ridgetop Depression Forest (CEGL008440, G2Q)
- *Quercus bicolor - Fraxinus pennsylvanica / Carex* spp. Forest (CEGL004422, G1G2)
- *Quercus lyrata - Quercus (palustris, phellos) - Liquidambar styraciflua - (Populus heterophylla)* Forest (CEGL004421, G2G3)
- *Quercus lyrata / Betula nigra / Pleopeltis polypodioides ssp. michauxiana* Forest (CEGL004975, G1)
- *Quercus lyrata* Pond Forest (CEGL004642, G1G3)
- *Quercus palustris - (Quercus bicolor) / Carex crinita / Sphagnum* spp. Forest (CEGL002406, G3?)
- *Quercus palustris - Quercus bicolor - (Liquidambar styraciflua)* Mixed Hardwood Forest (CEGL002432, G3G4)
- *Quercus palustris* Pond Forest (CEGL007809, G2)
- *Quercus phellos - Liquidambar styraciflua / Chasmanthium laxum* Cumberland / Southern Ridge and Valley Forest (CEGL008441, G3)
- *Saccharum baldwinii - Calamagrostis coarctata - Panicum rigidulum - Rhynchospora capitellata* Herbaceous Vegetation (CEGL004750, G2G3)
- *Salix nigra - Acer (rubrum, saccharinum) / Alnus serrulata - Cephalanthus occidentalis* Forest (CEGL007703, G5)
- *Scirpus cyperinus - Dulichium arundinaceum / Sphagnum* spp. Herbaceous Vegetation (CEGL004134, G1Q)
- *Scirpus cyperinus - Panicum rigidulum - Rhynchospora corniculata - (Dulichium arundinaceum)* Herbaceous Vegetation (CEGL004719, G2G3)
- *Sparganium americanum - (Sparganium erectum ssp. stoloniferum) - Epilobium leptophyllum* Herbaceous Vegetation (CEGL004510, G3?)
- *Typha latifolia* Southern Herbaceous Vegetation (CEGL004150, G5)
- *Vaccinium oxycoccos - (Vaccinium macrocarpon) / Rhynchospora alba - Drosera rotundifolia / Sphagnum* spp. Dwarf-shrubland (CEGL007856, G2)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Eastern Highland Rim Prairie and Barrens (CES202.354)
- Interior Highlands Unglaciated Flatwoods (CES202.454)

DISTRIBUTION

Range: This system is found from the Ozark and Ouachita mountains east to the southern and central Appalachians and the northern Piedmont regions (?), including the unglaciated Interior Low Plateau and Ridge and Valley. It ranges from Missouri, West Virginia, Pennsylvania, and Delaware south to Arkansas, Alabama and Georgia.
Divisions: 202:C
Nations: US
Subnations: AL, AR, DE, GA, IL, IN, KY, MD, MO, NC, NJ, OH, PA, TN, VA, WV
Map Zones: 44:C, 47:C, 48:C, 49:C, 53:C, 57:C, 61:C, 62:P, 64:P
USFS Ecomap Regions: 221F:CC, 221H:CC, 221J:CC, 223A:CC, 223D:CC, 223E:CC, 223F:CC, 231C:CC, 231D:CC, M221A:CC, M223A:CC, M231A:CC
TNC Ecoregions: 38:C, 39:C, 44:C, 50:C, 59:C, 61:C

SOURCES

References: Comer et al. 2003, Elliott, M. pers. comm., Evans 1991, Eyre 1980, Faber-Langendoen et al. 2011, Homoya and Hedge 1985, Wharton 1978, Wolfe 1996
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722687#references
Description Author: M. Pyne, S. Menard, D. Faber-Langendoen, mod. J. Drake
Version: 14 Jan 2014 **Stakeholders:** East, Midwest, Southeast
Concept Author: M. Pyne, S. Menard, D. Faber-Langendoen **ClassifResp:** Midwest

COLUMBIA BASIN FOOTHILL RIPARIAN WOODLAND AND SHRUBLAND (CES304.768)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Short (<5 yrs) Flooding Interval; Short (50-100 yrs) Persistence; Montane [Lower Montane]; Lowland [Foothill]; Riverine / Alluvial
Non-Diagnostic Classifiers: Forest and Woodland (Treed); Shrubland (Shrub-dominated); Temperate [Temperate Continental]; Unconsolidated; Needle-Leaved Tree; Broad-Leaved Deciduous Tree; Broad-Leaved Deciduous Shrub
National Mapping Codes: ESLF 9170

CONCEPT

Summary: This is a low-elevation riparian system found on the periphery of the mountains surrounding the Columbia River Basin, along major tributaries and the main stem of the Columbia at relatively low elevations. This is the riparian system associated with all streams at and below lower treeline, including permanent, intermittent and ephemeral streams with woody riparian vegetation. These forests and woodlands require flooding and some gravels for reestablishment. They are found in low-elevation canyons and draws, on floodplains, or in steep-sided canyons, or narrow V-shaped valleys with rocky substrates. Sites are subject to temporary flooding during spring runoff. Underlying gravels may keep the water table just below the ground surface and are favored substrates for cottonwood. Large bottomlands may have large occurrences, but most have been cut over or cleared for agriculture. Rafted ice and logs in freshets may cause considerable damage to tree boles. Beavers crop younger cottonwood and willows and frequently dam side channels occurring in these stands. In steep-sided canyons, streams typically have perennial flow on mid to high gradients. Important and diagnostic trees include *Populus balsamifera ssp. trichocarpa, Alnus rhombifolia, Populus tremuloides, Celtis laevigata var. reticulata, Betula occidentalis*, or *Pinus ponderosa*. Important shrubs include *Crataegus douglasii, Philadelphus lewisii, Cornus sericea, Salix lucida ssp. lasiandra, Salix eriocephala, Rosa nutkana, Rosa woodsii, Amelanchier alnifolia, Prunus virginiana*, and *Symphoricarpos albus*. Grazing is a major influence in altering structure, composition, and function of the system.
Similar Ecological Systems:
- Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland (CES306.804)

Related Concepts:
- AC Trembling Aspen Copse (Ecosystems Working Group 1998) Broader
- Black Cottonwood - Willow: 222 (Eyre 1980) Intersecting
- Cottonwood - Willow: 235 (Eyre 1980) Broader
- CR Black Cottonwood Riparian Habitat Class (Ecosystems Working Group 1998) Broader

DESCRIPTION

Environment: This is a low-elevation riparian system found on the periphery of the mountains surrounding the Columbia River Basin, along major tributaries and the main stem of the Columbia at relatively low elevations. This is the riparian system associated with all streams at and below lower treeline, including permanent, intermittent and ephemeral streams with woody riparian vegetation. These forests and woodlands require flooding and some fresh exposed gravel for reestablishment. They are found in low-elevation canyons and draws, on floodplains, or in steep-sided canyons, or narrow V-shaped valleys with rocky substrates. Sites are subject to temporary flooding during spring runoff. Underlying gravels may keep the water table just below the ground surface and are favored substrates for cottonwood. Large bottomlands may have large occurrences, but most have been cut over or cleared for agriculture. Rafted ice and logs in freshets may cause considerable damage to tree boles. Beavers crop younger cottonwood and willows and frequently dam side channels occurring in these stands. In steep-sided canyons, streams typically have perennial flow on mid to high gradients.
Vegetation: Important and diagnostic trees include *Populus balsamifera ssp. trichocarpa, Alnus rhombifolia, Populus tremuloides, Celtis laevigata var. reticulata, Betula occidentalis*, or *Pinus ponderosa*. Important shrubs include *Crataegus douglasii, Philadelphus lewisii, Cornus sericea, Salix lucida ssp. lasiandra, Salix eriocephala, Rosa nutkana, Rosa woodsii, Amelanchier alnifolia, Prunus virginiana*, and *Symphoricarpos albus*.
Dynamics: The majority of these forests and woodlands require flooding and freshly deposited gravel/sand for seedling establishment. The natural hydrologic cycle in these reaches includes high spring and early summer flow pulses from snowmelt run off and a natural drawdown into late-summer and fall months. Spring and early summer months also see a rise of the underlying alluvial groundwater table as well as natural lowering of the groundwater in late summer into fall months. High flows and flooding scour (removal) and deposit sediments that stimulate growth of cottonwoods and willows, replenish nutrients, move seeds and aquatic organisms (Merritt and Wohl 2002). These processes stimulate and revive riparian ecosystems. Some reaches are supported by groundwater discharge where flood disturbances are less vital to long-term viability.

Component Associations:
- *(Populus tremuloides) / Crataegus douglasii / Heracleum maximum* Shrubland (CEGL001094, G1)
- *(Populus tremuloides) / Crataegus douglasii / Symphoricarpos albus* Shrubland (CEGL001096, G3)

- *Alnus rhombifolia - Abies grandis* Forest (CEGL000630, G2?)
- *Alnus rhombifolia / Amelanchier alnifolia* Forest (CEGL000631, G3)
- *Alnus rhombifolia / Betula occidentalis* Forest (CEGL000632, G1)
- *Alnus rhombifolia / Celtis laevigata var. reticulata* Forest (CEGL000633, G1?)
- *Alnus rhombifolia / Philadelphus lewisii* Forest (CEGL000634, G1)
- *Alnus rhombifolia / Prunus virginiana* Forest (CEGL000635, G1?)
- *Alnus rhombifolia / Rosa woodsii* Forest (CEGL000636, G1)
- *Alnus rhombifolia / Sambucus caerulea* Forest (CEGL000637, G2?)
- *Alnus rubra / Adiantum pedatum* Forest (CEGL002600, G1)
- *Alnus rubra / Athyrium filix-femina - Asarum caudatum* Forest (CEGL000008, G1)
- *Alnus rubra / Physocarpus capitatus - Philadelphus lewisii* Forest (CEGL000002, G1)
- *Alnus viridis ssp. sinuata* / Mesic Forbs Shrubland (CEGL002633, G3G4)
- *Alnus viridis ssp. sinuata / Rubus (lasiococcus, parviflorus)* Shrubland (CEGL002602, G4)
- *Betula occidentalis - Celtis laevigata var. reticulata* Shrubland (CEGL003450, G2)
- *Betula occidentalis / Crataegus douglasii* Shrubland (CEGL001081, G1)
- *Betula occidentalis / Philadelphus lewisii - Symphoricarpos albus* Shrubland (CEGL000489, G1G2)
- *Betula occidentalis / Philadelphus lewisii* Shrubland (CEGL002668, G2)
- *Betula occidentalis* Shrubland (CEGL001080, G3G4)
- *Celtis laevigata var. reticulata / Philadelphus lewisii* Woodland (CEGL000792, G1)
- *Celtis laevigata var. reticulata / Pseudoroegneria spicata* Woodland (CEGL001085, G2G3)
- *Celtis laevigata var. reticulata / Toxicodendron rydbergii* Woodland (CEGL003451, G2)
- *Cornus sericea / Heracleum maximum* Shrubland (CEGL001167, G3)
- *Crataegus douglasii / Rosa woodsii* Shrubland (CEGL001095, G2)
- *Philadelphus lewisii / Symphoricarpos albus* Shrubland (CEGL000875, G1G2)
- *Philadelphus lewisii* Intermittently Flooded Shrubland (CEGL001170, G2)
- *Pinus monticola / Deschampsia caespitosa* Forest (CEGL003441, G1)
- *Pinus ponderosa / Symphoricarpos albus* Temporarily Flooded Woodland (CEGL000866, G2)
- *Populus balsamifera (ssp. trichocarpa, ssp. balsamifera) / Symphoricarpos (albus, oreophilus, occidentalis)* Forest (CEGL000677, G2)
- *Populus balsamifera ssp. trichocarpa / Alnus incana* Forest (CEGL000667, G3)
- *Populus balsamifera ssp. trichocarpa / Cicuta douglasii* Forest (CEGL000671, G1)
- *Populus balsamifera ssp. trichocarpa / Cornus sericea* Forest (CEGL000672, G3G4)
- *Populus balsamifera ssp. trichocarpa / Crataegus douglasii* Forest (CEGL000673, G1)
- *Populus balsamifera ssp. trichocarpa* / Mixed Herbs Forest (CEGL000675, G3?)
- *Populus balsamifera ssp. trichocarpa / Salix exigua* Forest (CEGL000676, G1)
- *Populus balsamifera ssp. trichocarpa / Salix lucida ssp. caudata* Woodland (CEGL003431, G2)
- *Populus tremuloides / Alnus incana / Betula nana - Ribes* spp. Forest (CEGL001149, G1)
- *Populus tremuloides / Carex pellita* Forest (CEGL000577, G2)
- *Quercus garryana / Elymus glaucus* Woodland (CEGL000550, G1G2)
- *Quercus garryana / Symphoricarpos albus* Woodland (CEGL000553, G2G3)
- *Salix amygdaloides / Salix exigua* Woodland (CEGL000948, G1Q)

DISTRIBUTION

Range: Found on the periphery of the northern Rockies in the Columbia River Basin, along major tributaries and the main stem of the Columbia at relatively low elevations.
Divisions: 304:C; 306:C
Nations: CA, US
Subnations: BC, CA, ID, MT?, NV, OR, UT, WA
Map Zones: 1:C, 7:C, 8:C, 9:C, 10:C, 16:?, 17:?, 18:C, 21:?
USFS Ecomap Regions: 331A:CC, 342B:CC, 342C:CC, 342D:CC, 342H:CC, 342I:CC, M242C:P?, M242D:PP, M261G:PP, M331A:P?, M331D:PP, M332A:CC, M332E:C?, M332F:CP, M332G:CC, M333A:CC, M333B:CC, M333D:CC
TNC Ecoregions: 6:C, 7:C, 68:C

SOURCES

References: Boes and Strauss 1994, Comer et al. 2003, Ecosystems Working Group 1998, Eyre 1980, Johnson and Simon 1985, Kauffman et al. 2004, Littell et al. 2009, Merritt and Wohl 2002, WNHP 2011
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722904#references
Description Author: NatureServe Western Ecology Team, mod. G. Kittel
Version: 14 Jan 2014 **Stakeholders:** Canada, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

COLUMBIA PLATEAU SILVER SAGEBRUSH SEASONALLY FLOODED SHRUB-STEPPE (CES304.084)

CLASSIFIERS

Classification Status: Standard

Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Impermeable Layer; Intermittent Flooding; Montane [Upper Montane]; Montane [Montane]; Montane [Lower Montane]; Lowland [Lowland]; Playa; Temperate [Temperate Xeric]; Depressional
National Mapping Codes: ESLF 9321

CONCEPT

Summary: This ecological system includes sagebrush communities occurring at lowland and montane elevations in the Columbia Plateau-northern Great Basin region, east almost to the Great Plains. These are generally depressional wetlands or non-alkaline playas, occurring as small- or occasionally large-patch communities, in a sagebrush or montane forest matrix. Climate is generally semi-arid, although it can be cool in montane areas. This system occurs in poorly drained depressional wetlands, the largest characterized as playas, the smaller as vernal pools, or along seasonal stream channels in valley bottoms or mountain meadows. *Artemisia cana ssp. bolanderi* or *Artemisia cana ssp. viscidula* are dominant, with *Artemisia tridentata ssp. tridentata, Artemisia tridentata ssp. wyomingensis*, or *Artemisia tridentata ssp. vaseyana* occasionally codominant; *Dasiphora fruticosa ssp. floribunda* can also be codominant. Understory graminoids and forbs are characteristic, with *Poa secunda (= Poa nevadensis), Poa cusickii, Festuca idahoensis, Muhlenbergia filiformis, Muhlenbergia richardsonis*, and *Leymus cinereus* dominant at the drier sites; *Eleocharis palustris, Deschampsia caespitosa*, and *Carex* species dominate at wetter or higher-elevation sites.
Related Concepts:
- Other Sagebrush Types (408) (Shiflet 1994) Intersecting. *Artemisia cana ssp. viscidula* shrublands are included in this ecological system.

DESCRIPTION

Environment: This ecological system includes sagebrush communities occurring at lowland and montane elevations in the Columbia Plateau-northern Great Basin region, east almost to the Great Plains. These are generally depressional wetlands or non-alkaline playas, occurring as small- or occasionally large-patch communities, in a sagebrush or montane forest matrix. Climate is generally semi-arid, although it can be cool in montane areas. This system occurs in poorly drained depressional wetlands, the largest characterized as playas, the smaller as vernal pools, or along seasonal stream channels in valley bottoms or mountain meadows.
Vegetation: *Artemisia cana ssp. bolanderi* or *Artemisia cana ssp. viscidula* are dominant, with *Artemisia tridentata ssp. tridentata, Artemisia tridentata ssp. wyomingensis*, or *Artemisia tridentata ssp. vaseyana* occasionally codominant; *Dasiphora fruticosa ssp. floribunda* can also be codominant. Understory graminoids and forbs are characteristic, with *Poa secunda (= Poa nevadensis), Poa cusickii, Festuca idahoensis, Muhlenbergia filiformis, Muhlenbergia richardsonis*, and *Leymus cinereus* dominant at the drier sites; *Eleocharis palustris, Deschampsia caespitosa*, and *Carex* species dominate at wetter or higher-elevation sites.

Component Associations:
- *Artemisia cana (ssp. bolanderi, ssp. viscidula) - Artemisia tridentata ssp. vaseyana / Poa cusickii* Shrub Herbaceous Vegetation (CEGL001549, G2)
- *Artemisia cana (ssp. bolanderi, ssp. viscidula) / Leymus cinereus* Shrubland (CEGL001460, G1)
- *Artemisia cana (ssp. bolanderi, ssp. viscidula) / Poa fendleriana ssp. fendleriana* Shrub Herbaceous Vegetation (CEGL001551, G2)
- *Artemisia cana (ssp. bolanderi, ssp. viscidula) / Poa secunda* Shrubland (CEGL001548, G2)
- *Artemisia cana ssp. bolanderi / Eleocharis palustris* Shrubland (CEGL002987, GU)
- *Artemisia cana ssp. bolanderi / Muhlenbergia richardsonis* Shrub Herbaceous Vegetation (CEGL001743, G3)
- *Artemisia cana ssp. viscidula* - (*Salix* spp.) / *Festuca idahoensis* Shrubland (CEGL001075, G3)
- *Artemisia cana ssp. viscidula / Deschampsia caespitosa* Shrubland (CEGL001074, G2G3)
- *Artemisia cana ssp. viscidula / Festuca idahoensis* Shrub Herbaceous Vegetation (CEGL001552, G3?)
- *Artemisia cana ssp. viscidula / Festuca ovina* Shrubland (CEGL001076, G4G5)
- *Artemisia cana ssp. viscidula / Festuca thurberi* Shrubland (CEGL001071, G2G3)
- *Artemisia cana ssp. viscidula / Purshia tridentata* Shrubland (CEGL001073, G3)

DISTRIBUTION

Range: This ecological system includes sagebrush communities occurring at lowland and montane elevations in the Columbia Plateau-northern Great Basin region, east almost to the Great Plains.
Divisions: 304:C; 306:C
Nations: US
Subnations: CA, CO?, ID, MT, NV, OR, UT?, WA?, WY
Map Zones: 7:C, 8:C, 9:C, 12:?, 18:P, 21:?, 22:?

USFS Ecomap Regions: 331A:??, 341G:CC, 342B:CC, 342C:CC, 342D:CC, 342H:CC, 342I:CC, 342J:CC, M242C:CC, M261D:CC, M261G:CC, M331A:??, M332A:C?, M332E:C?, M332F:C?, M332G:CC, M333A:PP, M341A:??
TNC Ecoregions: 6:C, 7:C, 8:C, 9:C, 12:C, 18:C, 19:C, 20:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.740193#references
Description Author: J. Kagan, mod. M.S. Reid
Version: 28 Sep 2007 **Stakeholders:** West
Concept Author: J. Kagan **ClassifResp:** West

CUMBERLAND RIVERSCOUR (CES202.036)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Short (<5 yrs) Flooding Interval; Riparian Mosaic; Riverine / Alluvial; Graminoid
Non-Diagnostic Classifiers: Lowland [Foothill]; Woody-Herbaceous; Broad-Leaved Deciduous Tree; Broad-Leaved Deciduous Shrub
National Mapping Codes: ESLF 9164

CONCEPT

Summary: Examples of this riverscour-influenced system may occur on high-gradient and very high-gradient streams in the gorges of the Cumberland Plateau, the Cumberland Mountains, and the more rugged parts of the Ridge and Valley in Kentucky, Tennessee, and Alabama, and possibly in Georgia. The succession of woody plants (particularly trees) is retarded by the force of "flashy," high-velocity water traveling down the stream channels. This system may occur on flood-scoured acidic or calcareous bedrock, cobble, pebble, or sandbar substrates of sandstone, limestone, dolomite, and possibly other sedimentary and weakly metamorphosed geologies. The most distinctive parts of the system are dominated by shrubs, perennial grasses, and forbs. In some areas, a riparian woodland composed of *Betula nigra* and *Platanus occidentalis* may be a component association. Some common shrubs include *Alnus serrulata, Betula nigra, Cephalanthus occidentalis, Cornus amomum, Fothergilla major, Itea virginica, Salix caroliniana, Rhododendron arborescens, Toxicodendron radicans*, and *Juniperus virginiana var. virginiana*. Some grasses (typical of prairies) include *Andropogon gerardii, Sorghastrum nutans, Schizachyrium scoparium, Chasmanthium latifolium, Tripsacum dactyloides*, and/or *Panicum virgatum*. Forbs are diverse and variable from occurrence to occurrence. This system is affected by flood-scouring in some areas and deposition in others. There is typically a gradient from dry, nutrient-poor conditions upslope to moist and relatively enriched conditions downslope. A variety of these conditions may exist at any one site. Some areas are prone to severe drought periods that may stress or kill some (particularly woody) vegetation. Flood-scouring is a powerful and ecologically important abrasive force along the riverbanks where this system is found.
Classification Comments: Examples of the system are sometimes called "scoured riverbank prairies," "riverside prairies," "linear prairies," "rivershore grasslands," or "scoured riverine bluff prairie." River systems where it is found include the Cumberland and its tributaries, the Obed, the Obey, Chickasaw Creek (Tennessee), the Cahaba (Alabama), the Red River Gorge (Kentucky), Rockcastle River (Kentucky), the Big South Fork of the Cumberland (Kentucky/Tennessee) and its tributaries, and others.
Similar Ecological Systems:
- Central Appalachian Stream and Riparian (CES202.609)--occurs to the north and east.
- South-Central Interior Small Stream and Riparian (CES202.706)

Related Concepts:
- River Birch - Sycamore: 61 (Eyre 1980) Finer

DESCRIPTION

Environment: Examples may occur on high-gradient and very high-gradient streams in the gorges of the Cumberland Plateau, the Cumberland Mountains, and rugged parts of the Ridge and Valley, in Kentucky, Tennessee, and Alabama, and possibly in Georgia. The succession of woody plants (particularly trees) is retarded by the force of "flashy," high-velocity water traveling down the stream channels. This system may occur on flood-scoured acidic or calcareous bedrock, cobble, pebble, or sandbar substrates of sandstone, limestone, dolomite, and possibly other sedimentary and weakly metamorphosed geologies. It is presumably more extensive and better developed in materials derived from sandstone, where the erodibility creates more material circulating in the stream to create the sandbar/gravelbar areas where the system may occur in extensive patches, and where the extremely well-drained qualities of the coarse sediments further help to retard woody plant succession.
Vegetation: Examples of this system are typically dominated by shrubs, perennial grasses, and forbs. In some areas, a riparian woodland composed of *Betula nigra* and *Platanus occidentalis* may be a component association. Some common shrub component species include *Alnus serrulata, Betula nigra, Cephalanthus occidentalis, Cornus amomum, Fothergilla major, Itea virginica, Salix caroliniana, Rhododendron arborescens, Toxicodendron radicans*, and *Juniperus virginiana var. virginiana*. More southern examples may contain *Hydrangea quercifolia*, *Hypericum densiflorum*, and *Morella cerifera (= Myrica cerifera var. cerifera)*. Some grasses and forbs include *Andropogon gerardii, Sorghastrum nutans, Schizachyrium scoparium, Chasmanthium latifolium, Tripsacum dactyloides, Panicum virgatum, Baptisia australis, Conoclinium coelestinum (= Eupatorium coelestinum), Coreopsis pubescens, Coreopsis tripteris, Elephantopus carolinianus, Helenium autumnale, Hydrocotyle* sp., *Ludwigia leptocarpa, Lycopus* spp., *Orontium aquaticum, Osmunda regalis var. spectabilis, Oxypolis rigidior, Phlox carolina, Pityopsis graminifolia var. latifolia, Rhynchospora colorata (= Dichromena colorata), Rudbeckia laciniata*, and *Vernonia gigantea*. Patches of *Carex torta* may be present in some examples. Distinctive shoals with *Hymenocallis coronaria* and *Justicia americana* may be present as well. Some of these species are typical of prairies, and thrive in the well-lit environment.
Dynamics: This system is prone to flooding in the upper regions and deposition in the topographically lower areas. There is typically

a gradient from dry acidic conditions higher on the bank to moist, fairly enriched conditions lower down may exist at any one site. It is prone to severe drought periods that may stress or kill some vegetation. Flood scouring is a powerful and ecologically important abrasive force along the riverbanks where this system is found. Soils in sandstone areas are rapidly drained Psamments, and may be restricted to the narrow interstices of tightly packed boulders, or to small crevices in bedrock exposures. Within the system the various species are distributed patchily probably due to microsite conditions.

Component Associations:
- *(Salix caroliniana, Rhododendron arborescens) - Andropogon gerardii - Baptisia australis - (Solidago simplex ssp. randii)* Herbaceous Vegetation (CEGL008471, G2?)
- *Alnus serrulata - Xanthorhiza simplicissima* Shrubland (CEGL003895, G3G4)
- *Betula nigra - Platanus occidentalis / Alnus serrulata / Boehmeria cylindrica* Forest (CEGL007312, G4G5)
- *Carex torta* Herbaceous Vegetation (CEGL004103, G3G4)
- *Hymenocallis coronaria - Justicia americana* Herbaceous Vegetation (CEGL004285, G1)
- *Hypericum densiflorum - Alnus serrulata / Jamesianthus alabamensis - Xyris tennesseensis* Shrubland (CEGL008494, G1G2)
- *Hypericum densiflorum - Alnus serrulata / Tripsacum dactyloides* Shrubland (CEGL008495, G1G2)
- *Justicia americana* Herbaceous Vegetation (CEGL004286, G4G5)
- *Osmunda regalis var. spectabilis* Seepage Scour Herbaceous Vegetation (CEGL008404, G3?)
- *Podostemum ceratophyllum* Herbaceous Vegetation (CEGL004331, G3G5)
- *Vallisneria americana - (Heteranthera dubia)* Riverine Herbaceous Vegetation (CEGL004333, G3G4)

DISTRIBUTION

Range: This system is found in the Cumberland Plateau, the Cumberland Mountains, and the more rugged parts of the Ridge and Valley, in Kentucky, Tennessee, and Alabama, and possibly in Georgia.
Divisions: 202:C
Nations: US
Subnations: AL, GA?, KY, TN, WV
Map Zones: 48:C, 53:C
USFS Ecomap Regions: 211E:CC, 221H:CC, 231C:CC, M221C:CC
TNC Ecoregions: 50:C

SOURCES

References: Bailey and Coe 2001, Comer et al. 2003, Eyre 1980, NatureServe Ecology - Southeastern U.S. unpubl. data
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722671#references
Description Author: R. Evans and M. Pyne, mod. C. Nordman
Version: 14 Jan 2014 **Stakeholders:** East, Midwest, Southeast
Concept Author: R. Evans, M. Pyne **ClassifResp:** Southeast

CUMBERLAND SEEPAGE FOREST (CES202.361)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Seepage-Fed Sloping [Mineral]; Broad-Leaved Tree
Non-Diagnostic Classifiers: Forest and Woodland (Treed)
National Mapping Codes: ESLF 9316

CONCEPT

Summary: This system of seepage-influenced, primarily forested wetlands is found in the Cumberland Plateau and Ridge and Valley regions of Alabama, Tennessee, West Virginia, and Kentucky. It is also found on the flat metasedimentary upland surfaces of Chilhowee Mountain, Tennessee. This area is part of the Southern Blue Ridge (TNC Ecoregion 51), but its ecological communities are similar to those of the Cumberlands. Examples most often occur in streamhead swales or on broad sandstone ridges where soils are sandy and saturated due to a combination of perched water table and seepage flow. Examples range in condition from open woodlands to forests, and some may lack a canopy and then will be dominated by shrubs or herbs. Typical woody species, when present, include *Acer rubrum, Nyssa sylvatica, Liriodendron tulipifera, Liquidambar styraciflua, Ilex opaca var. opaca, Oxydendrum arboreum*, and *Kalmia latifolia*.
Classification Comments: Examples range in condition from open woodlands to forests, and some may lack a canopy and then will be dominated by shrubs or herbs.
Similar Ecological Systems:
- East Gulf Coastal Plain Northern Seepage Swamp (CES203.554)

Related Concepts:
- Red Maple: 108 (Eyre 1980) Finer

DESCRIPTION

Environment: Examples occur in streamhead swales or on broad sandstone ridges. Soils are sandy and saturated due to a combination of perched water table and seepage flow.
Vegetation: Typical woody species, when present, include *Acer rubrum, Nyssa sylvatica, Liriodendron tulipifera, Liquidambar styraciflua, Ilex opaca var. opaca, Oxydendrum arboreum*, and *Kalmia latifolia*. Some extreme southerly examples may contain *Nyssa biflora*. Some stands are more open due to fire frequency, windthrow, or other disturbance. These are more likely to contain noteworthy herbaceous plant species (e.g., *Platanthera* spp.). Typical shrubs include *Ilex verticillata, Alnus serrulata, Rhododendron maximum, Photinia melanocarpa (= Aronia melanocarpa), Vaccinium simulatum, Viburnum nudum var. nudum* (or *Viburnum nudum var. cassinoides* in the Southern Blue Ridge), and *Cornus foemina*. Woody vines can be common and include *Toxicodendron radicans* and (especially towards the south), *Decumaria barbara*, and *Bignonia capreolata*. Typical herbaceous species include *Osmunda cinnamomea, Osmunda regalis var. spectabilis, Chasmanthium laxum, Thelypteris noveboracensis, Woodwardia areolata, Oxypolis rigidior, Carex intumescens, Carex debilis, Carex crinita, Medeola virginiana, Lobelia cardinalis, Juncus effusus var. pylaei, Scirpus polyphyllus, Rubus hispidus, Solidago patula var. patula, Athyrium filix-femina ssp. asplenioides*, and *Viola X primulifolia*. *Platanthera integrilabia* and *Platanthera clavellata* are also known from these forested seeps but are more typical in more open examples. Patches of *Sphagnum* spp. are common and *Sphagnum lescurii* is typical.

Component Associations:
- *Acer rubrum var. trilobum - Nyssa sylvatica / Osmunda cinnamomea - Chasmanthium laxum - Carex intumescens / Sphagnum lescurii* Forest (CEGL007443, G3?)
- *Acer rubrum var. trilobum / Alnus serrulata / Calamagrostis coarctata* Saturated Woodland (CEGL003737, G2G3)

DISTRIBUTION

Range: This systems is found in the Cumberland Plateau and Ridge and Valley regions of Alabama, Tennessee, West Virginia, and Kentucky. Related stands in the Interior Low Plateau of Kentucky ("Shawnee Hills") need to be provided for here or in a separate system.
Divisions: 202:C
Nations: US
Subnations: AL, KY, TN, WV
Map Zones: 48:C, 53:C, 57:C
TNC Ecoregions: 50:C, 51:C

SOURCES

References: Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723153#references

Description Author: R. Evans and M. Pyne
Version: 23 Feb 2010
Concept Author: R. Evans and M. Pyne

Stakeholders: East, Southeast
ClassifResp: Southeast

EAST GULF COASTAL PLAIN FRESHWATER TIDAL WOODED SWAMP (CES203.299)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Forest and Woodland (Treed); Riverine / Alluvial; Tidal / Estuarine
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Mixed evergreen-deciduous open tree canopy
National Mapping Codes: ESLF 9132

CONCEPT

Summary: This ecological system encompasses the tidally flooded portions of river floodplains which flow into the northern Gulf of Mexico east of the Mississippi River. Large outflows of freshwater keep salinity levels at a minimum, and flooding is of short enough duration to allow survival of tree canopies. Stands are dominated by a combination of *Nyssa aquatica, Nyssa biflora, Taxodium distichum*, and *Fraxinus pennsylvanica*. Other plants that are typically present include *Magnolia virginiana, Sabal palmetto, Juniperus virginiana var. silicicola, Cyrilla racemiflora, Quercus laurifolia, Sabal minor, Taxodium ascendens, Cliftonia monophylla, Pinus elliottii var. elliottii, Chamaecyparis thyoides, Hypericum nitidum, Cladium mariscus ssp. jamaicense*, and *Persea palustris*. These swamps may be regularly flooded at least twice daily.

Similar Ecological Systems:
- East Gulf Coastal Plain Small Stream and River Floodplain Forest (CES203.559)
- Southern Atlantic Coastal Plain Tidal Wooded Swamp (CES203.240)

Related Concepts:
- Baldcypress - Tupelo: 102 (Eyre 1980) Finer
- Baldcypress: 101 (Eyre 1980) Finer
- Freshwater Tidal Swamp (FNAI 1990) Broader
- Sweetbay - Swamp Tupelo - Redbay: 104 (Eyre 1980) Finer
- Sweetgum - Willow Oak: 92 (Eyre 1980) Finer
- Water Tupelo - Swamp Tupelo: 103 (Eyre 1980) Finer
- Willow Oak - Water Oak - Diamondleaf (Laurel) Oak: 88 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs in lower reaches of river floodplains and along estuary shorelines, in places regularly or irregularly flooded by lunar or wind tides. The water has little salt content, due to distance from the ocean and/or strong freshwater input. Soils may be mineral or organic. Soils are generally permanently saturated even when the tide is low. The transition of the hydrology to flood dominance rather than tidal dominance may be very gradual.

Vegetation: Stands are dominated by a combination of *Nyssa aquatica, Nyssa biflora, Taxodium distichum*, and *Fraxinus pennsylvanica*. Other plants that are typically present include *Magnolia virginiana, Sabal palmetto, Juniperus virginiana var. silicicola, Cyrilla racemiflora, Quercus laurifolia, Sabal minor, Taxodium ascendens, Cliftonia monophylla, Pinus elliottii var. elliottii, Chamaecyparis thyoides, Hypericum nitidum, Cladium mariscus ssp. jamaicense*, and *Persea palustris*.

Dynamics: Regular or irregular tidal flooding with freshwater is the ecological factor that makes this system distinct. These swamps may be regularly flooded at least twice a day for several hours and remain inundated for days during flood or storm events (Wharton et al. 1982, FNAI 1990). River floods may also seasonally affect this system. Wind and flooding are the dominant disturbance agents in this type and this includes wind damage from hurricanes and tornadoes as well as inundation of young stands. Canopy gaps can be created by high winds, such as from nor'easters, tropical storms and hurricanes (Nordman 2013). Infrequent intrusion of saltier water, which is stressful or fatal to many of the plant species, is an important periodic disturbance created by storms. Insect outbreaks would occur infrequently in these closed-canopy forests (Landfire 2007a). This system generally appears to be in a shifting relationship with tidal freshwater marshes of the same region. Most marshes have standing dead trees in them, suggesting they recently were swamps. But, conversely, some marshes are being invaded with trees and may be turning into swamps. Freshwater tidal marshes generally occur at the shallow edge of tidal rivers and streams, where river and tidal flow is high, and the vegetation is affected by the changing meanders of the tidal channel. Rising sea level is driving shifts in the communities of this system, causing upstream non-tidal swamps to develop into this system (as they become subject to tides) and causing parts of this system to turn into brackish marshes. In areas not too strongly affected by saltwater intrusion or drowning by rising sea level, these communities can be expected to exist as old-growth, multi-aged forests.

Component Associations:
- *Nyssa aquatica* Tidal Forest (CEGL008561, G3?)
- *Nyssa biflora - (Taxodium distichum, Nyssa aquatica) / Morella cerifera - Rosa palustris* Tidal Forest (CEGL004484, G3G4)
- *Nyssa biflora - Magnolia virginiana - Sabal palmetto - Juniperus virginiana var. silicicola* Forest (CEGL004684, G2)
- *Nyssa biflora - Magnolia virginiana / Cyrilla racemiflora* Forest (CEGL004683, G2)
- *Quercus laurifolia - Fraxinus pennsylvanica - Nyssa aquatica / Sabal minor* Tidal Forest (CEGL007884, G3?)

- *Taxodium ascendens - Cliftonia monophylla - Pinus elliottii var. elliottii - Chamaecyparis thyoides / Hypericum nitidum - Cladium mariscus ssp. jamaicense* Forest (CEGL004981, G2?)
- *Taxodium distichum - Nyssa aquatica - Persea palustris* Forest (CEGL004681, G2)
- *Taxodium distichum - Nyssa biflora - Magnolia virginiana - Fraxinus profunda* Forest (CEGL004682, G2)

Spatial Characteristics

Adjacent Ecological Systems:
- Atlantic Coastal Plain Brownwater Stream Floodplain Forest (CES203.248)

Distribution

Range: This system includes river floodplains which flow into the northern Gulf of Mexico east of the Mississippi River.
Divisions: 203:C
Nations: US
Subnations: AL, FL, MS
Map Zones: 55:C, 99:C
USFS Ecomap Regions: 232D:CC, 232L:CC
TNC Ecoregions: 53:C

Sources

References: Comer et al. 2003, Edwards et al. 2013, Eyre 1980, FNAI 1990, Harris 1989, Landfire 2007a, Nordman 2013, Odum et al. 1984, Schafale pers. comm., Wharton et al. 1982
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723192#references
Description Author: R. Evans, mod. M. Pyne
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: R. Evans **ClassifResp:** Southeast

EAST GULF COASTAL PLAIN INTERIOR SHRUB BOG (CES203.385)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Shrubland (Shrub-dominated); Seepage-Fed Sloping
National Mapping Codes: ESLF 9341

CONCEPT

Summary: This ecological system includes wet, shrub-dominated seepage communities in the Upper East Gulf Coastal Plain of Alabama, adjacent Georgia, and possibly Mississippi. These wetlands generally occur in small patches on slopes within a matrix of longleaf pine-dominated vegetation. Wetland conditions are maintained by seepage flow from adjacent uplands. Examples of this system can vary between densely shrubby and fairly open and herbaceous, depending on frequency of fire and amount of elapsed time since the previous fires. However, this system tends to be much shrubbier due to topographic isolation than related seepage bog system of the Outer Coastal Plain such as Southern Coastal Plain Herbaceous Seep and Bog (CES203.078). The globally rare pitcher plant *Sarracenia rubra ssp. alabamensis* may be present in some examples of this system.

Similar Ecological Systems:
- Atlantic Coastal Plain Sandhill Seep (CES203.253)
- Southern Coastal Plain Herbaceous Seep and Bog (CES203.078)

DESCRIPTION

Environment: Examples may be found along steep to gentle slopes in the historically longleaf pine-dominated landscape of the Upper East Gulf Coastal Plain.

Vegetation: The physiognomy is variable, depending on fire history, and can vary from densely shrubby to herbaceous. In current condition, most examples are shrubby. Dominant species include *Morella cerifera (= Myrica cerifera var. cerifera), Kalmia latifolia, Symplocos tinctoria, Ilex coriacea, Ilex glabra, Arundinaria gigantea ssp. tecta,* and *Cyrilla racemiflora*. A number of other shrubs may also be present. Some stands, or portions of them, are strongly dominated by *Arundinaria gigantea ssp. tecta*. A fairly rich herb layer is present that may include *Osmunda cinnamomea* (dominant), *Eupatorium album, Xyris caroliniana, Aletris farinosa, Aristida purpurascens, Dichanthelium dichotomum var. ensifolium, Epigaea repens, Eupatorium pilosum, Eupatorium rotundifolium, Helianthus angustifolius, Lachnocaulon anceps, Polygala nana, Pteridium aquilinum var. pseudocaudatum, Rhexia alifanus, Rhexia petiolata, Rhynchospora plumosa, Sarracenia rubra ssp. alabamensis, Schizachyrium scoparium, Solidago odora var. odora,* and *Xyris ambigua*.

Component Associations:
- *Arundinaria gigantea ssp. tecta* Shrubland (CEGL003843, G1)
- *Ilex (coriacea, glabra) / Osmunda cinnamomea - Rhexia petiolata* Herbaceous Vegetation (CEGL008550, G2?)
- *Ilex coriacea - Lyonia lucida - Smilax laurifolia* Shrubland (CEGL004666, G3G4)
- *Morella cerifera - Kalmia latifolia - Symplocos tinctoria / Osmunda cinnamomea* Herbaceous Vegetation (CEGL008548, G2?)
- *Pinus serotina / Lyonia lucida - Ilex glabra - (Cyrilla racemiflora)* Shrubland (CEGL003846, G3)

DISTRIBUTION

Range: This system is found in the Upper East Gulf Coastal Plain of Alabama, adjacent Georgia, and possibly Mississippi.
Divisions: 203:C
Nations: US
Subnations: AL, GA, MS?
Map Zones: 46:C, 55:C, 99:P
TNC Ecoregions: 43:C, 53:P

SOURCES

References: Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723131#references
Description Author: A. Schotz and R. Evans, mod. M. Pyne
Version: 27 Sep 2005
Concept Author: A. Schotz and R. Evans
Stakeholders: Southeast
ClassifResp: Southeast

EAST GULF COASTAL PLAIN LARGE RIVER FLOODPLAIN FOREST (CES203.489)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Forest and Woodland (Treed); Riverine / Alluvial [Brownwater]
National Mapping Codes: ESLF 9199

CONCEPT

Summary: This system represents a geographic subset of Southern Floodplain Forest. Examples may be found along large rivers of the East and Upper East Gulf Coastal Plain, especially the Apalachicola, Alabama/Cahaba, Tombigbee, Pascagoula, and Pearl rivers, all of which ultimately drain into the Gulf of Mexico. Several distinct plant communities can be recognized within this system that may be related to the array of different geomorphologic features present within the floodplain. Some of the major geomorphic features associated with different community types include natural levees, point bars, meander scrolls, oxbows, and sloughs. Vegetation generally includes forests dominated by bottomland hardwood species and other trees tolerant of flooding. However, herbaceous and shrub vegetation may be present in certain areas as well.
Classification Comments: In the Upper East Gulf Plain of Kentucky, this system is represented in the Ecoregions of Kentucky map (Woods et al. 2002) by the lower part of the Wabash-Ohio bottomlands (72a). In the lower Gulf Coastal Plain, this includes at least EPA (Omernik) Level IV ecoregions 65p and 75i (EPA 2004).
Similar Ecological Systems:
- East Gulf Coastal Plain Small Stream and River Floodplain Forest (CES203.559)
- Southern Atlantic Coastal Plain Large River Floodplain Forest (CES203.066)

Related Concepts:
- Baldcypress - Tupelo: 102 (Eyre 1980) Finer
- Baldcypress: 101 (Eyre 1980) Finer
- Black Willow: 95 (Eyre 1980) Finer
- Bottomland Forest (FNAI 1990) Intersecting
- Bottomland Hardwood Swamp (Evans 1991) Intersecting
- Bottomland Marsh (Evans 1991) Intersecting
- Coastal Plain Bottomland Hardwood Forest (Evans 1991) Intersecting
- Coastal Plain Slough (Evans 1991) Intersecting
- Cottonwood: 63 (Eyre 1980) Finer
- Cypress/Tupelo Swamp (Evans 1991) Intersecting
- Floodplain Forest (FNAI 1990) Intersecting
- Floodplain Ridge/Terrace Forest (Evans 1991) Intersecting
- Floodplain Swamp (FNAI 1990) Intersecting
- Gravel/Cobble Bar (Evans 1991) Finer
- Overcup Oak - Water Hickory: 96 (Eyre 1980) Finer
- Pondcypress: 100 (Eyre 1980) Finer
- River Birch - Sycamore: 61 (Eyre 1980) Finer
- Silver Maple - American Elm: 62 (Eyre 1980) Finer
- Sugarberry - American Elm - Green Ash: 93 (Eyre 1980) Finer
- Swamp Chestnut Oak - Cherrybark Oak: 91 (Eyre 1980) Finer
- Sweetgum - Willow Oak: 92 (Eyre 1980) Finer
- Sycamore - Sweetgum - American Elm: 94 (Eyre 1980) Finer
- Water Tupelo - Swamp Tupelo: 103 (Eyre 1980) Finer
- Willow Oak - Water Oak - Diamondleaf (Laurel) Oak: 88 (Eyre 1980) Finer

DESCRIPTION

Environment: This system represents a geographic subset of Kuchler's (1964) Southern Floodplain Forest. Examples of this system are generally forested with stands of bottomland hardwood species and other trees tolerant of flooding. Local composition varies depending upon actual position within the floodplain, disturbance history, and underlying soils and geology. Although most examples of this system may be thought of as acidic, some examples of this system flow through regions with sufficient calcareous influence to effect vegetation composition. Some of the major geomorphic features associated with different community types include natural levees, point bars, meander scrolls, oxbows, and sloughs (Sharitz and Mitsch 1993).
Dynamics: In pre-European settlement forests, community diversity in these bottomland systems was much more complex than in the modified landscapes of today. Fire, beaver activity, and flooding of varied intensity and frequency created a mosaic whose elements included canebrake, grass and young *Betula-Platanus* beds on reworked gravel or sand bars, beaver ponds, and grass-sedge meadows

in abandoned beaver clearings, as well as the streamside zones and mixed hardwood and/or pine forests that make up more than 95% of the land cover that exists today.

The dominant ecological processes in bottomland hardwood forests are windfall gaps and periodic flooding. Windfall gaps occur on the local scale (the fall of a single mature canopy tree) as well as the landscape scale (storms, hurricanes). When canopy trees fall, seedlings in the understory are released and compete for a spot in the canopy. This leads to dense areas of herbaceous and woody vegetation in windfall gaps of all sizes. This is a major process in forest regeneration in bottomland hardwood forests. Canopy decline and reproductive failure can create late-seral open stands.

Flooding is more frequent on the lower terraces but frequently impacts higher terraces as well (Wharton et al. (1982) zones IV & V). Catastrophic floods can cause the loss of canopy over large areas, and large coastal areas are also impacted by storm surges from hurricanes and tropical storms as well as by salt deposition in the immediate coastal area. The duration of flooding varies with the placement of a particular site in the landscape and is a dominant process affecting vegetation on a given site. Flooding can deposit alluvium or scour the ground, depending on the landscape position of a site and the severity of the flood event.

Fire is infrequent and of limited importance in lower, wetter areas, but was historically important in the older and higher terraces, especially areas adjacent to upland pine or pine flatwoods, and also crept into the floodplains. Putnam (1951 as cited in Wharton et al. 1982) states that a serious fire season occurs on an average of about every 5 to 8 years in the bottomland hardwood forests of the Mississippi Alluvial Plain. It is conjectured that Native Americans maintained canebrakes by deliberate fall burning. Infrequent, mild surface fires would occur in the system and would cause changes in composition and structure due to low fire tolerance.

Changes in hydrology due to the activities of beaver are also an important ecological process in bottomland hardwood forests. Beaver impoundments kill trees (sometimes over large areas) and may create open water habitat, cypress-tupelo stands, or cause stand replacement. Meandering streams are dynamic and frequently change course, eroding into the floodplain and depositing new point bars, thus creating new habitat for early-seral plant communities. In addition, insect outbreaks would occur infrequently in closed-canopy states, opening up the canopy at least temporarily.

Component Associations:
- *Acer negundo* Forest (CEGL005033, G4G5)
- *Acer saccharinum - Celtis laevigata - Carya illinoinensis* Forest (CEGL002431, G3G4)
- *Arundinaria gigantea ssp. gigantea* Shrubland (CEGL003836, G2?)
- *Betula nigra - Platanus occidentalis / Alnus serrulata / Boehmeria cylindrica* Forest (CEGL007312, G4G5)
- *Betula nigra / Salix nigra / Hypericum prolificum - Ampelopsis arborea* Forest (CEGL007794, G3?)
- *Brunnichia ovata* Vine-Shrubland (CEGL008446, G4?)
- *Catalpa bignonioides - Salix nigra / Brunnichia ovata / Eupatorium serotinum* Forest (CEGL008547, G2G3)
- *Cephalanthus occidentalis / Carex* spp. - *Lemna* spp. Southern Shrubland (CEGL002191, G4)
- *Decodon verticillatus* Seasonally Flooded Shrubland (CEGL003905, G4)
- *Forestiera acuminata - (Planera aquatica, Cephalanthus occidentalis)* Shrubland (CEGL003911, G3?)
- *Fraxinus pennsylvanica - Ulmus americana - Celtis laevigata / Ilex decidua* Forest (CEGL002427, G4G5)
- *Fraxinus pennsylvanica - Ulmus americana / Carpinus caroliniana / Boehmeria cylindrica* Forest (CEGL007806, G4?)
- *Gleditsia aquatica - Carya aquatica* Forest (CEGL007426, G3?)
- *Liquidambar styraciflua - Quercus pagoda - Carya* spp. / *Carpinus caroliniana / Carex* spp. Forest (CEGL007353, G3G4)
- *Nelumbo lutea* Herbaceous Vegetation (CEGL004323, G4?)
- *Nuphar advena - Nymphaea odorata* Herbaceous Vegetation (CEGL002386, G4G5)
- *Nyssa aquatica - Fraxinus pennsylvanica - Taxodium distichum / Sabal minor* Forest (CEGL008463, GNR)
- *Nyssa aquatica - Nyssa biflora* Forest (CEGL007429, G4G5)
- *Nyssa aquatica* Forest (CEGL002419, G4G5)
- *Nyssa biflora - Acer rubrum var. rubrum / Lyonia lucida* Forest (CEGL007864, G3G4)
- *Nyssa biflora - Taxodium ascendens / Ludwigia pilosa - Bacopa caroliniana* Woodland (CEGL003735, G1?)
- *Nyssa biflora / Itea virginica - Cephalanthus occidentalis* Depression Forest (CEGL007434, G3G4)
- *Nyssa ogeche - (Nyssa biflora, Taxodium ascendens)* Forest (CEGL007392, G4)
- *Nyssa ogeche - Nyssa aquatica* Forest (CEGL007393, G3)
- *Platanus occidentalis - Liquidambar styraciflua - (Ulmus americana) / (Crataegus viridis)* Forest (CEGL007335, G3G4)
- *Polygonum* spp. - *Phanopyrum gymnocarpon* Seasonally Flooded Herbaceous Vegetation (CEGL008555, G4)
- *Populus deltoides - Salix caroliniana* Forest (CEGL007343, G4G5)
- *Populus deltoides - Salix nigra - Acer saccharinum* Forest (CEGL002018, G3G4)
- *Populus deltoides - Salix nigra / Mikania scandens* Forest (CEGL007346, G4G5)
- *Populus deltoides / Acer negundo / Boehmeria cylindrica* Forest (CEGL007731, G3G5)
- *Quercus laurifolia - Quercus michauxii - Liquidambar styraciflua / Carpinus caroliniana* Forest (CEGL004678, G3G4)
- *Quercus lyrata - Carya aquatica* Forest (CEGL007397, G4G5)
- *Quercus lyrata - Liquidambar styraciflua* Forest (CEGL008583, G3G4)
- *Quercus michauxii - Quercus shumardii - Liquidambar styraciflua / Arundinaria gigantea* Forest (CEGL002099, G3G4)
- *Quercus nigra - Quercus pagoda - Carya myristiciformis / Cercis canadensis* Forest (CEGL004770, G3?)
- *Quercus pagoda - Quercus nigra / Halesia diptera - Ilex decidua / Chasmanthium sessiliflorum - Dicliptera brachiata* Forest (CEGL007354, G4?)

- *Quercus phellos - Quercus nigra - Liquidambar styraciflua* Mississippi River Alluvial Plain Forest (CEGL007915, G4G5)
- *Quercus shumardii - Quercus michauxii - Quercus nigra / Acer barbatum - Tilia americana var. heterophylla* Forest (CEGL008487, G3)
- *Quercus texana - Celtis laevigata - Ulmus (americana, crassifolia) - (Gleditsia triacanthos)* Forest (CEGL004619, G4G5)
- *Salix caroliniana* Temporarily Flooded Coastal Plain Shrubland (CEGL007052, G4?)
- *Salix nigra* Forest (CEGL002103, G4)
- *Salix nigra* Large River Floodplain Forest (CEGL007410, G3G5)
- *Taxodium distichum - Fraxinus pennsylvanica - Quercus laurifolia / Acer rubrum / Saururus cernuus* Forest (CEGL007719, G3G4)
- *Taxodium distichum - Nyssa ogeche* Forest (CEGL003841, G3G4)
- *Taxodium distichum / Lemna minor* Forest (CEGL002420, G4G5)
- *Typha latifolia* Southern Herbaceous Vegetation (CEGL004150, G5)
- *Zizaniopsis miliacea* Coastal Plain Slough Herbaceous Vegetation (CEGL004139, G4?)

DISTRIBUTION

Range: This system is found in the East and Upper East Gulf coastal plains, and includes the Apalachicola, Alabama, Tombigbee, Pascagoula, and Pearl rivers, all of which ultimately drain into the Gulf of Mexico.
Divisions: 203:C
Nations: US
Subnations: AL, FL, GA, KY, MS, TN
Map Zones: 46:C, 47:C, 55:C, 99:C
USFS Ecomap Regions: 231B:CC, 232B:CC, 232J:CC, 232L:CC
TNC Ecoregions: 43:C, 53:C

SOURCES

References: Comer et al. 2003, EPA 2004, Evans 1991, Eyre 1980, FNAI 1990, Harris 1989, Kuchler 1964, Landfire 2007a, Putnam 1951, Sharitz and Mitsch 1993, Wharton et al. 1982, Woods et al. 2002
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723097#references
Description Author: R. Evans and A. Schotz, mod. M. Pyne
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: R. Evans and A. Schotz **ClassifResp:** Southeast

EAST GULF COASTAL PLAIN NORTHERN SEEPAGE SWAMP (CES203.554)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Seepage-Fed Sloping
Non-Diagnostic Classifiers: Forest and Woodland (Treed); Broad-Leaved Deciduous Tree
National Mapping Codes: ESLF 9351

CONCEPT

Summary: This wetland system of the Upper East Gulf Coastal Plain consists of forested wetlands in acidic, seepage-influenced habitats. These are mostly deciduous forests (and less commonly herbaceous communities) generally found at the base of slopes or other habitats where seepage flow is concentrated. Resulting moisture conditions are saturated or even inundated. The vegetation is characterized by *Nyssa sylvatica, Nyssa biflora,* and *Acer rubrum*. Examples occur in portions of the Coastal Plain north of the range of *Persea palustris* and *Magnolia grandiflora*. *Magnolia virginiana* is of less value as a differential species. To the south this system grades into Southern Coastal Plain Seepage Swamp and Baygall (CES203.505), where evergreen species are of much greater importance in the canopy and understory. Due to excessive wetness, these habitats are normally protected from fire except those which occur during extreme droughty periods. These environments are prone to long-duration standing water and tend to occur on highly acidic, nutrient-poor soils.
Classification Comments: Some authors have treated *Persea palustris* (of wetlands) and *Persea borbonia* (of uplands) as one taxon under a broadly conceived *Persea borbonia*. We recognize two distinct taxa, following Kartesz (1999) and Weakley (2005).
Similar Ecological Systems:
- Cumberland Seepage Forest (CES202.361)
- Piedmont Seepage Wetland (CES202.298)
- Southern Coastal Plain Seepage Swamp and Baygall (CES203.505)

Related Concepts:
- Sweetbay - Swamp Tupelo - Redbay: 104 (Eyre 1980) Finer

DESCRIPTION

Vegetation: The vegetation is characterized by *Nyssa sylvatica, Nyssa biflora,* and *Acer rubrum*. The canopies of stands are primarily deciduous-dominated. Stands in the southern part of the system's range may contain *Magnolia virginiana,* particularly in the understory. This system occurs north of the range of *Persea palustris* and *Magnolia grandiflora,* and these species will be lacking from stands.
Dynamics: Due to excessive wetness, these habitats are normally protected from fire except those which occur during extreme droughty periods. These environments are prone to long-duration standing water and tend to occur on highly acidic, nutrient-poor soils.

Component Associations:
- *Acer rubrum var. trilobum - Nyssa sylvatica / Rhododendron canescens - Viburnum nudum var. nudum / Woodwardia areolata* Forest (CEGL004425, G2G3)
- *Carex crinita - Osmunda* spp. / *Sphagnum* spp. Herbaceous Vegetation (CEGL002263, G2G3)
- *Magnolia virginiana - Nyssa biflora / Oxydendrum arboreum / Viburnum nudum var. nudum* Forest (CEGL008552, G3?)
- *Nyssa biflora - Liquidambar styraciflua / Magnolia virginiana / Hamamelis virginiana - Viburnum nudum* Forest (CEGL008477, G2G3)

DISTRIBUTION

Range: This system is found in the East Gulf Coastal Plain portions of western Kentucky (Funk 1975) and Tennessee, northern Mississippi, northwestern and central Alabama, and southern Illinois.
Divisions: 203:C
Nations: US
Subnations: AL, IL, KY, MS, TN
Map Zones: 46:C, 47:C, 49:?
USFS Ecomap Regions: 231B:CC, 231H:CC
TNC Ecoregions: 43:C

SOURCES

References: Comer et al. 2003, Funk 1975, Kartesz 1999, Weakley 2005
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723050#references
Description Author: R. Evans and M. Pyne

Version: 27 Sep 2005
Concept Author: R. Evans and M. Pyne

Stakeholders: Midwest, Southeast
ClassifResp: Southeast

EAST GULF COASTAL PLAIN SMALL STREAM AND RIVER FLOODPLAIN FOREST (CES203.559)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Intermittent Flooding; Forest and Woodland (Treed); Riverine / Alluvial [Brownwater]
National Mapping Codes: ESLF 9339

CONCEPT

Summary: This is a predominantly forested system of the East Gulf Coastal Plain associated with small brownwater rivers and creeks. In contrast to East Gulf Coastal Plain Large River Floodplain Forest (CES203.489), it has fewer major geomorphic floodplain features typically associated with large river floodplains. Those features that are present tend to be smaller and more closely intermixed with one another, resulting in less obvious vegetational zonation. Bottomland hardwood tree species are typically important and diagnostic, although mesic hardwood species are also present in areas with less inundation, such as upper terraces and possibly second bottoms. As a whole, flooding occurs annually, but the water table usually is well below the soil surface throughout most of the growing season. Areas impacted by beaver impoundments are also included in this system.
Classification Comments: This is primarily a linear system, with some variability as to the size type of the associations included within it. Most are temporarily flooded, with the possible addition of smaller-scale seasonally flooded features such as beaver-created herbaceous wetlands and shrub-dominated features. It is confined to floodplains or terraces of streams and creeks. This system is dependent on a natural hydrologic regime, especially annual to episodic flooding. These landscapes usually encompass a variety of habitats resulting from natural hydrological spatial patterns (i.e., meander scars, sloughs, old depressions, and/or oxbows are present).
Similar Ecological Systems:
- East Gulf Coastal Plain Freshwater Tidal Wooded Swamp (CES203.299)
- East Gulf Coastal Plain Large River Floodplain Forest (CES203.489)

Related Concepts:
- Atlantic White-Cedar: 97 (Eyre 1980) Finer
- Baldcypress - Tupelo: 102 (Eyre 1980) Finer
- Black Willow: 95 (Eyre 1980) Finer
- Bottomland Forest (FNAI 1990) Intersecting
- Bottomland Hardwood Swamp (Evans 1991) Intersecting
- Bottomland Marsh (Evans 1991) Intersecting
- Coastal Plain Bottomland Hardwood Forest (Evans 1991) Intersecting
- Coastal Plain Slough (Evans 1991) Intersecting
- Cypress/Tupelo Swamp (Evans 1991) Intersecting
- Floodplain Forest (FNAI 1990) Intersecting
- Floodplain Ridge/Terrace Forest (Evans 1991) Intersecting
- Floodplain Swamp (FNAI 1990) Intersecting
- Gravel/Cobble Bar (Evans 1991) Intersecting
- Live Oak: 89 (Eyre 1980) Finer
- Loblolly Pine - Hardwood: 82 (Eyre 1980) Finer
- Loblolly Pine: 81 (Eyre 1980) Finer
- Riparian Forest (Evans 1991) Intersecting
- River Birch - Sycamore: 61 (Eyre 1980) Finer
- Shrub Swamp (Evans 1991) Intersecting
- Slash Pine: 84 (Eyre 1980) Intersecting
- Swamp Chestnut Oak - Cherrybark Oak: 91 (Eyre 1980) Finer
- Sweetgum - Willow Oak: 92 (Eyre 1980) Finer
- Sycamore - Sweetgum - American Elm: 94 (Eyre 1980) Finer
- Water Tupelo - Swamp Tupelo: 103 (Eyre 1980) Finer
- Willow Oak - Water Oak - Diamondleaf (Laurel) Oak: 88 (Eyre 1980) Finer

DESCRIPTION

Environment: This system is associated with small brownwater rivers and creeks of the East Gulf Coastal Plain. It is confined to floodplains or terraces of streams and creeks. This system is dependent on a natural hydrologic regime, especially annual to episodic flooding. These landscapes usually encompass a variety of habitats resulting from natural hydrological spatial patterns (i.e., meander scars, sloughs, gravel bars, old depressions, and/or oxbows are present). Most component associations are temporarily flooded, with the possible addition of smaller-scale seasonally flooded features such as beaver-created herbaceous wetlands and shrub-dominated features. Some larger examples of this system include the Escambia, the Yellow (Alabama, Florida), the Choctawhatchee, the

Chattahoochee, and the Flint rivers.

Vegetation: Examples of this system may include a number of different plant communities, each with distinctive floristic compositions. Drew et al. (1998) described vegetation attributable to this systems as including the following species: *Carya glabra, Magnolia grandiflora, Quercus virginiana, Liquidambar styraciflua, Acer barbatum, Fraxinus americana, Fraxinus caroliniana, Celtis laevigata, Sabal minor, Sebastiania fruticosa, Serenoa repens*, and *Itea virginica*. Smaller-scale features may be dominated by shrubs (*Cephalanthus occidentalis, Decodon verticillatus*) and/or perennial and annual herbs.

Dynamics: In pre-European settlement forests, community diversity in these bottomland systems was much more complex than in the modified landscapes of today. Fire, beaver activity, and flooding of varied intensity and frequency created a mosaic whose elements included canebrake, grass and young *Betula-Platanus* beds on reworked gravel or sand bars, beaver ponds, and grass-sedge meadows in abandoned beaver clearings, as well as the streamside zones and mixed hardwood and/or pine forests that make up more than 95% of the land cover that exists today.

Flooding is the principal disturbance in this system. When flooded, these systems may have a substantial aquatic faunal component, with high densities of invertebrates, and may play an important role in the life cycle of fish in the associated river. Unusually long or deep floods may stress vegetation or act as a disturbance for some species. Flood waters have significant energy. Larger floods cause local disturbance by scouring and depositing sediment along channels and occasionally causing channel shifts. There are two general types of floods: occasional catastrophic, prolonged floods (due to beaver activity or other severe event); and more frequent repeated minor flooding (i.e., several minor floods within a 10 year period). Flooding is more frequent on the lower terraces but frequently floods higher terraces (Wharton et al. (1982) zones IV and V). Catastrophic floods can cause the loss of canopy over large areas. Canopy decline and reproductive failure can create late-seral open stands. Duration of flooding varies with the placement of a site in the landscape and is a dominant process affecting vegetation on a given site. Flooding can deposit alluvium or scour the ground, depending on the landscape position of a site and the severity of the flood event. The sorting of plant communities by depositional landforms of different height suggest that wetness or depth of flood waters helps drive this process. Scouring and reworking of sediment make up an important factor in bar and bank communities. In addition to disturbance, floods bring nutrient input, deposit sediment, and disperse plant seeds (Landfire 2007a).

In addition to periodic flooding, the dominant ecological process in bottomland hardwood forests is the formation of windfall gaps, which can occur on the local scale (a single mature canopy tree) as well as the landscape scale (effects of tornadoes or hurricanes). Except for primary successional communities such as bars, most forests exist naturally as multi-aged old-growth forests driven by gap-phase regeneration. Windthrow is probably the most important cause of gaps, and is the primary cause of mortality in bottomlands. Major storms or hurricanes occurring at approximately 20-year intervals would have impacted whole stands. When canopy trees fall, seedlings in the understory are released and compete for a spot in the canopy. This leads to dense areas of herbaceous and woody vegetation in windfall gaps of all sizes. This is a major process in forest regeneration in bottomland hardwood forests.

Component Associations:

- *Acer rubrum var. trilobum - Nyssa sylvatica / Rhododendron canescens - Viburnum nudum var. nudum / Woodwardia areolata* Forest (CEGL004425, G2G3)
- *Alnus serrulata* Saturated Southern Interior Shrubland (CEGL007059, G3)
- *Alnus serrulata* Southeastern Seasonally Flooded Shrubland (CEGL008474, G4)
- *Betula nigra - Platanus occidentalis / Alnus serrulata / Boehmeria cylindrica* Forest (CEGL007312, G4G5)
- *Betula nigra / Salix nigra / Hypericum prolificum - Ampelopsis arborea* Forest (CEGL007794, G3?)
- *Cephalanthus occidentalis / Carex* spp. - *Lemna* spp. Southern Shrubland (CEGL002191, G4)
- *Chamaecyparis thyoides / Magnolia virginiana - Cliftonia monophylla / Orontium aquaticum - Sphagnum* spp. Forest (CEGL007151, G2G3)
- *Decodon verticillatus* Seasonally Flooded Shrubland (CEGL003905, G4)
- *Fagus grandifolia - Carya* spp. / (*Acer negundo, Magnolia macrophylla, Tilia americana var. heterophylla*) Temporarily Flooded Forest (CEGL004745, G3G4)
- *Fagus grandifolia - Magnolia grandiflora - Quercus michauxii - Quercus nigra / Rhododendron canescens* Forest (CEGL004965, G2G3)
- *Glottidium vesicarium - Lindernia dubia* Sandbar Herbaceous Vegetation (CEGL008498, G3G4)
- *Juncus effusus* Seasonally Flooded Herbaceous Vegetation (CEGL004112, G5)
- *Liquidambar styraciflua - Liriodendron tulipifera / Onoclea sensibilis* Forest (CEGL007329, G4)
- *Liquidambar styraciflua - Quercus pagoda - Carya* spp. / *Carpinus caroliniana / Carex* spp. Forest (CEGL007353, G3G4)
- *Ludwigia peploides* Herbaceous Vegetation (CEGL007835, G4G5)
- *Myriophyllum heterophyllum* Herbaceous Vegetation (CEGL008457, G4)
- *Nelumbo lutea* Herbaceous Vegetation (CEGL004323, G4?)
- *Nyssa aquatica* Forest (CEGL002419, G4G5)
- *Pallavicinia lyellii - Sphagnum* sp. Nonvascular Vegetation (CEGL004779, G3)
- *Panicum virgatum - Panicum rigidulum var. elongatum - Polygonum hydropiperoides* Herbaceous Vegetation (CEGL004921, G3?)
- *Pinus elliottii var. elliottii / Cliftonia monophylla - Cyrilla racemiflora* Woodland (CEGL003638, G2G3Q)
- *Pinus glabra - Quercus (laurifolia, michauxii, nigra) / Carpinus caroliniana ssp. caroliniana / Sabal minor* Forest (CEGL007544, G3G4)

- *Pinus taeda - Liquidambar styraciflua - Nyssa biflora* Temporarily Flooded Forest (CEGL004606, G4)
- *Pinus taeda - Quercus hemisphaerica / Osmanthus americanus / Ilex glabra* Woodland (CEGL003619, G2)
- *Pinus taeda* Temporarily Flooded Forest (CEGL007142, G4?)
- *Platanus occidentalis - Liquidambar styraciflua - (Ulmus americana) / (Crataegus viridis)* Forest (CEGL007335, G3G4)
- *Polygonum (hydropiperoides, punctatum) - Leersia* spp. Herbaceous Vegetation (CEGL004290, G4?)
- *Polygonum* spp. - *Phanopyrum gymnocarpon* Seasonally Flooded Herbaceous Vegetation (CEGL008555, G4)
- *Quercus laurifolia - Quercus michauxii - Liquidambar styraciflua / Carpinus caroliniana* Forest (CEGL004678, G3G4)
- *Quercus laurifolia / Carpinus caroliniana / Justicia ovata* Forest (CEGL007348, G4?)
- *Quercus nigra - Magnolia virginiana - Taxodium distichum* Forest (CEGL004978, G3?)
- *Quercus pagoda - Quercus nigra / Halesia diptera - Ilex decidua / Chasmanthium sessiliflorum - Dicliptera brachiata* Forest (CEGL007354, G4?)
- *Quercus phellos - Quercus nigra - Quercus alba / Chasmanthium (laxum, sessiliflorum)* Forest (CEGL004771, G3G4)
- *Quercus shumardii - Quercus michauxii - Quercus nigra / Acer barbatum - Tilia americana var. heterophylla* Forest (CEGL008487, G3)
- *Quercus virginiana - (Pinus taeda) / (Sabal minor, Serenoa repens)* Forest (CEGL007039, G3G4)
- *Salix caroliniana* Temporarily Flooded Forest (CEGL007373, G4)
- *Salix nigra* Forest (CEGL002103, G4)
- *Scirpus cyperinus* Seasonally Flooded Southern Herbaceous Vegetation (CEGL003866, G4)
- *Taxodium distichum - Fraxinus pennsylvanica - Quercus laurifolia / Acer rubrum / Saururus cernuus* Forest (CEGL007719, G3G4)
- *Taxodium distichum - Nyssa ogeche* Forest (CEGL003841, G3G4)

DISTRIBUTION

Range: This system is found in the East Gulf Coastal Plain, from the coast northward and inland to the extent of unconsolidated sediments in Kentucky.
Divisions: 203:C
Nations: US
Subnations: AL, FL, GA, KY, MS, TN
Map Zones: 46:C, 47:C, 55:C, 99:C
USFS Ecomap Regions: 231B:CC, 231H:CC, 232B:CC, 232D:CC, 232J:CC, 232K:CC, 232L:CC, 234A:CC
TNC Ecoregions: 43:C, 53:C

SOURCES

References: Comer et al. 2003, Drew et al. 1998, Evans 1991, Eyre 1980, FNAI 1990, Harris 1989, Landfire 2007a, Putnam 1951, Sharitz and Mitsch 1993, Wharton et al. 1982
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723045#references
Description Author: M. Pyne and R. Evans
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: M. Pyne and R. Evans **ClassifResp:** Southeast

EAST GULF COASTAL PLAIN SOUTHERN LOBLOLLY-HARDWOOD FLATWOODS (CES203.557)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Forest and Woodland (Treed); Extensive Wet Flat
Non-Diagnostic Classifiers: Pimple mounds; Isolated Wetland [Partially Isolated]; Needle-Leaved Tree; Broad-Leaved Deciduous Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Mixed evergreen-deciduous open tree canopy
National Mapping Codes: EVT 2455; ESLF 9124; ESP 1455

CONCEPT

Summary: This forested system occurs on broad upland flats in the East Gulf Coastal Plain of Alabama and Mississippi, as well as western parts of the lower terraces of the East Gulf Coastal Plain ("Florida Parishes"; EPA Ecoregion 74d) of Louisiana, and likely occurs in other parts of the region as well. Its status and extent in this intervening terrain is unknown. Known examples in the Alabama/Mississippi parts of the range include a mosaic of open forests dominated by *Pinus taeda* interspersed with patches of *Quercus phellos* and sometimes other tree species. The ground surface displays an evident microtopography of alternating mounds and swales occurring in a tight local mosaic. These mounds are most likely "gilgai" resulting from vertic or shrink-swell properties of the Luinn soil series. Known examples display a range of moisture conditions from dry to wet. The wettest examples trap significant moisture from local rainfall events. These areas have ponded water for a minimum of several days at an interval and potentially for long periods of the year, especially when evapotranspiration is lowest. The vegetation of this system supports relatively low vascular plant diversity and thus may appear floristically similar to other pine-hardwood vegetation of the region. The dry portion of this vegetational mosaic is dominated by grassy ground cover (*Chasmanthium sessiliflorum*) with scattered emergent greenbriars (*Smilax* spp.) underneath a nearly pure *Pinus taeda* overstory. The historical composition of this type is unknown, but it seems likely that *Pinus taeda* was a natural and even dominant component of this system, as it is in related systems in the West Gulf Coastal Plain. Wetter areas are dominated by an overstory of *Quercus phellos* with an abundance of *Sabal minor* in the understory. Although the specific role of fire in this system is unknown, low-intensity surface fires may have been ecologically important. Such fires could have originated in the surrounding East Gulf Coastal Plain Interior Shortleaf Pine-Oak Forest (CES203.506).

In the western parts of the lower terraces of the East Gulf Coastal Plain ("Florida Parishes") of Louisiana (EPA Ecoregion 74d and adjacent 75a), the flatwoods vegetation tends to be dominated primarily by hardwoods in the most western portion, and a mixture of *Pinus glabra* and *Pinus taeda* in the intermediate portion to the east of this (Smith 1996b). In this "Louisiana Florida Parishes Spruce Pine Flatwoods Forest" some characteristic species include *Pinus glabra, Quercus laurifolia, Quercus michauxii, Quercus nigra, Quercus pagoda, Quercus virginiana, Pinus taeda*, and *Magnolia grandiflora*. Some important understory trees and shrubs include *Crataegus opaca, Sabal minor* (which may often be very abundant or dominant), and *Arundinaria gigantea ssp. tecta*.
Classification Comments: The description of associations in the NVC for this system is undoubtedly incomplete. Classification work is in progress, but more information is needed.
Related Concepts:

- Swamp Chestnut Oak - Cherrybark Oak: 91 (Eyre 1980) Finer
- Wet Spruce Pine-Hardwood Flatwoods Forest (Smith 1996b) Finer
- Willow Oak - Water Oak - Diamondleaf (Laurel) Oak: 88 (Eyre 1980) Finer

DESCRIPTION

Environment: In the Alabama/Mississippi parts of this system's range, the ground surface displays an evident microtopography of alternating mounds and swales occurring in a tight local mosaic. In Louisiana, the soils are described as Hydric, acidic silt loams (including the Encrow, Gilbert, and Springfield series). The setting is broad, low flats, in small to large depressions, and along small, ill-defined drainages locally known as "slashes" (Smith 1996b).
Vegetation: Known examples of this system in the Alabama/Mississippi parts of its range include a mosaic of open forests dominated by *Pinus taeda* interspersed with patches of *Quercus phellos* and sometimes other tree species. The vegetation of this system supports a relatively low vascular plant diversity and thus may appear floristically similar to other pine-hardwood vegetation of the region. The dry portion of this vegetational mosaic is dominated by grassy ground cover (e.g., *Chasmanthium sessiliflorum*) with scattered emergent greenbriars (*Smilax* spp.) underneath a nearly pure *Pinus taeda* overstory. The historical composition of this type is unknown, but it seems likely that *Pinus taeda* was a natural and even dominant component of this system, as it is in related systems in the West Gulf Coastal Plain (R. Evans pers. obs., T. Foti pers. comm.). Wetter areas are dominated by an overstory of *Quercus phellos* with an abundance of *Sabal minor* in the understory.

In the western parts of the lower terraces of the East Gulf Coastal Plain ("Florida Parishes") of Louisiana, the flatwoods vegetation tends to be dominated primarily by hardwoods in the most western portion, and a mixture of *Pinus glabra* and *Pinus taeda* in the intermediate portion to the east of this. In this "Louisiana Florida Parishes Spruce Pine Flatwoods Forest" stands contain *Pinus glabra, Quercus laurifolia, Quercus phellos, Quercus michauxii, Quercus nigra, Quercus pagoda, Quercus virginiana, Pinus taeda, Nyssa*

biflora, Nyssa sylvatica, Magnolia grandiflora, Salix nigra, Liquidambar styraciflua, Carya glabra, Acer rubrum, and *Fraxinus pennsylvanica*. Understory trees and shrubs include *Crataegus opaca* and *Sabal minor* (which may often be very abundant or dominant), as well as *Arundinaria gigantea ssp. tecta, Cephalanthus occidentalis, Diospyros virginiana, Cornus foemina, Crataegus viridis, Ilex opaca var. opaca, Ilex decidua, Itea virginica, Morella cerifera (= Myrica cerifera), Sambucus canadensis, Styrax americanus*, and *Viburnum dentatum* (Smith 1996b).

Component Associations:
- *(Quercus laurifolia) / Crataegus opaca - Crataegus viridis* Forest (CEGL007386, G1)
- *Fagus grandifolia - Magnolia grandiflora - Quercus nigra - Pinus glabra / Viburnum dentatum* Forest (CEGL004964, G3)
- *Pinus glabra - Quercus laurifolia / Crataegus opaca / Sabal minor* Forest (CEGL004534, G1G2)
- *Quercus michauxii - Quercus (nigra, pagoda) - Liquidambar styraciflua - Pinus taeda* Forest (CEGL007715, G2G3)

SPATIAL CHARACTERISTICS

Spatial Summary: Apparently occurs in a variable patch size (large to small) across its range.
Adjacent Ecological Systems:
- East Gulf Coastal Plain Interior Shortleaf Pine-Oak Forest (CES203.506)

DISTRIBUTION

Range: This forested system occurs on broad upland flats in the East Gulf Coastal Plain of Alabama and Mississippi, as well as western parts of the lower terraces of the East Gulf Coastal Plain ("Florida Parishes") in Louisiana. The complete and detailed range of this system is being developed and is not completely understood. It is not thought to extend into the Mississippi River Alluvial Plain of Louisiana (P. Faulkner pers. comm.).
Divisions: 203:C
Nations: US
Subnations: AL, GA?, LA, MS
Map Zones: 46:C, 99:C
USFS Ecomap Regions: 231Bb:CCC, 232La:CCC, 234Ad:CCC
TNC Ecoregions: 43:C, 53:P

SOURCES

References: Comer et al. 2003, Eyre 1980, Smith 1996b
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723047#references
Description Author: R. Evans, mod. M. Pyne and C. Nordman
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: R. Evans **ClassifResp:** Southeast

EDWARDS PLATEAU FLOODPLAIN TERRACE (CES303.651)

CLASSIFIERS

Classification Status: Standard

Primary Division: Western Great Plains (303)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Floodplain; Lowland; Forest and Woodland (Treed); Depositional stream terrace
National Mapping Codes: ESLF 4154

CONCEPT

Summary: This forest/woodland system occurs on floodplain terraces along perennial rivers and streams in central Texas. Canopy dominants may include *Ulmus crassifolia, Juniperus ashei, Celtis laevigata, Quercus fusiformis, Fraxinus texensis, Platanus occidentalis, Acer negundo, Juglans major, Quercus macrocarpa,* or *Carya illinoinensis*. *Carya illinoinensis* may be more likely to occur in deeper and better-developed alluvial soils. Occurrences typically have a multi-layered physiognomy with a woody understory and patchy ground flora. Alluvial sedimentation processes dominate the formation and maintenance of this system. However, overgrazing and/or overbrowsing may influence recruitment of overstory species and composition of the understory and herbaceous layers.

Classification Comments: Further field investigation is needed to better develop the association-level information for this system. It occurs along larger, lower gradient rivers and streams in contrast with Edwards Plateau Riparian (CES303.652) which occurs along smaller, higher gradient streams. Any particular reach of a river would be classified and mapped as one or the other system.

Similar Ecological Systems:
- Edwards Plateau Riparian (CES303.652)--occurs along smaller, higher gradient streams.
- Southeastern Great Plains Floodplain Forest (CES205.710)

Related Concepts:
- Black Willow: 95 (Eyre 1980) Finer
- Edwards Plateau: Floodplain Ashe Juniper Forest (1001) [CES303.651.1] (Elliott 2011) Finer
- Edwards Plateau: Floodplain Ashe Juniper Shrubland (1005) [CES303.651.7] (Elliott 2011) Finer
- Edwards Plateau: Floodplain Deciduous Shrubland (1006) [CES303.651.8] (Elliott 2011) Finer
- Edwards Plateau: Floodplain Hardwood / Ashe Juniper Forest (1003) [CES303.651.4] (Elliott 2011) Finer
- Edwards Plateau: Floodplain Hardwood Forest (1004) [CES303.651.6] (Elliott 2011) Finer
- Edwards Plateau: Floodplain Herbaceous Vegetation (1007) [CES303.651.9] (Elliott 2011) Finer
- Edwards Plateau: Floodplain Herbaceous Wetland (1017) [CES303.651.10] (Elliott 2011) Finer
- Edwards Plateau: Floodplain Live Oak Forest (1002) [CES303.651.2] (Elliott 2011) Finer
- Sugarberry - American Elm - Green Ash: 93 (Eyre 1980) Finer

DESCRIPTION

Environment: This system is found in central Texas and usually occupies Quaternary alluvial deposits often within drainages underlain by Cretaceous limestones, or drainages that receive outwash from landscapes dominated by these limestones (Elliott 2011). Landforms include valley floors of large rivers and perennial streams. This system tends to occupy broad valley bottoms with alluvial deposits on the Edwards Plateau, and rivers and large creeks where outwash from the Edwards Plateau influences the substrate (Elliott 2011). Soils include bottomland soils of various types (loamy, clayey, and sandy).

Vegetation: These are forests and woodlands with a canopy dominated or codominated by *Carya illinoinensis, Ulmus crassifolia, Ulmus americana, Celtis laevigata, Celtis laevigata var. reticulata,* and/or *Quercus fusiformis*. *Carya illinoinensis* may be more likely to occur in deeper and better-developed alluvial soils (Elliott 2011). Apparent dominance of *Carya illinoinensis* may also be an artifact of preferential harvesting of other species, leaving this species in greater abundance. Other species present may include *Fraxinus texensis, Fraxinus pennsylvanica, Juglans major, Quercus macrocarpa, Quercus buckleyi, Acer negundo, Sapindus saponaria var. drummondii, Juniperus ashei, Prosopis glandulosa,* and *Platanus occidentalis*. *Quercus stellata* may be dominant on sandy soils within the floodplain at some sites. *Melia azedarach* is a common non-native tree encountered on floodplains. Woody species in the subcanopy may include *Sideroxylon lanuginosum, Ptelea trifoliata, Cornus drummondii, Morus rubra, Diospyros texana, Parthenocissus quinquefolia, Vitis* spp., *Smilax bona-nox, Baccharis neglecta, Malvaviscus arboreus var. drummondii, Juniperus ashei,* and *Ilex decidua*. The herbaceous layer may be continuous, though relatively sparse or patchy with species such as *Elymus virginicus, Chasmanthium latifolium, Nassella leucotricha, Verbesina virginica,* and *Carex* spp. Some sites lack, or have very sparse, overstory canopies and represent shrublands or grasslands. Shrublands may be dominated by species in the shrub layer of the surrounding woodlands. Other components or dominants may include species such as *Prosopis glandulosa, Acacia farnesiana, Sapindus saponaria var. drummondii, Juglans microcarpa, Mahonia trifoliolata,* and *Cephalanthus occidentalis*. Native species that may also be present in (and sometimes dominate) these sites include *Panicum virgatum, Andropogon glomeratus, Elymus virginicus, Nassella leucotricha, Hordeum pusillum, Tripsacum dactyloides, Muhlenbergia lindheimeri, Carex* spp., and *Eleocharis* spp. (Elliott 2011). Some grassland sites are frequently dominated by the non-native species *Cynodon dactylon* and/or *Bothriochloa ischaemum var. songarica*. Floodplain occurrences often include portions that resemble Edwards Plateau Riparian (CES303.652), especially along

stream margins, where *Platanus occidentalis, Taxodium distichum, Juglans microcarpa, Brickellia* spp., *Cladium mariscus ssp. jamaicense,* and *Panicum virgatum* are frequently encountered (Elliott 2011).
Dynamics: Alluvial sedimentation processes dominate the formation and maintenance of this system. However, overgrazing and/or overbrowsing may influence recruitment of overstory species and composition of the understory and herbaceous layers.

Component Associations:
- *Carya illinoinensis - Celtis laevigata* Forest (CEGL002087, G4?)
- *Carya illinoinensis - Ulmus crassifolia / Elymus virginicus* Floodplain Forest (CEGL004200, GNR)
- *Justicia americana - Bacopa monnieri* Edwards Plateau Herbaceous Vegetation (CEGL004926, G3)
- *Muhlenbergia reverchonii - Bouteloua curtipendula - Desmanthus velutinus* Herbaceous Vegetation (CEGL004219, GNR)
- *Panicum virgatum - Andropogon glomeratus - Cladium mariscus ssp. jamaicense* Herbaceous Vegetation (CEGL004928, G2G3)
- *Platanus occidentalis - Salix nigra* Woodland (CEGL002093, G5?)
- *Quercus fusiformis - (Celtis laevigata var. reticulata, Ulmus crassifolia)* Woodland (CEGL002153, G4?)
- *Quercus macrocarpa - Carya illinoinensis / Cornus drummondii - Frangula caroliniana* Forest (CEGL004196, GNR)
- *Salix nigra* Forest (CEGL002103, G4)
- *Ulmus americana - Celtis (laevigata, occidentalis) - Fraxinus pennsylvanica* Forest (CEGL002090, G3?)
- *Ulmus crassifolia - Celtis laevigata / Ilex decidua / Elymus virginicus* Forest (CEGL008468, G3?)
- *Zizania texana - Potamogeton illinoensis* Herbaceous Vegetation (CEGL004512, G1)

SPATIAL CHARACTERISTICS

Spatial Summary: This system is characteristically linear in spatial configuration.
Adjacent Ecological Systems:
- Edwards Plateau Carbonate Glade and Barrens (CES303.655)
- Edwards Plateau Cliff (CES303.653)
- Edwards Plateau Dry-Mesic Slope Forest and Woodland (CES303.656)
- Edwards Plateau Limestone Savanna and Woodland (CES303.660)
- Edwards Plateau Limestone Shrubland (CES303.041)
- Edwards Plateau Mesic Canyon (CES303.038)
- Edwards Plateau Riparian (CES303.652)
- Edwards Plateau Upland Depression (CES303.654)
- Llano Uplift Acidic Forest, Woodland and Glade (CES303.657)

DISTRIBUTION

Range: This system occurs along larger permanent rivers and streams throughout the Edwards Plateau of Texas and possibly adjacent ecoregions. It occurs from the Leon watershed in the Limestone Cutplain (EPA 29e) south to the edge of the Bacones Canyonlands (EPA 30c), west through the Edwards Plateau and north to the Pecan Bayou and Concho River watersheds in the lower Limestone Plains (EPA 27j) and lower Crosstimbers (EPA 29c) (EPA 2001).
Divisions: 302:C; 303:C
Nations: US
Subnations: TX
Map Zones: 32:C, 35:C
USFS Ecomap Regions: 255Ec:CCC, 255Ed:CCC, 315Cc:CCC, 315Da:CCC, 315Db:CCC, 315Dc:CCC, 315Ga:CCC, 321B:PP
TNC Ecoregions: 29:C

SOURCES

References: Elliott 2011, EPA 2004, Eyre 1980, Southeastern Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.791372#references
Description Author: L. Elliott and J. Teague
Version: 28 May 2013 **Stakeholders:** Midwest, Southeast, West
Concept Author: L. Elliott and J. Teague **ClassifResp:** Southeast

EDWARDS PLATEAU RIPARIAN (CES303.652)

CLASSIFIERS

Classification Status: Standard

Primary Division: Western Great Plains (303)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Forest and Woodland (Treed); Shrubland (Shrub-dominated); Woody-Herbaceous; Herbaceous; Streambed; Flood Scouring
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Mixed evergreen-deciduous open tree canopy
National Mapping Codes: EVT 2525; ESLF 9165; ESP 1525

CONCEPT

Summary: This system occurs in various situations along small and intermittent streams of the Edwards Plateau, with drier representatives occurring in the western plateau and the Stockton Plateau, and moister representatives (such as communities dominated by *Juglans microcarpa* and *Brickellia laciniata*) in the eastern plateau. Representatives of this system typically occur in stream-scoured situations and vary in the openness of the habitat and physiognomy. Woodland examples may have *Quercus fusiformis, Platanus occidentalis, Taxodium distichum, Fraxinus texensis, Fraxinus pennsylvanica, Ulmus crassifolia, Celtis laevigata* (including *var. reticulata*), *Acer negundo, Prosopis glandulosa, Quercus buckleyi, Juniperus ashei, Salix nigra,* and/or *Sapindus saponaria*. Shrub species that may be encountered in the understory of these woodlands include *Juglans microcarpa, Chilopsis linearis, Baccharis* spp., *Salix nigra, Juniperus ashei, Sapindus saponaria, Cornus drummondii, Sophora secundiflora, Sideroxylon lanuginosum, Diospyros texana, Ungnadia speciosa, Prosopis glandulosa, Cephalanthus occidentalis*, and/or *Aloysia gratissima*. Substantial patches of herbaceous cover may be present and often include species such as *Andropogon glomeratus, Panicum virgatum, Cladium mariscus ssp. jamaicense, Tripsacum dactyloides, Setaria scheelei, Nassella leucotricha, Eleocharis* spp., *Brickellia* spp., *Justicia americana, Hydrocotyle* spp., and/or *Muhlenbergia lindheimeri*.
Classification Comments: Further field investigation is needed to better develop the association-level information for this system. Edwards Plateau Floodplain (CES303.651) occurs along larger, lower gradient rivers and streams in contrast with Edwards Plateau Riparian (CES303.652) which occurs along smaller, higher gradient streams. Any particular reach of a river would be classified and mapped as one or the other system.
Similar Ecological Systems:
- Edwards Plateau Floodplain Terrace (CES303.651)
- North American Warm Desert Riparian Woodland and Shrubland (CES302.753)
- Southeastern Great Plains Riparian Forest (CES205.709)
- Western Great Plains Riparian (CES303.956)

Related Concepts:
- Baldcypress: 101 (Eyre 1980) Finer
- Black Willow: 95 (Eyre 1980) Finer
- Edwards Plateau: Riparian Ashe Juniper Forest (1401) [CES303.652.1] (Elliott 2011) Finer
- Edwards Plateau: Riparian Ashe Juniper Shrubland (1405) [CES303.652.7] (Elliott 2011) Finer
- Edwards Plateau: Riparian Deciduous Shrubland (1406) [CES303.652.8] (Elliott 2011) Finer
- Edwards Plateau: Riparian Hardwood / Ashe Juniper Forest (1403) [CES303.652.4] (Elliott 2011) Finer
- Edwards Plateau: Riparian Hardwood Forest (1404) [CES303.652.6] (Elliott 2011) Finer
- Edwards Plateau: Riparian Herbaceous Vegetation (1407) [CES303.652.9] (Elliott 2011) Finer
- Edwards Plateau: Riparian Herbaceous Wetland (1417) [CES303.652.10] (Elliott 2011) Finer
- Edwards Plateau: Riparian Live Oak Forest (1402) [CES303.652.2] (Elliott 2011) Finer
- Sugar Maple: 27 (Eyre 1980) Finer
- Sugarberry - American Elm - Green Ash: 93 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs on minor intermittent streams and tributaries throughout the Edwards Plateau of Texas. Its geology is usually Quaternary deposits along headwater streams. These may be alluvial or gravel deposits and are often within drainages dominated by limestone or other calcareous substrates on the Edwards Plateau or where substrate is influenced by outwash from the Edwards Plateau. This riparian system occupies small streams, either intermittent or perennial. These sites tend to be in erosional situations, as opposed to broad alluvial depositional sites. This system was mapped by TPWD in areas upstream of significant development of bottomland soils on soil types of the surrounding uplands. It includes vegetation along very small streams, reaching upstream to spring heads and runs (Elliott 2011).
Vegetation: Riparian vegetation may be characterized as woodlands, shrublands, or herbaceous vegetation. These erosional sites may be gravelly, cobbly or rocky and generally occupy the upper reaches of streams. Woodland examples may have *Quercus fusiformis, Platanus occidentalis, Taxodium distichum, Fraxinus texensis, Fraxinus pennsylvanica, Ulmus crassifolia, Celtis laevigata* (including *var. reticulata*), *Acer negundo, Prosopis glandulosa, Quercus buckleyi, Juniperus ashei, Salix nigra*, and/or *Sapindus saponaria*

(Elliott 2011). Shrub species that may be encountered in the understory of these woodlands include *Juglans microcarpa, Chilopsis linearis, Baccharis* spp., *Salix nigra, Juniperus ashei, Sapindus saponaria, Cornus drummondii, Sophora secundiflora, Sideroxylon lanuginosum, Diospyros texana, Ungnadia speciosa, Prosopis glandulosa, Cephalanthus occidentalis,* and/or *Aloysia gratissima*. In some cases, these species may form shrublands lacking a significant overstory tree canopy (Elliott 2011). Substantial patches of herbaceous cover may be present and often include species such as *Andropogon glomeratus, Panicum virgatum, Cladium mariscus ssp. jamaicense, Tripsacum dactyloides, Setaria scheelei, Nassella leucotricha, Eleocharis* spp., *Brickellia* spp., *Justicia americana, Hydrocotyle* spp., and/or *Muhlenbergia lindheimeri*. Frequently, *Cynodon dactylon* and/or *Bothriochloa ischaemum var. songarica* dominate these grassland sites. *Sorghum halepense* is also a commonly encountered non-native grass.

Component Associations:
- *Adiantum capillus-veneris - (Thelypteris ovata var. lindheimeri, Thelypteris kunthii)* Herbaceous Vegetation (CEGL004514, G2)
- *Celtis laevigata var. reticulata - Juglans microcarpa / Leptochloa dubia* Woodland (CEGL002166, GNR)
- *Chilopsis linearis / Brickellia laciniata* Scrub Woodland (CEGL004933, G3G4)
- *Juglans microcarpa - Brickellia laciniata / Indigofera lindheimeriana* Edwards Plateau Scrub Woodland (CEGL004932, G2?)
- *Justicia americana - Bacopa monnieri* Edwards Plateau Herbaceous Vegetation (CEGL004926, G3)
- *Muhlenbergia reverchonii - Bouteloua curtipendula - Desmanthus velutinus* Herbaceous Vegetation (CEGL004219, GNR)
- *Panicum virgatum - Andropogon glomeratus - Cladium mariscus ssp. jamaicense* Herbaceous Vegetation (CEGL004928, G2G3)
- *Platanus occidentalis - (Salix nigra) / Juglans microcarpa - Baccharis salicifolia* Woodland (CEGL004930, G5)
- *Platanus occidentalis - Juglans major* Woodland (CEGL004929, G5)
- *Platanus occidentalis - Salix nigra* Woodland (CEGL002093, G5?)
- *Quercus fusiformis - (Celtis laevigata var. reticulata, Ulmus crassifolia)* Woodland (CEGL002153, G4?)
- *Quercus muehlenbergii - Juglans major - (Ulmus rubra) / Verbesina virginica* Forest (CEGL004927, G2G3)
- *Salix nigra* Forest (CEGL002103, G4)
- *Taxodium distichum - Platanus occidentalis* Edwards Plateau Forest (CEGL002104, G2)
- *Ulmus americana - Celtis (laevigata, occidentalis) - Fraxinus pennsylvanica* Forest (CEGL002090, G3?)
- *Ulmus crassifolia - (Carya illinoinensis)* Small Stream Forest (CEGL004207, GNR)

SPATIAL CHARACTERISTICS

Spatial Summary: This system occurs as linear patches along small and intermittent streams throughout the Edwards Plateau.
Adjacent Ecological Systems:
- Edwards Plateau Carbonate Glade and Barrens (CES303.655)
- Edwards Plateau Cliff (CES303.653)
- Edwards Plateau Dry-Mesic Slope Forest and Woodland (CES303.656)
- Edwards Plateau Floodplain Terrace (CES303.651)
- Edwards Plateau Limestone Savanna and Woodland (CES303.660)
- Edwards Plateau Limestone Shrubland (CES303.041)
- Edwards Plateau Mesic Canyon (CES303.038)
- Edwards Plateau Upland Depression (CES303.654)
- Llano Uplift Acidic Forest, Woodland and Glade (CES303.657)

DISTRIBUTION

Range: This system is found along minor streams and tributaries throughout the Edwards Plateau.
Divisions: 302:C; 303:C
Nations: US
Subnations: TX
Map Zones: 32:C, 35:C
USFS Ecomap Regions: 255Ba:CCC, 255E:CC, 315C:C?, 315D:CC, 315G:C?, 321B:??
TNC Ecoregions: 29:C

SOURCES

References: Elliott 2011, Eyre 1980, Southeastern Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.791373#references
Description Author: J. Teague, mod. L. Elliott
Version: 24 Feb 2011 **Stakeholders:** Midwest, Southeast, West
Concept Author: L. Elliott and J. Teague **ClassifResp:** Southeast

GREAT BASIN FOOTHILL AND LOWER MONTANE RIPARIAN WOODLAND AND SHRUBLAND (CES304.045)

CLASSIFIERS

Classification Status: Standard

Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Short (<5 yrs) Flooding Interval; Riparian Mosaic; Forest and Woodland (Treed); Riverine / Alluvial
Non-Diagnostic Classifiers: Montane [Lower Montane]; Lowland [Foothill]; Temperate [Temperate Continental]
National Mapping Codes: ESLF 9168

CONCEPT

Summary: This system occurs in mountain ranges of the Great Basin and along the eastern slope of the Sierra Nevada within a broad elevation range from about 1220 m (4000 feet) to over 2135 m (7000 feet). This system often occurs as a mosaic of multiple communities that are tree-dominated with a diverse shrub component. The variety of plant associations connected to this system reflects elevation, stream gradient, floodplain width, and flooding events. Dominant trees may include *Abies concolor, Alnus incana, Betula occidentalis, Populus angustifolia, Populus balsamifera ssp. trichocarpa, Populus fremontii, Salix laevigata, Salix gooddingii*, and *Pseudotsuga menziesii*. Dominant shrubs include *Artemisia cana, Cornus sericea, Salix exigua, Salix lasiolepis, Salix lemmonii*, or *Salix lutea*. Herbaceous layers are often dominated by species of *Carex* and *Juncus*, and perennial grasses and mesic forbs such *Deschampsia caespitosa, Elymus trachycaulus, Glyceria striata, Iris missouriensis, Maianthemum stellatum*, or *Thalictrum fendleri*. Introduced forage species such as *Agrostis stolonifera, Poa pratensis, Phleum pratense*, and the weedy annual *Bromus tectorum* are often present in disturbed stands. These are disturbance-driven systems that require flooding, scour and deposition for germination and maintenance. Livestock grazing is a major influence in altering structure, composition, and function of the system.

Related Concepts:
- Cottonwood - Willow: 235 (Eyre 1980) Broader
- Riparian (422) (Shiflet 1994) Broader
- Riparian Woodland (203) (Shiflet 1994) Broader. System and SRM type overlap along eastern Sierran foothills region of California.

DESCRIPTION

Environment: This system is found in low-elevation canyons and draws, on floodplains, steep-sided canyons, or narrow V-shaped valleys with rocky substrates. This includes both perennial and intermittent streams. Sites are typically subject to temporary flooding during spring or late winter runoff. Overbank flooding and some gravel areas are required for regeneration of these riparian forests and woodlands, especially for cottonwoods.

Dynamics: The hydrologic regime is naturally highly variable temporally and spatially among the streams and rivers of this system. Where present, spring discharges from bedrock aquifers provide flows unaffected by rainfall and snowmelt. Otherwise, stream and river flows - where they occur, at what magnitudes, and when and how often - are subject to wide fluctuations as a result of the wide variation in where and when precipitation takes place, what form the precipitation takes (rain versus snow), and where and when snowmelt takes place (e.g., Abell et al. 2000, Levick et al. 2008, Miller et al. 2010a). Intense runoff associated with intense rainfall events is highly erosive, resulting in rapid reconfiguration of aquatic and riparian macrohabitats particularly along reaches with sand and gravel substrates. Fire disturbances occur in riparian zones, but are generally less severe and less often than in neighboring uplands (Reeves et al. 2005).

Component Associations:
- *Alnus incana / Cornus sericea* Shrubland (CEGL001145, G3G4)
- *Artemisia cana (ssp. bolanderi, ssp. viscidula) / Leymus cinereus* Shrubland (CEGL001460, G1)
- *Artemisia cana ssp. viscidula / Deschampsia caespitosa* Shrubland (CEGL001074, G2G3)
- *Artemisia nova - Ericameria nana* Shrubland (CEGL002773, G3)
- *Betula occidentalis / Cornus sericea* Shrubland (CEGL001161, G3)
- *Betula occidentalis / Maianthemum stellatum* Shrubland (CEGL001162, G4?)
- *Betula occidentalis* / Mesic Graminoids Shrubland (CEGL002654, G3)
- *Cornus sericea* Rocky Mountain Shrubland (CEGL001165, G4Q)
- *Pinus ponderosa - Populus tremuloides / Carex* spp. - (*Poa* spp.) Forest (CEGL000191, G2G3)
- *Populus angustifolia / Betula occidentalis* Woodland (CEGL000648, G3)
- *Populus angustifolia / Rhus trilobata* Woodland (CEGL000652, G3)
- *Populus balsamifera ssp. trichocarpa / Alnus incana* Forest (CEGL000667, G3)
- *Populus balsamifera ssp. trichocarpa* / Mixed Herbs Forest (CEGL000675, G3?)
- *Populus fremontii / Acer negundo* Forest (CEGL000662, G2Q)
- *Populus fremontii / Leymus triticoides* Woodland (CEGL002756, GNR)
- *Populus fremontii* / Mesic Forbs Woodland (CEGL002470, GNR)
- *Populus fremontii* / Mesic Graminoids Woodland (CEGL002473, GNR)

- *Populus fremontii / Salix exigua* Forest (CEGL000666, GNR)
- *Populus fremontii / Salix geyeriana* Woodland (CEGL000943, G3?)
- *Salix lasiolepis / Rosa woodsii* / Mixed Herbs Shrubland (CEGL001217, G3Q)
- *Salix lemmonii* / Mesic-Tall Forbs Shrubland (CEGL002771, G3?)
- *Salix lemmonii / Rosa woodsii* Shrubland (CEGL002772, G3)
- *Salix lutea / Carex utriculata* Shrubland (CEGL001220, G4)
- *Salix lutea* / Mesic Forbs Shrubland (CEGL002774, G3?)

DISTRIBUTION

Range: Occurs in mountain ranges of the Great Basin and along the eastern slope of the Sierra Nevada within a broad elevation range from about 1220 m (4000 feet) to over 2135 m (7000 feet).
Divisions: 304:C
Nations: US
Subnations: CA, NV, OR, UT
Map Zones: 6:C, 7:C, 9:C, 10:C, 12:C, 13:C, 16:?, 17:C, 18:C, 21:P
USFS Ecomap Regions: 322A:CC, 341A:CC, 341D:CC, 341E:CC, 341F:CC, 341G:CC, 342B:CC, 342C:CC, 342D:CC, 342J:CC, M261E:CC, M261G:CP, M331D:??, M332A:??, M341A:CC, M341D:CC
TNC Ecoregions: 6:P, 11:C, 12:C

SOURCES

References: Abell et al. 2000, Barbour and Billings 1988, Barbour and Major 1977, Brown and Mote 2009, Cayan et al. 2010, Chambers and Pellant 2008, Chambers and Wisdom 2009, Christensen and Lettenmaier 2007, Comer et al. 2003, Comer et al. 2013a, Covich 2009, Das et al. 2009, Daubenmire 1952, Dettinger et al. 2009, Eyre 1980, Field et al. 1999, Harper and Peckarsky 2006, Hultine et al. 2007, Jackson et al. 2009, Kittel et al. 1999b, Levick et al. 2008, Manning and Padgett 1989, Martin 2007, McCabe and Wolock 2009, Melack et al. 1997, Millar and Wolfenden 1999, Miller et al. 2010a, Mote 2006, Reeves et al. 2005, Sawyer and Keeler-Wolf 1995, Seavy et al. 2009, Shiflet 1994, USBOR 2011
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722664#references
Description Author: J. Nachlinger and K.A. Schulz, mod. G. Kittel
Version: 14 Jan 2014 **Stakeholders:** West
Concept Author: J. Nachlinger and K. Schulz **ClassifResp:** West

HAWAI'I FLOODPLAIN FOREST (CES412.221)

CLASSIFIERS

Classification Status: Standard

Primary Division: Northern Polynesia (412)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch, Linear, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Short (<5 yrs) Flooding Interval; Riparian Mosaic; Floodplain; Forest and Woodland (Treed); Riverine / Alluvial; Broad-Leaved Evergreen Tree
Non-Diagnostic Classifiers: Lowland; Toeslope/Valley Bottom; Tropical/Subtropical; Broad-Leaved Evergreen Shrub
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Evergreen closed tree canopy
National Mapping Codes: EVT 2800; ESLF 9388; ESP 1800

CONCEPT

Summary: The discerning features of this ecological system are low-elevation (up to 122 m [400 feet])] valley floors containing perennial streams that flood every 1 to 5 years. Valley floors typically widen towards the ocean (up to 1 mile), forming broad floodplains that allow periodic shifting of the stream channel. Soils are alluvial deposits and clay that remain moist due to influence from stream channel flooding, a shallow subsurface water table, and nutrient-rich alluvium deposited during flood events. Vegetation of floodplain forests is typically dominated by a patchy matrix of native and Polynesian-introduced lowland wet trees tolerant of occasional flooding. *Aleurites moluccana* and *Metrosideros polymorpha* can form a patch mosaic with *Hibiscus tiliaceus* that extends onto adjacent steeper gulches and coastal areas. *Aleurites moluccana* mixes in patches and extends up steep gulches well into the lowland zone. Plant species indicative of Polynesian agriculture dominate the majority of the floodplain forest, including *Cordyline fruticosa, Colocasia esculenta* and *Syzygium malaccense*.

DESCRIPTION

Environment: This low-elevation ecological system occurs on valley floors up to about 125 m (400 feet) elevation containing perennial streams that flood every 1 to 5 years. Valley floors typically widen towards the ocean (up to 1 mile), forming broad floodplains that allow periodic shifting of the stream channel. Climate is variable depending on which coast a stand occurs and ranges from arid to very wet (Zones 1-7), but is generally moderately dry to moderately wet (Zones 3-6) of the 7 Moisture Zones developed for the Hawaiian Islands by Price et al. (2007). Annual precipitation may vary from less than 500 mm to over 4500 mm.
Dynamics: Typical disturbances during the pre-European era included flood, landslide, and storms. A major threat now is Hawaiian wet valley irrigated agriculture that has nearly completely converted natural vegetation into *Colocasia esculenta* (kalo) and other planted vegetation. This ecological system is threatened by invasion of numerous alien fishes, mollusks, crustaceans and plants, which interfere with ecological functions and interrupt ecological processes.

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Hawai'i Freshwater Aquatic Bed (CES412.225)

Adjacent Ecological System Comments: The origins of Hawaiian freshwater stream biota is unique with fish, shrimp and mollusks descended from marine forms; and native damselflies and dragonflies descended from continental freshwater habitats. Damselfly (*Megalagrion*) and dragonfly (*Anax, Pantala*) naids utilize stream sediments as habitats, while adults utilize emergent vegetation. Shore bugs (*Saldula* spp.), freshwater snails (*Nertera* spp.), freshwater shrimp (*Halocaridina, Atyoida, Machrobrachium, Metabetaeus, Caligus, Hyalella, Penaeus,* and *Calappa*), and five endemic amphidromous freshwater fishes (*Awaous, Lentipes, Sicyopterus, Stenogobius,* and *Eleotris*) are part of the aquatic stream system in the stream. These lowland reaches of Hawaiian streams and rivers serve as important habitat to waterbirds such as the widely distributed black-crowned night heron (*Nycticorax nycticorax hoactli*).

DISTRIBUTION

Range: This system occurs from sea level to 122 m (400 feet) elevation on Kaua'i, O'ahu, Moloka'i, LÃ¢na'i, Maui, and Hawai'i.
Divisions: 412:C
Nations: US
Subnations: HI
Map Zones: 79:C
USFS Ecomap Regions: M423:C
TNC Ecoregions: 65:C

SOURCES

References: Gagne and Cuddihy 1990, Price et al. 2007, Wagner et al. 1999, Western Ecology Working Group n.d., Ziegler 2002
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.770647#references
Description Author: M. Castillo, mod. D. Johnson, J. Jacobi, S. Gon III, K.A. Schulz
Version: 05 Mar 2009 **Stakeholders:** West

HIGH ALLEGHENY WETLAND (CES202.069)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: >180-day hydroperiod; Bog and Fen Mosaic; Fen; Montane; Marsh; Swamp; Peat and mud; Temperate; Extensive Wet Flat; Depressional; Unglaciated; Palustrine; Bog; Depression
National Mapping Codes: ESLF 9356

CONCEPT

Summary: This system occurs along the high plateau of the Allegheny Mountains, immediately west of the Allegheny Front at elevations between 730 and 1430 m. Wetlands in this system are drained by low-gradient, meandering, intermittent to small headwater streams. Drainage is impounded in high, flat-lying basins by natural dams or "knickpoints" of resistant sandstone. In addition to poor moisture drainage, cold air drains from the surrounding uplands to pool in the flat basins, which function as frost pockets. Rainfall is plentiful, averaging about 1300 mm/year. Communities in this system may have substrates of shallow to deep peat or, less commonly, mineral soil. Soils are acidic to circumneutral. These high Allegheny wetlands form complex mosaics ranging in size from a few hectares to 6000 hectares. Forested swamps occupy the less disturbed margins or slightly higher "islands." This system has a distinctly northern character in its resemblance to bogs and swamps of New England. However, the striking absence of *Chamaedaphne calyculata* and *Picea mariana*, two abundant and common species of northern bogs and swamps, as well as the presence of species characteristic of the Southern Appalachians, such as *Hypericum densiflorum, Vaccinium erythrocarpum*, and *Rhododendron maximum*, distinguishes this system from its northern counterpart. Ombrotrophic bogs are rare but occur in undisturbed portions of a few of the larger wetlands. The more central, flood- or beaver-influenced portions contain shrub swamps, sedge fens, wet meadows, and open marshes. Forested swamps are dominated by *Picea rubens*, with varying cover by *Acer rubrum, Tsuga canadensis*, and *Betula alleghaniensis var. alleghaniensis*. It is likely that the role of *Pinus strobus* played a greater role in the structure and function of this system historically than it does today (Maryland Geological Survey and Curran 1902). Residual white pines in remote areas of this system in Cranesville Swamp in Maryland also suggest this possibility. Where limestone or calcareous shale influences seepage water, *Abies balsamea* and *Fraxinus nigra* are typical canopy dominants. Common shrub species are *Viburnum nudum var. cassinoides, Rhododendron maximum, Vaccinium myrtilloides, Alnus incana ssp. rugosa, Hypericum densiflorum, Ilex verticillata*, and *Photinia melanocarpa*. Herbaceous species frequently include *Rubus hispidus, Solidago uliginosa, Juncus effusus, Eriophorum virginicum, Osmunda cinnamomea var. cinnamomea, Polygonum sagittatum, Carex folliculata, Carex gynandra, Leersia oryzoides, Galium tinctorium, Solidago rugosa, Symplocarpus foetidus, Lycopus uniflorus var. uniflorus, Scirpus cyperinus, Carex scoparia var. scoparia*, and *Carex trisperma var. trisperma*. *Sphagnum* spp. and *Polytrichum* spp. dominate the bryophyte layer. This system is maintained by a spatially complex mix of seepage, low-energy flooding, beaver activity, and rainfall. Undisturbed examples exist (e.g., Cranberry Glades), where old-growth swamp buffers the central peatlands, which have been dated to 10,000 years. In presettlement time, some wetland mosaics in this system had significant forested components (e.g., Canaan Valley, Cranesville Swamp in West Virginia; Finzel Swamp, Hammel Glades in Maryland), while others (e.g., Cranberry Glades, Big Run Bog) were largely open peatlands with forested swamp only on the margins.

Similar Ecological Systems:
- North-Central Appalachian Acidic Swamp (CES202.604)
- Southern and Central Appalachian Bog and Fen (CES202.300)
- Southern Appalachian Seepage Wetland (CES202.317)

Related Concepts:
- Aspen: 217 (Eyre 1980) Finer
- Black Ash - American Elm - Red Maple: 39 (Eyre 1980) Finer
- Red Spruce - Balsam Fir: 33 (Eyre 1980) Finer
- Red Spruce: 32 (Eyre 1980) Finer
- Tamarack: 38 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs along the high plateau of the Allegheny Mountains, immediately west of the Allegheny Front at elevations between 610 and 1430 m. Wetlands in this system are drained by low-gradient, meandering, intermittent to small streams that form the headwaters of larger (often high-gradient) mountain rivers. The system is underlain by gently folded sedimentary rocks of Carboniferous and Devonian age. Drainage is impounded in high, flat-lying basins by natural dams or "knickpoints" of resistant sandstone (Pottsville and Price formations). These sandstone layers come to the surface along the gently dipping axes of breached anticlines or synclines, or occasionally on the gently dipping limb of a fold. Cold air drains from the surrounding uplands to pool in the flat basins, which function as frost pockets. Rainfall is plentiful, averaging about 1300 mm/year. Communities in this system may have substrates of shallow to deep peat (a few centimeters to up to 3 m depth) or, less commonly, mineral soil. Soils are acidic to circumneutral, with pH ranging from 3.1 to 6.5. High values for soil organic matter, total exchange capacity, exchangeable nitrogen,

soluble sulphur, and phosphorus are typical. Most soils are low in boron, copper, potassium, and manganese.
Vegetation: These High Allegheny wetlands form complex mosaics of small-patch communities. Forested swamps occupy the less disturbed margins or slightly higher "islands" in the wetland mosaic. Ombrotrophic bogs are rare but occur in undisturbed portions of a few of the larger wetlands. The more central, flood- or beaver-influenced sections contain shrub swamps, sedge fens, wet meadows, and open marshes. A number of species have northern affiliations, including some that are disjunct (e.g., *Abies balsamea, Larix laricina,* and *Andromeda polifolia var. glaucophylla*). The shrub strata include characteristic central Appalachian species (e.g., *Rhododendron maximum*), Appalachian endemic species (e.g., *Ilex collina*), and species with a more southern affiliation (e.g., *Vaccinium erythrocarpum*). Forested swamps are dominated by *Picea rubens*, with varying cover by *Acer rubrum, Tsuga canadensis*, and *Betula alleghaniensis var. alleghaniensis*. Where limestone or calcareous shale influences seepage water, *Abies balsamea* and *Fraxinus nigra* are typical canopy dominants. Common shrub species are *Viburnum nudum var. cassinoides, Rhododendron maximum, Vaccinium myrtilloides, Alnus incana ssp. rugosa, Hypericum densiflorum, Ilex verticillata, Photinia melanocarpa, Viburnum recognitum,* and *Kalmia latifolia*. Herbaceous species frequently include *Rubus hispidus, Solidago uliginosa, Juncus effusus, Eriophorum virginicum, Osmunda cinnamomea var. cinnamomea, Polygonum sagittatum, Carex folliculata, Carex gynandra, Leersia oryzoides, Galium tinctorium, Solidago rugosa, Symplocarpus foetidus, Lycopus uniflorus var. uniflorus, Scirpus cyperinus, Carex scoparia var. scoparia, Carex trisperma var. trisperma, Carex stipata,* and *Calamagrostis canadensis var. canadensis*. *Sphagnum* spp. and *Polytrichum* spp. dominate the bryophyte layer.
Dynamics: This system is maintained by a spatially complex mix of seepage, low-energy flooding, beaver activity, and rainfall. Drainage in the flat headwater basins is partly impounded by resistant sandstone at the basin outlet. Low-gradient, meandering headwater streams provide regular low-energy inundation. Seepage from surrounding forests provides nutrients at the margins of the wetland mosaic, and where limestone or calcareous shale is present, circumneutral wetlands are maintained. Beaver activity encourages the cycling of early- to mid-successional types. In the rare ombrotrophic bogs, rainfall is the only source of moisture. Many of the forested swamps in this system were logged during 1880-1920, and some were subsequently burned and/or heavily grazed. Flat headwater basins function as frost pockets, catchment areas for cold air draining from surrounding uplands. Cool temperatures (mean annual temperature 6.7-9.4 degrees C) and high rainfall (1220-1680 mm/year) are characteristic. Floristic diversity is controlled by underlying sedimentary rocks that weather to form high diversity of nutrient, acidity, and drainage conditions (Byers et al. 2007).

Component Associations:
- *(Andromeda polifolia var. glaucophylla) / Polytrichum strictum - Cladina* spp. - *Sphagnum* spp. Nonvascular Vegetation (CEGL006589, G1)
- *Abies balsamea - Picea rubens / Danthonia compressa - Lycopodium* spp. / *Sphagnum* spp. Forest (CEGL006592, G2)
- *Abies balsamea - Picea rubens / Ilex verticillata / Sphagnum* spp. Forest (CEGL006591, G2)
- *Acer rubrum - Nyssa sylvatica* High Allegheny Plateau, Central Appalachian Forest (CEGL006132, GNR)
- *Alnus incana - Viburnum recognitum / Calamagrostis canadensis* Shrubland (CEGL006546, GNR)
- *Alnus incana* Swamp Shrubland (CEGL002381, G5)
- *Calamagrostis canadensis* North-Central Wet Meadow (CEGL005449, G4G5)
- *Carex canescens - Eriophorum virginicum / Sphagnum* spp. Herbaceous Vegetation (CEGL006549, GNR)
- *Carex echinata - Solidago uliginosa / Sphagnum* spp. Herbaceous Vegetation (CEGL008534, G2?)
- *Carex gynandra - Scirpus cyperinus - Eriophorum virginicum - Osmunda cinnamomea* Herbaceous Vegetation (CEGL007771, G2)
- *Carex lacustris* Herbaceous Vegetation (CEGL002256, G4G5)
- *Carex stricta - Carex vesicaria* Herbaceous Vegetation (CEGL006412, G4G5)
- *Carex utriculata - Carex lacustris - (Carex vesicaria, Carex stricta)* Herbaceous Vegetation (CEGL002257, G4G5)
- *Chrysosplenium americanum* Herbaceous Vegetation (CEGL006193, G3G5)
- *Dulichium arundinaceum - Carex folliculata - Juncus* spp. Herbaceous Vegetation (CEGL006552, GNR)
- *Eriophorum virginicum - (Carex folliculata) / Sphagnum* spp. - *Polytrichum* spp. Herbaceous Vegetation (CEGL006570, G3)
- *Fraxinus nigra - Abies balsamea / Rhamnus alnifolia* Forest (CEGL006003, G1)
- *Hypericum densiflorum / Rubus hispidus* Scrub (CEGL006464, GNR)
- *Larix laricina / Photinia melanocarpa / Sphagnum* spp. Forest (CEGL002472, G4?)
- *Leersia oryzoides - Sagittaria latifolia* Herbaceous Vegetation (CEGL006461, GNR)
- *Photinia pyrifolia - Ilex verticillata - Nemopanthus mucronatus / Osmunda cinnamomea* Saturated Shrubland (CEGL006545, GNR)
- *Picea rubens - (Tsuga canadensis) / Rhododendron maximum* Saturated Forest (CEGL006277, G2?)
- *Picea rubens - Acer rubrum / Ilex verticillata* Forest (CEGL006556, G3)
- *Picea rubens / Carex trisperma / Sphagnum* spp. - *Polytrichum* spp. Forest (CEGL006590, G2)
- *Picea rubens / Rhododendron maximum - Kalmia latifolia / Eriophorum virginicum / Sphagnum* spp. Forest (CEGL006588, G2G3)
- *Picea rubens / Vaccinium erythrocarpum / Sphagnum* spp. - *Bazzania trilobata* Forest (CEGL006593, G2)
- *Populus tremuloides / Vaccinium myrtilloides / Solidago uliginosa* Forest (CEGL006594, GNR)
- *Salix sericea* Shrubland (CEGL006305, GNR)
- *Schoenoplectus (tabernaemontani, acutus)* Eastern Herbaceous Vegetation (CEGL006275, GNR)
- *Scirpus cyperinus* Seasonally Flooded Herbaceous Vegetation (CEGL006349, GNR)
- *Solidago rugosa - Euthamia graminifolia* Herbaceous Vegetation (CEGL006568, GNR)
- *Sparganium americanum - (Sparganium erectum ssp. stoloniferum) - Epilobium leptophyllum* Herbaceous Vegetation

(CEGL004510, G3?)
- *Spiraea alba* Shrubland (CEGL006595, GNR)
- *Vaccinium myrtilloides / Pteridium aquilinum / Polytrichum* spp. Shrubland (CEGL006596, GNR)
- *Vaccinium oxycoccos - (Vaccinium macrocarpon) / Rhynchospora alba - Drosera rotundifolia / Sphagnum* spp. Dwarf-shrubland (CEGL007856, G2)

SPATIAL CHARACTERISTICS

Spatial Summary: Large-patch system of wetland mosaics ranging in size from 5 to 6000 ha. Individual associations comprising the mosaic occur in small patches from 0.05 to 10 ha in size.

Adjacent Ecological Systems:
- Appalachian (Hemlock)-Northern Hardwood Forest (CES202.593)
- Central and Southern Appalachian Spruce-Fir Forest (CES202.028)
- Southern Appalachian Northern Hardwood Forest (CES202.029)

Adjacent Ecological System Comments: Occurrences are embedded in Central and Southern Appalachian Spruce-Fir Forest (CES202.028), Appalachian (Hemlock)-Northern Hardwood Forest (CES202.593), or Southern Appalachian Northern Hardwood Forest (CES202.029).

DISTRIBUTION

Range: The system occurs in a southwest/northeast-trending band about 40 km wide and 200 km long along the high, flat plateau of the Allegheny Mountains. The eastern boundary is the Allegheny Front, and the western boundary is the heavily dissected, lower elevation Allegheny Plateau. Minimum elevations range from 730 m in the north to 940 m in the south (Droop Mountain, West Virginia). The maximum elevation is 1422 m on Mount Porte Crayon, West Virginia.

Divisions: 202:C
Nations: US
Subnations: MD, PA, VA?, WV
Map Zones: 61:C
USFS Ecomap Regions: M221B:CC
TNC Ecoregions: 59:C

SOURCES

References: Byers et al. 2007, Darlington 1943, Eastern Ecology Working Group n.d., Edens 1973, Faber-Langendoen et al. 2011, Furedi 2011e, Grafton and Eye 1982, Maryland Geological Survey and Curran 1902, McPherson 2011a, Robinette 1964, Walbridge 1982, Walbridge and Lang 1982, Wieder et al. 1981, Zimmerman et al. 2012

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.800809#references

Description Author: E.A. Byers and S. Gawler, mod. L.A. Sneddon
Version: 14 Jan 2014 **Stakeholders:** East, Southeast
Concept Author: E.A. Byers and S. Gawler **ClassifResp:** East

INTERIOR HIGHLANDS FORESTED ACIDIC SEEP (CES202.321)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Forest and Woodland (Treed); Ozark/Ouachita; Seepage-Fed Sloping
Non-Diagnostic Classifiers: Broad-Leaved Deciduous Tree
National Mapping Codes: ESLF 9311

CONCEPT

Summary: This system of forested seeps occurs mainly in the Ouachita Mountains of central Arkansas, as well as on Mount Magazine and in the Ozarks. Examples may be found along the bottom slopes of smaller valleys where rock fractures allow water to seep out of the mountainsides and in the riparian zones of larger creeks, sometimes extending upslope along small ephemeral drainages. The soil remains saturated to very moist throughout the year. The vegetation is typically forested with highly variable canopy composition. *Acer rubrum var. trilobum, Nyssa sylvatica, Liquidambar styraciflua,* and *Quercus alba* are common and typical. Other canopy species may include *Fagus grandifolia* and *Magnolia tripetala*. Canopy coverage can be moderately dense to quite open. The subcanopy is often well-developed and characteristically includes *Ilex opaca var. opaca, Magnolia tripetala, Carpinus caroliniana,* and *Ostrya virginiana*.
Classification Comments: There are physiognomically and compositionally similar forested seep systems in the Appalachian Plateau that lack abundant evergreen ericads and are apparently less sphagnous. Examples from the Ozarks (on sandstone) are apparently less species-rich and may be associated with more acidic substrates; these are also included here.
Related Concepts:
- Black Ash - American Elm - Red Maple: 39 (Eyre 1980) Finer

DESCRIPTION

Environment: Examples of this system of forested seeps may be found along the bottom slopes of smaller valleys of the Ouachita Mountains of central Arkansas (where rock fractures allow water to seep out of the mountainsides), and in the riparian zones of larger creeks, sometimes extending upslope along small ephemeral drainages. The soil remains saturated to very moist throughout the year. More information is needed on the environmental details of Ozarkian examples.
Vegetation: Stands are typically forested with highly variable canopy composition. Some common and typical components are *Acer rubrum var. trilobum, Nyssa sylvatica, Liquidambar styraciflua,* and *Quercus alba*. Other canopy species may include *Fagus grandifolia* and *Magnolia tripetala*. The subcanopy is often well-developed and characteristically includes *Ilex opaca var. opaca, Magnolia tripetala, Carpinus caroliniana,* and *Ostrya virginiana*.

Component Associations:
- *Acer rubrum - Fraxinus pennsylvanica / Carex* spp. / *Climacium americanum* Forest (CEGL002407, GU)
- *Acer rubrum var. trilobum - Liquidambar styraciflua - Magnolia tripetala / Osmunda regalis - (Cypripedium kentuckiense)* Forest (CEGL007444, G3?)
- *Acer rubrum var. trilobum - Nyssa sylvatica / Rhexia mariana var. interior* Forest (CEGL007822, G2?)

SPATIAL CHARACTERISTICS

Spatial Summary: Many are less than one hectare in area, but riparian seeps are often much larger.

DISTRIBUTION

Range: This system is found in the Ozark and Ouachita mountains of Arkansas, possibly extending into adjacent Oklahoma and Missouri.
Divisions: 202:C
Nations: US
Subnations: AR, MO?, OK?
Map Zones: 44:C
USFS Ecomap Regions: 223A:CC, M223A:CC, M231A:CC
TNC Ecoregions: 38:C, 39:C

SOURCES

References: Comer et al. 2003, Eyre 1980
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723179#references
Description Author: T. Foti and R. Evans, mod. M. Pyne and C. Nordman
Version: 14 Jan 2014 **Stakeholders:** Midwest, Southeast
Concept Author: T. Foti and R. Evans **ClassifResp:** Southeast

LAURENTIAN-ACADIAN ALKALINE CONIFER-HARDWOOD SWAMP (CES201.575)

CLASSIFIERS

Classification Status: Standard

Primary Division: Laurentian-Acadian (201)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Mesotrophic Water; Circumneutral Water; Depressional; Thuja occidentalis - Fraxinus nigra
Non-Diagnostic Classifiers: Saturated Soil; Moderate (100-500 yrs) Persistence; Forest and Woodland (Treed); Mineral: W/ A-Horizon >10 cm; Mineral: W/ A-Horizon <10 cm; Needle-Leaved Tree; Broad-Leaved Deciduous Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Mixed evergreen-deciduous closed tree canopy
National Mapping Codes: EVT 2481; ESLF 9345; ESP 1481

CONCEPT

Summary: These forested wetlands are found across northern New England and the upper Midwest and eastern to south-central Canada in basins or floodplains where higher pH and/or nutrient levels are associated with a rich flora. The substrate is typically mineral soil, but there may be some peat; often, there is an organic epipedon over mineral soil. *Thuja occidentalis* is a diagnostic canopy species and may dominate the canopy or be mixed with other conifers or with deciduous trees, most commonly *Acer rubrum* or *Fraxinus nigra* but also *Tsuga canadensis*, *Larix laricina*, and *Betula alleghaniensis*. Some examples can be almost entirely deciduous and dominated by *Fraxinus nigra*. *Cornus sericea* is a common shrub. The herb layer tends to be more diverse than in acidic swamps. Small open fenny areas may occur within the wetland. Seepage may influence parts of the wetland, but the hydrology is dominated by the basin setting.
Classification Comments: This system encompasses both wet forests (on saturated mineral soils) and forest rich peatlands. Areas dominated by *Fraxinus nigra* and found throughout the Laurentian area in Minnesota and north of Green Bay in Wisconsin are included in this system.
Similar Ecological Systems:
- Laurentian-Acadian Alkaline Fen (CES201.585)
- North-Central Interior and Appalachian Rich Swamp (CES202.605)
- Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp (CES201.574)

Related Concepts:
- Black Ash - American Elm - Red Maple: 39 (Eyre 1980) Finer
- Black Ash Swamp (Gawler and Cutko 2010) Finer
- Northern White Cedar Swamp (Gawler and Cutko 2010) Finer
- Northern White-Cedar: 37 (Eyre 1980) Finer
- Tamarack: 38 (Eyre 1980) Finer

DESCRIPTION

Environment: This system is typically found in basins or in floodplains with higher pH and/or nutrient levels. Groundwater typically keeps these sites saturated or nearly so through most of the growing season. Surface water, either overland flow or from nearby lakes and streams, often contributes to the hydrologic regime, especially through flooding in the spring or after heavy rains. Some movement of groundwater is important in maintaining the dominant trees in this system (Schwintzer 1981, Johnson and Booker 1983). Soils are mineral or muck (well-decomposed peat) with sometimes a thin layer of peat over mineral soil. There is often pronounced microtopographic relief between hummock/mounds created by tree boles and roots and rotting fallen logs and small depressions. These provide different microhabitats and contribute to the diversity of the system.
Dynamics: Cold, nutrient-rich and alkaline groundwater is important in maintaining this system. While water chemistry is similar to alkaline fens (Laurentian-Acadian Alkaline Fen (CES201.585)), this is a treed conifer, conifer-hardwood, or hardwood swamp versus a shrub- or graminoid-dominated fen, implying other factors beyond just water chemistry are important in creating differing vegetation (Schwintzer and Tomberlin 1982). Other factors are likely hydrologic regime (length and degree of soil saturation), site history, and degree of water movement. Patchy windthrow creates small-scale canopy gaps. These swamps often occur on structurally weak organic soils where trees root shallowly due to anaerobic conditions and are thus particularly susceptible to windthrow (Slaughter et al. 2007). Fire was very infrequent in this system but could occur in very dry periods. If other factors remain the same, this system could regenerate after fire since *Thuja occidentalis* and many other dominants grow well on exposed mineral soil (Johnson and Booker 1983). Beaver (*Castor canadensis*) flooding can also shape conifer-hardwood swamp structure, species composition, and direct successional pathways.

Component Associations:
- *Acer rubrum - Fraxinus* spp. - *Betula papyrifera / Cornus canadensis* Forest (CEGL002071, G4)
- *Fraxinus nigra* - Mixed Hardwoods - Conifers / *Cornus sericea / Carex* spp. Forest (CEGL002105, G4)
- *Larix laricina - Thuja occidentalis* Swamp Forest (CEGL002455, G3G4)
- *Larix laricina / Alnus incana* Forest (CEGL002471, G4)
- *Populus tremuloides - Populus balsamifera* - Mixed Hardwoods Lowland Forest (CEGL005036, G5)

- *Thuja occidentalis - (Picea mariana, Abies balsamea) / Alnus incana* Forest (CEGL002456, G4)
- *Thuja occidentalis - Acer rubrum / Cornus sericea* Forest (CEGL006199, GNR)
- *Thuja occidentalis - Betula alleghaniensis* Forest (CEGL002450, G2Q)
- *Thuja occidentalis - Fraxinus nigra* Forest (CEGL005165, GNR)
- *Thuja occidentalis / Sphagnum (girgensohnii, warnstorfii)* Forest (CEGL006007, GNR)
- *Tsuga canadensis - Betula alleghaniensis* Saturated Forest (CEGL005003, G3)

DISTRIBUTION

Range: Scattered locations from New England and adjacent Canada west to the Great Lakes and northern Minnesota.
Divisions: 201:C
Nations: CA, US
Subnations: CT, ME, MI, MN, NY, ON, VT, WI
Map Zones: 40:C, 41:C, 50:C, 51:C, 63:C, 64:C, 65:C, 66:C
USFS Ecomap Regions: 211Aa:CCC, 211Ab:CCC, 211Ba:CCC, 211Bb:CCC, 211Ca:CCC, 211Cb:CCP, 211Ea:CCC, 211Eb:CCP, 211Ec:CCC, 211Ed:CCC, 211Ee:CCC, 211Fb:CCC, 211Ja:CCP, 211Jb:CCP, 211Jc:CCP, 211Jd:CCC, 212Ha:CCC, 212Hb:CCC, 212Hc:CCC, 212Hd:CCC, 212He:CCC, 212Hf:CCC, 212Hg:CCC, 212Hh:CCC, 212Hi:CCC, 212Hj:CCC, 212Hk:CCC, 212Hl:CCC, 212Hm:CCC, 212Ra:CCC, 212Rb:CCC, 212Rc:CCC, 212Rd:CCC, 212Re:CCC, 222Ib:CCC, 222Ic:CCC, 222Id:CCP, 222Ie:CCC, 222Ja:CCC, 222Ue:CCC, M211Aa:CCP, M211Ab:CCC, M211Ac:CCP, M211Ad:CCP, M211Ae:CCC, M211Af:CCC, M211Ba:CCC, M211Bb:CCP, M211Ca:CCC, M211Cb:CCC, M211Da:CCC, M211Db:CCC, M211Dc:CCC, M211Dd:CCC, M211De:CCC
TNC Ecoregions: 47:C, 48:C, 60:C, 61:C, 63:C, 64:C

SOURCES

References: Comer and Albert 1997, Comer et al. 1995a, Comer et al. 1998, Comer et al. 2003, DeSantis et al. 2012, Eyre 1980, Faber-Langendoen et al. 2011, Gawler and Cutko 2010, Herms et al. 2010, Johnson and Booker 1983, Kost et al. 2007, Rooney 2001, Rooney et al. 2002, Schwintzer 1981, Schwintzer and Tomberlin 1982, Slaughter et al. 2007, Ward et al. 2006
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723030#references
Description Author: S.C. Gawler, mod. J. Drake
Version: 14 Jan 2014 **Stakeholders:** Canada, East, Midwest
Concept Author: S.C. Gawler **ClassifResp:** East

LAURENTIAN-ACADIAN ALKALINE FEN (CES201.585)

CLASSIFIERS

Classification Status: Standard

Primary Division: Laurentian-Acadian (201)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Mesotrophic Water; Alkaline Water; Circumneutral Water; Organic Peat (>40 cm)
Non-Diagnostic Classifiers: Shallow (<15 cm) Water; Saturated Soil; Moderate (100-500 yrs) Persistence; Shrubland (Shrub-dominated); Extensive Wet Flat; Depressional; Broad-Leaved Shrub; Dwarf-Shrub; Graminoid
National Mapping Codes: ESLF 9198

CONCEPT

Summary: These fens, distributed across glaciated eastern and central North America, develop in open basins where bedrock or other substrate influence creates circumneutral to calcareous conditions. They are most abundant in areas of limestone bedrock, and widely scattered in areas where calcareous substrates are scarce. Shore fens, which are peatlands that are occasionally flooded along stream and lakeshores, are also included here because flooding tends to create moderately alkaline conditions. The vegetation may be graminoid-dominated, shrub-dominated, or a patchwork of the two; *Dasiphora fruticosa ssp. floribunda* is a common diagnostic shrub. The herbaceous flora is usually species-rich and includes calciphilic graminoids and forbs. *Sphagnum* dominates the substrate in many sites though in Michigan a patchy to continuous carpet of brown mosses is more typical; *Campylium stellatum* is an indicator bryophyte. The edge of the basin may be shallow to deep peat over a sloping substrate, where seepage waters provide nutrients.
Classification Comments: Need to clarify the conceptual boundaries between this and the boreal fens in central and eastern Canada. Alkaline wooded swamps, some of which have fen-like characteristics, are treated under Laurentian-Acadian Alkaline Conifer-Hardwood Swamp (CES201.575).
Similar Ecological Systems:
- Laurentian-Acadian Alkaline Conifer-Hardwood Swamp (CES201.575)
- North-Central Interior Shrub-Graminoid Alkaline Fen (CES202.702)
- Western Canadian Boreal Shrub-Sedge Rich and Alkaline Fen (CES103.872)

Related Concepts:
- Low Sedge - Buckbean Fen Lawn (Gawler and Cutko 2010) Finer
- Northern White Cedar Woodland Fen (Gawler and Cutko 2010) Finer
- Northern White-Cedar: 37 (Eyre 1980) Undetermined
- Shrubby Cinquefoil - Sedge Circumneutral Fen (Gawler and Cutko 2010) Finer

DESCRIPTION

Environment: This system usually occurs where there is flat, highly calcareous bedrock near the surface. Water slowly moves along this bedrock and, where it comes to the surface, fens can form in the cold, mineral-rich, anoxic water. Soils are organic and saturated most or all of the growing season. Waterflow through this system is slow but greater than in bogs (Schwintzer and Tomberlin 1982). Some fens in this system occur on the shore of lakes or ponds where wave action is low.
Dynamics: The presence of cold, mineral-rich, alkaline groundwater which promotes the formation of peat and marl is key to the formation and maintenance of this system. Where cold, mineral-rich groundwater emerges as diffuse seeps, decomposition of plant matter is slowed and peat can accumulate. Marl forms under sustained flow of calcium- and magnesium-rich water. Peat can form hummocks which have microenvironments that are drier and more acidic than the bulk of the fen. The hummock-and-hollow microtopography, which generates small-scale gradients in soil moisture and chemistry, contributes to fen floristic diversity. The high pH of the bulk of the fens strongly shapes the floristic composition.

Component Associations:
- *Betula pumila - Alnus incana - Salix* spp. / *Chamaedaphne calyculata* Shrubland (CEGL005227, GNR)
- *Betula pumila - Dasiphora fruticosa ssp. floribunda / Carex lasiocarpa - Trichophorum alpinum* Shrubland (CEGL002495, G3G5)
- *Betula pumila / Chamaedaphne calyculata / Carex lasiocarpa* Shrubland (CEGL002494, G4G5)
- *Carex (interior, hystericina, flava) - Trichophorum alpinum / Campylium stellatum* Shrub Herbaceous Vegetation (CEGL006331, G2G3)
- *Carex lasiocarpa - (Carex rostrata) - Equisetum fluviatile* Herbaceous Vegetation (CEGL005229, GNR)
- *Carex lasiocarpa - Calamagrostis* spp. - (*Eleocharis rostellata*) Herbaceous Vegetation (CEGL002383, G3G4)
- *Carex lasiocarpa - Carex buxbaumii - Trichophorum caespitosum* Boreal Herbaceous Vegetation (CEGL002500, G4G5)
- *Carex lasiocarpa - Trichophorum caespitosum - Rhynchospora capillacea / Andromeda polifolia* Herbaceous Vegetation (CEGL002496, G2Q)
- *Chamaedaphne calyculata - Myrica gale / Carex lasiocarpa* Dwarf-shrubland (CEGL005228, G4G5)
- *Dasiphora fruticosa ssp. floribunda / Carex (sterilis, hystericina, flava)* Shrub Herbaceous Vegetation (CEGL006326, G2)
- *Dasiphora fruticosa ssp. floribunda / Carex lasiocarpa / Campylium stellatum* Shrub Herbaceous Vegetation (CEGL006525, GNR)

- *Myrica gale - Dasiphora fruticosa ssp. floribunda / Carex lasiocarpa - Cladium mariscoides* Shrub Herbaceous Vegetation (CEGL006068, G2G3)
- *Prunus virginiana - Acer spicatum - Ribes triste / Angelica atropurpurea - Heracleum maximum* Shrubland (CEGL006583, G3)
- *Thuja occidentalis - (Myrica gale) / Trichophorum alpinum / Drepanocladus* spp. Shrubland (CEGL005193, GNR)
- *Thuja occidentalis - Abies balsamea / Ledum groenlandicum / Carex trisperma* Woodland (CEGL006507, GNR)

DISTRIBUTION

Range: Scattered locations from New England and adjacent Canada west to the Great Lakes and northern Minnesota.
Divisions: 201:C; 202:C
Nations: CA, US
Subnations: MA, ME, MI, MN, NB, NH, NY, PA, VT, WI
Map Zones: 41:C, 50:C, 51:C, 63:C, 64:C, 65:P, 66:C
USFS Ecomap Regions: 211A:CP, 211E:CC, 211F:CP, 211I:CC, 212Ha:CCP, 212Hb:CCP, 212Hc:CCP, 212Hd:CCP, 212He:CCC, 212Hf:CCC, 212Hg:CCC, 212Hh:CCP, 212Hi:CCC, 212Hj:CCP, 212Hk:CCC, 212Hl:CCC, 212Hm:CCP, 212J:CC, 212K:CC, 212L:CC, 212M:CC, 212N:CC, 212Q:CP, 212Ra:CCP, 212Rb:CCC, 212Rc:CCC, 212Rd:CCC, 212Re:CCC, 212S:CC, 212Tb:CCC, 212Te:CCP, 212X:CC, 212Y:CC, 212Z:CC, 221A:CC, 221B:CC, 222I:CC, M211A:CP, M211B:CP, M211C:CC
TNC Ecoregions: 47:C, 48:C, 60:C, 61:C, 63:C, 64:P

SOURCES

References: Comer et al. 2003, Eyre 1980, Faber-Langendoen et al. 2011, Gawler and Cutko 2010, Schwintzer and Tomberlin 1982
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723021#references
Description Author: S.C. Gawler, mod. J. Drake
Version: 14 Jan 2014 **Stakeholders:** Canada, East, Midwest
Concept Author: S.C. Gawler **ClassifResp:** East

LOWER MISSISSIPPI RIVER FLATWOODS (CES203.193)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Non-Diagnostic Classifiers: Forest and Woodland (Treed)
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Deciduous open tree canopy
National Mapping Codes: EVT 2513; ESLF 9191; ESP 1513

CONCEPT

Summary: This system encompasses forests, prairies and woodlands on Pleistocene terraces in the Mississippi Alluvial Plain of Arkansas, Missouri and Louisiana. It occurs primarily west of Crowley's Ridge on Pleistocene glacial outwash deposits in Arkansas and Missouri, and on Macon Ridge in Louisiana and adjacent Arkansas. The sites are above modern floodplains, but have poor internal drainage and are flat with poor runoff, leading to very wet conditions in winter and spring. They also often have a claypan that restricts both internal drainage and, later in the year, water availability. Therefore, they are very wet in the winter/spring and very dry in the summer, a moisture regime termed hydroxeric. Because of this moisture regime, the communities are variable, ranging from willow oak flats to post oak flats to prairies. In the 1940s, the Arkansas Game and Fish Commission produced a wildlife habitat map of Arkansas in which these sites were classified as "terrace hardwood forests." These communities have a large variety of upland and lowland tree species, ranging from post oak to overcup oak in a small area. Such species diversity may be explained by regeneration of species with dramatically different moisture tolerances on the same site in dry and wet years on these hydroxeric sites. Because the sites are above current floodplains and susceptible to being drained, they have been cleared at an even greater rate than nearby floodplain forests.
Classification Comments: T. Foti (pers. comm. 2007): "I think it does encompass the Louisiana Mesic Hardwood Flatwoods, and the species listed in that description look good for the whole system. Do we want to leave the potential for prairies in this system or include them in the Grand Prairie system? I am inclined to think that small prairie inclusions should remain in this system and larger, individually definable prairies, such as those formerly across the White River from the Grand Prairie proper, could be included in that system. That distinction might be mentioned in the description. The Grand Prairie should be listed as a similar ecological system."
Similar Ecological Systems:
- Interior Highlands Unglaciated Flatwoods (CES202.454)
- Lower Mississippi Alluvial Plain Grand Prairie (CES203.549)
- Mississippi River High Floodplain (Bottomland) Forest (CES203.196)
- West Gulf Coastal Plain Nonriverine Wet Hardwood Flatwoods (CES203.548)

Related Concepts:
- Mesic Hardwood Flatwood (LNHP 2004) Finer
- Wet Hardwood Flatwood (LNHP 2004) Finer

DESCRIPTION

Environment: The sites where this system is found are above modern floodplains, but have poor internal drainage and are flat with poor runoff, leading to very wet conditions in winter and spring. They also often have a claypan that restricts both internal drainage and, later in the year, water availability. Therefore, they are very wet in the winter/spring and very dry in the summer, a moisture regime termed hydroxeric. In Louisiana, distinct mesic and wet community variants are recognized (LNHP 2004, 2009).
Vegetation: The communities of this system are variable, ranging from willow oak flats to post oak flats to prairies. In examples on Macon Ridge (Louisiana), overstory dominants include *Carya alba, Nyssa sylvatica, Quercus alba, Quercus pagoda, Quercus nigra, Quercus michauxii*, and *Liquidambar styraciflua*. In addition, *Quercus shumardii* and *Quercus falcata* are fairly frequent but not usually abundant. Common midstory trees include *Cornus florida, Ostrya virginiana, Aralia spinosa, Ulmus alata, Sassafras albidum*, and *Acer rubrum*. Important shrubs/small trees are *Vaccinium arboreum, Vaccinium virgatum, Viburnum rufidulum, Crataegus marshallii, Aesculus pavia, Frangula caroliniana, Asimina triloba, Hypericum hypericoides*, and *Euonymus americanus*. Although infrequent, *Hamamelis virginiana* can be locally abundant. Important woody vines include *Toxicodendron radicans, Parthenocissus quinquefolia, Vitis rotundifolia, Vitis aestivalis*, and *Smilax smallii*. *Toxicodendron radicans* and *Parthenocissus quinquefolia* are usually thick on the ground, as well as being represented by high climbing individuals. Common and characteristic herbaceous plants include *Chasmanthium sessiliflorum, Dichanthelium boscii, Podophyllum peltatum, Carex cherokeensis, Elephantopus carolinianus, Elephantopus tomentosus, Scleria oligantha, Aristolochia serpentaria, Botrychium virginianum, Passiflora lutea, Dioscorea villosa, Clitoria mariana, Sanicula canadensis, Geum canadense, Galium circaezans, Agrimonia rostellata, Spigelia marilandica, Clematis virginiana, Phryma leptostachya, Ruellia caroliniensis*, and *Smallanthus uvedalius* (LNHP 2004).

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Mississippi River High Floodplain (Bottomland) Forest (CES203.196)

Adjacent Ecological System Comments: These flatwoods are above existing floodplains and they are ecologically controlled by

edaphic factors and precipitation.

DISTRIBUTION

Range: This system is found in the Mississippi Alluvial Plain from the Missouri "bootheel" south to Louisiana. It occurs primarily west of Crowley's Ridge on Pleistocene glacial outwash deposits in Arkansas and Missouri. In southeastern Arkansas and northeastern Louisiana it is found on Macon Ridge (Ecoregion 73j (EPA 2004, LNHP 2009)). It is not reported from Kentucky, Tennessee, or Mississippi.
Divisions: 203:C
Nations: US
Subnations: AR, LA, MO
Map Zones: 45:C, 98:P
USFS Ecomap Regions: 234A:CC, 234D:CC
TNC Ecoregions: 42:C

SOURCES

References: EPA 2004, Foti pers. comm., LNHP 2004, LNHP 2009, Nelson 2005, Southeastern Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.768783#references
Description Author: T. Foti and M. Pyne, mod. C. Nordman
Version: 14 Jan 2014 **Stakeholders:** Midwest, Southeast
Concept Author: T. Foti and M. Pyne **ClassifResp:** Southeast

MEDITERRANEAN CALIFORNIA ALKALI MARSH (CES206.947)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Alkaline Water; Saline Water Chemistry; Shallow (<15 cm) Water; Caliche Layer; Mediterranean [Mediterranean Xeric-Oceanic]; Depressional
Non-Diagnostic Classifiers: Short (50-100 yrs) Persistence; Lowland [Lowland]; Woody-Herbaceous; Herbaceous; Isolated Wetland [Partially Isolated]
National Mapping Codes: ESLF 9188

CONCEPT

Summary: These highly variable systems occur in scattered locations throughout the California Central Valley and along California's south coast extending into Baja Norte, all at elevations below 300 m (1000 feet). They are found in old lake beds or in floodplains of major river systems where seasonal water inputs are limited, and often include some groundwater seepage. High rates of evaporation lead to alkaline water and soil conditions, with layers of salt encrusted soils often accumulating near seeps. These are highly variable in plant composition, but often include *Schoenoplectus americanus (= Scirpus americanus), Atriplex* spp., *Triglochin maritima*, and *Cirsium* spp. Endemic plant species include *Puccinellia howellii*.
Related Concepts:
- Wetlands (217) (Shiflet 1994) Broader

DESCRIPTION

Environment: This system occurs at elevations below 300 m (1000 feet). Examples are found in old lakebeds or in floodplains of major river systems where seasonal water inputs are limited, and often include some groundwater seepage. High rates of evaporation lead to alkaline water and soil conditions, with layers of salt-encrusted soils often accumulating near seeps. Soils are alkaline to saline clays with hardpans. It is often associated with faults and seepage from salty or alkaline country rock, such as marine sediments, uplifted lake bed deposits, etc.) (T. Keeler-Wolf pers. comm. 2013).
Dynamics: Alkali marshes develop where freshwater inputs are ponded in shallow to deep pools that are exposed to strong evaporative forces, accumulating salts and creating the alkali chemistry (Mitsch and Gosselink 2000). The key process is a an internal drainage (playa) with a water source (seep, with fresh or saline waters) in inland areas with strong evapotranspiration rates, such as the southern Central Valley, and southern coastal regions (Sawyer et al. 2009).

DISTRIBUTION

Range: Scattered locations throughout the California Central Valley and along California's south coast extending into Baja Norte, all at elevations below 300 m (1000 feet).
Divisions: 206:C
Nations: MX, US
Subnations: CA, MXBC(MX)
Map Zones: 2:P, 4:C, 5:C
USFS Ecomap Regions: 261B:CC, 262A:CC, 322A:PP, 342B:??, M332G:??
TNC Ecoregions: 13:C, 16:C

SOURCES

References: Barbour and Major 1988, Brooks and Minnich 2006, Coffman 2007, Comer et al. 2003, Holland and Keil 1995, Keeler-Wolf pers. comm., Mitsch and Gosselink 2000, PRBO Conservation Science 2011, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Shiflet 1994, WNHP 2011
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722734#references
Description Author: P. Comer and T. Keeler-Wolf, mod. G. Kittel
Version: 14 Jan 2014 **Stakeholders:** Latin America, West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

MISSISSIPPI RIVER BOTTOMLAND DEPRESSION (CES203.490)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Forest and Woodland (Treed); Riverine / Alluvial [Brownwater]; Needle-Leaved Tree; Broad-Leaved Deciduous Tree
National Mapping Codes: ESLF 9352

CONCEPT

Summary: This system represents semipermanently flooded to saturated depressional areas of the lower Mississippi River Alluvial Valley, from southern Illinois south to Mississippi and Louisiana. These areas have a distinctly longer hydroperiod than other parts of the landscape. Typical and characteristic trees in examples of this system include *Acer rubrum var. drummondii, Carya aquatica, Fraxinus profunda, Gleditsia aquatica, Nyssa aquatica, Nyssa biflora, Planera aquatica, Quercus lyrata, Quercus palustris, Salix nigra*, and *Taxodium distichum*. Some characteristic shrubs include *Cephalanthus occidentalis, Cornus foemina, Decodon verticillatus, Forestiera acuminata, Itea virginica*, and *Planera aquatica*. Herbs are uncommon, but *Ludwigia peploides, Sagittaria lancifolia, Ceratophyllum* spp., *Elodea* spp., *Potamogeton* spp., and *Lemna minor* may be found.

Related Concepts:

- Baldcypress - Tupelo: 102 (Eyre 1980) Finer
- Baldcypress: 101 (Eyre 1980) Finer
- Black Willow: 95 (Eyre 1980) Finer
- Bottomland Hardwood Swamp (Evans 1991) Intersecting
- Bottomland Marsh (Evans 1991) Intersecting
- Coastal Plain Slough (Evans 1991) Intersecting
- Cypress/Tupelo Swamp (Evans 1991) Intersecting
- Overcup Oak - Water Hickory: 96 (Eyre 1980) Finer
- Shrub Swamp (Evans 1991) Intersecting
- Water Tupelo - Swamp Tupelo: 103 (Eyre 1980) Finer

DESCRIPTION

Environment: Examples of this system are found in depressions and backswamps of the lower Mississippi River Alluvial Valley, from southern Illinois south to Mississippi and Louisiana. These areas have a distinctly longer hydroperiod than other parts of the landscape.

Vegetation: Typical and characteristic trees in examples of this system include *Acer rubrum var. drummondii, Carya aquatica, Fraxinus profunda, Gleditsia aquatica, Nyssa aquatica, Nyssa biflora, Planera aquatica, Quercus lyrata, Quercus palustris, Salix nigra*, and *Taxodium distichum*. Some characteristic shrubs include *Cephalanthus occidentalis, Cornus foemina, Decodon verticillatus, Forestiera acuminata, Itea virginica*, and *Planera aquatica*. Herbs are uncommon, but *Ludwigia peploides, Sagittaria lancifolia, Ceratophyllum* spp., *Elodea* spp., *Potamogeton* spp., and *Lemna minor* may be found.

Dynamics: Flooding is more frequent and of longer duration in these depressions and on the lower terraces than the upper ones. Catastrophic floods of long duration as well as wind events can cause the loss of canopy over large areas, and large coastal areas are also impacted by storm surges from hurricanes. The duration of flooding varies with the placement of a particular site in the landscape and is a dominant process affecting vegetation on a given site. Flooding can deposit alluvium or scour the ground, depending on the landscape position of a site and the severity of the flood event. Fire is infrequent and of limited importance in these lower, wetter areas, but could affect them during periods of prolonged drought. Changes in hydrology due to the activities of beaver are also an important ecological process in bottomland hardwood forests. Beaver activity can add to the dynamics of the system, altering habitat over large areas. Beaver impoundments kill trees (sometimes over large areas) but may also create open water habitat, cypress-tupelo stands, or cause stand replacement.

Component Associations:

- *Acer rubrum - Gleditsia aquatica - Planera aquatica - Fraxinus profunda* Forest (CEGL002422, G3G5)
- *Cephalanthus occidentalis / Carex* spp. - *Lemna* spp. Southern Shrubland (CEGL002191, G4)
- *Decodon verticillatus* Seasonally Flooded Shrubland (CEGL003905, G4)
- *Forestiera acuminata - (Planera aquatica, Cephalanthus occidentalis)* Shrubland (CEGL003911, G3?)
- *Gleditsia aquatica - Carya aquatica* Forest (CEGL007426, G3?)
- *Ludwigia peploides* Herbaceous Vegetation (CEGL007835, G4G5)
- *Nyssa aquatica - Nyssa biflora* Forest (CEGL007429, G4G5)
- *Nyssa aquatica* Forest (CEGL002419, G4G5)
- *Planera aquatica* Forest (CEGL007394, G4?)
- *Potamogeton* spp. - *Ceratophyllum* spp. - *Elodea* spp. Permanently Flooded Herbaceous Vegetation (CEGL004725, G4?)

- *Quercus lyrata - Carya aquatica* Forest (CEGL007397, G4G5)
- *Quercus lyrata - Quercus palustris / Acer rubrum var. drummondii / Itea virginica - Cornus foemina - (Lindera melissifolia)* Forest (CEGL004778, G2?)
- *Salix nigra / (Cephalanthus occidentalis)* Forest (CEGL004773, G4G5)
- *Salix nigra / Sagittaria lancifolia* Forest (CEGL007436, G4?)
- *Taxodium distichum - (Nyssa aquatica) / Forestiera acuminata - Planera aquatica* Forest (CEGL002421, G3G5)
- *Taxodium distichum - Nyssa aquatica - Acer rubrum / Itea virginica* Forest (CEGL007422, G4?)
- *Taxodium distichum / Lemna minor* Forest (CEGL002420, G4G5)
- *Taxodium distichum / Planera aquatica - Forestiera acuminata* Lakeshore Woodland (CEGL007909, GNR)

DISTRIBUTION

Range: This system is found in the Mississippi Alluvial Plain from southern Illinois south to Mississippi and Louisiana.
Divisions: 203:C
Nations: US
Subnations: AR, IL, KY, LA, MO, MS, TN
Map Zones: 45:C, 47:?, 98:C
USFS Ecomap Regions: 232E:CC, 234A:CC, 234C:CC, 234D:CC, 234E:CC
TNC Ecoregions: 42:C

SOURCES

References: Comer et al. 2003, Evans 1991, Eyre 1980, Harris 1989, Heineke 1987, Sharitz and Mitsch 1993
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723096#references
Description Author: T. Foti and R. Evans, mod. M. Pyne
Version: 14 Jan 2014 **Stakeholders:** Midwest, Southeast
Concept Author: T. Foti and R. Evans **ClassifResp:** Southeast

MISSISSIPPI RIVER HIGH FLOODPLAIN (BOTTOMLAND) FOREST (CES203.196)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Riverine / Alluvial [Brownwater]
Non-Diagnostic Classifiers: Forest and Woodland (Treed)
National Mapping Codes: ESLF 9180

CONCEPT

Summary: "High bottomlands" are often temporarily flooded on older Holocene point bars and natural levees, with flooding less frequent than every five years. Wetland functions are primarily driven by precipitation and are classed as floodplain flats in a hydrogeomorphic classification (Klimas et al. 2004). They are flooded less frequently than adjacent riparian floodplains or low floodplains. These floodplains are of particular conservation interest because they have been cleared to a greater extent than riparian or low floodplains because of the reduced flooding of these sites. Also, flood control levees protect many of these sites, and with protection from levees, almost all sites are cleared. Thus, most wetlands remaining in large bottomland areas are riparian or low bottomlands, and the species, communities and other characteristics of high bottomlands have been essentially lost. Wildlife agency partners support the recognition of this distinction. Because many of these sites are adjacent to uplands or non-flooded hydroxeric flatwoods, both of which have a relatively high fire frequency, and high floodplains are relatively dry, they have a much higher typical fire frequency than lower bottomlands. Therefore, under pre-development conditions, they would have been more open and would have had a greater ground layer diversity than other floodplain systems.

Similar Ecological Systems:
- Lower Mississippi River Flatwoods (CES203.193)
- Mississippi River Low Floodplain (Bottomland) Forest (CES203.195)
- Mississippi River Riparian Forest (CES203.190)

Related Concepts:
- Bottomland Hardwood Swamp (Evans 1991) Intersecting
- Bottomland Marsh (Evans 1991) Intersecting
- Coastal Plain Bottomland Hardwood Forest (Evans 1991) Intersecting
- Coastal Plain Slough (Evans 1991) Intersecting
- Cypress/Tupelo Swamp (Evans 1991) Intersecting
- Floodplain Ridge/Terrace Forest (Evans 1991) Intersecting
- Live Oak: 89 (Eyre 1980) Finer
- Pin Oak - Sweetgum: 65 (Eyre 1980) Finer
- Shrub Swamp (Evans 1991) Intersecting
- Silver Maple - American Elm: 62 (Eyre 1980) Finer
- Sugarberry - American Elm - Green Ash: 93 (Eyre 1980) Finer
- Swamp Chestnut Oak - Cherrybark Oak: 91 (Eyre 1980) Finer
- Sweetgum - Willow Oak: 92 (Eyre 1980) Finer
- Willow Oak - Water Oak - Diamondleaf (Laurel) Oak: 88 (Eyre 1980) Finer

DESCRIPTION

Environment: These "high bottomlands" are often temporarily flooded on older Holocene point bars and natural levees, with flooding less frequent than every five years. Wetland functions are primarily driven by precipitation and are classed as floodplain flats in a hydrogeomorphic classification (Klimas et al. 2004). They are flooded less frequently than adjacent riparian floodplains or low floodplains.

Vegetation: Typical dominant trees in stands of this system include *Liquidambar styraciflua, Quercus laurifolia, Quercus michauxii, Quercus nigra, Quercus pagoda, Quercus phellos, Quercus shumardii, Quercus texana,* and *Carya* spp. Southern examples may contain *Quercus virginiana* and/or *Magnolia grandiflora,* northern ones may contain *Quercus palustris*. Wetter inclusions may contain *Quercus lyrata*. Some stands which lack these species may exhibit dominance by *Fraxinus pennsylvanica, Ulmus americana*, and *Celtis laevigata*. *Gleditsia triacanthos* may also be a component. *Ulmus crassifolia* may be more commonly found west of the Mississippi River. Some small trees and shrubs include *Cornus florida, Ilex decidua, Ilex opaca* var. *opaca, Viburnum dentatum,* and *Carpinus caroliniana*. Southern stands may contain *Sabal minor*. The perennial graminoid bamboo *Arundinaria gigantea* ssp. *gigantea* may dominate the shrub stratum of some forests, or it may form non-forested stands called "canebrakes." *Vitis rotundifolia, Ampelopsis arborea,* and *Campsis radicans* are common vines.

Dynamics: Flooding is the principal disturbance in this system. Flooding frequently floods higher terraces (Wharton et al. (1982) zones IV and V), but not as frequently as the lower ones. Unusually long or deep floods may stress vegetation or act to regenerate some species. Occasional, long duration flooding can cause the loss of canopy over large areas. This canopy decline and reproductive

failure can create late-seral open stands. Duration of flooding varies with the placement of a site in the landscape and is a dominant process affecting vegetation on a given site. Flooding can deposit alluvium or scour the ground, depending on the landscape position of a site and the severity of the flood event.

In addition to periodic flooding, the dominant ecological process in bottomland hardwood forests is the formation of windfall gaps, which can occur on the local scale (a single mature canopy tree) as well as the landscape scale (tornadoes or hurricanes). When canopy trees fall, seedlings in the understory are released and compete for a spot in the canopy. This leads to dense areas of herbaceous and woody vegetation in windfall gaps of all sizes. This is a major process in forest regeneration in bottomland hardwood forests.

The fire history of this type is poorly understood, in part because there has been the widespread assumption that fire was not a factor in its ecological dynamics. However, the presence of extensive cane understories and canebrakes indicates that fire was much more common than is generally believed. These canebrakes exist as a patch community maintained by wind and fire. Fire played a greater role in this system than in the related "low bottomlands." Infrequent, mild surface fires would occur in the system; however, they would not alter species composition or structure. Fire was frequent historically on older terraces outside the floodplain, and also crept into the floodplains; it is infrequent and of limited importance in the lower, wetter terraces. Putnam (1951 as cited in Wharton et al. 1982) states that a serious fire season occurs on an average of about every 5 to 8 years in the bottomland hardwood forests of the Mississippi Alluvial Plain. This system is also bordered by a number of upland communities from which fire would have occasionally burned down into the bottoms, especially in drought years. It is conjectured that Native Americans maintained canebrakes by deliberate fall burning.

Currently, the regeneration of remaining examples occurs through small gap regeneration or large patch regeneration in blowdowns from tornados or large storms. Originally, fire may have functioned to open larger patches in which regeneration occurred.

Beaver activity causes changes in hydrology, and this is an important ecological process in bottomland hardwood forests; the effects are poorly understood at the landscape level, especially in the presettlement context. Beaver impoundments can kill trees (sometimes over large areas) and may create open water habitat or cypress-tupelo stands, or cause stand replacement. Meandering streams are dynamic and frequently change course, eroding into the floodplain and depositing new point bars, thus creating new habitat for early-seral plant communities. In addition, insect outbreaks would occur infrequently in closed-canopy states.

Component Associations:
- *Arundinaria gigantea ssp. gigantea* Shrubland (CEGL003836, G2?)
- *Fraxinus pennsylvanica - Populus heterophylla - Ulmus americana - (Quercus texana)* Forest (CEGL004694, G2?)
- *Fraxinus pennsylvanica - Ulmus americana - Celtis laevigata / Ilex decidua* Forest (CEGL002427, G4G5)
- *Quercus laurifolia - Quercus nigra* Mississippi River Alluvial Plain Forest (CEGL007916, GNR)
- *Quercus michauxii - Quercus shumardii - Liquidambar styraciflua / Arundinaria gigantea* Forest (CEGL002099, G3G4)
- *Quercus palustris - (Quercus stellata) - Quercus pagoda / Isoetes* spp. Forest (CEGL002101, G2G3)
- *Quercus phellos - (Quercus lyrata) / Carex* spp. - *Leersia* spp. Forest (CEGL002102, G3G4Q)
- *Quercus phellos - (Quercus similis) - Ulmus crassifolia* Forest (CEGL007921, G3G4)
- *Quercus phellos - Quercus nigra - Liquidambar styraciflua* Mississippi River Alluvial Plain Forest (CEGL007915, G4G5)
- *Quercus texana - Celtis laevigata - Ulmus (americana, crassifolia) - (Gleditsia triacanthos)* Forest (CEGL004619, G4G5)
- *Quercus virginiana - Celtis laevigata - Quercus pagoda / Sabal minor* Forest (CEGL004648, G2)
- *Quercus virginiana - Quercus nigra - Liquidambar styraciflua / Ilex opaca var. opaca / Viburnum dentatum* Forest (CEGL007476, G2G3)
- *Quercus virginiana - Quercus pagoda - Magnolia grandiflora / Cornus florida / Sanicula* sp. Forest (CEGL007469, G2G3)

Spatial Characteristics

Size: Large patch.
Adjacent Ecological Systems:
- Lower Mississippi River Flatwoods (CES203.193)
- Mississippi River Low Floodplain (Bottomland) Forest (CES203.195)

Distribution

Range: This system is found in the Mississippi Alluvial Plain from southern Illinois south to Mississippi and Louisiana.
Divisions: 203:C
Nations: US
Subnations: AR, IL, KY, LA, MO, MS, TN
Map Zones: 45:C, 47:C, 98:C
USFS Ecomap Regions: 232E:CC, 234A:CC, 234C:CC, 234D:CC, 234E:CC
TNC Ecoregions: 42:C

Sources

References: Evans 1991, Eyre 1980, Foti 2001, Harris 1989, Heineke 1987, Landfire 2007a, Putnam 1951, Rudis 2001, Sharitz and Mitsch 1993, Southeastern Ecology Working Group n.d., Wharton et al. 1982
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.768761#references
Description Author: T. Foti and M. Pyne

Version: 14 Jan 2014
Concept Author: T. Foti and M. Pyne

Stakeholders: Midwest, Southeast
ClassifResp: Southeast

MISSISSIPPI RIVER LOW FLOODPLAIN (BOTTOMLAND) FOREST (CES203.195)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Riverine / Alluvial [Brownwater]
Non-Diagnostic Classifiers: Forest and Woodland (Treed)
National Mapping Codes: ESLF 9183

CONCEPT

Summary: These "low bottomlands" are usually seasonally flooded in backswamps, with flooding more frequent than every five years, usually more frequently than every two years, generally by still water that may be impounded behind natural levees, and are classed as Low Gradient Riverine Backwater wetlands in hydrogeomorphic classifications. Low bottomlands occur along the Mississippi River and its tributaries in the Mississippi River Alluvial Plain ecoregion. Prolonged flooding dominates this system, and its duration is greater than in the adjacent Mississippi River Riparian Forest. Overcup oak is the characteristic dominant species. Soils are clayey with poor internal drainage.

Similar Ecological Systems:
- Mississippi River High Floodplain (Bottomland) Forest (CES203.196)
- Mississippi River Riparian Forest (CES203.190)--Flooding is of lower duration.

Related Concepts:
- Bottomland Hardwood Swamp (Evans 1991) Intersecting
- Bottomland Marsh (Evans 1991) Intersecting
- Coastal Plain Bottomland Hardwood Forest (Evans 1991) Intersecting
- Coastal Plain Slough (Evans 1991) Intersecting
- Cypress/Tupelo Swamp (Evans 1991) Intersecting
- Overcup Oak - Water Hickory: 96 (Eyre 1980) Finer
- Shrub Swamp (Evans 1991) Intersecting

DESCRIPTION

Environment: These "low bottomlands" are usually seasonally flooded in backswamps, with flooding more frequent than every five years, usually more frequently than every two years, generally by still water that may be impounded behind natural levees, and are classed as Low Gradient Riverine Backwater wetlands in hydrogeomorphic classifications (Klimas et al. 1981).

Dynamics: Changes in soils and vegetation of this system are much slower than in the adjacent Mississippi River riparian forest. Flooding is the principal disturbance in this system. Unusually long or deep floods may stress vegetation or act to regenerate some species. Larger floods cause local disturbance by scouring and depositing sediment along channels and occasionally causing channel shifts. Duration of flooding varies with the placement of a site in the landscape and is a dominant process affecting vegetation on a given site. Flooding can deposit alluvium or scour the ground, depending on the landscape position of a site and the severity of the flood event. Flooding occurs in lower terraces more frequently than in the higher ones. Occasional, long-duration flooding can cause the loss of canopy over large areas. This canopy decline and reproductive failure can create late-seral open stands. Duration of flooding varies with the placement of a site in the landscape and is a dominant process affecting vegetation on a given site. Flooding can deposit alluvium or scour the ground, depending on the landscape position of a site and the severity of the flood event.

In addition to periodic flooding, the dominant ecological process in bottomland hardwood forests is the formation of windfall gaps, which can occur on the local scale (a single mature canopy tree) as well as the landscape scale (effects of tornadoes or hurricanes). When canopy trees fall, seedlings in the understory are released and compete for a spot in the canopy. This leads to dense areas of herbaceous and woody vegetation in windfall gaps of all sizes. This is a major process in forest regeneration in bottomland hardwood forests.

The fire history of this type is poorly understood, in part because there has been the widespread assumption that fire was not a factor in its ecological dynamics. However, the presence of extensive cane understories and canebrakes indicates that fire was much more common than is generally believed. These canebrakes exist as a patch community maintained by wind and fire. Fire presumably played a lesser role in this system than in the related "high bottomlands." This system is also bordered by a number of upland communities from which fire would have occasionally burned down into the bottoms, especially in drought years. Beaver activity causes changes in hydrology, and this is an important ecological process in bottomland hardwood forests; the effects are poorly understood at the landscape level, especially in the presettlement context. Beaver impoundments can kill trees (sometimes over large areas) and may create open water habitat or cypress-tupelo stands, or cause stand replacement. Meandering streams are dynamic and frequently change course, eroding into the floodplain and depositing new point bars, thus creating new habitat for early-seral plant communities. In addition, insect outbreaks would occur infrequently in closed-canopy states.

Component Associations:

- *Quercus lyrata - Carya aquatica - (Quercus texana) / Forestiera acuminata* Forest (CEGL002423, G3?)
- *Quercus lyrata - Liquidambar styraciflua / Forestiera acuminata* Forest (CEGL002424, G4?)
- *Quercus texana - Quercus lyrata* Forest (CEGL007407, G3G4)

Spatial Characteristics

Size: Large patch.
Adjacent Ecological Systems:
- Mississippi River High Floodplain (Bottomland) Forest (CES203.196)
- Mississippi River Riparian Forest (CES203.190)

Adjacent Ecological System Comments: Flooding is of lower duration in riparian forests and soil deposition is often more rapid, leading to rapid vegetation changes.

Distribution

Range: This system is found in the Mississippi Alluvial Plain from southern Illinois south to Mississippi and Louisiana.
Divisions: 203:C
Nations: US
Subnations: AR, IL, KY, LA, MO, MS, TN
Map Zones: 45:C, 47:C, 98:C
USFS Ecomap Regions: 232E:CC, 234A:CC, 234C:CC, 234D:CC, 234E:CC
TNC Ecoregions: 42:C

Sources

References: Evans 1991, Eyre 1980, Foti 2001, Harris 1989, Heineke 1987, Klimas et al. 1981, Landfire 2007a, Rudis 2001, Sharitz and Mitsch 1993, Southeastern Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.768395#references
Description Author: T. Foti and M. Pyne
Version: 14 Jan 2014 **Stakeholders:** Midwest, Southeast
Concept Author: T. Foti, M. Pyne **ClassifResp:** Southeast

MISSISSIPPI RIVER RIPARIAN FOREST (CES203.190)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Riverine / Alluvial [Brownwater]
Non-Diagnostic Classifiers: Forest and Woodland (Treed)
National Mapping Codes: ESLF 9161

CONCEPT

Summary: This ecological system consists of riverfront vegetation, which is generally temporarily (but rarely seasonally) flooded, on point bars and natural levees adjacent to the river that formed them. The period between floods is less than five years, and the flooding is caused by water flowing directly from the channel. Examples occur along the lower Mississippi River and its tributaries in the Mississippi River Alluvial Plain ecoregion. They are classed as Low Gradient Riverine Overbank wetlands in a hydrogeomorphic classification. The flooding is of shorter duration than on adjacent backswamps where water is impounded behind riverfront natural levees, and is of longer duration than on adjacent high bottomlands that are typically temporarily flooded. Soils are typically sandier than those of low bottomlands. Giant cane is a common understory component in these forests on natural levees and higher point bars, and may become dominant after thinning or removal of the overstory. Willow and cottonwood sandbars may have an open-canopy (woodland) structure.

Similar Ecological Systems:
- Mississippi River High Floodplain (Bottomland) Forest (CES203.196)
- Mississippi River Low Floodplain (Bottomland) Forest (CES203.195)

Related Concepts:
- Black Willow: 95 (Eyre 1980) Finer
- Cottonwood: 63 (Eyre 1980) Finer
- Live Oak: 89 (Eyre 1980) Finer
- Riparian Forest (Evans 1991) Broader
- Silver Maple - American Elm: 62 (Eyre 1980) Finer
- Sugarberry - American Elm - Green Ash: 93 (Eyre 1980) Finer
- Sweetgum - Willow Oak: 92 (Eyre 1980) Finer
- Sycamore - Sweetgum - American Elm: 94 (Eyre 1980) Finer
- Willow Oak - Water Oak - Diamondleaf (Laurel) Oak: 88 (Eyre 1980) Finer

DESCRIPTION

Environment: Stands of this system are generally temporarily (but rarely seasonally) flooded on point bars and natural levees adjacent to the river that formed them, with flooding more frequent than every five years, by flowing water directly from the stream. They are classed as Low Gradient Riverine Overbank wetlands in a hydrogeomorphic classification (Klimas et al. 2004). Flooding is of lower duration than on adjacent backswamps where water is impounded behind riverfront natural levees. Flooding is of longer duration than on adjacent high bottomlands that are typically temporarily flooded. Soils are typically sandier than those of low bottomlands.

Vegetation: Some of the most typical and characteristic tree species found in stands of this system include *Acer negundo*, *Acer saccharinum*, *Platanus occidentalis*, *Populus deltoides*, and *Salix nigra*. Other trees may include *Celtis laevigata*, *Carya illinoinensis*, *Fraxinus pennsylvanica*, *Gleditsia triacanthos*, *Liquidambar styraciflua*, *Quercus nigra*, *Quercus pagoda*, *Quercus texana*, *Ulmus americana*, and *Ulmus crassifolia*. In addition, *Quercus virginiana* may be present within its range. *Arundinaria gigantea ssp. gigantea* is a common understory component in these forests on natural levees and higher point bars, and may become dominant after thinning or removal of the overstory.

Dynamics: Often on sites with rapid soil deposition and, therefore, with rapid development of vegetation from low-diversity willow- and cottonwood-dominated communities to more diverse communities dominated by sycamore, pecan, sugarberry, green ash or Nuttall oak. Regeneration is through small treefall gaps or large tornado tracks.

Component Associations:
- *Acer negundo* Forest (CEGL005033, G4G5)
- *Acer saccharinum - Celtis laevigata - Carya illinoinensis* Forest (CEGL002431, G3G4)
- *Acer saccharinum - Fraxinus pennsylvanica - Ulmus americana* Forest (CEGL002586, G4?)
- *Arundinaria gigantea ssp. gigantea* Shrubland (CEGL003836, G2?)
- *Carya illinoinensis - Celtis laevigata - Ulmus (americana, crassifolia)* Mississippi River Alluvial Plain Forest (CEGL007912, G2G3)
- *Fraxinus pennsylvanica - Ulmus americana - Celtis laevigata / Ilex decidua* Forest (CEGL002427, G4G5)
- *Platanus occidentalis - Fraxinus pennsylvanica - Celtis laevigata - (Liquidambar styraciflua)* Forest (CEGL007913, G4)

- *Populus deltoides - Salix nigra - Acer saccharinum* Forest (CEGL002018, G3G4)
- *Populus deltoides - Salix nigra / Mikania scandens* Forest (CEGL007346, G4G5)
- *Quercus laurifolia - Quercus nigra* Mississippi River Alluvial Plain Forest (CEGL007916, GNR)
- *Quercus texana - Celtis laevigata - Ulmus (americana, crassifolia) - (Gleditsia triacanthos)* Forest (CEGL004619, G4G5)
- *Quercus virginiana - Celtis laevigata - Quercus pagoda / Sabal minor* Forest (CEGL004648, G2)
- *Quercus virginiana - Quercus nigra - Liquidambar styraciflua / Ilex opaca var. opaca / Viburnum dentatum* Forest (CEGL007476, G2G3)
- *Quercus virginiana - Quercus pagoda - Magnolia grandiflora / Cornus florida / Sanicula* sp. Forest (CEGL007469, G2G3)

Spatial Characteristics

Size: Large patch.
Adjacent Ecological Systems:
- Mississippi River Low Floodplain (Bottomland) Forest (CES203.195)

Distribution

Range: This system is found in the Mississippi Alluvial Plain from southern Illinois south to Mississippi and Louisiana.
Divisions: 203:C
Nations: US
Subnations: AR, IL, KY, LA, MO, MS, TN
Map Zones: 45:C, 47:C, 98:C
USFS Ecomap Regions: 232E:CC, 234A:CC, 234C:CC, 234D:CC, 234E:CC
TNC Ecoregions: 42:C

Sources

References: Klimas et al. 1981, Southeastern Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.768386#references
Description Author: T. Foti and M. Pyne
Version: 17 Mar 2009 **Stakeholders:** Midwest, Southeast
Concept Author: T. Foti, M. Pyne **ClassifResp:** Southeast

NORTH AMERICAN WARM DESERT LOWER MONTANE RIPARIAN WOODLAND AND SHRUBLAND (CES302.748)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: North American Warm Desert (302)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Forest and Woodland (Treed); Shrubland (Shrub-dominated); Riverine / Alluvial
Non-Diagnostic Classifiers: Short (50-100 yrs) Persistence; Lowland [Lowland]; Tropical/Subtropical [Tropical Xeric]; Temperate [Temperate Xeric]
National Mapping Codes: ESLF 9172

CONCEPT

Summary: This ecological system occurs in foothill and mountain canyons and valleys of the warm desert regions of the southwestern U.S. and adjacent Mexico, and consists of mid-to low-elevation (1100-1800 m) riparian corridors along perennial and seasonally intermittent streams. Rivers include upper portions of the Gila, Santa Cruz, Salt, San Pedro, and tributaries of the lower Colorado River (below the Grand Canyon), the lower Rio Grande and Pecos (up to its confluence with Rio Hondo) that occur in the desert portions of their range. The vegetation is a mix of riparian woodlands and shrublands. Dominant trees include *Acer negundo, Populus deltoides ssp. wislizeni, Populus fremontii, Platanus wrightii, Juglans major, Fraxinus velutina*, and *Sapindus saponaria*. Occasionally *Populus angustifolia* may come in from higher elevations. Shrub dominants include *Salix exigua, Shepherdia argentea, Prunus* spp., *Alnus oblongifolia*, and *Baccharis salicifolia*. Vegetation is dependent upon annual or periodic flooding and associated sediment scour and/or annual rise in the water table for growth and reproduction.

Similar Ecological Systems:
- Madrean Mesic Canyon Forest and Woodland (CES302.454)

Related Concepts:
- Arizona Cypress: 240 (Eyre 1980) Intersecting
- Cottonwood - Willow: 235 (Eyre 1980) Broader
- Riparian Woodland (203) (Shiflet 1994) Broader. System and SRM type overlap in Mojave Desert region of California.

DESCRIPTION

Environment: This ecological system occurs in foothill and mountain canyons and valleys of the warm desert regions of the southwestern U.S. and adjacent Mexico, and consists of mid- to low-elevation (1100-1800 m) riparian corridors and their associated perennial and seasonally intermittent streams. Some occurrences originate as, or receive flow from, headwater streams supported by surface runoff and shallow groundwater seepage; others originate at montane springs.

Dynamics: The hydrologic regime is naturally highly variable temporally and spatially among the streams of this ecosystem. Where present, bedrock formations that force alluvial and basin-fill groundwater to the surface and spring discharges from bedrock aquifers provide flows unaffected by rainfall and snowmelt. Otherwise, stream and river flows are subject to wide fluctuations in where they occur, at what magnitudes, and when and how often as a result of the wide variation in where and when precipitation takes place (cool versus warm season), what form the precipitation takes (rain versus snow), and where and when snowmelt takes place (e.g., Abell et al. 2000, Izbicki and Michel 2004, Levick et al. 2008, Miller et al. 2010a). Intense runoff associated with intense rainfall events are highly erosive, resulting in rapid reconfiguration of aquatic and riparian macrohabitats particularly along reaches with sand and gravel substrates. As a result of this intense regime of fluvial disturbance, occurrences of this ecosystem contain early-, mid- and late-seral riparian plant associations.

Component Associations:
- *Distichlis spicata* Herbaceous Vegetation (CEGL001770, G5)
- *Juglans major - Pinus edulis / Bromus carinatus* Forest (CEGL001101, GUQ)
- *Juglans microcarpa* Scrub (CEGL001103, GNR)
- *Platanus wrightii - Alnus oblongifolia / Baccharis salicifolia* Forest (CEGL002686, G2)
- *Platanus wrightii - Fraxinus velutina* Forest (CEGL000644, GNR)
- *Platanus wrightii - Juglans major* Forest (CEGL000645, G2)
- *Platanus wrightii* Woodland (CEGL000937, GNR)
- *Populus angustifolia - Juniperus deppeana / Brickellia californica* Woodland (CEGL000933, G4Q)
- *Populus angustifolia / Alnus oblongifolia* Woodland (CEGL000938, G4)
- *Populus angustifolia / Salix exigua* Woodland (CEGL000654, G4)
- *Populus angustifolia / Salix irrorata* Woodland (CEGL002647, G2)
- *Populus deltoides (ssp. wislizeni, ssp. monilifera) / Artemisia tridentata* Woodland (CEGL005966, G2G3)
- *Populus deltoides (ssp. wislizeni, ssp. monilifera) / Distichlis spicata* Woodland (CEGL000939, G2)
- *Populus deltoides (ssp. wislizeni, ssp. monilifera) / Salix exigua* Woodland (CEGL002685, G3)
- *Populus deltoides ssp. wislizeni / Acer negundo* Woodland (CEGL002336, GNR)
- *Populus deltoides ssp. wislizeni / Baccharis sarothroides* Forest (CEGL000663, GNR)

- *Populus deltoides ssp. wislizeni* / Disturbed Understory Woodland (CEGL003810, GNR)
- *Populus deltoides ssp. wislizeni / Rhus trilobata* Woodland (CEGL000940, G2)
- *Populus fremontii - Fraxinus velutina* Woodland (CEGL000942, G2G3)
- *Populus fremontii - Platanus wrightii* Forest (CEGL000665, G2)
- *Populus fremontii - Salix gooddingii / Baccharis salicifolia* Forest (CEGL002683, G2)
- *Populus fremontii - Salix gooddingii / Salix exigua* Forest (CEGL002684, G2)
- *Populus fremontii - Salix gooddingii* Woodland (CEGL000944, G2)
- *Populus fremontii / Acer negundo* Forest (CEGL000662, G2Q)
- *Populus fremontii / Baccharis emoryi* Woodland (CEGL002946, GNR)
- *Populus fremontii / Baccharis salicifolia* Woodland (CEGL000941, G2)
- *Populus fremontii / Betula occidentalis* Wooded Shrubland (CEGL002981, GNR)
- *Populus fremontii* / Mesic Forbs Woodland (CEGL002470, GNR)
- *Populus fremontii* / Mesic Graminoids Woodland (CEGL002473, GNR)
- *Populus fremontii / Muhlenbergia rigens* Woodland (CEGL001455, G2)
- *Populus fremontii / Salix geyeriana* Woodland (CEGL000943, G3?)
- *Rhus trilobata - Prunus serotina* Shrubland (CEGL001119, GUQ)
- *Robinia neomexicana / Thalictrum fendleri* Shrubland (CEGL001125, GNR)
- *Salix bonplandiana* Forest (CEGL000679, GNR)
- *Salix exigua / Elymus X pseudorepens* Shrubland (CEGL001198, G3)
- *Salix gooddingii - Fraxinus velutina* Temporarily Flooded Woodland (CEGL003729, G2)
- *Salix gooddingii* Woodland (CEGL002743, G3)
- *Salix irrorata* Shrubland (CEGL001214, GNR)
- *Salix laevigata - Fraxinus velutina* Woodland (CEGL000950, G1G2)

DISTRIBUTION

Range: This system occurs in southern Arizona, New Mexico, and adjacent Mexico, as well as in the desert mountain ranges of southeastern California, at low elevations. It also occurs in southern Nevada and western Texas.
Divisions: 302:C
Nations: MX, US
Subnations: AZ, CA, MXBC(MX), MXBS(MX), MXCH(MX), MXSO(MX), NM, NV, TX
Map Zones: 12:C, 13:C, 14:C, 15:C, 16:?, 17:P, 24:C, 25:C, 26:C, 27:P
USFS Ecomap Regions: 313A:CC, 313C:CC, 315A:CC, 315B:CC, 321A:CC, 322A:CC, 322B:CC, 341F:CC, M261E:CC, M313A:CC, M313B:CC
TNC Ecoregions: 17:C, 22:C, 23:C, 24:C

SOURCES

References: Abell et al. 2000, Brown 1982a, Brown and Mote 2009, Cayan et al. 2010, Chambers and Pellant 2008, Chambers and Wisdom 2009, Christensen and Lettenmaier 2007, CNHP 2010b, Comer et al. 2003, Comer et al. 2013b, Covich 2009, Das et al. 2009, Daubenmire 1952, Dettinger et al. 2009, Dick-Peddie 1993, Eyre 1980, Field et al. 1999, Harper and Peckarsky 2006, Hultine et al. 2007, Izbicki and Michel 2004, Jackson et al. 2009, Kittel et al. 1999b, Levick et al. 2008, Martin 2007, McCabe and Wolock 2009, Melack et al. 1997, Miller et al. 2010a, Mote 2006, Muldavin et al. 2000a, Reeves et al. 2005, Seavy et al. 2009, Shiflet 1994, Szaro 1989, Thomas et al. 2004, USBOR 2011, WNHP 2011
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722924#references
Description Author: NatureServe Western Ecology Team, mod. G. Kittel
Version: 14 Jan 2014 **Stakeholders:** Latin America, Southeast, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

NORTH AMERICAN WARM DESERT RIPARIAN MESQUITE BOSQUE (CES302.752)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: North American Warm Desert (302)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Lowland [Lowland]; Toeslope/Valley Bottom; Tropical/Subtropical [Tropical Xeric]; Temperate [Temperate Xeric]; Riverine / Alluvial; Prosopis spp.-dominated
Non-Diagnostic Classifiers: Forest and Woodland (Treed); Shrubland (Shrub-dominated)
National Mapping Codes: ESLF 9178

CONCEPT

Summary: This ecological system consists of low-elevation (<1100 m) riparian corridors along perennial and intermittent streams in valleys of the warm desert regions of the southwestern U.S. and adjacent Mexico. Rivers include the lower Colorado (within and downstream of the Grand Canyon), Gila, Santa Cruz, Salt, lower Rio Grande, Pecos (up to near its confluence with Rio Hondo), and their tributaries that occur in the desert portions of their range. Dominant trees include *Prosopis glandulosa* and *Prosopis velutina*. Shrub dominants include *Baccharis salicifolia*, *Pluchea sericea*, and *Salix exigua*. Woody vegetation is relatively dense, especially when compared to drier washes. Vegetation, especially the mesquites, tap groundwater below the streambed when surface flows stop. Vegetation is dependent upon annual rise in the water table for growth and reproduction.

Component Associations:
- *Baccharis salicifolia / Muhlenbergia rigens* Shrubland (CEGL004572, G3?)
- *Baccharis sarothroides - Baccharis salicifolia* Shrubland (CEGL001160, G4)
- *Baccharis sarothroides - Parkinsonia microphylla* Shrubland (CEGL001159, G4)
- *Pluchea sericea* Seasonally Flooded Shrubland (CEGL003080, G3?)
- *Prosopis glandulosa - Artemisia filifolia / Sporobolus giganteus* Shrubland (CEGL002192, G4)
- *Prosopis glandulosa - Atriplex* spp. Shrubland (CEGL002193, GNR)
- *Prosopis glandulosa / Atriplex canescens* Shrubland (CEGL001382, G5)
- *Prosopis glandulosa / Bouteloua curtipendula - Nassella leucotricha* Woodland (CEGL002133, G3?)
- *Prosopis glandulosa / Bouteloua curtipendula* Shrubland (CEGL002194, GNR)
- *Prosopis glandulosa / Bouteloua eriopoda* Shrub Herbaceous Vegetation (CEGL001510, G3G4)
- *Prosopis glandulosa / Bouteloua gracilis* Shrubland (CEGL001383, G5)
- *Prosopis glandulosa* / Mixed Grasses Shrubland (CEGL001384, GNRQ)
- *Prosopis glandulosa / Muhlenbergia porteri* Shrubland (CEGL001511, G5)
- *Prosopis glandulosa / Pleuraphis mutica* Shrub Herbaceous Vegetation (CEGL001641, G5)
- *Prosopis glandulosa / Sporobolus airoides* Shrubland (CEGL001385, G5)
- *Prosopis glandulosa / Sporobolus flexuosus* Shrubland (CEGL001386, G4)
- *Prosopis glandulosa* Temporarily Flooded Woodland (CEGL004934, GNR)
- *Prosopis glandulosa var. glandulosa / Bouteloua gracilis - Buchloe dactyloides* Shrubland (CEGL003877, GNR)
- *Prosopis glandulosa var. torreyana* Shrubland (CEGL001381, G3)
- *Prosopis pubescens* Shrubland (CEGL001387, G1?)
- *Prosopis velutina - Acacia greggii* Shrubland (CEGL001388, GUQ)
- *Prosopis velutina / Celtis laevigata var. reticulata* Shrubland (CEGL001390, GNR)
- *Prosopis velutina / Muhlenbergia porteri* Shrubland (CEGL001391, G3Q)

DISTRIBUTION

Range: This system is found along perennial and intermittent streams in valleys of southern Arizona, southern Nevada, southeastern California, New Mexico, western Texas, and adjacent Mexico. Major rivers include the lower Colorado (within and downstream of the Grand Canyon), Gila, Santa Cruz, Salt, lower Rio Grande, Pecos (up to near its confluence with Rio Hondo), and their tributaries that occur in the desert portions of their range.
Divisions: 302:C
Nations: MX, US
Subnations: AZ, CA, MXBC(MX), MXCH(MX), MXSO(MX), NM, NV, TX
Map Zones: 13:C, 14:C, 15:C, 23:?, 25:C, 26:C, 27:?
USFS Ecomap Regions: 313C:CC, 321A:CC, 322A:CC, 322B:CC, 322C:CC, M313A:PP, M313B:PP
TNC Ecoregions: 17:C, 22:C, 23:C, 24:C

SOURCES

References: Barbour and Major 1988, Brown 1982a, Comer et al. 2003, Dick-Peddie 1993, Muldavin et al. 2000a, Muldavin et al. 2000b, Szaro 1989, Thomas et al. 2004

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722920#references
Description Author: NatureServe Western Ecology Team
Version: 16 Jan 2009 **Stakeholders:** Latin America, Southeast, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

NORTH AMERICAN WARM DESERT RIPARIAN WOODLAND AND SHRUBLAND (CES302.753)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: North American Warm Desert (302)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Lowland [Lowland]; Forest and Woodland (Treed); Shrubland (Shrub-dominated); Tropical/Subtropical [Tropical Xeric]; Temperate [Temperate Xeric]; Riverine / Alluvial
Non-Diagnostic Classifiers: Short (50-100 yrs) Persistence; Toeslope/Valley Bottom
National Mapping Codes: ESLF 9182

CONCEPT

Summary: This ecological system consists of low-elevation (<1200 m) riparian corridors along medium to large perennial streams throughout canyons and desert valleys of the southwestern United States and adjacent Mexico. Rivers include the lower Colorado (into the Grand Canyon), Gila, Santa Cruz, Salt, lower Rio Grande (below Elephant Butte Reservoir in New Mexico to the Coastal Plain of Texas), and the lower Pecos (up to near its confluence with Rio Hondo in southeastern New Mexico). These are disturbance-driven plant communities that require flooding, scour and deposition of sands and gravel, and a periodically elevated water table for germination and maintenance. The aquatic communities, in turn, vary with the frequency, intensity, duration and timing of flow, including its often extreme inter-annual variability; the relative contributions of rainfall, snowmelt, and diffuse groundwater and spring discharges to flow; water temperature and chemistry; channel substrate and form; the extent of the hyporheic zone; and drainage network connectivity. These latter conditions, in turn, vary with elevation, latitude and longitude, channel gradient, floodplain width (a function of topography and geology), and surrounding geology and land cover. The vegetation is a mix of riparian woodlands and shrublands. Dominant trees include *Fraxinus velutina, Populus fremontii, Salix gooddingii, Salix lasiolepis, Celtis laevigata var. reticulata, Platanus racemosa*, and *Juglans major*. Shrub dominants include *Salix geyeriana* and *Salix exigua*. Vegetation is dependent upon annual or periodic flooding and associated sediment scour and/or annual rise in the water table for growth and reproduction.

Similar Ecological Systems:
- Edwards Plateau Riparian (CES303.652)
- Southeastern Great Plains Riparian Forest (CES205.709)

Related Concepts:
- Cottonwood - Willow: 235 (Eyre 1980) Broader

DESCRIPTION

Environment: These are disturbance-driven plant communities that require flooding, scour and deposition of sands and gravel, and a periodically elevated water table for germination and maintenance. The aquatic communities, in turn, vary with the frequency, intensity, duration and timing of flow, including its often extreme inter-annual variability; the relative contributions of rainfall, snowmelt, and diffuse groundwater and spring discharges to flow; water temperature and chemistry; channel substrate and form; the extent of the hyporheic zone; and drainage network connectivity. These latter conditions, in turn, vary with elevation, latitude and longitude, channel gradient, floodplain width (a function of topography and geology), and surrounding geology and land cover.
Dynamics: From MBR conceptual model (Comer et al. 2013b): The hydrologic regime is naturally highly variable temporally and spatially among the streams of this ecosystem. Where present, bedrock formations that force alluvial and basin-fill groundwater to the surface and spring discharges from bedrock aquifers provide flows unaffected by rainfall and snowmelt. Otherwise, stream and river flows are subject to wide fluctuations in where they occur, at what magnitudes, and when and how often as a result of the wide variation in where and when precipitation takes place (cool versus warm season), what form the precipitation takes (rain versus snow), and where and when snowmelt takes place (e.g., Abell et al. 2000, Izbicki and Michel 2004, Levick et al. 2008, Miller et al. 2010a). Intense runoff associated with intense rainfall events are highly erosive, resulting in rapid reconfiguration of aquatic and riparian macrohabitats particularly along reaches with sand and gravel substrates. As a result of this intense regime of fluvial disturbance, occurrences of this ecosystem contain early-, mid- and late-seral riparian plant associations. Occurrences also contains non-obligate riparian species. Cottonwood communities are early-, mid- or late-seral, depending on the age-class of the trees and the associated species of the occurrence (Kittel et al. 1999b). Cottonwoods, however, do not reach a climax stage as defined by Daubenmire (1952). Mature cottonwood occurrences do not regenerate in place, but regenerate by "moving" up and down a river reach. Over time, a healthy riparian area supports all stages of cottonwood communities (Kittel et al. 1999b).

Component Associations:
- *Acer negundo - Celtis laevigata var. reticulata* Woodland (CEGL002599, GNR)
- *Baccharis emoryi - Salix exigua* Shrubland (CEGL005947, G3)
- *Baccharis salicifolia* Riparian Shrubland (CEGL003549, G5)
- *Celtis laevigata var. reticulata - Juglans microcarpa / Leptochloa dubia* Woodland (CEGL002166, GNR)
- *Celtis laevigata var. reticulata / Celtis pallida* Shrubland (CEGL001163, G3)
- *Chilopsis linearis / Brickellia laciniata* Scrub Woodland (CEGL004933, G3G4)

- *Fallugia paradoxa* Colorado Plateau Desert Wash Shrubland (CEGL002357, GNR)
- *Juglans major - Pinus edulis / Bromus carinatus* Forest (CEGL001101, GUQ)
- *Juglans major - Prosopis velutina* Forest (CEGL005326, GNR)
- *Juglans microcarpa* Scrub (CEGL001103, GNR)
- *Platanus wrightii - Alnus oblongifolia / Baccharis salicifolia* Forest (CEGL002686, G2)
- *Platanus wrightii - Fraxinus velutina* Forest (CEGL000644, GNR)
- *Platanus wrightii - Juglans major* Forest (CEGL000645, G2)
- *Platanus wrightii* Woodland (CEGL000937, GNR)
- *Pluchea sericea* Seasonally Flooded Shrubland (CEGL003080, G3?)
- *Populus deltoides (ssp. wislizeni, ssp. monilifera) / Artemisia tridentata* Woodland (CEGL005966, G2G3)
- *Populus deltoides (ssp. wislizeni, ssp. monilifera) / Distichlis spicata* Woodland (CEGL000939, G2)
- *Populus deltoides / Muhlenbergia asperifolia* Forest (CEGL000678, G3)
- *Populus deltoides ssp. wislizeni / Acer negundo* Woodland (CEGL002336, GNR)
- *Populus deltoides ssp. wislizeni / Baccharis sarothroides* Forest (CEGL000663, GNR)
- *Populus deltoides ssp. wislizeni / Rhus trilobata* Woodland (CEGL000940, G2)
- *Populus fremontii - Celtis laevigata var. reticulata / Salvia pinguifolia* Forest (CEGL000664, GU)
- *Populus fremontii - Fraxinus velutina* Woodland (CEGL000942, G2G3)
- *Populus fremontii - Platanus wrightii* Forest (CEGL000665, G2)
- *Populus fremontii - Salix gooddingii / Baccharis salicifolia* Forest (CEGL002683, G2)
- *Populus fremontii - Salix gooddingii / Salix exigua* Forest (CEGL002684, G2)
- *Populus fremontii - Salix gooddingii* Woodland (CEGL000944, G2)
- *Populus fremontii / Acer negundo* Forest (CEGL000662, G2Q)
- *Populus fremontii / Baccharis emoryi* Woodland (CEGL002946, GNR)
- *Populus fremontii / Baccharis salicifolia* Woodland (CEGL000941, G2)
- *Populus fremontii / Ericameria nauseosa* Woodland (CEGL002465, GNR)
- *Populus fremontii / Leymus triticoides* Woodland (CEGL002756, GNR)
- *Populus fremontii / Muhlenbergia rigens* Woodland (CEGL001455, G2)
- *Populus fremontii / Salix (ligulifolia, lutea)* Woodland (CEGL004002, GNR)
- *Prosopis glandulosa var. torreyana* Shrubland (CEGL001381, G3)
- *Salix exigua* / Barren Shrubland (CEGL001200, G5)
- *Salix gooddingii - Fraxinus velutina* Temporarily Flooded Woodland (CEGL003729, G2)
- *Salix gooddingii / Baccharis emoryi* Woodland (CEGL005981, G2?)
- *Salix gooddingii* Woodland (CEGL002743, G3)

DISTRIBUTION

Range: This systems occurs throughout canyons and desert valleys of the southwestern United States and adjacent Mexico. Major rivers and tributaries include the lower Colorado (up into the lower portions of the Grand Canyon), Gila, Salt, Rio Grande (from Elephant Butte Reservoir to the Gulf Coastal Plain), and the lower Pecos (near its confluence with Rio Hondo in southeastern New Mexico).
Divisions: 302:C
Nations: MX, US
Subnations: AZ, CA, MXBC(MX), MXCH(MX), MXSO(MX), NM, NV, TX
Map Zones: 4:?, 13:C, 14:C, 15:C, 16:C, 17:?, 23:C, 24:?, 25:C, 26:C, 27:P, 35:P
USFS Ecomap Regions: 313A:CC, 313C:CC, 315A:CC, 315B:CC, 321A:CC, 322A:CC, 322B:CC, 322C:CC, 341F:PP, M261E:CC, M313A:CP, M313B:CC
TNC Ecoregions: 17:C, 22:C, 23:C, 24:C, 29:P

SOURCES

References: Abell et al. 2000, Barbour and Major 1988, Brown 1982a, Brown and Mote 2009, Cayan et al. 2010, Chambers and Pellant 2008, Chambers and Wisdom 2009, Christensen and Lettenmaier 2007, CNHP 2010b, Comer et al. 2003, Comer et al. 2013b, Covich 2009, Das et al. 2009, Daubenmire 1952, Dettinger et al. 2009, Dick-Peddie 1993, Eyre 1980, Field et al. 1999, Griffith et al. 2004, Harper and Peckarsky 2006, Holland and Keil 1995, Hultine et al. 2007, Izbicki and Michel 2004, Jackson et al. 2009, Kittel et al. 1999b, Levick et al. 2008, Martin 2007, McCabe and Wolock 2009, Melack et al. 1997, Millar and Wolfenden 1999, Miller et al. 2010a, Mote 2006, Muldavin et al. 2000a, Reeves et al. 2005, Sawyer et al. 2009, Seavy et al. 2009, Szaro 1989, USBOR 2011, WNHP 2011
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722919#references
Description Author: K.A. Schulz, G. Kittel and M. Reid
Version: 14 Jan 2014 **Stakeholders:** Latin America, Southeast, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

NORTH AMERICAN WARM DESERT WASH (CES302.755)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: North American Warm Desert (302)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Intermittent Flooding; Lowland [Lowland]; Shrubland (Shrub-dominated); Toeslope/Valley Bottom; Tropical/Subtropical [Tropical Xeric]; Temperate [Temperate Xeric]; Riverine / Alluvial
Non-Diagnostic Classifiers: Short (50-100 yrs) Persistence; Sideslope
National Mapping Codes: ESLF 9151

CONCEPT

Summary: This ecological system is restricted to intermittently flooded washes or arroyos that dissect bajadas, mesas, plains and basin floors throughout the warm deserts of North America. Although often dry, the intermittent fluvial processes define this system, which are often associated with rapid sheet and gully flow. This system occurs as linear or braided strips within desert scrub-or desert grassland-dominated landscapes. The vegetation of desert washes is quite variable, ranging from sparse and patchy to moderately dense, and typically occurs along the banks, but may occur within the channel. The woody layer is typically intermittent to open and may be dominated by shrubs and small trees such as *Acacia greggii, Brickellia laciniata, Baccharis sarothroides, Chilopsis linearis, Fallugia paradoxa, Hymenoclea salsola, Hymenoclea monogyra, Juglans microcarpa, Olneya tesota, Parkinsonia florida, Prosopis* spp., *Psorothamnus spinosus, Prunus fasciculata, Rhus microphylla, Salazaria mexicana,* or *Sarcobatus vermiculatus*. Common upland shrubs such as *Larrea tridentata* and *Ambrosia dumosa* are often present along the edges of these washes.
Related Concepts:
- Creosotebush - Bursage (506) (Shiflet 1994) Intersecting. Washes occur as linear inclusions in the SRM type.
- Palo Verde - Cactus (507) (Shiflet 1994) Intersecting. Washes occur as linear inclusions in this SRM type.

Component Associations:
- *Acacia greggii - Parkinsonia microphylla* Shrubland (CEGL001340, G4G5)
- *Acacia greggii* Wash Shrubland (CEGL005390, GNR)
- *Baccharis salicifolia / Muhlenbergia rigens* Shrubland (CEGL004572, G3?)
- *Baccharis sarothroides - Baccharis salicifolia* Shrubland (CEGL001160, G4)
- *Baccharis sarothroides - Parkinsonia microphylla* Shrubland (CEGL001159, G4)
- *Bebbia juncea* Shrubland (CEGL005391, GNR)
- *Brickellia laciniata - Hymenoclea monogyra* Shrubland (CEGL001953, G4)
- *Brickellia longifolia* Shrubland (CEGL005392, GNR)
- *Chilopsis linearis / Brickellia laciniata* Scrub Woodland (CEGL004933, G3G4)
- *Chilopsis linearis* Shrubland (CEGL001164, G3)
- *Encelia virginensis* Shrubland (CEGL001335, G4)
- *Ericameria paniculata* Wash Shrubland (CEGL002706, G4G5)
- *Fallugia paradoxa* Colorado Plateau Desert Wash Shrubland (CEGL002357, GNR)
- *Fallugia paradoxa* Grand Canyon Desert Wash Shrubland (CEGL005298, GNR)
- *Grayia spinosa - Lycium andersonii* Shrubland (CEGL001347, G5)
- *Grayia spinosa - Lycium pallidum* Shrubland (CEGL001348, G5)
- *Hymenoclea monogyra* Thicket Shrubland (CEGL001169, G3)
- *Hymenoclea salsola - (Ambrosia eriocentra)* Shrubland (CEGL002702, G5)
- *Hymenoclea salsola - Salazaria mexicana* Shrubland (CEGL002703, G3?)
- *Isocoma acradenia* Shrubland (CEGL005395, GNR)
- *Juglans microcarpa* Scrub (CEGL001103, GNR)
- *Panicum bulbosum - Alopecurus aequalis* Herbaceous Vegetation (CEGL001653, G2)
- *Panicum bulbosum - Lycurus phleoides* Herbaceous Vegetation (CEGL001654, GNRQ)
- *Prosopis glandulosa - Atriplex* spp. Shrubland (CEGL002193, GNR)
- *Prosopis glandulosa / Atriplex canescens* Shrubland (CEGL001382, G5)
- *Prosopis glandulosa / Bouteloua curtipendula - Nassella leucotricha* Woodland (CEGL002133, G3?)
- *Prosopis glandulosa / Bouteloua eriopoda* Shrub Herbaceous Vegetation (CEGL001510, G3G4)
- *Prosopis glandulosa / Bouteloua gracilis* Shrubland (CEGL001383, G5)
- *Prosopis glandulosa* / Mixed Grasses Shrubland (CEGL001384, GNRQ)
- *Prosopis glandulosa / Muhlenbergia porteri* Shrubland (CEGL001511, G5)
- *Prosopis glandulosa / Sporobolus airoides* Shrubland (CEGL001385, G5)
- *Prosopis glandulosa* Temporarily Flooded Woodland (CEGL004934, GNR)
- *Prosopis glandulosa var. glandulosa / Bouteloua gracilis - Buchloe dactyloides* Shrubland (CEGL003877, GNR)

- *Prosopis glandulosa var. torreyana* Shrubland (CEGL001381, G3)
- *Prosopis pubescens* Shrubland (CEGL001387, G1?)
- *Prosopis velutina - Acacia greggii* Shrubland (CEGL001388, GUQ)
- *Prosopis velutina / Celtis laevigata var. reticulata* Shrubland (CEGL001390, GNR)
- *Rhus microphylla / Bouteloua curtipendula* Shrubland (CEGL001354, GNR)
- *Salix gooddingii / Baccharis emoryi* Woodland (CEGL005981, G2?)
- *Sapindus saponaria - Juglans major* Forest (CEGL000557, GNR)

DISTRIBUTION

Range: This system is restricted to intermittently flooded washes or arroyos that dissect bajadas, mesas, plains and basin floors throughout the warm deserts of North America.
Divisions: 302:C
Nations: MX, US
Subnations: AZ, CA, MXBC(MX), MXCH(MX), MXSO(MX), NM, NV, TX
Map Zones: 4:P, 12:P, 13:C, 14:C, 15:P, 16:P, 17:C, 23:?, 24:C, 25:C, 26:C, 27:C
USFS Ecomap Regions: 261B:CC, 313A:CC, 313B:CP, 313C:CC, 313D:C?, 315A:CC, 315B:CC, 315H:CC, 321A:CC, 322A:CC, 322B:CC, 322C:CC, 341E:C?, 341F:CC, M261E:PP, M313A:CC, M313B:CC
TNC Ecoregions: 17:C, 22:C, 23:C, 24:C

SOURCES

References: Barbour and Major 1988, Brown 1982a, Comer et al. 2003, Dick-Peddie 1993, MacMahon 1988, Muldavin et al. 2000b, Szaro 1989, Thomas et al. 2004
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722917#references
Description Author: NatureServe Western Ecology Team
Version: 16 Jan 2009 **Stakeholders:** Latin America, Southeast, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

NORTH PACIFIC BOG AND FEN (CES204.063)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Lowland [Foothill]; Shrubland (Shrub-dominated); Temperate [Temperate Oceanic]; Depressional; Organic Peat (>40 cm); Sphagnum spp.
National Mapping Codes: ESLF 9166

CONCEPT

Summary: This wetland system occurs in peatlands along the Pacific Coast from British Columbia south to northern California, in and west of the coastal mountain summits but including the Puget Sound lowlands. Elevations are mostly under 457 m (1500 feet), and annual precipitation ranges from 890-3050 mm (35-120 inches). These wetlands are relatively abundant in British Columbia but diminish rapidly in size and number farther south. They occur in river valleys, around lakes and marshes, or on slopes. The organic soils are characterized by an abundance of sodium cations from oceanic precipitation. Poor fens and bogs are often intermixed except in a few calcareous areas in British Columbia where rich fen vegetation may dominate. *Sphagnum* characterizes poor fens and bogs (pH <5.5), and the two are lumped here, while "brown mosses" and sedges characterize rich fens (pH >5.5). Mire profiles in British Columbia may be flat, raised (domed), or sloping, but most occurrences in Washington and Oregon are flat with only localized hummock development. Vegetation is usually a mix of conifer-dominated swamp, shrub swamp, and open sphagnum or sedge mire, often with small lakes and ponds interspersed. Vegetation includes many species common to boreal continental bogs and fens, such as *Ledum groenlandicum, Vaccinium uliginosum, Myrica gale, Andromeda polifolia, Vaccinium oxycoccos, Equisetum fluviatile, Comarum palustre*, and *Drosera rotundifolia*. However, it is also distinguished from boreal continental bogs and fens by the presence of Pacific coastal species, including *Chamaecyparis nootkatensis, Pinus contorta var. contorta, Picea sitchensis, Tsuga heterophylla, Ledum glandulosum, Thuja plicata, Gaultheria shallon, Spiraea douglasii, Carex aquatilis var. dives, Carex lyngbyei, Carex obnupta, Carex pluriflora, Darlingtonia californica, Sphagnum pacificum, Sphagnum henryense*, and *Sphagnum mendocinum*.
Classification Comments: This system is distinguished and split from Boreal Depressional Shrub Bog (CES103.871) and Western Canadian Boreal Shrub-Sedge Rich and Alkaline Fen (CES103.872). The communities comprising this system are not well-described or classified. Several bog or fen ecological systems have recently (2007-2008) been classified for southeastern Alaska, hence this system no longer is considered to occur in Alaska. Where the "muskeg" of northern British Columbia should be placed is unclear and needs review from ecologists there. Discussion is that muskeg in the hypermaritime region is extensive, covering large areas of landscape, whereas this system in Oregon and Washington tends to occur in much smaller patches. How distinct is the hypermaritime muskeg of northern British Columbia from bogs and fens from central Vancouver Island south?
Similar Ecological Systems:
- Alaskan Pacific Maritime Dwarf-Shrub-Sphagnum Peatland (CES204.165)
- Alaskan Pacific Maritime Fen and Wet Meadow (CES204.158)
- Alaskan Pacific Maritime Mountain Hemlock Peatland (CES204.156)
- Alaskan Pacific Maritime Shore Pine Peatland (CES204.164)
- Boreal Depressional Shrub Bog (CES103.871)
- Western Canadian Boreal Shrub-Sedge Rich and Alkaline Fen (CES103.872)

Related Concepts:
- Labrador tea - Bog-laurel - Peat-moss (CWHvm1/Wb50) (Banner et al. 1993) Intersecting
- Lodgepole Pine: 218 (Eyre 1980) Intersecting
- Lt - Water sedge - Fen Moss (BWBSmw1/10) (DeLong et al. 1990) Intersecting
- Narrow-leaved cotton-grass - Peat-moss (CWHvm1/Wf50) (Banner et al. 1993) Intersecting
- Narrow-leaved cotton-grass - Peat-moss (MHmm1/Wf50) (Banner et al. 1993) Intersecting
- Non-forested bog (CWHvm1/31) (Banner et al. 1993) Intersecting
- Non-forested bog (CWHvm2/31) (Banner et al. 1993) Intersecting
- Non-forested bog (CWHwm/31) (Banner et al. 1993) Intersecting
- Non-forested bog (CWHws1/31) (Banner et al. 1993) Intersecting
- Non-forested bog (CWHws2/31) (Banner et al. 1993) Intersecting
- Non-forested bog (ESSFmk/31) (Banner et al. 1993) Intersecting
- Non-forested bog (ESSFwk2/31) (DeLong et al. 1994) Intersecting
- Non-forested bog (ICHmc2/31) (Banner et al. 1993) Intersecting
- Non-forested bog (ICHwc/31) (Banner et al. 1993) Intersecting
- Non-forested bog (SBPSmc/31) (Banner et al. 1993) Intersecting
- Non-forested bog (SBPSmc/31) (Steen and Coupe 1997) Intersecting
- Non-forested bog (SBSdk/31) (Banner et al. 1993) Intersecting
- Non-forested bog (SBSdk/31) (Steen and Coupe 1997) Intersecting

- Pl - Sphagnum (CWHms1/10) (Steen and Coupe 1997) Intersecting
- Pl - Sphagnum (CWHvm1/13) (Banner et al. 1993) Intersecting
- Pl - Sphagnum (CWHvm2/10) (Banner et al. 1993) Intersecting
- Pl - Sphagnum (CWHwm/10) (Banner et al. 1993) Intersecting
- Pl - Sphagnum (CWHws1/10) (Banner et al. 1993) Intersecting
- Pl - Sphagnum (CWHws2/10) (Banner et al. 1993) Intersecting
- Sedge - Sphagnum (ICHmw3/09) (Steen and Coupe 1997) Intersecting
- Sedge - Sphagnum (SBSmm/09) (Steen and Coupe 1997) Intersecting
- Sitka sedge - Peat-moss (CWHvh2/Wf51) (Banner et al. 1993) Intersecting
- Sitka sedge - Peat-moss (CWHvm1/Wf51) (Banner et al. 1993) Intersecting
- Sitka sedge - Peat-moss (CWHvm2/Wf51) (Banner et al. 1993) Intersecting
- Sitka sedge - Peat-moss (CWHwm/Wf51) (Banner et al. 1993) Intersecting
- Sitka sedge - Peat-moss (CWHws2/Wf51) (Banner et al. 1993) Intersecting
- Sitka sedge - Peat-moss (ICHvc/Wf51) (Banner et al. 1993) Intersecting
- Sitka sedge - Peat-moss (ICHwc/Wf51) (Banner et al. 1993) Intersecting
- Sitka sedge - Peat-moss (MHmm1/Wf51) (Banner et al. 1993) Intersecting
- Sitka Spruce: 223 (Eyre 1980) Intersecting
- Sweet gale - Sitka sedge (CWHvh2/Wf52) (Banner et al. 1993) Intersecting
- Sweet gale - Sitka sedge (CWHwm/Wf52) (Banner et al. 1993) Intersecting

DESCRIPTION

Dynamics: Successional patterns of wet meadows to fens to bogs in Alaska have been documented as follows, and are likely to be similar in this ecological system. Species that dominate the early stages of succession in newly formed ponded basins include *Equisetum variegatum, Equisetum fluviatile*, and *Comarum palustre*. *Sphagnum* species invade the surface and help in forming peat. Acidic and nutrient-poor-tolerant vascular species eventually dominate the sites, such as *Myrica gale, Empetrum nigrum, Vaccinium uliginosum, Andromeda polifolia*, and *Vaccinium oxycoccos (= Oxycoccus microcarpus)*. The late-successional stage of a peatland supports various community types, depending on the pH, waterflow, and nutrient status of a site such as *Myrica gale / Empetrum nigrum* and *Picea sitchensis / Sphagnum* plant associations. Peat buildup, patterned ground, and changes in water table are recurrent aspects of peatland development rather than unidirectional successional events. It is unlikely that any of the late-seral peatland communities are stable in the sense of climax vegetation.

Component Associations:

- *Carex (livida, utriculata) / Sphagnum* spp. Herbaceous Vegetation (CEGL003423, G1G2)
- *Carex aquatilis var. dives - Comarum palustre* Herbaceous Vegetation (CEGL003433, G2)
- *Carex aquatilis var. dives* Herbaceous Vegetation (CEGL001826, G4)
- *Carex cusickii - (Menyanthes trifoliata)* Herbaceous Vegetation (CEGL003332, G2G3)
- *Carex interior - Hypericum anagalloides* Herbaceous Vegetation (CEGL001857, G2?Q)
- *Carex limosa* Herbaceous Vegetation (CEGL001811, G2)
- *Dulichium arundinaceum* Seasonally Flooded Herbaceous Vegetation (CEGL001831, G3)
- *Eriophorum chamissonis / Sphagnum* spp. Herbaceous Vegetation (CEGL003333, G4)
- *Kalmia microphylla - Ledum groenlandicum / Xerophyllum tenax* Shrubland (CEGL003359, G1)
- *Ledum glandulosum - Gaultheria shallon / Carex obnupta* Shrubland (CEGL003437, G2)
- *Ledum glandulosum / Carex obnupta / Sphagnum* spp. Shrubland (CEGL003434, G2)
- *Ledum glandulosum / Darlingtonia californica / Sphagnum* spp. Shrubland (CEGL003435, G2)
- *Ledum glandulosum / Sanguisorba officinalis / Sphagnum* spp. Shrubland (CEGL003436, G1G2)
- *Ledum groenlandicum - Kalmia microphylla / Sphagnum* spp. Shrubland (CEGL003414, G4)
- *Ledum groenlandicum - Myrica gale / Sphagnum* spp. Shrubland (CEGL003335, G2)
- *Malus fusca* Shrubland (CEGL003385, G3)
- *Myrica gale - Spiraea douglasii / Sphagnum* spp. Shrubland (CEGL003420, G2?)
- *Myrica gale / Boykinia intermedia - Carex obnupta* Shrubland (CEGL003336, G1)
- *Myrica gale / Carex (aquatilis var. dives, utriculata)* Shrubland (CEGL003376, G3)
- *Myrica gale / Sanguisorba officinalis / Sphagnum* spp. Shrubland (CEGL003419, G1?)
- *Pinus contorta - (Chamaecyparis nootkatensis) / Gaultheria shallon* Woodland (CEGL003205, G4G5)
- *Pinus contorta / Carex aquatilis var. dives* Woodland (CEGL003203, G3)
- *Pinus contorta / Empetrum nigrum* Woodland (CEGL003202, G5)
- *Pinus contorta / Trichophorum caespitosum* Woodland (CEGL003204, G4G5)
- *Pinus contorta / Vaccinium ovalifolium* Woodland (CEGL003206, G3)
- *Pinus contorta var. contorta / Ledum groenlandicum / Sphagnum* spp. Woodland (CEGL003337, G3)
- *Pinus monticola / Ledum groenlandicum / Sphagnum* spp. Woodland (CEGL003360, G1)
- *Ranunculus flammula - Juncus nevadensis - Carex lenticularis* Herbaceous Vegetation (CEGL003426, G1)
- *Rhynchospora alba - (Vaccinium oxycoccos) / Sphagnum tenellum* Herbaceous Vegetation (CEGL003338, G3)
- *Spiraea douglasii / Carex aquatilis var. dives* Shrubland (CEGL003415, G4)
- *Spiraea douglasii / Sphagnum* spp. Shrubland (CEGL003416, G3)

- *Spiraea douglasii* Shrubland (CEGL001129, G5)
- *Tsuga heterophylla - (Thuja plicata) / Ledum groenlandicum / Sphagnum* spp. Forest (CEGL003339, G3)
- *Tsuga heterophylla - (Thuja plicata) / Sphagnum* spp. Forest (CEGL003417, G1)
- *Tsuga heterophylla / Ledum glandulosum / Carex obnupta - Lysichiton americanus* Forest (CEGL000477, G1)

DISTRIBUTION

Range: This system occurs along the Pacific Coast from British Columbia south to northern California, west of the coastal mountain summits but including the Puget Sound lowlands. Occurrences diminish rapidly in size and number south of British Columbia.
Divisions: 204:C; 206:P
Nations: CA, US
Subnations: BC, OR, WA
Map Zones: 1:C, 2:C, 7:C
USFS Ecomap Regions: 242A:CC, 242B:CP, 342C:P?, 342H:PP, M242A:CC, M242B:CC, M242C:CC, M242D:CC, M332G:CC
TNC Ecoregions: 1:C, 2:C, 3:C, 69:P, 81:C

SOURCES

References: Banner et al. 1993, Comer et al. 2003, DeLong et al. 1990, DeLong et al. 1994, Eyre 1980, Steen and Coupe 1997
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722029#references
Description Author: M.S. Reid, K. Boggs, J. Christy, mod. C. Chappell
Version: 08 Dec 2008 **Stakeholders:** Canada, West
Concept Author: J.C. Christy **ClassifResp:** West

NORTH PACIFIC HARDWOOD-CONIFER SWAMP (CES204.090)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Eutrophic Water; Lowland [Lowland]; Forest and Woodland (Treed); Temperate [Temperate Oceanic]; Depressional [Lakeshore]; Needle-Leaved Tree; Broad-Leaved Deciduous Tree; Pinus contorta; Sphagnum spp.
National Mapping Codes: ESLF 9190

CONCEPT

Summary: This wetland ecological system occurs from southern coastal British Columbia south into coastal Washington and Oregon, west of the coastal mountain summits (not interior). Treed swamps are common in southeastern Alaska (but are placed into different systems than this one), less so farther south. Forested swamps are mostly small-patch size, occurring sporadically in glacial depressions, in river valleys, around the edges of lakes and marshes, or on slopes with seeps that form subirrigated soils. These are primarily on flat to gently sloping lowlands up to 457 m (1500 feet) elevation but also occur up to near the lower limits of continuous forest (below the subalpine parkland). It can occur on steeper slopes where soils are shallow over unfractured bedrock. This system is indicative of poorly drained, mucky areas, and areas are often a mosaic of moving water and stagnant water. Soils can be woody peat, muck, or mineral. It can be dominated by any one or a number of conifer and hardwood species (*Tsuga heterophylla, Picea sitchensis, Tsuga mertensiana, Chamaecyparis nootkatensis, Pinus contorta var. contorta, Alnus rubra, Fraxinus latifolia, Betula papyrifera*) that are capable of growing on saturated or seasonally flooded soils. Overstory is often less than 50% cover, but shrub understory can have high cover. In the southern end of the range of this type, e.g., the Willamette Valley, tends to have more hardwood-dominated stands (especially *Fraxinus latifolia*) and very little in the way of conifer-dominated stands. While the typical landscape context for the type is extensive upland forests, for the *Fraxinus latifolia* stands, landscapes were very often formerly dominated by prairies and now by agriculture. Many conifer-dominated stands have been converted to dominance by *Alnus rubra* due to timber harvest.
Classification Comments: Shrub swamps are usually not intermixed with the forested swamps and tend to be more wet. Deciduous and conifer forested swamps are often intermixed and more similar to each other in hydrology, and so are combined here in this system.
Similar Ecological Systems:
- Alaskan Pacific Maritime Poorly Drained Conifer Woodland (CES204.315)

Related Concepts:
- Lodgepole Pine: 218 (Eyre 1980) Intersecting

Component Associations:
- *Abies amabilis / Lysichiton americanus* Forest (CEGL000223, G3)
- *Alnus rubra / Athyrium filix-femina - Lysichiton americanus* Forest (CEGL003388, G3G4)
- *Alnus rubra / Rubus spectabilis / Carex obnupta - Lysichiton americanus* Forest (CEGL003389, G3G4)
- *Fraxinus latifolia - (Populus balsamifera ssp. trichocarpa) / Cornus sericea* Forest (CEGL003390, G4)
- *Fraxinus latifolia / Carex deweyana - Urtica dioica* Forest (CEGL003365, G1)
- *Fraxinus latifolia / Carex obnupta* Forest (CEGL000640, G4)
- *Fraxinus latifolia / Juncus patens* Forest (CEGL003391, G2)
- *Fraxinus latifolia / Spiraea douglasii* Forest (CEGL003392, G3)
- *Fraxinus latifolia / Symphoricarpos albus* Forest (CEGL003393, G4)
- *Picea sitchensis / Carex obnupta - Lysichiton americanus* Forest (CEGL000400, G2G3)
- *Picea sitchensis / Cornus sericea / Lysichiton americanus* Forest (CEGL000055, G2)
- *Picea sitchensis / Oplopanax horridus / Lysichiton americanus* Forest (CEGL003257, G4)
- *Picea sitchensis / Vaccinium ovalifolium / Lysichiton americanus* Forest (CEGL003265, G5)
- *Pinus contorta (var. latifolia, var. murrayana) / Vaccinium uliginosum* Forest (CEGL000171, G3)
- *Pinus contorta - (Populus tremuloides) / Vaccinium uliginosum* Forest (CEGL000158, G3Q)
- *Pinus contorta / Carex (aquatilis, angustata)* Woodland (CEGL000140, G4Q)
- *Pinus contorta / Deschampsia caespitosa* Forest (CEGL000147, G3)
- *Pinus contorta / Empetrum nigrum* Woodland (CEGL003202, G5)
- *Pinus contorta var. contorta / Gaultheria shallon - Rhododendron macrophyllum - Vaccinium ovatum* Forest (CEGL000152, G1)
- *Pinus contorta var. murrayana - Populus tremuloides / Spiraea douglasii* Forest (CEGL000157, G3G4)
- *Populus balsamifera ssp. trichocarpa - Alnus rubra / Carex obnupta* Woodland (CEGL003361, G1)
- *Populus tremuloides / Carex obnupta* Forest (CEGL003371, G2)
- *Thuja plicata - Tsuga heterophylla / Lysichiton americanus* Forest (CEGL002670, G3?)
- *Tsuga heterophylla - Chamaecyparis nootkatensis / Vaccinium ovalifolium / Lysichiton americanus* Forest (CEGL003240, G3)
- *Tsuga heterophylla - Thuja plicata / Vaccinium ovalifolium / Lysichiton americanus* Forest (CEGL003223, G5)

- *Tsuga heterophylla / Ledum glandulosum / Carex obnupta - Lysichiton americanus* Forest (CEGL000477, G1)
- *Tsuga heterophylla / Oplopanax horridus / Lysichiton americanus* Forest (CEGL003235, G4G5)
- *Tsuga mertensiana - Chamaecyparis nootkatensis / Elliottia pyroliflorus / Nephrophyllidium crista-galli* Woodland (CEGL003215, G4)
- *Tsuga mertensiana - Chamaecyparis nootkatensis / Gaultheria shallon / Lysichiton americanus* Woodland (CEGL003213, G3)
- *Tsuga mertensiana - Chamaecyparis nootkatensis / Lysichiton americanus - Athyrium filix-femina* Forest (CEGL003216, G3)
- *Tsuga mertensiana - Chamaecyparis nootkatensis / Vaccinium ovalifolium / Lysichiton americanus* Forest (CEGL003209, G5)

DISTRIBUTION

Range: This system occurs from southern British Columbia south to northwestern Oregon, including the Willamette Valley, west of the Cascade Crest.
Divisions: 204:C
Nations: CA, US
Subnations: BC, OR, WA
Map Zones: 1:C, 2:C, 7:C
USFS Ecomap Regions: 242A:CC, 242B:CC, M242A:CC, M242B:CC, M242C:CC, M242D:CC
TNC Ecoregions: 1:C, 2:C, 3:C, 69:C, 81:C

SOURCES

References: Chappell 1999, Chappell and Christy 2004, Chappell et al. 2001, Green and Klinka 1994, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.768136#references
Description Author: C. Chappell, mod. M.S. Reid
Version: 08 Dec 2008 **Stakeholders:** Canada, West
Concept Author: K. Boggs, G. Kittel, C. Chappell **ClassifResp:** West

NORTH PACIFIC INTERIOR LODGEPOLE PINE BOG (CES207.390)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Warm Continental (207)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Depression
National Mapping Codes: ESLF 9501

CONCEPT

Summary: Most of the site series included in this ecosystem concept are identified as very wet, dominated by *Pinus contorta*, with *Aulacomnium palustre* or other wetland indicator mosses. These bogs are variable, differing in the depth of organic material and the richness of the water moving through the site. Most of the bogs are in shallow depressions over lacustrine material. Tree cover is very low, around 10%, with *Picea mariana* and *Pinus contorta* intermixed. Shrub cover is around 30-50% with *Ledum groenlandicum* and *Betula glandulosa*. Herb cover is abundant (30-50%) cover. The moss layer is significant with 75-95% cover, generally dominated by *Sphagnum* spp. and *Pleurozium schreberi*.
Classification Comments: This ecological system was developed for the purpose of capturing the coarse filter of terrestrial biodiversity in the interior of British Columbia Ecoregional Assessment, conducted by The Nature Conservancy of Canada, with NatureServe's assistance. This system was designed to be equivalent to those developed for neighboring ecoregions: Canadian Rocky Mountains (7), Okanagan (68), Alaska Coastal Forest and Mountains (69), and the North Cascades (3).
Related Concepts:

- Lt - Buckbean (BWBSmw2/10) (DeLong et al. 1990) Intersecting
- Pl - Water sedge - Peat-moss (ICHmk3/08) (Steen and Coupe 1997) Intersecting
- Pl - Water sedge - Peat-moss (ICHwc/10) (Banner et al. 1993) Intersecting
- Pl - Water sedge - Peat-moss (ICHwk2/09) (Steen and Coupe 1997) Intersecting
- Pl - Water sedge - Peat-moss (MSxk/10) (Steen and Coupe 1997) Intersecting
- Pl - Bog rosemary - Peat-moss (ICHmc1/07) (Meidinger et al. 1988) Intersecting
- Pl - Bog rosemary - Peat-moss (ICHmc1/07) (Banner et al. 1993) Intersecting
- Pl - Bog rosemary - Peat-moss (ICHvk2/08) (DeLong 2003) Intersecting
- Pl - Bog rosemary - Peat-moss (ICHwk3/10) (Meidinger et al. 1988) Intersecting
- Pl - Bog rosemary - Peat-moss (SBSwk1/14) (DeLong 2003) Intersecting
- Pl - Bog rosemary - Peat-moss (SBSwk1/14) (Steen and Coupe 1997) Intersecting
- Pl - Dwarf blueberry - Sphagnum (ESSFwc2/09) (Lloyd et al. 1990) Intersecting
- Pl - Few-flowered sedge - Peat-moss (ESSFmc/11) (Banner et al. 1993) Intersecting
- Pl - Few-flowered sedge - Peat-moss (ESSFwc3/04) (Steen and Coupe 1997) Intersecting
- Pl - Few-flowered sedge - Peat-moss (ESSFwc3/04) (DeLong et al. 1994) Intersecting
- Pl - Few-flowered sedge - Peat-moss (ICHwk2/10) (Steen and Coupe 1997) Intersecting
- Pl - Few-flowered sedge - Peat-moss (SBSmc2/15) (Banner et al. 1993) Intersecting
- Pl - Few-flowered sedge - Peat-moss (SBSmc2/15) (DeLong et al. 1993) Intersecting
- Pl - Sphagnum (CWHds1/11) (Steen and Coupe 1997) Intersecting
- Sb - Lingonberry - Coltsfoot (BWBSmw2/04) (DeLong et al. 1990) Intersecting

DISTRIBUTION

Range: This ecological system occurs entirely within central interior British Columbia.
Divisions: 207:C
Nations: CA
Subnations: BC
TNC Ecoregions: 144:C

SOURCES

References: Banner et al. 1993, DeLong 2003, DeLong et al. 1990, DeLong et al. 1993, DeLong et al. 1994, Lloyd et al. 1990, Meidinger et al. 1988, Steen and Coupe 1997, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.820981#references
Description Author: G. Kittel
Version: 26 Jan 2009
Concept Author: G. Kittel
Stakeholders: Canada, West
ClassifResp: West

NORTH PACIFIC INTERIOR SHRUB SWAMP (CES207.397)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Warm Continental (207)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Swamp
National Mapping Codes: ESLF 9506

CONCEPT

Summary: This ecological system encompasses medium-tall to short shrublands of slow-moving interior streams and rivers, around beaver ponds in the peripheral zones of wetlands and lakeshores, where there is early season flooding, continuous seepage near the surface and poor drainage. Stands are dominated by *Alnus incana, Salix maccalliana, Betula glandulosa, Arctostaphylos uva-ursi*, or *Salix glauca*. Soils are often fine-textured, poorly to imperfectly drained with some accumulation of organics.
Classification Comments: This ecological system was developed for the purpose of capturing the coarse filter of terrestrial biodiversity in the interior of British Columbia Ecoregional Assessment, conducted by The Nature Conservancy of Canada, with NatureServe's assistance. This system was designed to be equivalent to those developed for neighboring ecoregions: Canadian Rocky Mountains (7), Okanagan (68), Alaska Coastal Forest and Mountains (69), and the North Cascades (3).
Similar Ecological Systems:
- Boreal Willow-Alder Swamp Thicket (CES103.524)

Related Concepts:
- Barclay's willow - Arrow-leaved groundsel (ESSFxc/Sc03) (Steen and Coupe 1997) Intersecting
- Dogwood - Sedge (IDFmw2/05) (Steen and Coupe 1997) Intersecting
- Grey-leaved willow - Glow moss (ESSFxv2/Sc02) (Steen and Coupe 1997) Intersecting
- Grey-leaved willow - Glow moss (SBPSxc/Sc02) (Steen and Coupe 1997) Intersecting
- Maccalla's willow - Beaked sedge (SBPSmk/Ws05) (Steen and Coupe 1997) Intersecting
- Maccalla's willow - Beaked sedge (SBPSxc/Ws05) (Steen and Coupe 1997) Intersecting
- Maccalla's willow - Beaked sedge (SBSdh1/Ws05) (MacKenzie and Moran 2004) Intersecting
- Maccalla's willow - Beaked sedge (SBSdk/Ws05) (DeLong et al. 1993) Intersecting
- Maccalla's willow - Beaked sedge (SBSdk/Ws05) (Steen and Coupe 1997) Intersecting
- Maccalla's willow - Beaked sedge (SBSdk/Ws05) (Banner et al. 1993) Intersecting
- Mountain alder - Skunk cabbage - Lady fern (SBSvk/Ws01) (DeLong 2003) Intersecting
- Mountain alder - Skunk cabbage - Lady fern (SBSwk1/Ws01) (DeLong 2003) Intersecting
- Mountain alder - Skunk cabbage - Lady fern (SBSwk1/Ws01) (Steen and Coupe 1997) Intersecting
- Scrub birch - Kinnikinnick (IDFdk3/Sc01) (Steen and Coupe 1997) Intersecting
- Scrub birch - Kinnikinnick (IDFdk4/Sc01) (Steen and Coupe 1997) Intersecting
- Scrub birch - Kinnikinnick (MSxv/Sc01) (Steen and Coupe 1997) Intersecting
- Scrub birch - Kinnikinnick (SBPSxc/Sc01) (Steen and Coupe 1997) Intersecting
- Scrub birch - Sedge - Sphagnum (ESSFwk1/08) (DeLong 2003) Intersecting
- Scrub birch - Sedge - Sphagnum (ESSFwk1/31) (DeLong 2003) Intersecting
- Scrub birch - Water sedge (MSdc2/Wf02) (Steen and Coupe 1997) Intersecting
- Scrub birch - Water sedge (MSxk/Wf02) (Steen and Coupe 1997) Intersecting
- Scrub birch - Water sedge (MSxv/Wf02) (Steen and Coupe 1997) Intersecting
- Willow - Sedge (IDFdk1/07) (Steen and Coupe 1997) Intersecting

DISTRIBUTION

Range: This ecological system occurs entirely within central interior British Columbia.
Divisions: 207:C
Nations: CA
Subnations: BC
TNC Ecoregions: 144:C

SOURCES

References: Banner et al. 1993, DeLong 2003, DeLong et al. 1993, MacKenzie and Moran 2004, Steen and Coupe 1997, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.821002#references
Description Author: G. Kittel
Version: 26 Jan 2009
Concept Author: G. Kittel
Stakeholders: Canada, West
ClassifResp: West

NORTH PACIFIC INTERIOR WET TOESLOPE/RIPARIAN HYBRID WHITE SPRUCE-WESTERN RED-CEDAR FOREST (CES207.392)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Warm Continental (207)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Fluvial; Toeslope
National Mapping Codes: ESLF 9503

CONCEPT

Summary: This ecological system encompasses toeslopes of colluvial and steep lacustrine sites and subirrigated sites dominated by *Thuja plicata, Tsuga heterophylla, Picea glauca X engelamannii* (hybrid white spruce), and *Abies lasiocarpa*. Shrubs include *Acer glabrum, Ribes lacustre, Amelanchier alnifolia,* and *Spiraea betulifolia*. The herb layer is variable with *Chimaphila umbellata, Gymnocarpium dryopteris, Maianthemum racemosum (= Smilacina racemosa),* and others. Moss cover is about 50% with *Pleurozium schreberi, Hylocomium splendens,* and others.
Classification Comments: This ecological system was developed for the purpose of capturing the coarse filter of terrestrial biodiversity in the interior of British Columbia Ecoregional Assessment, conducted by The Nature Conservancy of Canada, with NatureServe's assistance. This system was designed to be equivalent to those developed for neighboring ecoregions: Canadian Rocky Mountains (7), Okanagan (68), Alaska Coastal Forest and Mountains (69), and the North Cascades (3).
Related Concepts:

- CwSxw - Prince's pine - Cat's-tail moss (ICHwk3/03) (Meidinger et al. 1988) Intersecting
- CwSxw - Skunk cabbage (ICHwk1/08) (Lloyd et al. 1990) Intersecting
- CwSxw - Skunk cabbage (ICHwk2/08) (Steen and Coupe 1997) Intersecting
- CwSxw - Skunk cabbage (ICHwk3/09) (Meidinger et al. 1988) Intersecting
- CwSxw - Skunk cabbage - Sphagnum (ICHmm/08) (DeLong 1996) Intersecting

DISTRIBUTION

Range: This ecological system occurs entirely within central interior British Columbia.
Divisions: 207:C
Nations: CA
Subnations: BC
TNC Ecoregions: 144:C

SOURCES

References: DeLong 1996, Lloyd et al. 1990, Meidinger et al. 1988, Steen and Coupe 1997, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.820987#references
Description Author: G. Kittel
Version: 26 Jan 2009
Concept Author: G. Kittel
Stakeholders: Canada, West
ClassifResp: West

NORTH PACIFIC INTERIOR WET TOESLOPE/RIPARIAN MIXED CONIFER FOREST (CES207.393)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Warm Continental (207)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Fluvial; Toeslope
National Mapping Codes: ESLF 9504

CONCEPT

Summary: This is the toeslope, wet version of North Pacific Interior Dry-Mesic Mixed Conifer Forest [Provisional] (CES207.152).
Classification Comments: This ecological system was developed for the purpose of capturing the coarse filter of terrestrial biodiversity in the interior of British Columbia Ecoregional Assessment, conducted by The Nature Conservancy of Canada, with NatureServe's assistance. This system was designed to be equivalent to those developed for neighboring ecoregions: Canadian Rocky Mountains (7), Okanagan (68), Alaska Coastal Forest and Mountains (69), and the North Cascades (3).
Related Concepts:

- $Ac - Cow parsnip (BWBSmw1/07) (DeLong et al. 1990) Intersecting
- $At - Hardhack (ICHmc2/07) (Banner et al. 1993) Intersecting
- $At - Lady fern (ICHmc2/07) (Banner et al. 1993) Intersecting
- Cw - Devil's club - Ostrich fern (ICHvk2/05) (DeLong 2003) Intersecting
- CwHw - Devil's club - Lady fern (ICHmk3/06) (Steen and Coupe 1997) Intersecting
- CwHw - Devil's club - Lady fern (ICHmw3/07) (Steen and Coupe 1997) Intersecting
- CwHw - Devil's club - Lady fern (ICHvk2/01) (DeLong 2003) Intersecting
- CwHw - Devil's club - Lady fern (ICHwk1/05) (Lloyd et al. 1990) Intersecting
- CwHw - Devil's club - Lady fern (ICHwk2/07) (Steen and Coupe 1997) Intersecting
- CwHw - Devil's club - Lady fern (ICHwk3/05) (Meidinger et al. 1988) Intersecting
- CwHw - Devil's club - Lady fern (ICHwk4/07) (Steen and Coupe 1997) Intersecting
- CwSx - Horsetail - Skunk cabbage (ICHmc2/07) (Banner et al. 1993) Intersecting
- CwSxw - Devil's club - Horsetail (ICHmk3/07) (Steen and Coupe 1997) Intersecting
- CwSxw - Devil's club - Horsetail (ICHmm/06) (DeLong 1996) Intersecting
- CwSxw - Devil's club - Horsetail (ICHwk1/06) (Lloyd et al. 1990) Intersecting
- CwSxw - Devil's club - Horsetail (ICHwk3/06) (Meidinger et al. 1988) Intersecting
- CwSxw - Falsebox - Knight's plume (ICHmk3/01) (Steen and Coupe 1997) Intersecting
- CwSxw - Oak fern - Cat's-tail moss (ICHmk3/04) (Steen and Coupe 1997) Intersecting
- CwSxw - Skunk cabbage (ICHmw3/08) (Steen and Coupe 1997) Intersecting
- CwSxw - Skunk cabbage (ICHvk2/06) (DeLong 2003) Intersecting
- CwSxw - Skunk cabbage (ICHwk2/08) (Steen and Coupe 1997) Intersecting
- Hw - Azalea - Skunk cabbage (ICHmc1/06) (Banner et al. 1993) Intersecting
- Hw - Azalea - Skunk cabbage (ICHmc1/06) (Meidinger et al. 1988) Intersecting
- Hw - Cloudberry - Peat-moss (ICHmc2/09) (Banner et al. 1993) Intersecting
- Hw - Cloudberry - Peat-moss (ICHvc/07) (Banner et al. 1993) Intersecting
- Hw - Cloudberry - Peat-moss (ICHwc/09) (Banner et al. 1993) Intersecting
- Hw - Step moss (ICHmc1/01) (Meidinger et al. 1988) Intersecting
- Hw - Step moss (ICHmc1/01) (Banner et al. 1993) Intersecting
- Hw - Step moss (ICHwc/03) (Banner et al. 1993) Intersecting
- Hw - Step moss, Mesic (ICHmc1/01) (Meidinger et al. 1988) Intersecting
- Hw - Step moss, Mesic (ICHmc1/01) (Banner et al. 1993) Intersecting
- Hw - Step moss, Submesic (ICHmc1/01) (Banner et al. 1993) Intersecting
- Hw - Step moss, Submesic (ICHmc1/01) (Meidinger et al. 1988) Intersecting
- HwBa - Devil's club - Lady fern (ICHmc1a/03) (Banner et al. 1993) Intersecting
- HwBl - Devil's club (ICHmc1/04) (Meidinger et al. 1988) Intersecting
- HwBl - Devil's club (ICHmc1/04) (Banner et al. 1993) Intersecting
- HwBl - Devil's club (ICHvc/01) (Banner et al. 1993) Intersecting
- HwBl - Devil's club (ICHwc/04) (Banner et al. 1993) Intersecting
- HwBl - Devil's club, Bl Variation (ICHvc/01) (Banner et al. 1993) Intersecting
- HwBl - Devil's club, Hw Variation (ICHvc/01) (Banner et al. 1993) Intersecting
- HwCw - Spruce - Step moss (ICHmm/01) (DeLong 1996) Intersecting
- HwSx - Blueberry - Sphagnum (ICHwc/07) (Banner et al. 1993) Intersecting
- no data (ICHmk2/) (BCMF 2006) Intersecting

- SbSx - Scrub birch - Sedge (ICHmc2/08) (Banner et al. 1993) Intersecting
- Sxw - Devil's club - Lady fern (ICHdk/08) (Steen and Coupe 1997) Intersecting
- Sxw - Horsetail (ICHdk/09) (Steen and Coupe 1997) Intersecting
- Sxw - Twinberry - Oak fern (ICHdk/07) (Steen and Coupe 1997) Intersecting
- Sxw - Twinberry - Oak fern (ICHwk2/06) (Steen and Coupe 1997) Intersecting
- Sxw - Twinberry - Oak fern (ICHwk4/06) (Steen and Coupe 1997) Intersecting
- SxwCw - Oak fern (ICHmk3/05) (Steen and Coupe 1997) Intersecting
- SxwCw - Oak fern (ICHwk2/05) (Steen and Coupe 1997) Intersecting

DISTRIBUTION

Range: This ecological system occurs entirely within central interior British Columbia.
Divisions: 207:C
Nations: CA
Subnations: BC
TNC Ecoregions: 144:C

SOURCES

References: Banner et al. 1993, BCMF 2006, DeLong 1996, DeLong 2003, DeLong et al. 1990, Lloyd et al. 1990, Meidinger et al. 1988, Steen and Coupe 1997, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.820990#references
Description Author: G. Kittel
Version: 26 Jan 2009 **Stakeholders:** Canada, West
Concept Author: G. Kittel **ClassifResp:** West

NORTH PACIFIC LOWLAND RIPARIAN FOREST AND SHRUBLAND (CES204.869)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Lowland [Lowland]; Forest and Woodland (Treed); Riverine / Alluvial
Non-Diagnostic Classifiers: Temperate [Temperate Oceanic]
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Mixed evergreen-deciduous open tree canopy
National Mapping Codes: EVT 2156; ESLF 9106; ESP 1156

CONCEPT

Summary: Lowland riparian systems occur throughout the Pacific Northwest. They are the low-elevation, alluvial floodplains that are confined by valleys and inlets and are more abundant in the central and southern portions of the Pacific Northwest Coast. These forests and tall shrublands are linear in character, occurring on floodplains or lower terraces of rivers and streams. Major broadleaf dominant species are *Acer macrophyllum*, *Alnus rubra*, *Populus balsamifera ssp. trichocarpa*, *Salix sitchensis*, *Salix lucida ssp. lasiandra*, *Cornus sericea*, and *Fraxinus latifolia*. Conifers tend to increase with succession in the absence of major disturbance. Conifer-dominated types are relatively uncommon and not well-described; *Abies grandis*, *Picea sitchensis*, and *Thuja plicata* are important. Riverine flooding and the succession that occurs after major flooding events are the major natural processes that drive this system. Very early-successional stages can be sparsely vegetated or dominated by herbaceous vegetation.
Classification Comments: This system is driven by snowmelt and rainfall hydrology. It differs from Alaskan Pacific Maritime Floodplain Forest and Shrubland (CES204.154) by the presence of mature black cottonwood gallery forests, and generally narrow linear deciduous riparian forests and shrublands. The Alaskan type includes glacier melt-driven hydrology, which results in very wide riverine habitats with fewer mature deciduous forests, as well as non-glacial rivers common on the island archipelago, but also on the mainland, which are narrower and are mostly dominated by Sitka spruce with and without the codominance of black cottonwood.
Similar Ecological Systems:
- Alaskan Pacific Maritime Floodplain Forest and Shrubland (CES204.154)

Related Concepts:
- Black Cottonwood - Willow: 222 (Eyre 1980) Intersecting
- Red Alder: 221 (Eyre 1980) Intersecting

DESCRIPTION

Environment: Stands occur on low-elevation, alluvial floodplains on alluvial soils in valleys and inlets, on riverbanks, outer floodplains or low terraces of rivers and streams.
Dynamics: Beaver activity is an important driver of hydrological change and subsequent development of a diversity of habitat patches. The contribution of large woody debris (LWD) from riparian or adjacent upland trees is important to maintaining the hydrological and sediment regimes. LWD has a significant impact on the evolution of channel morphology and also contributes to the spatial distribution and diversity of habitat patches within this system (Naiman and Bilby 1998). Major flood events and consequent flood scour, overbank deposition of water and sediments, and stream meandering are the key fluvial processes that provide new substrates, remove old banks and stimulate renewed growth of cottonwood and willow species (Sawyer et al. 2009). Natural fire-return interval was long or moderate with low-intensity surface fires.

Component Associations:
- *Abies grandis - Acer macrophyllum / Symphoricarpos albus* Forest (CEGL000519, G3Q)
- *Acer circinatum / Athyrium filix-femina - Tolmiea menziesii* Shrubland (CEGL003291, G5)
- *Acer macrophyllum - Pseudotsuga menziesii / Acer circinatum / Polystichum munitum* Forest (CEGL003394, G4)
- *Acer macrophyllum - Pseudotsuga menziesii / Corylus cornuta / Hydrophyllum tenuipes* Forest (CEGL000517, G3)
- *Acer macrophyllum / Acer circinatum* Forest (CEGL000560, G4G5)
- *Acer macrophyllum / Carex deweyana* Forest (CEGL003297, G3)
- *Acer macrophyllum / Rubus spectabilis* Forest (CEGL000561, G4)
- *Acer macrophyllum / Rubus ursinus* Forest (CEGL003395, G3)
- *Acer macrophyllum / Symphoricarpos albus / Urtica dioica ssp. gracilis* Forest (CEGL003396, G3)
- *Acer macrophyllum / Urtica dioica ssp. gracilis* Forest (CEGL003397, G3)
- *Alnus (incana, viridis ssp. sinuata) / Lysichiton americanus - Oenanthe sarmentosa* Shrubland (CEGL003293, G1)
- *Alnus rubra / Acer circinatum / Claytonia sibirica* Forest (CEGL003298, G4G5)
- *Alnus rubra / Elymus glaucus* Forest (CEGL003398, G4)
- *Alnus rubra / Oplopanax horridus - Rubus spectabilis* Forest (CEGL003399, G4G5)
- *Alnus rubra / Oxalis (oregana, trilliifolia)* Forest (CEGL003400, G4)
- *Alnus rubra / Petasites frigidus* Forest (CEGL003401, G4)
- *Alnus rubra / Rubus parviflorus* Forest (CEGL003402, G4)

- *Alnus rubra / Rubus spectabilis / Carex obnupta - Lysichiton americanus* Forest (CEGL003389, G3G4)
- *Alnus rubra / Rubus spectabilis* Forest (CEGL000639, G4G5)
- *Alnus rubra / Stachys chamissonis var. cooleyae - Tolmiea menziesii* Forest (CEGL003403, G4)
- *Cornus sericea - Salix (hookeriana, sitchensis)* Shrubland (CEGL003292, G3)
- *Cornus sericea* Pacific Shrubland (CEGL005301, GNR)
- *Corydalis scouleri* Herbaceous Vegetation (CEGL001939, G3?Q)
- *Deschampsia caespitosa - Artemisia lindleyana* Herbaceous Vegetation (CEGL003425, G1)
- *Equisetum arvense* Herbaceous Vegetation (CEGL003314, G5)
- *Fraxinus latifolia - (Populus balsamifera ssp. trichocarpa) / Cornus sericea* Forest (CEGL003390, G4)
- *Fraxinus latifolia - Populus balsamifera ssp. trichocarpa / Acer circinatum* Forest (CEGL003404, G3)
- *Fraxinus latifolia - Populus balsamifera ssp. trichocarpa / Corylus cornuta - Physocarpus capitatus* Forest (CEGL003364, G3)
- *Fraxinus latifolia - Populus balsamifera ssp. trichocarpa / Rubus spectabilis* Forest (CEGL003405, G2)
- *Fraxinus latifolia - Populus balsamifera ssp. trichocarpa / Symphoricarpos albus* Forest (CEGL000641, G4)
- *Fraxinus latifolia / Carex deweyana - Urtica dioica* Forest (CEGL003365, G1)
- *Fraxinus latifolia / Carex obnupta* Forest (CEGL000640, G4)
- *Fraxinus latifolia / Symphoricarpos albus* Forest (CEGL003393, G4)
- *Picea sitchensis / Alnus viridis ssp. sinuata* Woodland (CEGL003254, G5)
- *Picea sitchensis / Carex obnupta - Lysichiton americanus* Forest (CEGL000400, G2G3)
- *Picea sitchensis / Oplopanax horridus - Rubus spectabilis* Forest (CEGL003256, G4)
- *Populus balsamifera (ssp. trichocarpa, ssp. balsamifera) / Symphoricarpos (albus, oreophilus, occidentalis)* Forest (CEGL000677, G2)
- *Populus balsamifera ssp. trichocarpa - Acer macrophyllum / Equisetum hyemale* Forest (CEGL003406, G3)
- *Populus balsamifera ssp. trichocarpa - Acer macrophyllum / Symphoricarpos albus* Forest (CEGL003363, G3)
- *Populus balsamifera ssp. trichocarpa - Alnus rhombifolia* Forest (CEGL000668, G1)
- *Populus balsamifera ssp. trichocarpa - Alnus rubra / Rubus spectabilis* Forest (CEGL003407, G2G3)
- *Populus balsamifera ssp. trichocarpa - Alnus rubra / Symphoricarpos albus* Forest (CEGL003362, G3)
- *Populus balsamifera ssp. trichocarpa - Fraxinus latifolia* Forest (CEGL000674, G2Q)
- *Populus balsamifera ssp. trichocarpa - Picea sitchensis - (Acer macrophyllum) / Oxalis oregana* Forest (CEGL003418, G2G3)
- *Populus balsamifera ssp. trichocarpa / Alnus incana* Forest (CEGL000667, G3)
- *Populus balsamifera ssp. trichocarpa / Cornus sericea / Impatiens capensis* Forest (CEGL003408, G1)
- *Populus balsamifera ssp. trichocarpa / Cornus sericea* Forest (CEGL000672, G3G4)
- *Populus balsamifera ssp. trichocarpa / Oplopanax horridus* Woodland (CEGL003284, G3)
- *Populus balsamifera ssp. trichocarpa / Rubus spectabilis* Woodland (CEGL003283, G3)
- *Populus tremuloides / Carex pellita* Forest (CEGL000577, G2)
- *Quercus garryana - (Fraxinus latifolia) / Symphoricarpos albus* Forest (CEGL003299, G2)
- *Salix geyeriana - Salix eriocephala* Shrubland (CEGL001213, GU)
- *Salix geyeriana - Salix lemmonii / Carex aquatilis var. dives* Shrubland (CEGL001212, G3)
- *Salix lucida ssp. lasiandra / Salix fluviatilis* Woodland (CEGL000949, G3Q)
- *Salix lucida ssp. lasiandra / Urtica dioica ssp. gracilis* Woodland (CEGL003409, G2)
- *Salix sitchensis / Equisetum arvense - Petasites frigidus* Shrubland (CEGL003296, G4?)
- *Tsuga heterophylla - (Thuja plicata) / Oplopanax horridus / Polystichum munitum* Forest (CEGL000497, G4)

DISTRIBUTION

Range: This system occurs throughout the Pacific Northwest below the Silver Fir Zone in elevation.
Divisions: 204:C
Nations: CA, US
Subnations: AK, BC, OR, WA
Map Zones: 1:C, 2:C, 7:C
USFS Ecomap Regions: 242A:CC, 242B:CC, 342I:CC, M242A:CC, M242B:CC, M242C:CC, M242D:CC, M261A:CC, M261D:CP
TNC Ecoregions: 1:C, 81:C

SOURCES

References: Boes and Strauss 1994, Chappell and Christy 2004, Comer et al. 2003, Eyre 1980, Franklin and Dyrness 1973, Littell et al. 2009, Merritt and Wohl 2002, Naiman and Bilby 1998, Sawyer et al. 2009, WNHP 2011
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722806#references
Description Author: G. Kittel and C. Chappell
Version: 14 Jan 2014 **Stakeholders:** Canada, West
Concept Author: G. Kittel and C. Chappell **ClassifResp:** West

NORTH PACIFIC MONTANE RIPARIAN WOODLAND AND SHRUBLAND (CES204.866)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Forest and Woodland (Treed); Temperate [Temperate Oceanic]; Riverine / Alluvial
Non-Diagnostic Classifiers: Short (50-100 yrs) Persistence; Montane [Montane]
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Mixed evergreen-deciduous open tree canopy
National Mapping Codes: EVT 2158; ESLF 9108; ESP 1158

CONCEPT

Summary: This ecological system occurs throughout mountainous areas of the Pacific Northwest coast, both on the mainland and on larger islands. It occurs on steep streams and narrow floodplains above foothills but below the alpine environments, e.g., above 1500 m (4550 feet) elevation in the Klamath Mountains and western Cascades of Oregon, up as high as 3300 m (10,000 feet) in the southern Cascades, and above 610 m (2000 feet) in northern Washington. Surrounding habitats include subalpine parklands and montane forests. In Washington, they are defined as occurring primarily above the *Tsuga heterophylla* zone, i.e., beginning at or near the lower boundary of the *Abies amabilis* zone. Dominant species include *Pinus contorta var. murrayana, Populus balsamifera ssp. trichocarpa, Abies concolor, Abies magnifica, Populus tremuloides, Alnus incana ssp. tenuifolia (= Alnus tenuifolia), Alnus viridis ssp. crispa (= Alnus crispa), Alnus viridis ssp. sinuata (= Alnus sinuata), Alnus rubra, Rubus spectabilis, Ribes bracteosum, Oplopanax horridus, Acer circinatum,* and several *Salix* species. In western Washington, major species are *Alnus viridis ssp. sinuata, Acer circinatum, Salix, Oplopanax horridus, Alnus rubra, Petasites frigidus, Rubus spectabilis,* and *Ribes bracteosum.* This is a disturbance-driven system that requires flooding, scour and deposition for germination and maintenance. It occurs on streambanks where the vegetation is significantly different than surrounding forests, usually because of its shrubby or deciduous character.
Classification Comments: Riparian and floodplain woodlands and shrublands in Alaska have been placed into a different system. Still need to determine where the Alaskan type grades into this one, and whether British Columbian riparian systems should be placed here or in the new Alaskan system.
Similar Ecological Systems:
- Alaskan Pacific Maritime Floodplain Forest and Shrubland (CES204.154)

Related Concepts:
- $Mountain alder - Lady fern (ICHvc/52) (Banner et al. 1993) Intersecting
- $Mountain alder - Lady fern (ICHwc/52) (Banner et al. 1993) Intersecting
- Act - Dogwood - Twinberry (ICHwk1/07) (Lloyd et al. 1990) Intersecting
- Act - Red-osier dogwood (CWHds1/09) (Steen and Coupe 1997) Intersecting
- Act - Red-osier dogwood (CWHms1/08) (Steen and Coupe 1997) Intersecting
- Act - Red-osier dogwood (CWHvm1/10) (Banner et al. 1993) Intersecting
- Act - Red-osier dogwood (CWHwm/06) (Banner et al. 1993) Intersecting
- Act - Red-osier dogwood (CWHws1/08) (Banner et al. 1993) Intersecting
- Act - Red-osier dogwood (CWHws2/08) (Banner et al. 1993) Intersecting
- Act - Willow (CWHds1/10) (Steen and Coupe 1997) Intersecting
- Act - Willow (CWHms1/09) (Steen and Coupe 1997) Intersecting
- Act - Willow (CWHvm1/11) (Banner et al. 1993) Intersecting
- Act - Willow (CWHwm/07) (Banner et al. 1993) Intersecting
- Act - Willow (CWHws1/09) (Banner et al. 1993) Intersecting
- Act - Willow (CWHws2/09) (Banner et al. 1993) Intersecting
- ActSx - Dogwood (ICHmc1/05) (Banner et al. 1993) Intersecting
- ActSx - Dogwood (ICHmc1/05) (Meidinger et al. 1988) Intersecting
- ActSx - Dogwood (ICHmc2/06) (Banner et al. 1993) Intersecting
- ActSx - Dogwood (ICHvc/05) (Banner et al. 1993) Intersecting
- ActSx - Dogwood (ICHwc/06) (Banner et al. 1993) Intersecting
- ActSx - Dogwood, High-bench (ICHmc2/06) (Banner et al. 1993) Intersecting
- ActSx - Dogwood, Medium-bench (ICHmc2/06) (Banner et al. 1993) Intersecting
- ActSxw - Red-osier dogwood (ICHwk4/10) (Steen and Coupe 1997) Intersecting
- Alder - Lady fern (ESSFwk1/09) (DeLong 2003) Intersecting
- Alder - Lady fern (ESSFwk1/51) (DeLong 2003) Intersecting
- Bl - Alder - Horsetail (ESSFmv2/06) (DeLong et al. 1994) Intersecting
- Bl - Alder - Horsetail (ESSFmv4/05) (DeLong et al. 1994) Intersecting
- Black Cottonwood - Willow: 222 (Eyre 1980) Broader
- Dr - Lily-of-the-valley (CWHvh2/10) (Banner et al. 1993) Intersecting

- Hardhack - Sitka sedge (ICHmc1/Ws50) (Banner et al. 1993) Intersecting
- Hardhack - Sitka sedge (ICHmc1/Ws50) (Meidinger et al. 1988) Intersecting
- Hardhack - Sitka sedge (SBSmk1/Ws50) (DeLong et al. 1993) Intersecting
- Hardhack - Sitka sedge (SBSwk1/Ws50) (Steen and Coupe 1997) Intersecting
- Hardhack - Sitka sedge (SBSwk1/Ws50) (DeLong 2003) Intersecting
- Maccalla's willow - Beaked sedge (ESSFxc/Ws05) (Steen and Coupe 1997) Intersecting
- Maccalla's willow - Beaked sedge (IDFdk3/Ws05) (Steen and Coupe 1997) Intersecting
- Maccalla's willow - Beaked sedge (IDFdk4/Ws05) (Steen and Coupe 1997) Intersecting
- Mountain alder - Mitrewort (ICHmc2/55) (Banner et al. 1993) Intersecting
- Mountain alder - Pink spirea - Sitka sedge (CWHwm/Ws02) (Banner et al. 1993) Intersecting
- Mountain alder - Pink spirea - Sitka sedge (ESSFwv/Ws02) (Banner et al. 1993) Intersecting
- Mountain alder - Pink spirea - Sitka sedge (ICHmc2/Ws02) (Banner et al. 1993) Intersecting
- Mountain alder - Pink spirea - Sitka sedge (ICHvc/Ws02) (Banner et al. 1993) Intersecting
- Mountain alder - Pink spirea - Sitka sedge (ICHwk1/Ws02) (Lloyd et al. 1990) Intersecting
- Mountain alder - Pink spirea - Sitka sedge (SBSmc2/Ws02) (Banner et al. 1993) Intersecting
- Mountain alder - Pink spirea - Sitka sedge (SBSmc2/Ws02) (DeLong et al. 1993) Intersecting
- Mountain alder - Pink spirea - Sitka sedge (SBSwk1/Ws02) (Steen and Coupe 1997) Intersecting
- Mountain alder - Pink spirea - Sitka sedge (SBSwk1/Ws02) (DeLong 2003) Intersecting
- Mountain alder - Red-osier dogwood - Horsetail (ICHmc2/Fl02) (Banner et al. 1993) Intersecting
- Mountain alder - Red-osier dogwood - Horsetail (ICHwk1/Fl02) (Lloyd et al. 1990) Intersecting
- Mountain alder - Red-osier dogwood - Horsetail (ICHwk4/Fl02) (Steen and Coupe 1997) Intersecting
- Mountain alder - Skunk cabbage - Lady fern (ICHmc2/Ws01) (Banner et al. 1993) Intersecting
- Mountain alder - Skunk cabbage - Lady fern (ICHvk2/Ws01) (DeLong 2003) Intersecting
- Red Alder: 221 (Eyre 1980) Intersecting
- Sitka willow - Red-osier dogwood - Horsetail (SBSmk2/Fl04) (MacKinnon et al. 1990) Intersecting
- Sitka willow - Red-osier dogwood - Horsetail (SBSvk/Fl04) (DeLong 2003) Intersecting
- Sitka willow - Sitka sedge (CWHvm1/Ws06) (Banner et al. 1993) Intersecting
- Sitka willow - Sitka sedge (CWHvm2/Ws06) (Banner et al. 1993) Intersecting
- Sitka willow - Sitka sedge (SBSvk/Ws06) (DeLong 2003) Intersecting
- Sitka willow - Sitka sedge (SBSwk1/Ws06) (DeLong 2003) Intersecting
- Sitka willow - Sitka sedge (SBSwk1/Ws06) (Steen and Coupe 1997) Intersecting

Component Associations:
- *Alnus incana / Athyrium filix-femina* Shrubland (CEGL002628, G3)
- *Alnus incana / Cornus sericea* Shrubland (CEGL001145, G3G4)
- *Alnus incana / Equisetum arvense* Shrubland (CEGL001146, G3)
- *Alnus incana* / Mesic Forbs Shrubland (CEGL001147, G3)
- *Alnus incana / Spiraea douglasii* Shrubland (CEGL001152, G3)
- *Alnus incana / Symphoricarpos albus* Shrubland (CEGL001153, G3G4)
- *Alnus incana* Shrubland (CEGL001141, GNRQ)
- *Alnus viridis ssp. sinuata / Athyrium filix-femina - Cinna latifolia* Shrubland (CEGL001156, G4)
- *Alnus viridis ssp. sinuata / Oplopanax horridus* Shrubland (CEGL001157, G4G5)
- *Betula glandulosa / Carex utriculata* Shrubland (CEGL001079, G4?)
- *Salix (boothii, geyeriana) / Carex aquatilis* Shrubland (CEGL001176, G3)
- *Salix boothii - Salix eastwoodiae / Carex nigricans* Shrubland (CEGL002607, G3)
- *Salix boothii - Salix geyeriana / Carex angustata* Shrubland (CEGL001185, G2)
- *Salix boothii - Salix lemmonii* Shrubland (CEGL001186, G3)
- *Salix boothii / Carex utriculata* Shrubland (CEGL001178, G4)
- *Salix commutata / Carex scopulorum* Shrubland (CEGL001189, G3)
- *Salix drummondiana / Carex utriculata* Shrubland (CEGL002631, G4)
- *Salix sitchensis / Equisetum arvense - Petasites frigidus* Shrubland (CEGL003296, G4?)

DISTRIBUTION

Range: This system occurs throughout mountainous areas of the Pacific Northwest Coast, both on the mainland and on larger islands, above 1500 m (4550 feet) elevation in the Klamath Mountains and western Cascades, up as high as 3300 m (10,000 feet) in the southern Cascades, and above 610 m (2000 feet) in northern Washington.
Divisions: 204:C
Nations: CA, US
Subnations: AK, BC, OR, WA
Map Zones: 1:C, 2:C, 3:?, 7:C
USFS Ecomap Regions: 242A:CC, 242B:C?, M242A:CC, M242B:CC, M242C:CC, M242D:CC, M261A:CC, M261D:CP, M261G:CC
TNC Ecoregions: 1:C, 3:C, 4:C, 69:?, 81:C

SOURCES

References: Comer et al. 2003, Franklin and Dyrness 1973, Holland and Keil 1995

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722809#references

Description Author: G. Kittel, mod. C. Chappell

Version: 08 Dec 2008

Concept Author: G. Kittel

Stakeholders: Canada, West

ClassifResp: West

NORTH PACIFIC SHRUB SWAMP (CES204.865)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Eutrophic Water; Forest and Woodland (Treed); Depressional [Lakeshore]; Broad-Leaved Deciduous Tree; Broad-Leaved Deciduous Shrub
Non-Diagnostic Classifiers: Lowland [Lowland]; Depressional [Pond]; Depressional [Sinkhole]
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Deciduous shrubland
National Mapping Codes: EVT 2663; ESLF 9173; ESP 1663

CONCEPT

Summary: Swamps vegetated by shrublands occur throughout the Pacific Northwest Coast, from Cook Inlet and Prince William Sound, Alaska, to the southern coast of Oregon. These are deciduous broadleaf tall shrublands that are located in depressions, around lakes or ponds, or river terraces where water tables fluctuate seasonally (mostly seasonally flooded regime), in areas that receive nutrient-rich waters. These depressions are poorly drained with fine-textured organic, muck or mineral soils and standing water common throughout the growing season. *Alnus viridis ssp. sinuata* often dominates the shrub layer, but many *Salix* species may also occur. The shrub layer can have many dead stems. However, various species of *Salix, Spiraea douglasii, Malus fusca, Cornus sericea, Alnus incana ssp. tenuifolia (= Alnus tenuifolia), Alnus viridis ssp. crispa (= Alnus crispa),* and/or *Alnus viridis ssp. sinuata (= Alnus sinuata)* can be the major dominants. They may occur in mosaics with marshes or forested swamps, being on average more wet than forested swamps and more dry than marshes. However, it is also frequent for them to dominate entire wetland systems. Hardwood-dominated stands (especially *Fraxinus latifolia*) may be considered a shrub swamp when they are not surrounded by conifer forests but do not occur in Alaska. Typical landscape for the *Fraxinus latifolia* stands were very often formerly dominated by prairies and now by agriculture. Wetland species, including *Carex aquatilis var. dives (= Carex sitchensis), Carex utriculata, Equisetum fluviatile*, and *Lysichiton americanus*, dominate the understory. On some sites, *Sphagnum* spp. are common in the understory (Stikine, Yakutat Forelands, Copper River Delta).
Classification Comments: Shrub swamps are usually not intermixed with the forested swamps and tend to be more wet. Deciduous and conifer forested swamps are often intermixed and more similar to each other in hydrology, and so are combined into North Pacific Hardwood-Conifer Swamp (CES204.090). This system includes what is known by the Alaska Natural Heritage Program as Maritime Tall-Shrub Swamp. Associations found in this system in Alaska need to be identified and added to the list. Deciduous shrub swamps in the Cook Inlet Basin are better placed in Western North American Boreal Deciduous Shrub Swamp (CES105.122).
Similar Ecological Systems:
- Western North American Boreal Riparian Stringer Forest and Shrubland (CES105.144)

Related Concepts:
- II.B.1.f - Shrub swamp (closed) (Viereck et al. 1992) Intersecting
- II.B.2.f - Shrub swamp (open) (Viereck et al. 1992) Intersecting

Component Associations:
- *Alnus (incana, viridis ssp. sinuata) / Lysichiton americanus - Oenanthe sarmentosa* Shrubland (CEGL003293, G1)
- *Cornus sericea - Salix (hookeriana, sitchensis)* Shrubland (CEGL003292, G3)
- *Cornus sericea* Pacific Shrubland (CEGL005301, GNR)
- *Fraxinus latifolia / Carex deweyana - Urtica dioica* Forest (CEGL003365, G1)
- *Fraxinus latifolia / Carex obnupta* Forest (CEGL000640, G4)
- *Fraxinus latifolia / Juncus patens* Forest (CEGL003391, G2)
- *Fraxinus latifolia / Spiraea douglasii* Forest (CEGL003392, G3)
- *Fraxinus latifolia / Symphoricarpos albus* Forest (CEGL003393, G4)
- *Ledum glandulosum - Gaultheria shallon / Carex obnupta* Shrubland (CEGL003437, G2)
- *Malus fusca* Shrubland (CEGL003385, G3)
- *Myrica gale / Boykinia intermedia - Carex obnupta* Shrubland (CEGL003336, G1)
- *Salix (hookeriana, sitchensis) - Spiraea douglasii* Shrubland (CEGL003386, G3G4)
- *Salix geyeriana - Salix hookeriana* Shrubland (CEGL003295, G1)
- *Salix hookeriana - (Malus fusca) / Carex obnupta - Lysichiton americanus* Shrubland (CEGL003432, G3)
- *Salix hookeriana - (Salix sitchensis)* Shrubland (CEGL003387, G2)
- *Salix sitchensis* Shrubland (CEGL002896, G4)
- *Spiraea douglasii* Shrubland (CEGL001129, G5)
- *Vaccinium caespitosum / Sanguisorba officinalis* Dwarf-shrubland (CEGL003438, G1)
- *Vaccinium uliginosum / Deschampsia caespitosa* Dwarf-shrubland (CEGL001250, G2)

DISTRIBUTION

Range: This system occurs throughout the Pacific Northwest Coast, from Cook Inlet Basin and Prince William Sound, Alaska, to the southern coast of Oregon.
Divisions: 204:C
Nations: CA, US
Subnations: AK, BC, OR, WA
Map Zones: 1:C, 2:C, 3:P, 7:C, 9:?, 77:C, 78:C
USFS Ecomap Regions: 242A:CC, 242B:CC, 342I:??, M242A:CC, M242B:CC, M242C:CC, M242D:CC, M261A:CC
TNC Ecoregions: 1:C, 2:C, 3:C, 4:C, 69:C, 70:C, 81:C

SOURCES

References: Boggs 2002, Chappell and Christy 2004, Comer et al. 2003, Franklin and Dyrness 1973, Viereck et al. 1992
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722810#references
Description Author: G. Kittel, P. Comer, K. Boggs, C. Chappell
Version: 10 Dec 2008 **Stakeholders:** Canada, West
Concept Author: G. Kittel, P. Comer, K. Boggs, C. Chappell **ClassifResp:** West

NORTH PACIFIC SUB-BOREAL RIPARIAN WOODLAND AND SHRUBLAND (CES207.394)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Warm Continental (207)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Fluvial
National Mapping Codes: ESLF 9505

CONCEPT

Summary: This ecological system encompasses tall willow woodlands lining streams, rivers, oxbow lakes on levees or bars of active floodplains of sluggish, low-gradient streams. Stands are dominated by *Salix lucida* or *Salix sitchensis* with *Salix drummondiana* and *Cornus sericea (= Cornus stolonifera)*. The herb layer is sparse but *Equisetum* spp. can be abundant. Soils are sandy and well-drained but remain saturated at depth for much of the growing season.
Classification Comments: This ecological system was developed for the purpose of capturing the coarse filter of terrestrial biodiversity in the interior of British Columbia Ecoregional Assessment, conducted by The Nature Conservancy of Canada, with NatureServe's assistance. This system was designed to be equivalent to those developed for neighboring ecoregions: Canadian Rocky Mountains (7), Okanagan (68), Alaska Coastal Forest and Mountains (69), and the North Cascades (3).
Related Concepts:

- $Ac - Horsetail (BWBSmw2/05) (DeLong et al. 1990) Intersecting
- ActSw - Red-osier dogwood (BWBSdk1/12) (Banner et al. 1993) Intersecting
- ActSw - Red-osier dogwood (BWBSdk1/12) (MacKinnon et al. 1990) Intersecting
- ActSw - Red-osier dogwood (BWBSmw1/09) (DeLong et al. 1990) Intersecting
- Pacific willow - Red-osier dogwood - Lady fern (BWBSdk1/Fl03) (MacKinnon et al. 1990) Intersecting
- Pacific willow - Red-osier dogwood - Lady fern (BWBSdk1/Fl03) (Banner et al. 1993) Intersecting
- Sandbar willow (BWBSmw2/Fl06) (DeLong et al. 1990) Intersecting
- Sw - Currant - Horsetail (BWBSmw2/05) (DeLong et al. 1990) Intersecting

DISTRIBUTION

Range: This ecological system occurs entirely within central interior British Columbia.
Divisions: 207:C
Nations: CA
Subnations: BC
TNC Ecoregions: 144:C

SOURCES

References: Banner et al. 1993, DeLong et al. 1990, MacKinnon et al. 1990, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.820993#references
Description Author: G. Kittel
Version: 26 Jan 2009
Concept Author: G. Kittel
Stakeholders: Canada, West
ClassifResp: West

NORTH PACIFIC SUB-BOREAL WET TOESLOPE/RIPARIAN HYBRID WHITE SPRUCE FOREST (CES207.391)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Warm Continental (207)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Fluvial; Toeslope
National Mapping Codes: ESLF 9502

CONCEPT

Summary: These are wet and well-aerated sites, with highly variable soils, slopes and aspects. What they have in common is that they occur on the toeslopes of hillsides, or on the edges of forested, more poorly drained wetlands. They are usually on or near fluvial-derived parent materials. Coarse fragments have 0-87% cover. Tree cover is generally closed to moderately closed and dominated by *Picea glauca X engelmannii* (hybrid white spruce), mixed with *Abies lasiocarpa, Pinus contorta*, or others. The shrub layer is generally abundant with *Oplopanax horridus, Ribes lacustre, Rubus parviflorus, Vaccinium membranaceum, Lonicera involucrata*, and *Vaccinium ovalifolium*. The herb layer is often varied and abundant with *Dryopteris expansa, Gymnocarpium dryopteris, Rubus pedatus, Streptopus lanceolatus var. roseus (= Streptopus roseus), Cornus canadensis, Athyrium filix-femina, Galium triflorum, Tiarella trifoliata, Veratrum viride*, and *Streptopus amplexifolius*. The moss layer is moderate, with 30-45% cover, and includes *Pleurozium schreberi, Ptilium crista-castrensis*, and *Rhytidiadelphus triquetrus*.
Classification Comments: This ecological system was developed for the purpose of capturing the coarse filter of terrestrial biodiversity in the interior of British Columbia Ecoregional Assessment, conducted by The Nature Conservancy of Canada, with NatureServe's assistance. This system was designed to be equivalent to those developed for neighboring ecoregions: Canadian Rocky Mountains (7), Okanagan (68), Alaska Coastal Forest and Mountains (69), and the North Cascades (3).
Related Concepts:
- $At - Canada violet (SBSdk/06) (DeLong et al. 1993) Intersecting
- $At - Canada violet (SBSdk/06) (Steen and Coupe 1997) Intersecting
- $At - Canada violet (SBSdk/06) (Banner et al. 1993) Intersecting
- $At - Canada violet (SBSdk/07) (DeLong et al. 1993) Intersecting
- $At - Canada violet (SBSdk/07) (Banner et al. 1993) Intersecting
- $At - Canada violet (SBSdk/07) (Steen and Coupe 1997) Intersecting
- $At - Hardhack (SBSdk/07) (DeLong et al. 1993) Intersecting
- $At - Hardhack (SBSdk/07) (Banner et al. 1993) Intersecting
- $At - Hardhack (SBSdk/07) (Steen and Coupe 1997) Intersecting
- $At - Lady fern (SBSdk/07) (Steen and Coupe 1997) Intersecting
- $At - Lady fern (SBSdk/07) (DeLong et al. 1993) Intersecting
- $At - Lady fern (SBSdk/07) (Banner et al. 1993) Intersecting
- Bl - Devil's club - Lady fern (ESSFmk/05) (Banner et al. 1993) Intersecting
- Bl - Devil's club - Lady fern (ESSFmm1/06) (DeLong 1996) Intersecting
- Bl - Devil's club - Lady fern (ESSFwc2/07) (Lloyd et al. 1990) Intersecting
- Bl - Devil's club - Lady fern (ESSFwk1/05) (DeLong 2003) Intersecting
- Bl - Devil's club - Lady fern (ESSFwk1/05) (Steen and Coupe 1997) Intersecting
- Bl - Devil's club - Lady fern (ESSFwv/06) (Banner et al. 1993) Intersecting
- Bl - Devil's club - Rhododendron (ESSFmv2/05) (DeLong et al. 1994) Intersecting
- Bl - Devil's club - Rhododendron (ESSFmv3/05) (Banner et al. 1993) Intersecting
- Bl - Devil's club - Rhododendron (ESSFwk2/04) (DeLong et al. 1994) Intersecting
- Bl - Globeflower - Horsetail (ESSFwc3/03) (Steen and Coupe 1997) Intersecting
- Bl - Gooseberry - Foamflower (ESSFxc/07) (Steen and Coupe 1997) Intersecting
- Bl - Horsetail - Feathermoss (ESSFmv3/07) (Banner et al. 1993) Intersecting
- Bl - Horsetail - Glow moss (ESSFmc/09) (Banner et al. 1993) Intersecting
- Bl - Horsetail - Glow moss (ESSFmv1/05) (Banner et al. 1993) Intersecting
- Bl - Horsetail - Glow moss (ESSFmv1/05) (Steen and Coupe 1997) Intersecting
- Bl - Horsetail - Glow moss (ESSFmv1/05) (DeLong et al. 1993) Intersecting
- Bl - Horsetail - Glow moss (ESSFwv/08) (Banner et al. 1993) Intersecting
- Bl - Horsetail - Glow moss (ESSFxc/08) (Steen and Coupe 1997) Intersecting
- Bl - Horsetail - Glow moss (ESSFxv1/08) (Steen and Coupe 1997) Intersecting
- Bl - Horsetail - Glow moss (ESSFxv2/08) (Steen and Coupe 1997) Intersecting
- Bl - Horsetail - Leafy moss (ESSFmc/10) (Banner et al. 1993) Intersecting
- Bl - Horsetail - Leafy moss (ESSFmk/06) (Banner et al. 1993) Intersecting
- Bl - Horsetail - Sphagnum (ESSFwc2/08) (Lloyd et al. 1990) Intersecting

- Bl - Horsetail - Sphagnum (ESSFwk1/06) (DeLong 2003) Intersecting
- Bl - Horsetail - Sphagnum (ESSFwk1/06) (Steen and Coupe 1997) Intersecting
- Bl - Horsetail - Sphagnum (ESSFwk2/06) (DeLong et al. 1994) Intersecting
- Bl - Labrador tea - Horsetail (ESSFmm1/07) (DeLong 1996) Intersecting
- Bl - Lady fern - Horsetail (ESSFmk/07) (Banner et al. 1993) Intersecting
- Bl - Lady fern - Horsetail (ESSFwk1/07) (Steen and Coupe 1997) Intersecting
- Bl - Lady fern - Horsetail (ESSFwv/09) (Banner et al. 1993) Intersecting
- Bl - Twinberry - Hellebore (ESSFxv1/09) (Steen and Coupe 1997) Intersecting
- Bl - Twinberry - Lady fern (ESSFwk1/04) (Steen and Coupe 1997) Intersecting
- SbSxw - Scrub birch - Sedge (SBSmw/10) (DeLong 2003) Intersecting
- Sxw - Common horsetail - Leafy moss (ESSFxc/11) (Steen and Coupe 1997) Intersecting
- Sxw - Crowberry - Glow moss (MSxv/07) (Steen and Coupe 1997) Intersecting
- Sxw - Crowberry - Knight's plume (MSxv/06) (Steen and Coupe 1997) Intersecting
- Sxw - Devil's club (SBSmc2/09) (DeLong et al. 1993) Intersecting
- Sxw - Devil's club (SBSmc2/09) (Banner et al. 1993) Intersecting
- Sxw - Devil's club (SBSmk1/08) (DeLong et al. 1993) Intersecting
- Sxw - Devil's club (SBSmw/08) (DeLong 2003) Intersecting
- Sxw - Devil's club (SBSmw/08) (Steen and Coupe 1997) Intersecting
- Sxw - Devil's club (SBSvk/01) (DeLong 2003) Intersecting
- Sxw - Devil's club (SBSwk1/08) (DeLong 2003) Intersecting
- Sxw - Devil's club (SBSwk1/08) (Steen and Coupe 1997) Intersecting
- Sxw - Devil's club (SBSwk2/05) (MacKinnon et al. 1990) Intersecting
- Sxw - Devil's club (SBSwk3/07) (Banner et al. 1993) Intersecting
- Sxw - Devil's club (SBSwk3/07) (MacKinnon et al. 1990) Intersecting
- Sxw - Devil's club (SBSwk3a/07) (DeLong 2004) Intersecting
- Sxw - Devil's club - Knight's plume (SBSdw2/09) (DeLong et al. 1993) Intersecting
- Sxw - Devil's club - Knight's plume (SBSdw2/09) (Steen and Coupe 1997) Intersecting
- Sxw - Devil's club - Lady fern (SBSwk1/10) (DeLong 2003) Intersecting
- Sxw - Devil's club - Ostrich fern (SBSvk/07) (DeLong 2003) Intersecting
- Sxw - Devil's club - Spiny wood fern (SBSvk/05) (DeLong 2003) Intersecting
- Sxw - Devil's club - Step moss (SBSmc1/07) (Steen and Coupe 1997) Intersecting
- Sxw - Devil's club, Fluvial (SBSmc2/09) (Banner et al. 1993) Intersecting
- Sxw - Devil's club, Morainal (SBSmc2/09) (Banner et al. 1993) Intersecting
- Sxw - Dogwood - Fairybells (SBSwk3a/01) (DeLong 2004) Intersecting
- Sxw - Falsebox - Knight's plume (SBSmm/01) (Steen and Coupe 1997) Intersecting
- Sxw - Gooseberry (MSdc2/07) (Steen and Coupe 1997) Intersecting
- Sxw - Gooseberry - Grouseberry (MSxk/08) (Steen and Coupe 1997) Intersecting
- Sxw - Horsetail (IDFxm/09) (Steen and Coupe 1997) Intersecting
- Sxw - Horsetail (SBPSmc/05) (Banner et al. 1993) Intersecting
- Sxw - Horsetail (SBPSmc/05) (Steen and Coupe 1997) Intersecting
- Sxw - Horsetail (SBPSmc/05) (DeLong et al. 1993) Intersecting
- Sxw - Horsetail (SBSdh1/07) (DeLong 1996) Intersecting
- Sxw - Horsetail (SBSdk/07) (Banner et al. 1993) Intersecting
- Sxw - Horsetail (SBSdk/07) (Steen and Coupe 1997) Intersecting
- Sxw - Horsetail (SBSdk/07) (DeLong et al. 1993) Intersecting
- Sxw - Horsetail (SBSdw2/10) (DeLong et al. 1993) Intersecting
- Sxw - Horsetail (SBSdw2/10) (Steen and Coupe 1997) Intersecting
- Sxw - Horsetail (SBSmc2/10) (DeLong et al. 1993) Intersecting
- Sxw - Horsetail (SBSmc2/10) (Banner et al. 1993) Intersecting
- Sxw - Horsetail (SBSmc3/08) (DeLong et al. 1993) Intersecting
- Sxw - Horsetail (SBSmc3/08) (Steen and Coupe 1997) Intersecting
- Sxw - Horsetail (SBSmk1/09) (DeLong et al. 1993) Intersecting
- Sxw - Horsetail (SBSmk2/06) (MacKinnon et al. 1990) Intersecting
- Sxw - Horsetail (SBSmm/08) (Steen and Coupe 1997) Intersecting
- Sxw - Horsetail (SBSmw/09) (DeLong 2003) Intersecting
- Sxw - Horsetail (SBSmw/09) (Steen and Coupe 1997) Intersecting
- Sxw - Horsetail (SBSvk/06) (DeLong 2003) Intersecting
- Sxw - Horsetail (SBSwk1/09) (Steen and Coupe 1997) Intersecting
- Sxw - Horsetail (SBSwk1/09) (DeLong 2003) Intersecting
- Sxw - Horsetail (SBSwk2/06) (MacKinnon et al. 1990) Intersecting
- Sxw - Horsetail (SBSwk3/08) (Banner et al. 1993) Intersecting
- Sxw - Horsetail (SBSwk3/08) (MacKinnon et al. 1990) Intersecting

- Sxw - Horsetail (SBSwk3a/08) (DeLong 2004) Intersecting
- Sxw - Horsetail - Glow moss (SBSmc2/11) (Steen and Coupe 1997) Intersecting
- Sxw - Horsetail - Leafy moss (MSdc2/08) (Steen and Coupe 1997) Intersecting
- Sxw - Horsetail - Leafy moss (MSxk/09) (Steen and Coupe 1997) Intersecting
- Sxw - Horsetail - Meadowrue (SBPSdc/06) (Steen and Coupe 1997) Intersecting
- Sxw - Horsetail - Meadowrue (SBPSxc/06) (Steen and Coupe 1997) Intersecting
- Sxw - Horsetail, Fluvial (SBSmc2/10) (Banner et al. 1993) Intersecting
- Sxw - Horsetail, Fluvial (SBSmk1/09) (DeLong et al. 1993) Intersecting
- Sxw - Horsetail, Freely drained (SBSdk/07) (Banner et al. 1993) Intersecting
- Sxw - Horsetail, Freely drained (SBSdk/07) (Steen and Coupe 1997) Intersecting
- Sxw - Horsetail, Lacustrine/morainal (SBSmc2/10) (Banner et al. 1993) Intersecting
- Sxw - Horsetail, Organic (SBSmk1/09) (DeLong et al. 1993) Intersecting
- Sxw - Horsetail, Poorly drained (SBSdk/07) (Steen and Coupe 1997) Intersecting
- Sxw - Horsetail, Poorly drained (SBSdk/07) (Banner et al. 1993) Intersecting
- Sxw - Mountain alder - Lady fern (SBSmw/13) (Steen and Coupe 1997) Intersecting
- Sxw - Oak fern (SBSmk1/07) (DeLong et al. 1993) Intersecting
- Sxw - Ostrich fern (SBSmh/08) (Steen and Coupe 1997) Intersecting
- Sxw - Ostrich fern (SBSmh/08) (DeLong 2003) Intersecting
- Sxw - Pink spirea - Sphagnum (SBSmw/12) (Steen and Coupe 1997) Intersecting
- Sxw - Rhododendron - Crowberry (MSdc2/05) (Steen and Coupe 1997) Intersecting
- Sxw - Scrub birch - Feathermoss (SBPSdc/05) (Steen and Coupe 1997) Intersecting
- Sxw - Scrub birch - Feathermoss (SBPSmc/04) (DeLong et al. 1993) Intersecting
- Sxw - Scrub birch - Feathermoss (SBPSmc/04) (Banner et al. 1993) Intersecting
- Sxw - Scrub birch - Feathermoss (SBPSmc/04) (Steen and Coupe 1997) Intersecting
- Sxw - Scrub birch - Feathermoss (SBPSxc/04) (Steen and Coupe 1997) Intersecting
- Sxw - Scrub birch - Feathermoss (SBSmc2/07) (DeLong et al. 1993) Intersecting
- Sxw - Scrub birch - Feathermoss (SBSmc2/07) (Banner et al. 1993) Intersecting
- Sxw - Scrub birch - Fen moss (SBPSxc/03) (Steen and Coupe 1997) Intersecting
- Sxw - Skunk cabbage (SBSvk/10) (DeLong 2003) Intersecting
- Sxw - Snowberry - Prickly rose (IDFxm/08) (Steen and Coupe 1997) Intersecting
- Sxw - Soopolallie - Scouring-rush (MSdv/08) (Steen and Coupe 1997) Intersecting
- Sxw - Trapper's tea - Grouseberry (MSxk/07) (Steen and Coupe 1997) Intersecting
- Sxw - Twinberry (SBSdw2/08) (DeLong et al. 1993) Intersecting
- Sxw - Twinberry (SBSdw2/08) (Steen and Coupe 1997) Intersecting
- Sxw - Twinberry (SBSdw3/07) (DeLong et al. 1993) Intersecting
- Sxw - Twinberry (SBSdw3/07) (Banner et al. 1993) Intersecting
- Sxw - Twinberry (SBSmc3/07) (DeLong et al. 1993) Intersecting
- Sxw - Twinberry (SBSmc3/07) (Steen and Coupe 1997) Intersecting
- Sxw - Twinberry - Coltsfoot (SBSdw1/07) (DeLong 2003) Intersecting
- Sxw - Twinberry - Coltsfoot (SBSdw1/07) (Steen and Coupe 1997) Intersecting
- Sxw - Twinberry - Coltsfoot (SBSmc2/05) (Banner et al. 1993) Intersecting
- Sxw - Twinberry - Coltsfoot (SBSmc2/05) (DeLong et al. 1993) Intersecting
- Sxw - Twinberry - Oak fern (SBSdw1/08) (Steen and Coupe 1997) Intersecting
- Sxw - Twinberry - Oak fern (SBSdw1/08) (DeLong 2003) Intersecting
- Sxw - Twinberry - Oak fern (SBSmc2/08) (DeLong et al. 1993) Intersecting
- Sxw - Twinberry - Oak fern (SBSmc2/08) (Steen and Coupe 1997) Intersecting
- Sxw - Twinberry - Oak fern (SBSmw/07) (Steen and Coupe 1997) Intersecting
- Sxw - Twinberry - Oak fern (SBSmw/07) (DeLong 2003) Intersecting
- Sxw - Twinberry - Oak fern (SBSwk1/07) (Steen and Coupe 1997) Intersecting
- Sxw - Twinberry - Oak fern (SBSwk1/07) (DeLong 2003) Intersecting
- Sxw - Twinberry - Reedgrass (MSdc2/06) (Steen and Coupe 1997) Intersecting
- Sxw - Twinberry - Reedgrass (MSdv/06) (Steen and Coupe 1997) Intersecting
- SxwEp - Devil's club (SBSmh/07) (Steen and Coupe 1997) Intersecting
- SxwEp - Devil's club (SBSmh/07) (DeLong 2003) Intersecting
- SxwFd - Thimbleberry (SBSvk/03) (DeLong 2003) Intersecting

DISTRIBUTION

Range: This ecological system occurs entirely within central interior British Columbia.
Divisions: 207:C
Nations: CA
Subnations: BC
TNC Ecoregions: 144:C

SOURCES

References: Banner et al. 1993, DeLong 1996, DeLong 2003, DeLong 2004, DeLong et al. 1993, DeLong et al. 1994, Lloyd et al. 1990, MacKinnon et al. 1990, Steen and Coupe 1997, Western Ecology Working Group n.d.

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.820984#references

Description Author: G. Kittel

Version: 26 Jan 2009 **Stakeholders:** Canada, West

Concept Author: G. Kittel **ClassifResp:** West

NORTH-CENTRAL APPALACHIAN ACIDIC SWAMP (CES202.604)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: 30-180-day hydroperiod; Forest and Woodland (Treed); Extensive Wet Flat; Needle-Leaved Tree
Non-Diagnostic Classifiers: Acidic Water; Shallow (<15 cm) Water; Moderate (100-500 yrs) Persistence; Lowland; Temperate; Mineral: W/ A-Horizon >10 cm; Broad-Leaved Deciduous Tree
National Mapping Codes: ESLF 9307

CONCEPT

Summary: These swamps are distributed from central New England through the Central Appalachians south to Virginia and west to Ohio. They are found at low to mid elevations (generally <700 m) in basins or on gently sloping seepage lowlands. The acidic substrate is mineral soil, often with a component of organic muck; if peat is present, it usually forms an organic epipedon over the mineral soil rather than a true peat substrate (although peat layers up to 1 m deep have been found in some of these swamps). *Tsuga canadensis* is usually present and may be dominant. It is often mixed with deciduous wetland trees such as *Acer rubrum* or *Nyssa sylvatica*. *Sphagnum* is an important component of the bryoid layer. Basin swamps tend to be more nutrient-poor and less species-rich than seepage swamps; in some settings, the two occur adjacent to each other with the basin swamp vegetation surrounded by seepage swamp vegetation on its upland periphery.
Classification Comments: This system excludes swamps with *Chamaecyparis thyoides*, a tree more characteristic of the Coastal Plain but which sometimes occurs inland. See Northern Atlantic Coastal Plain Basin Peat Swamp (CES203.522). Some examples of this system may appear similar to Southern and Central Appalachian Bog and Fen (CES202.300) or North-Central Interior and Appalachian Acidic Peatland (CES202.606); those systems are distinguished by their deeper peat substrate and overall partly forested character compared to the shallower organic soil and generally forested nature of the present system. Wetlands on the Allegheny Plateau, at higher elevations, are a distinct system, High Allegheny Wetland (CES202.069). There are many species with this type, but it is distinguished by occurring as a mosaic of open wetlands and smaller forest patches with a distinctive hydrology.
Similar Ecological Systems:
- High Allegheny Wetland (CES202.069)
- Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp (CES201.574)
- Northern Atlantic Coastal Plain Basin Peat Swamp (CES203.522)
- Piedmont Seepage Wetland (CES202.298)
- Piedmont Upland Depression Swamp (CES202.336)

Related Concepts:
- Eastern Hemlock: 23 (Eyre 1980) Finer
- Hemlock - Yellow Birch: 24 (Eyre 1980) Finer
- Mountain / Piedmont Acidic Seepage Swamps (Fleming et al. 2005) Broader. can be attributed to one of two systems depending on their location. Occurrences in the central Appalachians are attributed to this system (CES202.604) while occurrences in the Piedmont are attributed to Piedmont Seepage Wetland (CES202.298).
- Red Maple: 108 (Eyre 1980) Finer

Component Associations:
- *Acer rubrum - Fraxinus (pennsylvanica, americana) / Lindera benzoin / Symplocarpus foetidus* Forest (CEGL006406, G4G5)
- *Acer rubrum - Nyssa sylvatica - Betula alleghaniensis / Sphagnum* spp. Forest (CEGL006014, G3)
- *Acer rubrum - Nyssa sylvatica / Ilex verticillata - Vaccinium fuscatum / Osmunda cinnamomea* Forest (CEGL007853, G2)
- *Acer rubrum - Nyssa sylvatica* High Allegheny Plateau, Central Appalachian Forest (CEGL006132, GNR)
- *Acer rubrum / Carex lacustris* Woodland (CEGL006105, GNR)
- *Acer rubrum / Carex stricta - Onoclea sensibilis* Woodland (CEGL006119, G3G5)
- *Acer rubrum / Nemopanthus mucronatus - Vaccinium corymbosum* Forest (CEGL006220, G4G5)
- *Acer rubrum / Rhododendron viscosum - Clethra alnifolia* Forest (CEGL006156, GNR)
- *Betula alleghaniensis - Acer rubrum - (Tsuga canadensis, Abies balsamea) / Osmunda cinnamomea* Forest (CEGL006380, G4?)
- *Picea rubens - (Tsuga canadensis) / Rhododendron maximum* Saturated Forest (CEGL006277, G2?)
- *Picea rubens / Rhododendron maximum - Kalmia latifolia / Eriophorum virginicum / Sphagnum* spp. Forest (CEGL006588, G2G3)
- *Tsuga canadensis - Betula alleghaniensis / Ilex verticillata / Sphagnum* spp. Forest (CEGL006226, G5)
- *Tsuga canadensis - Betula alleghaniensis / Veratrum viride - Carex scabrata - Oclemena acuminata* Forest (CEGL008533, G2)
- *Tsuga canadensis / Rhododendron maximum / Sphagnum* spp. Forest (CEGL006279, G4?)

DISTRIBUTION

Range: This system occurs from central New England south to western Virginia (the Central Appalachians region) and west to Ohio.
Divisions: 202:C

Nations: US
Subnations: CT, MA, MD, NH, NJ, NY, OH, PA, RI, VA, VT
Map Zones: 53:C, 60:C, 61:C, 62:C, 63:C, 64:C, 65:C, 66:P
USFS Ecomap Regions: 211E:CP, 211F:CC, 211G:CC, 211I:CC, 211J:CC, 221A:CC, 221B:CC, 221D:CC, 222I:CC, M211A:CP, M211B:CC, M211C:CC, M221A:CC
TNC Ecoregions: 49:C, 52:C, 59:C, 60:C, 61:C, 63:C

SOURCES

References: Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723005#references
Description Author: S.C. Gawler
Version: 05 May 2008 **Stakeholders:** East, Midwest, Southeast
Concept Author: S.C. Gawler **ClassifResp:** East

NORTH-CENTRAL INTERIOR AND APPALACHIAN ACIDIC PEATLAND (CES202.606)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Acidic Water; >180-day hydroperiod; Shrubland (Shrub-dominated); Organic Peat (>40 cm)
Non-Diagnostic Classifiers: Oligotrophic Water; Long (>500 yrs) Persistence; Lowland; Temperate; Depressional; Isolated Wetland [Partially Isolated]; Unconsolidated
National Mapping Codes: ESLF 9193

CONCEPT

Summary: These *Sphagnum* and shrub peatlands occur in basins south of the Laurentian-Acadian region down to near the glacial boundary in the northeastern and north-central U.S. Unlike the true raised bogs of boreal regions, the vegetation is not raised above the groundwater level. They are found in colder regions, mostly in areas where glacial stagnation left coarse deposits and glacial depressions (many are "kettleholes"). The basins are generally closed, i.e., without inlets or outlets of surface water, and typically small in area. The nutrient-poor substrate and the reduced throughflow of water create oligotrophic conditions fostering the development of *Sphagnum* peat and the growth of peatland vegetation. In deeper basins, the vascular vegetation grows on a *Sphagnum* mat over water, with no mineral soil development. Ericaceous shrubs and dwarf-shrubs (e.g., *Chamaedaphne calyculata*) dominate, with patches of graminoid dominance. Some peatlands may have a sparse tree layer. Although these are often called bogs, in most cases they are technically fens (albeit nutrient-poor ones), as the vegetation remains in contact with the surface water.
Classification Comments: This system occurs south of the Laurentian-Acadian division in the Midwest, south of the Northern Appalachian-Boreal ecoregion in the Northeast, and inland from the Coastal Plain, and these acidic peatlands are distinctive and discrete elements of the landscape. They are related to Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp (CES201.574) and Boreal-Laurentian-Acadian Acidic Basin Fen (CES201.583), but occur in a different landscape setting and often have some more temperate floristic elements to distinguish them. They include treed, shrub, and graminoid associations, often occurring in a mosaic. In the Midwest, it may be necessary to split off the shrub/graminoid acid peatland (poor fen) types.
Similar Ecological Systems:
- Atlantic Coastal Plain Northern Bog (CES203.893)
- Boreal-Laurentian Bog (CES103.581)--raised bogs of Canada and parts of the extreme northeastern and northern midwestern U.S.
- Boreal-Laurentian Conifer Acidic Swamp and Treed Poor Fen (CES103.724)
- Boreal-Laurentian-Acadian Acidic Basin Fen (CES201.583)--similar fens but more northerly in distribution, centered in Division 201 rather than 202.
- Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp (CES201.574)--more-or-less uniform tree cover.

Related Concepts:
- Atlantic White Cedar Bog (Gawler and Cutko 2010) Finer
- Black Spruce - Tamarack: 13 (Eyre 1980) Finer
- Leatherleaf Boggy Fen (Gawler and Cutko 2010) Finer
- Mixed Tall Sedge Fen (Gawler and Cutko 2010) Finer
- Red Maple: 108 (Eyre 1980) Finer
- Sedge - Leatherleaf Fen Lawn (Gawler and Cutko 2010) Finer
- Spruce - Larch Wooded Bog (Gawler and Cutko 2010) Finer

DESCRIPTION

Environment: These peatlands occur in kettle depressions on pitted outwash and moraines and in flat areas and shallow depressions on glacial outwash and glacial lakeplain. Groundwater and surface water feed these temperate peatlands. It is not strongly calcareous and may be acidic in some places but not as much as boreal sites. These peatlands occurred in landscapes dominated by either forest or grassland/savanna. The fire regime is not well known but periodic surface fires likely helped limit the cover by trees. The basins in which these occur tend to be small and, where open water is still present, these peatlands form where wave energy is low (Swinehart 1997). These peatlands are characterized by organic soils composed of saturated peat that contains partially decomposed sphagnum mosses and frequently fragments of sedges and wood. The peat soils are acidic, cool, and characterized by low nutrient availability and oxygen levels. The water-retaining capacity of sphagnum peat is tremendous and as a result these are saturated, anoxic systems with water tables near the surface (Kost et al. 2007).
Dynamics: The cool, nutrient-poor water which feeds into this system favors peat development. This water can come from surface runoff or groundwater. Basins in which these peatlands occur are small, which limits the amount of nutrients that can be brought in by surface water. Groundwater sources flow through nutrient-poor, neutral to somewhat acidic substrates. Once peat begins to develop, it tends to create conditions favorable for continued peat development by contributing to the acidic, anoxic character of the water.

Component Associations:
- *Acer rubrum / Alnus incana - Ilex verticillata / Osmunda regalis* Woodland (CEGL006395, GNR)

- *Carex lasiocarpa - Carex oligosperma - (Lysimachia terrestris) / Sphagnum* spp. Herbaceous Vegetation (CEGL005279, G3G4)
- *Carex oligosperma - Carex pauciflora - Eriophorum vaginatum / Sphagnum* spp. Herbaceous Vegetation (CEGL005256, G4G5)
- *Chamaedaphne calyculata - (Gaylussacia dumosa) - Decodon verticillatus / Woodwardia virginica* Dwarf-shrubland (CEGL006008, G5)
- *Chamaedaphne calyculata / Carex oligosperma - Eriophorum virginicum* Dwarf-shrubland (CEGL005092, G3G4)
- *Chamaedaphne calyculata / Eriophorum virginicum / Sphagnum rubellum* Dwarf-shrubland (CEGL006513, GNR)
- *Dulichium arundinaceum - Triadenum virginicum / Sphagnum fallax* Herbaceous Vegetation (CEGL006077, GNR)
- *Dulichium arundinaceum / Sphagnum* spp. Herbaceous Vegetation (CEGL006131, GNR)
- *Larix laricina / Photinia melanocarpa / Sphagnum* spp. Forest (CEGL002472, G4?)
- *Myrica gale - Chamaedaphne calyculata / Carex (lasiocarpa, utriculata) - Utricularia* spp. Shrub Herbaceous Vegetation (CEGL006302, G4G5)
- *Picea mariana / (Vaccinium corymbosum, Gaylussacia baccata) / Sphagnum* sp. Woodland (CEGL006098, G3G5)
- *Pinus rigida - Picea rubens / Viburnum nudum var. cassinoides / Sphagnum* spp. Woodland (CEGL006587, G1G2)
- *Pinus rigida / Chamaedaphne calyculata / Sphagnum* spp. Woodland (CEGL006194, G3G5)
- *Pinus rigida / Vaccinium myrtilloides / Sphagnum* spp. Woodland (CEGL006022, G1G2)
- *Sphagnum (cuspidatum, torreyanum) - Vaccinium macrocarpon* Nonvascular Vegetation (CEGL006394, GNR)
- *Sphagnum rubellum - Vaccinium oxycoccos* Nonvascular Vegetation (CEGL006135, GNR)
- *Vaccinium corymbosum - Gaylussacia baccata - Photinia melanocarpa / Calla palustris* Shrubland (CEGL005085, G2G3)
- *Vaccinium corymbosum / Sphagnum* spp. Shrubland (CEGL006190, G4)

DISTRIBUTION

Range: This system is found from central New England to the Great Lakes and south-central Minnesota southward, generally associated with the glacial terminus or stagnation zones, and interior from the Coastal Plain.
Divisions: 202:C
Nations: CA, US
Subnations: CT, IL, IN, MA, ME, MI, MN, NH, NJ, NY, OH, ON, PA, RI, VT, WI
Map Zones: 41:?, 49:P, 50:P, 51:P, 52:P, 61:C, 62:C, 63:C, 64:C, 65:C, 66:P
USFS Ecomap Regions: 211F:CC, 211I:CP, 211J:CC, 221A:CC, 221B:CC, 221D:CC, 221E:CC, 221Fa:CCC, 222I:CC, 222Ja:CCC, 222Jb:CCC, 222Jc:CCC, 222Je:CCC, 222Jg:CCC, 222Jh:CCC, 222Ji:CCC, 222R:CC, 222Ua:CCP, 222Ud:CCC, 222Ue:CCC
TNC Ecoregions: 45:P, 46:P, 48:P, 49:P, 60:C, 61:C, 64:C

SOURCES

References: Comer et al. 2003, Damman and French 1987, Eyre 1980, Faber-Langendoen et al. 2011, Gawler and Cutko 2010, Kost et al. 2007, Swinehart 1997, Swinehart and Starks 1994
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723003#references
Description Author: S.C. Gawler, mod. J. Drake
Version: 14 Jan 2014 **Stakeholders:** Canada, East, Midwest, Southeast
Concept Author: S.C. Gawler **ClassifResp:** East

NORTH-CENTRAL INTERIOR AND APPALACHIAN RICH SWAMP (CES202.605)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Mesotrophic Water; Saturated Soil; Temperate; Depressional; Broad-Leaved Deciduous Tree
Non-Diagnostic Classifiers: Intermittent Flooding; Moderate (100-500 yrs) Persistence; Lowland; Forest and Woodland (Treed); Extensive Wet Flat; Mineral: W/ A-Horizon >10 cm
National Mapping Codes: ESLF 9306

CONCEPT

Summary: These forested wetlands are scattered throughout the north-central Midwest (south of the Laurentian region), the north-central Appalachians and southern New England at low to mid elevations. They are found in basins where higher pH and/or nutrient levels are associated with a rich flora. Species include *Acer rubrum, Fraxinus nigra*, as well as calciphilic herbs. Conifers include *Larix laricina*, but typically not *Thuja occidentalis*, which is characteristic of more northern wetland systems. There may be shrubby or herbaceous openings within the primarily wooded cover. The substrate is primarily mineral soil, but there may be some peat development.
Classification Comments: This system occurs south of the Laurentian-Acadian region, and these circumneutral or enriched swamps are often rather distinctive and discrete elements of the landscape. They are related to Laurentian-Acadian Alkaline Conifer-Hardwood Swamp (CES201.575) but have more temperate elements and generally lack *Thuja occidentalis*. More alkaline shrub/herb fens are treated as part of North-Central Interior Shrub-Graminoid Alkaline Fen (CES202.702).
Similar Ecological Systems:
- Laurentian-Acadian Alkaline Conifer-Hardwood Swamp (CES201.575)
- North-Central Interior Shrub-Graminoid Alkaline Fen (CES202.702)
- Piedmont Seepage Wetland (CES202.298)--ranges north into Virginia.

Related Concepts:
- Black Ash - American Elm - Red Maple: 39 (Eyre 1980) Finer
- Mountain / Piedmont Basic Seepage Swamp (Fleming et al. 2005) Intersecting. in Virginia.
- Tamarack: 38 (Eyre 1980) Finer

DESCRIPTION

Environment: Water can come from nutrient-rich groundwater or surface runoff. Sites are basins or low areas in floodplains, usually near the edge of the floodplain in a localized basin or at the base of a bluff where groundwater emerges. Soils are muck or fine-textured mineral. Small hummocks and depressions, created from tree tip-ups, sluggish streams, or tree root build up, create drier and wetter microsites within the system. Sites are usually flooded in the spring, and low areas may remain wet for all or most of the growing season, but if stands remain under water for multiple years, the trees die (Kost et al. 2007). The microsite differences allow a mixture of wet-mesic upland species and wetland species to exist in the herbaceous layer of this system (WNHI 2012).
Dynamics: The hydrologic regime is critical to maintenance of this system. Sites must be wet or flooded for part of the growing season but not completely saturated or under water for too long over a large portion of the site. Periodic sustained floods or droughts can kill canopy trees and allow the mostly shade-intolerant canopy trees (*Fraxinus nigra, Fraxinus pennsylvanica, Larix laricina*) to regenerate. Trees are shallowly rooted in this system so wind can blow canopy trees over relatively easily. This creates gaps in the canopy and allows smaller trees enough light to reach the canopy. Windthrow contributes to hummock-and-hollow microtopography, which generates small-scale gradients in soil moisture and chemistry, contributing to floristic diversity.

Component Associations:
- *Acer (rubrum, saccharinum) - Fraxinus* spp. - *Ulmus americana* Forest (CEGL005038, G4?)
- *Acer rubrum - Fraxinus americana - Fraxinus nigra - Betula alleghaniensis / Veratrum viride - Carex bromoides* Forest (CEGL008416, G3)
- *Acer rubrum - Fraxinus nigra - (Larix laricina) / Rhamnus alnifolia* Forest (CEGL006009, GNR)
- *Acer rubrum - Fraxinus nigra - (Tsuga canadensis) / Tiarella cordifolia* Forest (CEGL006502, GNR)
- *Fraxinus nigra - Acer rubrum / Rhamnus alnifolia / Carex leptalea* Saturated Forest (CEGL007441, GNR)
- *Larix laricina - Acer rubrum / (Rhamnus alnifolia, Vaccinium corymbosum)* Forest (CEGL005232, G2G3)

DISTRIBUTION

Range: This system is found from central New England to the southern Great Lakes and south-central Minnesota south to northern Illinois, Indiana, Ohio, and Pennsylvania. It is not known to extend south into the Southern Blue Ridge.
Divisions: 202:C
Nations: CA, US
Subnations: CT, DE?, IL, IN, MA, MD, MI, MN, NJ, NY, OH, ON, PA, RI, VT, WI

Map Zones: 41:C, 49:C, 50:C, 51:C, 52:C, 53:C, 61:C, 62:C, 63:C, 64:C, 65:C
USFS Ecomap Regions: 212Hb:CCP, 222H:CC, 222Ja:CCC, 222Jb:CCC, 222Jc:CCC, 222Je:CCC, 222Jg:CCC, 222Jh:CCC, 222Ji:CCC, 222K:CC, 222L:CC, 222M:CC, 222Ua:CCC, 222Ud:CCC, 222Ue:CCC, M211Cc:CCC
TNC Ecoregions: 45:C, 46:C, 48:C, 49:P, 59:C, 60:?, 61:C

SOURCES

References: Comer et al. 2003, DeSantis et al. 2012, Eyre 1980, Faber-Langendoen et al. 2011, Fleming et al. 2005, Herms et al. 2010, Kost et al. 2007, Ward et al. 2006, WNHI 2012

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723004#references

Description Author: S.C. Gawler, mod. J. Drake
Version: 14 Jan 2014 **Stakeholders:** Canada, East, Midwest, Southeast
Concept Author: S.C. Gawler **ClassifResp:** East

NORTH-CENTRAL INTERIOR SHRUB-GRAMINOID ALKALINE FEN (CES202.702)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Non-Diagnostic Classifiers: Alkaline Water; Saturated Soil; Fen; Shrubland (Shrub-dominated); Woody-Herbaceous; Herbaceous; Seepage-Fed Sloping; Isolated Wetland [Partially Isolated]
National Mapping Codes: ESLF 9184

CONCEPT

Summary: This fen system is found in the glaciated portions of the Midwest and southern Canada. Examples of this system can be located on level to sloping seepage areas, in pitted outwash or in kettle lakes associated with kettle-kame-moraine topography. Groundwater flows through marls and shallow peat soils, and groundwater is typically minerotrophic and slightly alkaline. Examples of this system contain a core fen area of graminoids surrounded by shrubs. Herbaceous and shrub cover is variable with little to no tree cover. Characteristic species include prairie grasses such as *Andropogon gerardii* and *Spartina pectinata* with prairie forbs and sedges (*Carex* spp.). Common shrub species include *Dasiphora fruticosa ssp. floribunda*, *Cornus* spp., *Salix* spp., and *Toxicodendron vernix*. Alterations in wetland hydrology and agricultural development can threaten examples of this system.

Similar Ecological Systems:
- Laurentian-Acadian Alkaline Fen (CES201.585)
- North-Central Interior and Appalachian Rich Swamp (CES202.605)
- Western Canadian Boreal Shrub-Sedge Rich and Alkaline Fen (CES103.872)

DESCRIPTION

Environment: Examples of this system can be located on level to sloping seepage areas, in pitted outwash or in kettle lakes associated with kettle-kame-moraine topography. Prairie fens can occur along the margins of small lakes or on slopes or level areas among upland vegetation. This system can form where mineral-rich groundwater emerges as springs or seeps. Soils are saturated peat or marl, and these fens typically show strong zonal patterns in soil chemistry, physiognomy, and floristic composition, between areas with peat versus marly areas where groundwater springs run (Van der Valk 1976, Moran 1981b, Bowles et al. 2005).
Vegetation: Examples of this system contain a core fen area of graminoids surrounded by shrubs with a fairly continuous sphagnum moss layer. Herbaceous and shrub cover is variable with little to no tree cover. Characteristic species include prairie grasses such as *Andropogon gerardii* and *Spartina pectinata* with prairie forbs and sedges (*Carex* spp.). Common shrub species include *Dasiphora fruticosa ssp. floribunda*, *Cornus* spp., and *Salix* spp.
Dynamics: The presence of cold, mineral-rich groundwater which promotes the formation of peat and marl is key to the formation and maintenance of this system. Where cold, mineral-rich groundwater emerges as seeps and diffuse springs, decomposition of plant matter is slowed and peat can accumulate. Marl forms under sustained flow of calcium- and magnesium-rich water. The marl occurs where the groundwater emerges and in "spring runs" where water has cut a channel through the peat. Peat accumulation tends to be thickest in the center of the fens and can form raised mounds over time (Stuckey and Denny 1981). Periodic fire is an important factor in limiting the growth of trees and shrubs.

Component Associations:
- *Betula pumila - Salix candida / Carex lasiocarpa - Symphyotrichum boreale* Prairie Fen Shrubland (CEGL002189, G3)
- *Carex lasiocarpa - Calamagrostis* spp. - (*Eleocharis rostellata*) Herbaceous Vegetation (CEGL002383, G3G4)
- *Carex lasiocarpa - Carex oligosperma / Sphagnum* spp. Herbaceous Vegetation (CEGL002265, G3G4)
- *Cladium mariscoides - (Carex lasiocarpa, Hypericum kalmianum, Oligoneuron riddellii, Eleocharis elliptica)* Herbaceous Vegetation (CEGL005104, G2?)
- *Cornus amomum - Salix* spp. - *Toxicodendron vernix - Rhamnus lanceolata* Fen Shrubland (CEGL005087, G2G3)
- *Cornus racemosa / Carex (sterilis, aquatilis, lacustris)* Shrub Herbaceous Vegetation (CEGL006123, G2G3)
- *Cornus* spp. - *Salix* spp. - *Vaccinium corymbosum - Rhamnus alnifolia - Toxicodendron vernix* Shrubland (CEGL005083, G4?)
- *Dasiphora fruticosa ssp. floribunda / Carex interior - Carex flava - Sarracenia purpurea* Shrub Herbaceous Vegetation (CEGL005140, G3)
- *Dasiphora fruticosa ssp. floribunda / Carex sterilis - Andropogon gerardii - Arnoglossum plantagineum* Shrub Herbaceous Vegetation (CEGL005139, G3G4)
- *Symplocarpus foetidus* - Mixed Forbs Wet Meadow (CEGL002385, G4?)
- *Vaccinium corymbosum - Gaylussacia baccata - Photinia melanocarpa / Calla palustris* Shrubland (CEGL005085, G2G3)

DISTRIBUTION

Range: This system is found in the glaciated, prairie landscape of the northern Midwest and southern Canada from the eastern Dakotas and northwestern Iowa through southern Wisconsin and Michigan, northern Illinois and Indiana, to western and northeastern Ohio and western Pennsylvania.

Divisions: 201:C; 202:C
Nations: CA, US
Subnations: IA, IL, IN, MI, MN, ND, OH, ON, PA, SD, WI
Map Zones: 39:C, 40:C, 41:C, 42:C, 43:C, 49:C, 50:C, 51:C, 52:C, 62:P
USFS Ecomap Regions: 221F:CC, 222H:CC, 222Ja:CCC, 222Jb:CCC, 222Jc:CCC, 222Je:CCC, 222Jf:CCP, 222Jg:CCC, 222Jh:CCC, 222Ji:CCC, 222K:CC, 222M:CC, 222U:CP, 251B:CC
TNC Ecoregions: 35:C, 36:C, 45:C, 46:C, 47:C, 48:C, 49:P

SOURCES

References: Bowles et al. 2005, Comer et al. 2003, Faber-Langendoen et al. 2011, Kost et al. 2007, MNNHP 1993, Moran 1981b, Pearson and Leoschke 1992, Stuckey and Denny 1981, van der Valk 1976
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722958#references
Description Author: S. Menard, mod. J. Drake
Version: 14 Jan 2014 **Stakeholders:** Canada, East, Midwest
Concept Author: S. Menard **ClassifResp:** Midwest

NORTH-CENTRAL INTERIOR WET FLATWOODS (CES202.700)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Non-Diagnostic Classifiers: Saturated Soil; Flat; Forest and Woodland (Treed); Extensive Wet Flat; Isolated Wetland [Partially Isolated]
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Deciduous open tree canopy
National Mapping Codes: EVT 2518; ESLF 9186; ESP 1518

CONCEPT

Summary: This small-patch system is found throughout the northern glaciated Midwest ranging east into Lower New England and the Champlain Valley. It usually occurs on somewhat poorly drained uplands or in depressions associated with glacial features such as tillplains, lakeplains or outwash plains. Soils often have an impermeable or nearly impermeable clay layer that can create a shallow, perched water table. Saturation can vary, with ponding common during wetter seasons, and drought possible during the summer and autumn months. Microtopography and fluctuating moisture levels can lead to complexes of forest upland and wetland species occurring within this system. *Quercus palustris* and/ or *Quercus bicolor* typically dominate the wetter portions and are often associated with *Acer rubrum*. *Quercus alba*, *Quercus rubra*, and *Fagus grandifolia* are common in the better-drained areas. *Carya ovata* is a characteristic tree in the Champlain Valley. *Liquidambar styraciflua, Nyssa sylvatica, Acer saccharinum, Fraxinus americana*, and *Fraxinus pennsylvanica* are also common associates, though their occurrence varies somewhat by region. Understory herbaceous and shrub species present in examples of this system can vary. Stands with more dense tree cover have less shrub and herbaceous cover, while those with moderate tree canopy cover tend to have a dense understory. Some common species in the wetter portions include *Carex* spp., *Osmunda cinnamomea, Cephalanthus occidentalis, Alnus* spp., and *Ilex* spp. Flooding, windthrow, drought, and fire can influence this system.
Classification Comments: These are mostly north of the glacial line, but one association is in the Interior Low Plateau and that placement may need to be reviewed. Some examples in Michigan, Indiana, Ohio, Vermont, and southern Ontario are dominated by *Fagus grandifolia*, oak (primarily *Quercus alba* and *Quercus rubra*) and maple species (*Acer* spp.). Vermont's Valley Clayplain Forest is placed here tenuously as it has more of an upland component and occurs at a local matrix scale, not as a small-patch element.
Related Concepts:
- Pin Oak - Sweetgum: 65 (Eyre 1980) Finer

DESCRIPTION

Environment: This system usually occurs on poorly drained uplands or in depressions associated with glacial features such as tillplains, lakeplains, or outwash plains. Soils often have an impermeable or nearly impermeable clay layer that impedes waterflow. This favors flooding or ponding in the spring or after heavy rains. It also restricts subsurface water movement into the system and slows the growth of roots through it. Both of these factors lead to water deficits for the vegetation in the late summer and fall. These fluctuating moisture levels can lead to complexes of forest upland and wetland species occurring within this system. Overall topographic relief is very flat in this system though small tip-up mounds and depressions can occur from windthrow and often create small pockets with vegetation more typical of upland or swamp forest, respectively.
Vegetation: *Quercus palustris* and/or *Quercus bicolor* typically dominate the wetter portions and are often associated with *Acer rubrum*. *Quercus alba, Quercus rubra, Fagus grandifolia*, and *Acer saccharum* are common in the better-drained areas, seen in some examples around the southern Great Lakes and Lake Champlain. *Carya ovata* is a characteristic tree in the Champlain Valley. *Liquidambar styraciflua, Nyssa sylvatica, Fraxinus americana*, and *Fraxinus pennsylvanica* are also common associates, though their occurrence varies somewhat by region. Understory herbaceous and shrub species present in examples of this system can vary. Stands with more dense tree cover have less shrub and herbaceous cover, while those with moderate tree canopy cover tend to have a dense understory. Some common species include *Carex* spp., *Osmunda cinnamomea, Cephalanthus occidentalis, Alnus* spp., and *Ilex* spp. In the clayplain forests of Vermont, characteristic herbs include *Waldsteinia fragarioides* and *Moehringia lateriflora (= Arenaria lateriflora)*.
Dynamics: The large seasonal change in local available moisture is key to the development and maintenance of this system. Plants must be able to tolerate the excessive available moisture (surface flooding or saturation) and drought conditions that occur in most growing seasons. Fire can occur after the system dries, typically late in the growing season. Fires rarely start in this system but under favorable conditions can spread from nearby fire-prone systems (typically prairies, oak savannas, or oak woodlands). Under proper hydrologic conditions, this system can be self-maintaining (Tecic and McCain 2001). With the often shallowly-rooted trees, strong winds can create canopy openings. Small-scale windthrow is a characteristic disturbance in flatwoods that influences composition and structure by creating canopy gaps that are suitable for the colonization and growth of light-dependent tree seedlings and saplings, shrubs, and herbs. Windthrow also tips and uproots trees, creating pit-and-mound topography that provides suitable microhabitats for a diversity of plant species (Slaughter et al. 2010).

Component Associations:

- *Cephalanthus occidentalis / Carex* spp. Northern Shrubland (CEGL002190, G4)
- *Fagus grandifolia - Acer rubrum / Vaccinium corymbosum* Forest (CEGL006072, GNR)
- *Fagus grandifolia - Acer saccharum - Quercus bicolor - Acer rubrum* Flatwoods Forest (CEGL005173, G2G3)
- *Fagus grandifolia - Quercus alba - (Quercus michauxii) - Acer rubrum* Flatwoods Forest (CEGL005015, G3)
- *Quercus alba - Acer rubrum - Carya ovata / Viburnum acerifolium / Waldsteinia fragarioides* Forest (CEGL006122, GNR)
- *Quercus alba - Quercus stellata - Quercus velutina / Cornus florida / Andropogon gerardii* Woodland (CEGL006434, G1G3)
- *Quercus palustris - (Quercus bicolor) - Acer rubrum / Vaccinium corymbosum / Osmunda cinnamomea* Forest (CEGL006240, GNR)
- *Quercus palustris - (Quercus stellata) - Quercus pagoda / Isoetes* spp. Forest (CEGL002101, G2G3)
- *Quercus palustris - Quercus bicolor - (Liquidambar styraciflua)* Mixed Hardwood Forest (CEGL002432, G3G4)
- *Quercus palustris - Quercus bicolor - Acer rubrum* Flatwoods Forest (CEGL005037, G2G3)
- *Quercus palustris - Quercus bicolor - Nyssa sylvatica - Acer rubrum* Sand Flatwoods Forest (CEGL002100, G2?)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- North-Central Interior Beech-Maple Forest (CES202.693)

DISTRIBUTION

Range: This system is found in the northern Midwest, southern Ontario, and portions of the northeastern U.S.
Divisions: 201:P; 202:C
Nations: CA, US
Subnations: CT, IA, IL, IN, MA, MI, MO, NY, OH, ON, PA, VT
Map Zones: 41:?, 42:C, 43:C, 44:P, 47:C, 49:?, 50:?, 51:C, 52:C, 53:P, 61:C, 62:P, 63:C, 64:P, 65:C
USFS Ecomap Regions: 211E:CC, 211F:CP, 221A:CC, 221B:CP, 222I:CP, 222Jh:CCC, 222Ua:CCC, 222Ue:CC?
TNC Ecoregions: 36:C, 44:C, 45:C, 47:?, 48:C, 49:P, 59:P, 61:C, 64:C

SOURCES

References: Bowles et al. 2003, Braun 1950, Comer et al. 2003, Eyre 1980, Faber-Langendoen et al. 2011, Kost et al. 2007, Slaughter et al. 2010, Stroke and Anderson 1992, Tecic and McCain 2001
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722960#references
Description Author: S. Menard, mod. J. Drake and S.C. Gawler
Version: 14 Jan 2014 **Stakeholders:** Canada, East, Midwest, Southeast
Concept Author: S. Menard **ClassifResp:** Midwest

NORTH-CENTRAL INTERIOR WET MEADOW-SHRUB SWAMP (CES202.701)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Depressional [Lakeshore]; Broad-Leaved Shrub; Graminoid
Non-Diagnostic Classifiers: Circumneutral Water; Acidic Water; Shallow (<15 cm) Water; Moderate (100-500 yrs) Persistence; Herbaceous; Depressional [Pond]; Isolated Wetland [Partially Isolated]; Muck
National Mapping Codes: ESLF 9185

CONCEPT

Summary: This system is found throughout the northern Midwest ranging into southern Canada. It is typically found on glacial potholes, river valleys, ponds, channels in glacial outwash, and on lakeplains. This system contains a deep to shallow area of freshwater marsh dominated by emergent species surrounded by a zone of wet meadow. The emergent marsh zone within this system contains hydric soils flooded by water ranging from several centimeters to over 1 meter for most of the growing season. Emergent marsh species such as *Typha* spp. and *Schoenoplectus* spp. dominate the core of this system. Wet meadows can surround the emergent marsh core along wet mineral soils or shallow peat with the water table typically just below the surface for most of the growing season. The vegetation in this zone of the system is dominated by sedges (*Carex* spp.) and grasses such as *Calamagrostis canadensis*. This system also can contain a zone of wet prairie species such as *Spartina pectinata*. Shrub swamps can also be associated with the wet meadows within this system. Typical shrub species include *Cornus* spp., *Salix* spp., and/or *Cephalanthus occidentalis*. Trees are generally absent and, if present, are scattered. Fire originating in adjacent uplands, as well as hydrology, can influence this system. In the absence of fire, drought and/or ditching can increase the proportion of shrubs compared to the wet meadow or prairie species.
Classification Comments: If examples of these associations are found within a medium to large floodplain, they should be considered part of North-Central Interior Floodplain (CES202.694). The freshwater marsh component was removed from this system to create a new system, North-Central Interior Freshwater Marsh (CES202.899).
Similar Ecological Systems:
- Cumberland Wet-Mesic Meadow and Savanna (CES202.053)
- Laurentian-Acadian Shrub-Herbaceous Wetland Systems (CES201.642)
- Laurentian-Acadian Wet Meadow-Shrub Swamp (CES201.582)

DESCRIPTION

Environment: This system is typically found on glacial potholes, river valleys, ponds, channels in glacial outwash, and on lakeplains. It contains a deep to shallow area of freshwater marsh dominated by emergent species surrounded by a zone of wet meadow. The emergent marsh zone within this system contains hydric soils flooded by water ranging from several centimeters to over 1 meter for most of the growing season.
Vegetation: Emergent marsh species such as *Typha* spp. and *Schoenoplectus* spp. dominate the core of this system. Wet meadows can surround the emergent marsh core along wet mineral soils or shallow peat with the water table typically just below the surface for most of the growing season. The vegetation in this zone of the system is dominated by sedges (*Carex* spp.) and grasses such as *Calamagrostis canadensis*. This system also can contain a zone of wet prairie species such as *Spartina pectinata*. Shrub swamps can also be associated with the wet meadows within this system. Typical shrub species include *Cornus* spp., *Salix* spp., and/or *Cephalanthus occidentalis*. Trees are generally absent and, if present, are scattered.
Dynamics: Fire originating in adjacent uplands, as well as hydrology, can influence this system. In the absence of fire, drought and/or ditching can increase the proportion of shrubs compared to the wet meadow or prairie species.

Component Associations:
- *Calamagrostis canadensis* North-Central Wet Meadow (CEGL005449, G4G5)
- *Carex aquatilis - Carex* spp. Herbaceous Vegetation (CEGL002262, G4?)
- *Carex atherodes* Herbaceous Vegetation (CEGL002220, G3G5)
- *Carex crinita - Osmunda* spp. / *Physocarpus opulifolius* Seep Herbaceous Vegetation (CEGL002392, G2)
- *Carex lacustris* Herbaceous Vegetation (CEGL002256, G4G5)
- *Carex stricta - Carex* spp. Herbaceous Vegetation (CEGL002258, G4?)
- *Carex utriculata - Carex lacustris - (Carex vesicaria, Carex stricta)* Herbaceous Vegetation (CEGL002257, G4G5)
- *Cephalanthus occidentalis / Carex* spp. Northern Shrubland (CEGL002190, G4)
- *Cornus sericea - Salix (bebbiana, discolor, petiolaris) / Calamagrostis stricta* Shrubland (CEGL002187, G3G4)
- *Cornus sericea - Salix* spp. - (*Rosa palustris*) Shrubland (CEGL002186, G5)
- *Spartina pectinata - Calamagrostis stricta - Carex* spp. Herbaceous Vegetation (CEGL002027, G3?)
- *Spartina pectinata - Carex* spp. - *Calamagrostis canadensis - Lythrum alatum - (Oxypolis rigidior)* Herbaceous Vegetation (CEGL002224, G3?)
- *Spartina pectinata - Carex* spp. - *Calamagrostis canadensis* Sand Herbaceous Vegetation (CEGL005178, G3?)

- *Spiraea tomentosa - Salix humilis / Andropogon gerardii - Panicum virgatum* Shrubland (CEGL005069, G1Q)

DISTRIBUTION

Range: This system is found in the northern Midwest and southern Canada.
Divisions: 201:C; 202:C
Nations: CA, US
Subnations: IA, IL, IN, MI, MN, MO, ND, OH, ON, SD, WI
Map Zones: 39:C, 40:C, 41:C, 42:C, 43:C, 44:P, 49:C, 50:C, 51:C, 52:C, 62:P
USFS Ecomap Regions: 212Hb:CCP, 222Ja:CCC, 222Jb:CCC, 222Jc:CCC, 222Je:CCC, 222Jg:CCC, 222Jh:CCC, 222Ji:CCC, 222Ua:CCC, 222Ud:CCC, 222Ue:CCC
TNC Ecoregions: 35:C, 36:C, 45:C, 46:C, 47:C, 48:C, 49:?

SOURCES

References: Comer and Albert 1997, Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722959#references
Description Author: S. Menard, mod. J. Drake
Version: 18 Jul 2006 **Stakeholders:** Canada, Midwest, Southeast
Concept Author: S. Menard **ClassifResp:** Midwest

NORTHERN APPALACHIAN-ACADIAN CONIFER-HARDWOOD ACIDIC SWAMP (CES201.574)

CLASSIFIERS

Classification Status: Standard

Primary Division: Laurentian-Acadian (201)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Acidic Water; Extensive Wet Flat; Picea (rubens, mariana) - Acer rubrum
Non-Diagnostic Classifiers: Mesotrophic Water; Oligotrophic Water; Saturated Soil; Intermittent Flooding [Intermittent interval, Irregular Flooding]; Intermittent Flooding [Intermittent interval, Spring Flooding]; Moderate (100-500 yrs) Persistence; Forest and Woodland (Treed); Isolated Wetland [Partially Isolated]; Mineral: W/ A-Horizon <10 cm; Needle-Leaved Tree; Broad-Leaved Deciduous Tree
National Mapping Codes: ESLF 9346

CONCEPT

Summary: These forested wetlands are found in temperate northeastern and north-central U.S., primarily in glaciated regions in the eastern Laurentian-Acadian region. They occur on mineral soils that are nutrient-poor; there may be an organic epipedon, but the substrate is generally not deep peat. These basin wetlands remain saturated for all or nearly all of the growing season, and may have standing water seasonally. There may be some seepage influence, especially near the periphery. *Acer rubrum*, *Fraxinus* spp., *Picea rubens* (rarely *Picea mariana*), and *Abies balsamea* are the most typical trees. The herbaceous and shrub layers tend to be fairly species-poor. *Nemopanthus mucronatus* and *Osmunda* spp. are typical shrub and herb species.
Classification Comments: Acadian Sub-boreal Spruce Flat (CES201.562) is related but is more northern and occurs on imperfectly drained but not persistently saturated soils. *Picea rubens* in the East versus *Picea mariana* in the West and North may be helpful in distinguishing between this type and the more boreal acidic swamp, Boreal-Laurentian Conifer Acidic Swamp and Treed Poor Fen (CES103.724). This type is distributed in the Acadian and Northern Appalachian region of the U.S. and Canada, whereas Boreal-Laurentian Conifer Acidic Swamp and Treed Poor Fen (CES103.724) is found in the Upper Great Lakes region and into Canada. The attribution of CEGL006380 to this system is questionable given that it is a seepage wetland, not a basin swamp association, but is included because portions of these wetlands may have seepage influence.
Similar Ecological Systems:
- Acadian Sub-boreal Spruce Flat (CES201.562)
- Boreal-Laurentian Conifer Acidic Swamp and Treed Poor Fen (CES103.724)--is similar but occurs in the upper Great Lakes region and adjacent Canada.
- Laurentian-Acadian Alkaline Conifer-Hardwood Swamp (CES201.575)
- North-Central Appalachian Acidic Swamp (CES202.604)
- North-Central Interior and Appalachian Acidic Peatland (CES202.606)

Related Concepts:
- Eastern Hemlock: 23 (Eyre 1980) Finer
- Hemlock - Hardwood Pocket Swamp (Gawler and Cutko 2010) Finer
- Hemlock - Yellow Birch: 24 (Eyre 1980) Finer
- Red Maple - Sensitive Fern Swamp (Gawler and Cutko 2010) Finer
- Red Maple Wooded Fen (Gawler and Cutko 2010) Finer
- Red Maple: 108 (Eyre 1980) Finer
- Red Spruce - Balsam Fir: 33 (Eyre 1980) Finer
- Red Spruce: 32 (Eyre 1980) Finer
- Spruce - Fir - Cinnamon Fern Forest (Gawler and Cutko 2010) Finer

Component Associations:
- *Acer rubrum / Carex stricta - Onoclea sensibilis* Woodland (CEGL006119, G3G5)
- *Acer rubrum / Nemopanthus mucronatus - Vaccinium corymbosum* Forest (CEGL006220, G4G5)
- *Betula alleghaniensis - Acer rubrum - (Tsuga canadensis, Abies balsamea) / Osmunda cinnamomea* Forest (CEGL006380, G4?)
- *Picea rubens - Abies balsamea / Gaultheria hispidula / Osmunda cinnamomea / Sphagnum* spp. Forest (CEGL006312, GNR)
- *Picea rubens - Acer rubrum / Nemopanthus mucronatus* Forest (CEGL006198, GNR)

DISTRIBUTION

Range: This system occurs in New England and adjacent Canada west through New York. Occurrences in Massachusetts, Connecticut, and Pennsylvania are at higher elevations and peripheral to the range.
Divisions: 201:C
Nations: CA, US
Subnations: CT, MA, ME, NB, NH, NY, ON, PA, VT
Map Zones: 63:C, 64:C, 65:C, 66:C
USFS Ecomap Regions: 211A:CC, 211B:CC, 211C:CC, 211D:CC, 211I:CC, 211J:CC, 221A:CC, 221B:CC, M211A:CC,

M211D:CC
TNC Ecoregions: 48:C, 60:C, 61:C, 63:C

SOURCES

References: Comer et al. 2003, Golet et al. 1993
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723031#references
Description Author: S.C. Gawler
Version: 05 May 2008 **Stakeholders:** Canada, East, Midwest
Concept Author: S.C. Gawler and D. Faber-Langendoen **ClassifResp:** East

NORTHERN ATLANTIC COASTAL PLAIN BASIN PEAT SWAMP (CES203.522)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Non-Diagnostic Classifiers: Forest and Woodland (Treed); Depressional [Peaty]; Isolated Wetland [Partially Isolated]
National Mapping Codes: ESLF 9343

CONCEPT

Summary: This system is comprised of acidic peat swamps formed in basins of various sizes, predominantly Atlantic white-cedar swamps, occurring on the northern portion of the Atlantic Coastal Plain from Massachusetts south to Virginia. The hydrology is saturated, as evidenced by *Sphagnum*-dominated hummock-and-hollow microtopography. *Chamaecyparis thyoides* is characteristic and often dominant. *Acer rubrum* may also be an important species, especially after logging.
Classification Comments: Atlantic white-cedar swamps do occur inland of the coastal plain and are considered inland disjuncts of this type. Where *Chamaecyparis* is present but not dominant inland, and other coastal plain indicators are absent, North-Central Appalachian Acidic Swamp (CES202.604) is the more appropriate system.
Similar Ecological Systems:
- North-Central Appalachian Acidic Swamp (CES202.604)
- Southern Atlantic Coastal Plain Nonriverine Swamp and Wet Hardwood Forest (CES203.304)--has a *Chamaecyparis thyoides* component which is similar to this system in certain respects.

Related Concepts:
- Atlantic White Cedar Swamp (Gawler and Cutko 2010) Finer
- Atlantic White-Cedar: 97 (Eyre 1980) Finer
- Red Maple: 108 (Eyre 1980) Finer

DESCRIPTION

Environment: Topographic depression.
Dynamics: Seasonal to saturated hydrology.

Component Associations:
- *Acer rubrum - Nyssa sylvatica - Magnolia virginiana / Viburnum nudum var. nudum / Osmunda cinnamomea - Woodwardia areolata* Forest (CEGL006238, G3?)
- *Acer rubrum / Rhododendron maximum* Forest (CEGL006396, GNR)
- *Acer rubrum / Rhododendron viscosum - Clethra alnifolia* Forest (CEGL006156, GNR)
- *Chamaecyparis thyoides - (Tsuga canadensis, Betula alleghaniensis) / Clethra alnifolia* Forest (CEGL006189, G3)
- *Chamaecyparis thyoides - Acer rubrum - Magnolia virginiana* Forest (CEGL006078, GNR)
- *Chamaecyparis thyoides - Acer rubrum / Lycopus* spp. Forest (CEGL006364, GNR)
- *Chamaecyparis thyoides - Picea rubens / Gaylussacia baccata / Gaultheria hispidula* Forest (CEGL006363, G3?)
- *Chamaecyparis thyoides / Ilex glabra - Rhododendron viscosum* Forest (CEGL006188, G3)
- *Chamaecyparis thyoides / Rhododendron maximum* Forest (CEGL006355, G2G3)
- *Vaccinium corymbosum - Rhododendron viscosum - Clethra alnifolia* Shrubland (CEGL006371, G3)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Northern Atlantic Coastal Plain Pitch Pine Barrens (CES203.269)

DISTRIBUTION

Range: This system occurs on the northern portion of the Atlantic Coastal Plain from Massachusetts south to Virginia, with sporadic occurrences north to mid-coast Maine, and occasional disjunct occurrences inland; it is historic in eastern Pennsylvania.
Divisions: 201:C; 202:C; 203:C
Nations: US
Subnations: CT, DE, MA, MD, ME, NH, NJ, NY, VA
Map Zones: 60:C, 65:C, 66:C
USFS Ecomap Regions: 211Da:CCC, 221Ah:CCC, 221Ai:CCC, 221Ak:CCC, 221Al:CCC, M211Bc:CCC
TNC Ecoregions: 58:C, 60:P, 61:C, 62:C, 63:C

SOURCES

References: Comer et al. 2003, Eastern Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723070#references

Description Author: R. Evans, mod. S.C. Gawler and L.A. Sneddon
Version: 14 Jan 2014
Concept Author: R. Evans

Stakeholders: East, Southeast
ClassifResp: East

NORTHERN ATLANTIC COASTAL PLAIN BASIN SWAMP AND WET HARDWOOD FOREST (CES203.520)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Forest and Woodland (Treed); North Atlantic Coastal Plain; Seepage-Fed Sloping
Non-Diagnostic Classifiers: Isolated Wetland [Partially Isolated]
National Mapping Codes: ESLF 9342

CONCEPT

Summary: This system is comprised of nonriverine hardwood swamps of seasonally flooded habitats, including relatively shallow groundwater-influenced depressions and Coastal Plain terraces. It ranges from the southern glaciated Atlantic Plain of Long Island, New York, south along the northern Coastal Plain to Virginia. Although supporting some seepage indicators, it is also affected by overland flow. The substrate is mineral soil overlain by a variable organic but non-peaty layer. Characteristic tree species include *Acer rubrum*, *Liquidambar styraciflua*, *Nyssa sylvatica*, *Quercus michauxii*, *Quercus pagoda*, *Quercus palustris*, and *Quercus phellos*. *Pinus taeda* is not uncommon south of Delaware Bay.
Classification Comments: Vegetation along streams is accommodated in a new system, Northern Atlantic Coastal Plain Stream and River (CES203.070).
Similar Ecological Systems:
- Southern Coastal Plain Nonriverine Basin Swamp (CES203.384)

Related Concepts:
- Pin Oak - Sweetgum: 65 (Eyre 1980) Finer
- Pond Pine: 98 (Eyre 1980) Finer
- Red Maple: 108 (Eyre 1980) Finer
- Swamp Chestnut Oak - Cherrybark Oak: 91 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs in low-lying areas, such as stream headwaters or depressions, or along water courses.
Vegetation: Characteristic tree species include *Acer rubrum*, *Liquidambar styraciflua*, *Nyssa sylvatica*, *Quercus phellos*, and *Fraxinus pennsylvanica*. *Pinus taeda* is not uncommon south of Delaware Bay.
Dynamics: This system occurs on extensive, flat terraces and very wide, ancient floodplains that are no longer subject to alluvial processes. Its hydrology is seasonally to nearly permanently saturated, with occasional ponding or groundwater sheetflows, and is maintained by a high water table rather than riverine or estuarine flooding.

Component Associations:
- *Acer rubrum - Fraxinus pennsylvanica / Saururus cernuus* Forest (CEGL006606, G3G4)
- *Acer rubrum - Nyssa sylvatica - Liquidambar styraciflua - Populus heterophylla* Forest (CEGL006013, G1)
- *Liquidambar styraciflua - Acer rubrum - Nyssa biflora / Carex joorii* Forest (CEGL006223, G1G2)
- *Liquidambar styraciflua - Acer rubrum - Quercus phellos / Leucothoe racemosa* Forest (CEGL006110, G3)
- *Quercus (phellos, pagoda, michauxii) / Ilex opaca var. opaca / Clethra alnifolia / Woodwardia areolata* Forest (CEGL004644, G2?)
- *Quercus falcata - Quercus phellos / Ilex opaca* Forest (CEGL006390, GNR)
- *Quercus palustris - (Quercus bicolor) - Acer rubrum / Vaccinium corymbosum / Osmunda cinnamomea* Forest (CEGL006240, GNR)

DISTRIBUTION

Range: It ranges from Long Island, New York, south to Virginia.
Divisions: 203:C
Nations: US
Subnations: DE, MD, NJ, NY, PA, VA
Map Zones: 60:C, 65:C
TNC Ecoregions: 58:C, 62:C

SOURCES

References: Comer et al. 2003, Eastern Ecology Working Group n.d., Faber-Langendoen et al. 2011, NYNHP 2013c, Rhoads and Block 2011d, Stevens 1992, Zimmerman et al. 2012
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723072#references
Description Author: R. Evans, mod. J. Teague, M. Pyne, L.A. Sneddon
Version: 14 Jan 2014 **Stakeholders:** East, Southeast

Concept Author: R. Evans **ClassifResp:** East

NORTHERN ATLANTIC COASTAL PLAIN PITCH PINE LOWLAND (CES203.374)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Non-Diagnostic Classifiers: Woody-Herbaceous; Extensive Wet Flat
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2456; ESLF 9125; ESP 1456

CONCEPT

Summary: This system is comprised of wetland Pine Barrens vegetation and Coastal Plain peatlands from the New Jersey Pine Barrens south into the Delmarva Peninsula and upper Chesapeake Bay. Although this system can be extensive, components often co-occur as a mosaic with upland pine barrens vegetation as well. The vegetation is characterized by associations having variable hydroperiods, occurring on a range of substrates from saturated deep peats to seasonally saturated mineral soils. Physiognomy of the component associations is similarly widely variable, ranging from wet grasslands dominated by *Calamovilfa brevipilis*, to boggy shrublands characterized by *Gaylussacia dumosa, Chamaedaphne calyculata, Leucothoe racemosa*, and others, to seasonally saturated pine forests characterized by mesic species such as *Clethra alnifolia*. Fire frequency, as well as hydrology, has a profound influence on the vegetation. Where fire frequency is high, woody vegetation is impeded, favoring the development of large wet grasslands.
Classification Comments: Ponded wetlands with standing water (which may drop over the course of the season) and mineral soils are treated as Northern Atlantic Coastal Plain Pond (CES203.518).
Similar Ecological Systems:
- Atlantic Coastal Plain Northern Bog (CES203.893)--occurs to the north.
- Northern Atlantic Coastal Plain Pond (CES203.518)--pitch pine wetlands set in low areas of the pine barrens and similar areas.

Related Concepts:
- Pitch Pine: 45 (Eyre 1980) Undetermined

DESCRIPTION

Environment: This system occurs within the larger matrix of pitch pine - scrub oak barrens of the New Jersey Pinelands. Hydrology is primarily groundwater-controlled; vegetation composition is a reflection of depth to water table.
Dynamics: This system and the composition and structure of its mosaic of patch types are influenced by depth to water table (Ehrenfeld 1986). Pitch pines are also structured by fires, but fire regime differs from uplands in that in the wet environment, fire frequency is lower, but the high shrub density often leads to crown fires. In high-intensity fires, pitch pines are killed, and even the organic layer may be consumed during periods of drought. Successional pathways following fire depend on depth of remaining organic layer and proximity of seed source (Little 1979c).

Component Associations:
- *Acer rubrum - Nyssa sylvatica - Magnolia virginiana / Viburnum nudum var. nudum / Osmunda cinnamomea - Woodwardia areolata* Forest (CEGL006238, G3?)
- *Chamaedaphne calyculata / Carex striata* Dwarf-shrubland (CEGL006208, GNR)
- *Gaylussacia dumosa / Calamovilfa brevipilis* Shrub Herbaceous Vegetation (CEGL006397, G1)
- *Nyssa sylvatica - Magnolia virginiana - (Pinus rigida) / Rhododendron viscosum - Toxicodendron vernix / Smilax pseudochina* Woodland (CEGL006219, G1)
- *Panicum virgatum* Seasonally Flooded Herbaceous Vegetation (CEGL004128, GNR)
- *Pinus rigida - Nyssa sylvatica / Clethra alnifolia - Leucothoe racemosa* Forest (CEGL006926, G2G3)
- *Pinus rigida / Chamaedaphne calyculata / Sphagnum* spp. Woodland (CEGL006194, G3G5)
- *Pinus rigida / Gaylussacia baccata - Kalmia angustifolia* Woodland (CEGL006387, GNR)
- *Pinus rigida / Gaylussacia dumosa / Calamovilfa brevipilis* Woodland (CEGL006388, G1)
- *Pinus rigida / Vaccinium corymbosum - Leucothoe racemosa / Sphagnum* spp. Woodland (CEGL006195, G3)
- *Vaccinium corymbosum / Sphagnum* spp. Shrubland (CEGL006190, G4)

DISTRIBUTION

Range: This system is best developed in the New Jersey Pine Barrens, but occurrences are present south to the inner Coastal Plain of Maryland.
Divisions: 203:C
Nations: US
Subnations: DE?, MD, NJ
Map Zones: 60:C
USFS Ecomap Regions: 232A:CC, 232H:CC
TNC Ecoregions: 58:C, 62:C

SOURCES

References: Comer et al. 2003, Eastern Ecology Working Group n.d., Ehrenfeld 1986, Faber-Langendoen et al. 2011, Little 1979c, Zampella et al. 1992

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723142#references

Description Author: R. Evans and L.A. Sneddon, mod. S.C. Gawler

Version: 14 Jan 2014 **Stakeholders:** East, Southeast

Concept Author: R. Evans and L. Sneddon **ClassifResp:** East

NORTHERN ATLANTIC COASTAL PLAIN TIDAL SWAMP (CES203.282)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Forest and Woodland (Treed); Tidal / Estuarine
National Mapping Codes: ESLF 9303

CONCEPT

Summary: This system encompasses freshwater to oligohaline tidally-flooded deciduous forests and shrublands in lower river floodplains and edges of estuaries of the North Atlantic Coastal Plain. This system is restricted to narrow zones along upper tidal reaches of Inner Coastal Plain rivers and tributaries which have sufficient volumes of freshwater and short flooding to support tree canopies. These areas are influenced by lunar tides up to 1 m (3 feet), but diluting freshwater flows from upstream, keeping salinity levels below 0.5 ppt. Deciduous hardwood species predominate, especially *Nyssa biflora* and/or *Fraxinus profunda* or *Fraxinus pennsylvanica*. In Maryland and Virginia, *Taxodium distichum* may be locally dominant.
Classification Comments: The range of this system is generally conceived as Chesapeake Bay and northward (e.g., in the Coastal Plain from the James River, Virginia, northward to New Jersey). Examples of tidal swamp forests south of this region are treated under Southern Atlantic Coastal Plain Tidal Wooded Swamp (CES203.240); the boundaries may overlap somewhere in Virginia.
Similar Ecological Systems:
- Southern Atlantic Coastal Plain Tidal Wooded Swamp (CES203.240)

Related Concepts:
- Baldcypress: 101 (Eyre 1980) Finer

DESCRIPTION

Environment: This association occurs along fresh reaches of tidal rivers, usually receiving diurnal or irregular tidal flooding. There is distinct hummock-and-hollow microtopography with hollows flooded during higher tides. Soil is generally organic-rich and contains a frequently deep organic horizon over silty alluvial deposits. Pronounced hummock-and-hollow microtopography is characteristic. Hollows are inundated by diurnal tides; hummocks may be only irregularly flooded, and the tops of hummocks are only rarely (< annually) submerged (Rheinhardt and Hershner 1992).
Dynamics: Development and persistence of this association appears to be limited downstream by halinity and upstream by the availability of sufficient sediment. Hence, tidal hardwood swamps are associated primarily with the upper (higher halinity) end of the freshwater portion of the halinity gradient and typically occur on higher landscape positions adjacent to tidal freshwater marshes (Rheinhardt and Hershner 1992). These swamps are maintained by regular biomass input deposited by regular tidal flow.

Component Associations:
- *Acer rubrum - Fraxinus pennsylvanica / Polygonum* spp. Forest (CEGL006165, G2)
- *Alnus (incana ssp. rugosa, serrulata) - Cornus amomum* Shrubland (CEGL006337, GNR)
- *Fraxinus profunda - Nyssa biflora - (Fraxinus pennsylvanica) / Ilex verticillata / Polygonum arifolium* Forest (CEGL006287, G3)
- *Pinus taeda - Nyssa biflora - Taxodium distichum / Morella cerifera / Osmunda regalis var. spectabilis* Forest (CEGL004651, G2?)
- *Taxodium distichum - Nyssa biflora - Fraxinus profunda / Peltandra virginica - (Bignonia capreolata)* Tidal Forest (CEGL006850, G3)
- *Taxodium distichum / Carex hyalinolepis* Woodland (CEGL004654, G2?)

DISTRIBUTION

Range: This system ranges from the James River, Virginia, northward to the New Jersey Coastal Plain. Possible occurrence of this system in Pennsylvania requires additional study. Examples are probably most common in the Chesapeake Bay region.
Divisions: 203:C
Nations: US
Subnations: DE, MD, NJ, NY, PA?, VA
Map Zones: 60:C, 65:C
TNC Ecoregions: 58:C, 62:C

SOURCES

References: Comer et al. 2003, Eyre 1980, Faber-Langendoen et al. 2011, Fleming and Patterson 2013, Fleming et al. 2013, NYNHP 2013d, Rheinhardt and Hershner 1992
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723205#references
Description Author: R. Evans and P. Coulling, mod. L.A. Sneddon
Version: 14 Jan 2014 **Stakeholders:** East, Southeast

Concept Author: R. Evans and P. Coulling **ClassifResp:** East

NORTHERN ROCKY MOUNTAIN CONIFER SWAMP (CES306.803)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Saturated Soil; Forest and Woodland (Treed); Seepage-Fed Sloping [Mineral]; Depressional; Mineral: W/ A-Horizon <10 cm
Non-Diagnostic Classifiers: Montane; Toeslope; Valley bottom; Temperate [Temperate Continental]; Bench; Needle-Leaved Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2161; ESLF 9111; ESP 1161

CONCEPT

Summary: This ecological system occurs in the northern Rocky Mountains from northwestern Wyoming north into the Canadian Rockies and west into eastern Oregon and Washington. It is dominated by conifers on poorly drained soils that are saturated year-round or may have seasonal flooding in the spring. These are primarily on flat to gently sloping lowlands, but also occur up to near the lower limits of continuous forest (below the subalpine parkland). It can occur on steeper slopes where soils are shallow over unfractured bedrock. This system is indicative of poorly drained, mucky areas, and areas are often a mosaic of moving water and stagnant water. Soils can be woody peat, muck or mineral but tend toward mineral. Stands generally occupy sites on benches, toeslopes or valley bottoms along mountain streams. Associations present include wetland phases of *Thuja plicata, Tsuga heterophylla,* and *Picea engelmannii* forests. The wetland types are generally distinguishable from other upland forests and woodlands by shallow water tables and mesic or hydric undergrowth vegetation; some of the most typical species include *Athyrium filix-femina, Dryopteris* spp., *Lysichiton americanus, Equisetum arvense, Senecio triangularis, Mitella breweri, Mitella pentandra, Streptopus amplexifolius, Calamagrostis canadensis*, or *Carex disperma*.
Classification Comments: May need to split out calcareous cedar (*Thuja plicata*) swamps from the other conifer swamps- needs more review.
Related Concepts:
- Engelmann Spruce - Subalpine Fir: 206 (Eyre 1980) Intersecting. Swamps dominated by engelmann spruce occur in this system.
- Western Redcedar - Western Hemlock: 227 (Eyre 1980) Intersecting
- Western Redcedar: 228 (Eyre 1980) Intersecting

Component Associations:
- *Abies lasiocarpa - Picea engelmannii / Oplopanax horridus* Forest (CEGL000322, G3)
- *Abies lasiocarpa - Picea engelmannii / Streptopus amplexifolius* Forest (CEGL000336, G4)
- *Betula glandulosa / Carex* spp. Shrubland (CEGL005887, GNR)
- *Betula glandulosa / Carex utriculata* Shrubland (CEGL001079, G4?)
- *Picea (engelmannii X glauca, engelmannii) / Carex disperma* Forest (CEGL000405, G2Q)
- *Picea (engelmannii X glauca, engelmannii) / Lysichiton americanus* Forest (CEGL000412, G2)
- *Picea engelmannii / Calamagrostis canadensis* Forest (CEGL002678, G4)
- *Picea engelmannii / Caltha leptosepala* Forest (CEGL000357, G3?)
- *Picea engelmannii / Equisetum arvense* Forest (CEGL005927, G4)
- *Thuja plicata - Tsuga heterophylla / Lysichiton americanus / Sphagnum* spp. Forest (CEGL001787, G3G4)
- *Thuja plicata - Tsuga heterophylla / Lysichiton americanus* Forest (CEGL002670, G3?)
- *Thuja plicata - Tsuga heterophylla / Oplopanax horridus* Rocky Mountain Forest (CEGL000479, G3)
- *Thuja plicata / Athyrium filix-femina* Forest (CEGL000473, G3G4)
- *Thuja plicata / Carex disperma* Forest (CEGL005931, G2?)

DISTRIBUTION

Range: This system occurs in the northern Rocky Mountains from northwestern Wyoming and central Montana, north into the Canadian Rockies and west into eastern Oregon and Washington.
Divisions: 306:C
Nations: CA, US
Subnations: AB, BC, ID, MT, OR, WA, WY
Map Zones: 9:C, 10:C, 19:C, 20:C, 21:C, 29:C
USFS Ecomap Regions: 331A:PP, M331A:PP, M331D:P?, M332A:CC, M332B:CC, M332D:CP, M332E:CP, M332F:CC, M332G:CP, M333A:CC, M333B:CC, M333C:CC, M333D:CC
TNC Ecoregions: 7:C, 8:C, 9:P, 26:C, 68:C

SOURCES

References: Comer et al. 2003, Meidinger and Pojar 1991, NCC 2002

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722870#references
Description Author: M.S. Reid
Version: 07 Sep 2005 **Stakeholders:** Canada, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

NORTHERN ROCKY MOUNTAIN LOWER MONTANE RIPARIAN WOODLAND AND SHRUBLAND (CES306.804)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Short (<5 yrs) Flooding Interval [Short interval, Spring Flooding]; Montane [Lower Montane]; Riverine / Alluvial
Non-Diagnostic Classifiers: Circumneutral Water; Forest and Woodland (Treed); Shrubland (Shrub-dominated); Temperate [Temperate Continental]; Unconsolidated
National Mapping Codes: ESLF 9155

CONCEPT

Summary: This ecological system of the northern Rocky Mountains and the east slopes of the Cascades consists of deciduous, coniferous, and mixed conifer-deciduous forests that occur on streambanks and river floodplains of the lower montane and foothill zones. Riparian forest stands are maintained by annual flooding and hydric soils throughout the growing season. Riparian forests are often accompanied by riparian shrublands or open areas dominated by wet meadows. *Populus balsamifera* is the key indicator species. Several other tree species can be mixed in the canopy, including *Populus tremuloides*, *Betula papyrifera*, *Betula occidentalis*, *Picea mariana*, and *Picea glauca*. *Abies grandis*, *Thuja plicata*, and *Tsuga heterophylla* are commonly dominant canopy species in British Columbia, western Montana and northern Idaho occurrences, in lower montane riparian zones. Shrub understory components include *Cornus sericea*, *Acer glabrum*, *Alnus incana*, *Betula papyrifera*, *Oplopanax horridus*, and *Symphoricarpos albus*. Ferns and forbs of mesic sites are commonly present in many occurrences, including such species as *Athyrium filix-femina*, *Gymnocarpium dryopteris*, and *Senecio triangularis*.
Classification Comments: This system is from the Canadian Rockies ecoregion project and represents lower montane riparian in Montana north into Canada. In the Okanagan, this is defined as all the cottonwood-dominated or -codominated riparian systems below subalpine and above the Ponderosa pine zone. This system occurs in fire-dominated landscapes, which distinguishes it from North Pacific and subalpine/alpine landscapes that have significantly different fire regimes. This system is distinguished from the similar Rocky Mountain Subalpine-Montane Riparian Woodland (CES306.833) by the floristic component of northern Rocky Mountain species, both in the woody layers and in the herbaceous taxa. This system may occur in northwestern Wyoming where *Populus balsamifera* dominates or codominates some woodlands, but those woodlands may be better placed into Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821), which lists *Populus balsamifera* as a possible dominant.
Similar Ecological Systems:
- Columbia Basin Foothill Riparian Woodland and Shrubland (CES304.768)
- Rocky Mountain Subalpine-Montane Riparian Woodland (CES306.833)

Related Concepts:
- Act - Dogwood - Prickly rose (SBSdk/08) (Steen and Coupe 1997) Intersecting
- Act - Dogwood - Prickly rose (SBSdk/08) (DeLong et al. 1993) Intersecting
- Act - Dogwood - Prickly rose (SBSdk/08) (Banner et al. 1993) Intersecting
- Act - Dogwood - Prickly rose, High-bench (SBSdk/08) (Steen and Coupe 1997) Intersecting
- Act - Dogwood - Prickly rose, High-bench (SBSdk/08) (DeLong et al. 1993) Intersecting
- Act - Dogwood - Prickly rose, High-bench (SBSdk/08) (Banner et al. 1993) Intersecting
- Act - Dogwood - Prickly rose, Medium-bench (SBSdk/08) (Steen and Coupe 1997) Intersecting
- Act - Dogwood - Prickly rose, Medium-bench (SBSdk/08) (Banner et al. 1993) Intersecting
- Act - Dogwood - Prickly rose, Medium-bench (SBSdk/08) (DeLong et al. 1993) Intersecting
- ActBl - Devil's club (SBSvk/12) (DeLong 2003) Intersecting
- ActSxw - Red-osier dogwood (SBSwk1/13) (DeLong 2003) Intersecting
- ActSxw - Red-osier dogwood (SBSwk1/13) (Steen and Coupe 1997) Intersecting
- Bebb's willow - Bluejoint (SBSdk/Ws03) (Banner et al. 1993) Intersecting
- Bebb's willow - Bluejoint (SBSdk/Ws03) (DeLong et al. 1993) Intersecting
- Bebb's willow - Bluejoint (SBSdk/Ws03) (Steen and Coupe 1997) Intersecting
- Black Cottonwood - Willow: 222 (Eyre 1980) Intersecting
- CR Black Cottonwood Riparian (Ecosystems Working Group 1998) Broader
- Drummond's willow - Beaked sedge (ESSFdc2/Ws04) (Steen and Coupe 1997) Intersecting
- Drummond's willow - Beaked sedge (ICHvc/Ws04) (Banner et al. 1993) Intersecting
- Drummond's willow - Beaked sedge (MSxk/Ws04) (Steen and Coupe 1997) Intersecting
- Drummond's willow - Beaked sedge (SBPSmk/Ws04) (Steen and Coupe 1997) Intersecting
- Drummond's willow - Beaked sedge (SBSdk/Ws04) (DeLong et al. 1993) Intersecting
- Drummond's willow - Beaked sedge (SBSdk/Ws04) (Steen and Coupe 1997) Intersecting
- Drummond's willow - Beaked sedge (SBSdk/Ws04) (Banner et al. 1993) Intersecting

- Drummond's willow - Beaked sedge (SBSmc2/Ws04) (Banner et al. 1993) Intersecting
- Drummond's willow - Beaked sedge (SBSmc2/Ws04) (DeLong et al. 1993) Intersecting
- Drummond's willow - Beaked sedge (SBSmk1/Ws04) (DeLong et al. 1993) Intersecting
- Drummond's willow - Beaked sedge (SBSwk1/Ws04) (DeLong 2003) Intersecting
- Drummond's willow - Beaked sedge (SBSwk1/Ws04) (Steen and Coupe 1997) Intersecting
- Drummond's willow - Bluejoint (ICHmc2/56) (Banner et al. 1993) Intersecting
- Drummond's willow - Bluejoint (SBPSdc/Fl05) (Steen and Coupe 1997) Intersecting
- Drummond's willow - Bluejoint (SBPSdc/Fl05) (MacKenzie and Moran 2004) Intersecting
- Drummond's willow - Bluejoint (SBSdk/54) (DeLong et al. 1993) Intersecting
- Drummond's willow - Bluejoint (SBSdk/54) (Steen and Coupe 1997) Intersecting
- Drummond's willow - Bluejoint (SBSdk/54) (Banner et al. 1993) Intersecting
- Drummond's willow - Bluejoint (SBSdk/Fl05) (DeLong et al. 1993) Intersecting
- Drummond's willow - Bluejoint (SBSdk/Fl05) (Steen and Coupe 1997) Intersecting
- Drummond's willow - Bluejoint (SBSdk/Fl05) (Banner et al. 1993) Intersecting
- Drummond's willow - Bluejoint (SBSdw3/Fl05) (Banner et al. 1993) Intersecting
- Drummond's willow - Bluejoint (SBSdw3/Fl05) (DeLong et al. 1993) Intersecting
- Mountain alder - Common horsetail (BWBSdk1/Fl01) (MacKinnon et al. 1990) Intersecting
- Mountain alder - Common horsetail (BWBSdk1/Fl01) (Banner et al. 1993) Intersecting
- Mountain alder - Common horsetail (CWHwm/Fl01) (Banner et al. 1993) Intersecting
- Mountain alder - Common horsetail (ICHvc/Fl01) (Banner et al. 1993) Intersecting
- Mountain alder - Common horsetail (MSxv/Fl01) (Steen and Coupe 1997) Intersecting
- Mountain alder - Common horsetail (SBSvk/Fl01) (DeLong 2003) Intersecting
- Mountain alder - Lady fern (SBSvk/11) (DeLong 2003) Intersecting
- Mountain alder - Lady fern (SBSvk/51) (DeLong 2003) Intersecting
- Mountain alder - Mitrewort (SBSdk/53) (Steen and Coupe 1997) Intersecting
- Mountain alder - Mitrewort (SBSdk/53) (DeLong et al. 1993) Intersecting
- Mountain alder - Mitrewort (SBSdk/53) (Banner et al. 1993) Intersecting
- Mountain alder - Red-osier dogwood - Horsetail (SBSdk/Fl02) (Steen and Coupe 1997) Intersecting
- Mountain alder - Red-osier dogwood - Horsetail (SBSdk/Fl02) (Banner et al. 1993) Intersecting
- Mountain alder - Red-osier dogwood - Horsetail (SBSdk/Fl02) (DeLong et al. 1993) Intersecting
- Mountain alder - Red-osier dogwood - Horsetail (SBSmk2/Fl02) (MacKinnon et al. 1990) Intersecting
- Mountain alder - Red-osier dogwood - Horsetail (SBSvk/Fl02) (DeLong 2003) Intersecting
- Mountain alder - Red-osier dogwood - Horsetail (SBSwk1/Fl02) (DeLong 2003) Intersecting
- Mountain alder - Red-osier dogwood - Horsetail (SBSwk1/Fl02) (Steen and Coupe 1997) Intersecting
- Mountain alder - Stinging nettle (SBSdk/52) (Banner et al. 1993) Intersecting
- Mountain alder - Stinging nettle (SBSdk/52) (Steen and Coupe 1997) Intersecting
- Mountain alder - Stinging nettle (SBSdk/52) (DeLong et al. 1993) Intersecting
- RR Western Redcedar - Black Cottonwood Riparian (Ecosystems Working Group 1998) Broader
- Western Redcedar - Western Hemlock: 227 (Eyre 1980) Intersecting
- Western Redcedar: 228 (Eyre 1980) Intersecting
- WR Hybrid White Spruce - Black Cottonwood Riparian (Ecosystems Working Group 1998) Broader
- Ws - Thimbleberry (SBSdk/51) (Steen and Coupe 1997) Intersecting
- Ws - Thimbleberry (SBSdk/51) (Banner et al. 1993) Intersecting
- Ws - Thimbleberry (SBSdk/51) (DeLong et al. 1993) Intersecting

DESCRIPTION

Environment: Alluvial soils along perennial and intermittent streams. Valley type is an important variable, as riparian woodlands are mostly found in V-shaped, steep valleys with many large boulders and coarse soils or U-shaped gullies formed by glacial processes. These systems can also be found in broad unconfined reaches with deeper soils and more complex geomorphic surfaces. Narrow and steep (i.e., confined) occurrences have minimal to no floodplain development, whereas less steep and wider valley bottoms (i.e., unconfined) occurrences are often associated with substantial floodplain development (Gregory et al. 1991).

Dynamics: Natural disturbance regimes are the primary influence on riparian system characteristics. Maintained by the complex interaction of hydrological and geomorphological processes which influence periodic flooding and hydric soils, riparian systems are the most dynamic of all forested, woodland and shrub systems. Hydrogeomorphology determines the form, composition and function of riparian woodland and shrub systems. Typically occurring in watersheds with snow-dominated hydrological processes, sometimes mixed rain and snow, these riparian systems are further influenced by the variability of inter-annual and seasonal weather patterns. Typical flow regimes of British Columbia's central interior plateau and mountains are snow- (nival) dominated. Precipitation falls as snow and is stored for long periods of time, resulting in low winter flows, and peak flows following snowmelt in May to July (depending on annual temperature variations and snow depth). Glacial snow regimes are similar to nival, except that high flows may continue until August or September (Eaton and Moore 2010). Periods of peak flow have greatest influence on channel morphology and vegetation dynamics. Large woody debris is important for affecting channel morphology.

Beaver can be important hydrogeomorphic driver of montane riparian systems, especially along unconfined reaches. The direct, local

presence of beaver creates a heterogeneous complex of wet meadows, marshes and riparian shrublands and increases species richness on the landscape. Naiman et al. (1988) note that beaver-influenced streams are very different from those not impacted by beaver activity by having numerous zones of open water and vegetation, large accumulations of detritus and nutrients, more wetland areas, having more anaerobic biogeochemical cycles, and in general are more resistance to disturbance.

Component Associations:
- *Abies grandis / Athyrium filix-femina* Forest (CEGL000270, G3Q)
- *Abies grandis / Senecio triangularis* Forest (CEGL000280, G3)
- *Populus balsamifera (ssp. trichocarpa, ssp. balsamifera) / Symphoricarpos (albus, oreophilus, occidentalis)* Forest (CEGL000677, G2)
- *Populus balsamifera ssp. trichocarpa - (Populus tremuloides) / Heracleum maximum* Forest (CEGL000542, G2)
- *Populus balsamifera ssp. trichocarpa - Alnus rhombifolia* Forest (CEGL000668, G1)
- *Populus balsamifera ssp. trichocarpa / Alnus incana* Forest (CEGL000667, G3)
- *Populus balsamifera ssp. trichocarpa / Betula papyrifera* Forest (CEGL000670, GNRQ)
- *Populus balsamifera ssp. trichocarpa / Calamagrostis canadensis* Forest (CEGL005845, G2?)
- *Populus balsamifera ssp. trichocarpa / Cornus sericea* Forest (CEGL000672, G3G4)
- *Populus balsamifera ssp. trichocarpa / Oplopanax horridus - Acer glabrum* Forest (CEGL000482, G2)
- *Thuja plicata - Tsuga heterophylla / Oplopanax horridus* Rocky Mountain Forest (CEGL000479, G3)
- *Thuja plicata / Gymnocarpium dryopteris* Forest (CEGL000476, G3)
- *Tsuga heterophylla / Athyrium filix-femina* Forest (CEGL000491, G2Q)
- *Tsuga heterophylla / Gymnocarpium dryopteris* Forest (CEGL000494, G3G4)

DISTRIBUTION

Range: This system is found in the northern Rocky Mountains.
Divisions: 303:P; 306:C
Nations: CA, US
Subnations: AB, BC, ID, MT, OR?, WA, WY
Map Zones: 8:C, 9:C, 10:C, 18:?, 19:C, 20:C, 21:C, 22:P
USFS Ecomap Regions: 331A:P?, 331D:PP, 331N:PP, 342A:??, 342C:??, 342D:??, M242C:PP, M331A:PP, M331B:P?, M332A:CP, M332B:CC, M332D:CC, M332E:CC, M332F:CC, M332G:CP, M333A:CC, M333B:CP, M333C:CC, M333D:CC
TNC Ecoregions: 7:C, 8:C, 68:C

SOURCES

References: Bales et al. 2006, Banner et al. 1993, CNHP 2010b, Comer et al. 2003, DeLong 2003, DeLong et al. 1993, Eaton and Moore 2010, Ecosystems Working Group 1998, Eyre 1980, Gregory et al. 1991, Hansen et al. 1988b, Hansen et al. 1989, Haughian et al. 2012, Karl et al. 2009, Kerns et al. 2009, Knowles et al. 2006, MacKenzie and Moran 2004, MacKinnon et al. 1990, Naiman et al. 1988, NCC 2002, Peterson et al. 2008, Schreiner 1974, Steen and Coupe 1997, Stewart et al. 2004, Stromberg et al. 2010b, Wiensczyk 2012, WNHP 2011
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722869#references
Description Author: M.S. Reid, mod. G. Kittel
Version: 14 Jan 2014 **Stakeholders:** Canada, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

NORTHERN ROCKY MOUNTAIN WOODED VERNAL POOL (CES304.060)

CLASSIFIERS

Classification Status: Standard

Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Depressional; Isolated Wetland [Strictly Isolated]
National Mapping Codes: ESLF 9162

CONCEPT

Summary: These wooded vernal pools are small shallow circumneutral freshwater wetlands of glacial origin that partially or totally dry up as the growing season progresses. They are documented to occur in northern Idaho and western Montana. These vernal ponds and wetlands usually fill with water over the fall, winter and early spring, but then at least partially dry up towards the end of the growing season. Depending on annual patterns of temperature and precipitation, the drying of the pond may be complete or partial by the fall. These sites are usually shallow and less than 1 m in depth, but can be as much as 2 m deep. The pool substrate is a poorly drained, often clayey layer with shallow organic sediments. The freshwater ponds have pH ranges from 6.2 to 7.8 with most measurements between 6.5 and 7.5, i.e., relatively neutral. The ponds in Montana were thought to be isolated, but it has been shown that in high water years the ponds spill over, and there is an exchange of surface water between ponds. The pools have a ring of trees surrounding the ponds that provide shade and influence their hydrology. A variety of tree species dominant the upper canopy, including *Abies grandis*, *Abies lasiocarpa*, *Larix occidentalis*, *Picea engelmannii*, *Pinus contorta*, *Pseudotsuga menziesii*, and the broadleaf trees *Populus balsamifera ssp. trichocarpa (= Populus trichocarpa)* (black cottonwood), *Fraxinus latifolia*, and, to a lesser extent, *Populus tremuloides* (quaking aspen) and *Betula papyrifera* (paper birch). Common shrubs include *Alnus incana*, *Cornus sericea (= Cornus stolonifera)*, *Rhamnus alnifolia*, and *Salix* spp. *Alopecurus aequalis*, *Callitriche heterophylla*, *Carex vesicaria* (inflated sedge), *Eleocharis palustris*, and *Phalaris arundinacea* (reed canarygrass) are common herbaceous plant associates.

DISTRIBUTION

Divisions: 304:C
Nations: US
Subnations: ID, MT
Map Zones: 9:P, 10:C, 19:C, 21:P
USFS Ecomap Regions: M332A:??, M332B:??, M332E:??, M332G:??, M333A:PP, M333B:PP, M333C:PP, M333D:PP
TNC Ecoregions: 7:C, 8:P, 68:C

SOURCES

References: Mincemoyer 2005, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.785246#references
Description Author: G. Kittel
Version: 01 Oct 2007
Concept Author: Western Ecology Group
Stakeholders: West
ClassifResp: West

NORTHWESTERN GREAT PLAINS FLOODPLAIN (CES303.676)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Western Great Plains (303)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Non-Diagnostic Classifiers: Long (>25 yrs) Flooding Interval; Floodplain; Forest and Woodland (Treed); Riverine / Alluvial
National Mapping Codes: ESLF 9159

CONCEPT

Summary: This ecological system is found in the floodplains of medium and large rivers of the northwestern Great Plains, ranging from the Dakotas Mixedgrass Prairie west through the Northern Great Plains Steppe and north into Canada. This system occurs in the upper Missouri River Basin and includes parts of the Niobrara, White, Cheyenne, Little Missouri, Yellowstone, Powder, Bighorn, Milk, and Musselshell rivers. Alluvial soils and periodic, intermediate flooding (every 5-25 years) typify this system. These are the perennial big rivers of the region with hydrologic dynamics largely driven by snowmelt in the mountains, rather than local precipitation events. Dominant communities within this system range from floodplain forests to wet meadows to gravel/sand flats, however, they are linked by underlying soils and flooding regime. Dominant species are *Populus balsamifera ssp. trichocarpa* or *Populus deltoides* and *Salix* spp. *Fraxinus pennsylvanica, Salix amygdaloides*, and *Ulmus americana* are common in some stands. If present, common shrub species include *Amorpha fruticosa, Cornus drummondii, Cornus sericea, Symphoricarpos occidentalis, Salix exigua, Salix interior*, and *Salix planifolia*. Grass cover underneath the trees is an important part of this system and is a mix of cool-season graminoid species, including *Carex pellita (= Carex lanuginosa), Elymus lanceolatus, Pascopyrum smithii*, and *Schoenoplectus* spp., with warm-season species such as *Panicum virgatum, Schizachyrium scoparium*, and *Spartina pectinata*. This system is often subjected to heavy grazing and/or agriculture and can be heavily degraded. In Montana, most occurrences are now degraded to the point where the cottonwood overstory is the only remaining natural component; undergrowth is dominated by *Bromus inermis*, or a complex of pasture grasses. Another factor is that groundwater depletion and lack of fire have created additional species changes. In most cases, the majority of the wet meadow and prairie communities may be extremely degraded or extirpated from the system.

Classification Comments: This system needs to be more clearly delineated from Northwestern Great Plains Riparian (CES303.677). The component plant association list is incomplete. All the riparian/floodplain/alluvial systems of the Great Plains region need to be revisited for naming conventions, along with better definitions of conceptual boundaries. There is much apparent overlap in their concepts and distribution, and the names add to the confusion. In particular, the difference between "riparian" and "floodplain" usage in the names needs revisiting and possible changing. These systems include Northwestern Great Plains Floodplain (CES303.676), Northwestern Great Plains Riparian (CES303.677), Western Great Plains Floodplain (CES303.678), and Western Great Plains Riparian (CES303.956).

Similar Ecological Systems:
- Western Great Plains Floodplain (CES303.678)

Related Concepts:
- Bluestem Prairie (601) (Shiflet 1994) Intersecting
- Cottonwood: 63 (Eyre 1980) Finer
- Western Great Plains Floodplain (Rolfsmeier and Steinauer 2010) Broader

Component Associations:
- *Calamagrostis canadensis - Juncus* spp. - *Carex* spp. Sandhills Herbaceous Vegetation (CEGL002028, G3G4)
- *Carex nebrascensis* Herbaceous Vegetation (CEGL001813, G4)
- *Cornus drummondii - Amorpha fruticosa - Cornus sericea* Shrubland (CEGL005220, G4?)
- *Fraxinus pennsylvanica - (Ulmus americana) / Symphoricarpos occidentalis* Forest (CEGL002088, G4?)
- *Populus deltoides - (Salix amygdaloides) / Salix (exigua, interior)* Woodland (CEGL000659, G3G4)
- *Populus deltoides - Fraxinus pennsylvanica* Forest (CEGL000658, G2G3)
- *Populus deltoides / Cornus sericea* Forest (CEGL000657, G2G3)
- *Populus deltoides / Juniperus scopulorum* Woodland (CEGL002152, G1G2)
- Riverine Sand Flats - Bars Sparse Vegetation (CEGL002049, G4G5)
- *Salix planifolia* Shrubland (CEGL001224, G4)
- *Schoenoplectus acutus - Typha latifolia - (Schoenoplectus tabernaemontani)* Sandhills Herbaceous Vegetation (CEGL002030, G4)
- *Schoenoplectus tabernaemontani - Typha* spp. - (*Sparganium* spp., *Juncus* spp.) Herbaceous Vegetation (CEGL002026, G4G5)
- *Spartina pectinata - Carex* spp. Herbaceous Vegetation (CEGL001477, G3?)
- *Spartina pectinata* Western Herbaceous Vegetation (CEGL001476, G3?)
- *Symphoricarpos occidentalis* Shrubland (CEGL001131, G4G5)
- *Typha* spp. - *Schoenoplectus* spp. - Mixed Herbs Great Plains Herbaceous Vegetation (CEGL002228, G4G5)

DISTRIBUTION

Range: This system is found in the northwestern Great Plains, north of the North Platte River through southern Canada. It is found in eastern Montana along the upper Missouri, Yellowstone, Bighorn, Milk, and Musselshell rivers; in northern Nebraska and the Dakotas on the Niobrara, upper Missouri, White, Cheyenne, and Little Missouri rivers; and in Canada on the Saskatchewan River.
Divisions: 205:P; 303:C
Nations: CA, US
Subnations: AB, MB, MT, ND, NE, SD, SK, WY?
Map Zones: 20:C, 29:C, 30:C, 31:C, 39:C, 40:C
USFS Ecomap Regions: 331D:C?, 331E:C?, 331F:CC, 331G:CP, 331K:CC, 331L:CC, 331M:CC
TNC Ecoregions: 26:C, 34:C, 66:P, 67:P

SOURCES

References: Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722982#references
Description Author: S. Menard, K. Kindscher, mod. M.S. Reid and K.A. Schulz
Version: 23 Jan 2008 **Stakeholders:** Canada, Midwest, West
Concept Author: S. Menard, K. Kindscher, NatureServe Western Ecology Team **ClassifResp:** Midwest

PIEDMONT SEEPAGE WETLAND (CES202.298)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Forest and Woodland (Treed); Seepage-Fed Sloping
National Mapping Codes: ESLF 9308

CONCEPT

Summary: This Piedmont system consists of seepage-fed wetlands on gentle slopes, with substantial seepage flow. Vegetation is variable, both within and among examples. Included are hillside seepage bogs with substantial boggy flora and with strong influence by fire, and lower slope and floodplain edge seeps with forb-dominated vegetation.
Classification Comments: This system is fairly heterogeneous, covering a broad range of environments and vegetation. Two distinct subtypes can be recognized, which may warrant separating into different systems. Seepage bogs have a very distinctive flora, appear to be naturally influenced by fire, and usually occur in more upland settings, often with upland systems completely surrounding them. Some are related to the Atlantic Coastal Plain Sandhill Seep (CES203.253). Non-boggy seeps have a non-fire-tolerant flora and occur in lower topographic settings. Between these two extremes are seepage bogs with less Coastal Plain character, though they still have *Sarracenia* spp. There are also streamhead seeps, which have some bog flora and have Coastal Plain species, but which occur along drainages. They are transitional to Southern Piedmont Small Floodplain and Riparian Forest (CES202.323), but are also related to the Atlantic Coastal Plain Streamhead Seepage Swamp, Pocosin and Baygall (CES203.252). These different Piedmont wetland communities are put into one system, rather than separated as in the Coastal Plain, because the differences are not as sharp and the range of variation smaller within each. This system is readily distinguished from adjacent upland systems by the presence of wetland flora and soils, as well as seepage. They are somewhat less clearly distinguished from adjacent floodplain systems, but are distinctly wetter most of the time. They are saturated without having standing water as floodplain pools do. These differences are reflected in the vegetation.

Piedmont seepage wetlands are separated from Southern Appalachian Seepage Wetland (CES202.317) by floristic differences. A few examples in the upper Piedmont may be better placed with the southern Appalachian system, but most are geographically separated.
Similar Ecological Systems:
- Atlantic Coastal Plain Sandhill Seep (CES203.253)
- Atlantic Coastal Plain Streamhead Seepage Swamp, Pocosin and Baygall (CES203.252)
- East Gulf Coastal Plain Northern Seepage Swamp (CES203.554)
- North-Central Appalachian Acidic Swamp (CES202.604)--ranges south to northern Virginia.
- North-Central Interior and Appalachian Rich Swamp (CES202.605)--ranges south to northern Virginia.
- Southern Appalachian Seepage Wetland (CES202.317)
- Southern Piedmont Small Floodplain and Riparian Forest (CES202.323)

Related Concepts:
- Red Maple: 108 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs in small patches where seepage water creates wetland conditions. Seepage commonly occurs at the base of slopes. In Georgia, this occurs where water percolates through quartzite or where shallow soils overlie bedrock (Edwards et al. 2013) on the edge of bottomlands or in headwaters of small streams. Others occur on gently sloping hillsides where impermeable soils and slope force shallow groundwater to the surface. The soil is saturated seasonally to permanently, but has no substantial amount of standing water.
Vegetation: Vegetation generally is patchy and heterogeneous in structure. Most examples do not have closed tree canopies, and well-developed shrub or herb layers are almost always present. The trees are often not very distinctive, consisting of widespread wetland species, such as *Acer rubrum*, or of non-wetland species shared with adjacent communities. Often tree cover comes primarily from trees rooted in adjacent communities. The shrub layer normally consists of wetland species. *Alnus serrulata, Viburnum nudum, Vaccinium* spp., and other ericaceous species are most common. The herb layer is quite variable. Large wetland ferns such as *Osmunda cinnamomea* are often prominent. Various wetland grasses, sedges, and rushes may be abundant, and forbs such as *Impatiens capensis, Saururus cernuus, Boehmeria cylindrica,* and *Rudbeckia laciniata* are also often prominent. A distinct subtype is boggy in character, with substantial amounts of *Sphagnum*. The boggy seeps often have a number of species characteristic of Coastal Plain wetlands and otherwise absent in the Piedmont, such as *Sarracenia purpurea*, *Sarracenia flava, Smilax laurifolia,* and *Cyrilla racemiflora*. Examples from the southwestern end of this system's range (e.g., in Alabama's Talladega Ridge Subsection [231Dd] or level IV ecoregion 45d), contain *Magnolia virginiana*, which is more typical of the Coastal Plain.
Dynamics: The presence of seepage is the primary determinant of this system. Long-term droughts that affect seepage flow presumably have an effect. Canopy dynamics are not well known and potentially may vary substantially over short distances in response to wetness. Wetness clearly limits recruitment of most tree and shrub seedlings to drier microsites in the wettest examples.

Smaller examples are often shaded by trees rooted in adjacent forest communities. As in the surrounding forests, trees likely regenerate primarily in small gaps created by wind. Fire is an important influence in some examples. Many of the boggy seeps are associated with Southeastern Interior Longleaf Pine Woodland (CES202.319) and have a substantial fire-tolerant flora. At the other end of the spectrum, floodplain edge seeps may seldom if ever have burned. Long-term geomorphic processes may be important in these systems. Headward erosion by small streams, or meandering by larger stream channels, sometimes drains seeps and eliminates the wetland vegetation. Piedmont Seepage Wetland (CES202.298) are often left undisturbed when surrounding forests are logged. Effects of logging on water infiltration or surface flow may have significant indirect effects.

Component Associations:
- *Acer rubrum - Fraxinus (pennsylvanica, americana) / Lindera benzoin / Symplocarpus foetidus* Forest (CEGL006406, G4G5)
- *Acer rubrum - Nyssa sylvatica - Magnolia virginiana / Viburnum nudum var. nudum / Osmunda cinnamomea - Woodwardia areolata* Forest (CEGL006238, G3?)
- *Acer rubrum / Alnus serrulata - Lindera benzoin / Glyceria striata - Impatiens capensis* Seep Forest (CEGL007031, G4)
- *Acer rubrum / Viburnum nudum - Photinia pyrifolia / Smilax laurifolia / Carex debilis var. pubera* Seepage Forest (CEGL007041, G2)
- *Acer rubrum var. trilobum - Liriodendron tulipifera / Ilex opaca var. opaca / Osmunda cinnamomea* Forest (CEGL004551, G2G3)
- *Acer rubrum var. trilobum / Morella caroliniensis - Gaylussacia frondosa / Andropogon glomeratus - (Sarracenia flava)* Woodland (CEGL004781, G2)
- *Acer rubrum var. trilobum / Viburnum nudum var. nudum / Osmunda cinnamomea - Saururus cernuus - Impatiens capensis* Forest (CEGL004426, G3?)
- *Alnus serrulata - Magnolia virginiana / Andropogon glomeratus - Eupatorium pilosum - Rhynchospora gracilenta - Xyris torta* Shrubland (CEGL006499, GNR)

SPATIAL CHARACTERISTICS

Spatial Summary: Small-patch system, usually less than one acre.
Size: Occurs as small patches, most less than one acre in size. A few stream seepage wetlands may cover a couple of acres in branching linear bodies. Occasionally two or three patches will occur close enough together to be treated as a single occurrence, but most examples are isolated.
Adjacent Ecological Systems:
- Southeastern Interior Longleaf Pine Woodland (CES202.319)
- Southern Piedmont Dry Oak-(Pine) Forest (CES202.339)
- Southern Piedmont Large Floodplain Forest (CES202.324)
- Southern Piedmont Small Floodplain and Riparian Forest (CES202.323)

Adjacent Ecological System Comments: This system may be embedded in a variety of other systems. Most common are Southern Piedmont Dry Oak-(Pine) Forest (CES202.339), Southeastern Interior Longleaf Pine Woodland (CES202.319), Southern Piedmont Small Floodplain and Riparian Forest (CES202.323), and Southern Piedmont Large Floodplain Forest (CES202.324).

DISTRIBUTION

Range: This system ranges throughout the Piedmont, from Alabama to North Carolina and possibly southern Virginia.
Divisions: 202:C
Nations: US
Subnations: AL, GA, NC, SC, VA
Map Zones: 54:C, 59:C
USFS Ecomap Regions: 221D:CC, 231A:CC, 231I:CC, M221D:CC
TNC Ecoregions: 50:P, 52:C

SOURCES

References: Comer et al. 2003, Edwards et al. 2013, Engeman et al. 2007, Eyre 1980, Nordman 2012
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723193#references
Description Author: M. Schafale and R. Evans, mod. M. Pyne and C. Nordman
Version: 14 Jan 2014 **Stakeholders:** East, Southeast
Concept Author: M. Schafale and R. Evans **ClassifResp:** Southeast

PIEDMONT UPLAND DEPRESSION SWAMP (CES202.336)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Depressional
Non-Diagnostic Classifiers: Shrubland (Shrub-dominated); Isolated Wetland [Strictly Isolated]
National Mapping Codes: ESLF 9302

CONCEPT

Summary: This system represents isolated wetlands primarily of the Piedmont in small, shallow basins in upland settings where water pools due to limited soil drainage. Most known examples occur over mafic bedrock. The typical hydrology is seasonally flooded. Most examples consist of forests of wetland oaks, but a few are treeless or open-canopied ponds. Vegetation in open ponds is typically zoned with an outer ring of trees, a more interior ring of shrubs, herbs and vines, and a central area with or without standing water year round depending on precipitation. This system also includes the wet hardwood forests ("Iredell Flatwoods" or "Gabbro Glades") which occur on gently sloping terrain or shallowly depressed upland flats over gabbro-derived clays in the Piedmont of Georgia and South Carolina. A few examples of this system occur in the adjacent Southern Blue Ridge; these are extremely rare and small-patch examples.

Classification Comments: This system is distinct from all other Piedmont systems in its ponded wetland hydrology in upland settings. The vegetation is generally also distinct from all other Piedmont systems. Though apparently quite different, Piedmont Hardpan Woodland and Forest (CES202.268) is closely related by the importance of an impermeable clay hardpan, and some intermediate gradations occur. A few examples of this system (CES202.336) appear to be closely related to Coastal Plain depressional wetlands, sharing some flora, but most are more distinct. The system has significant variation in vegetation and environment. The forested swamps and open pools represent well-marked subtypes. There is a more subtle distinction between the basic and acidic soil swamps. There is substantial variation among the pools, related to substrate, basin morphology, and geographic location. This system includes the depression swamps of the Triassic Basins of Virginia and Maryland. A few disjunct examples may occur in the Southern Blue Ridge because of similarity in topographic setting and general structure. They do, however, occur on different substrates (quartzite and sandstone) than any examples in the Piedmont. Their vegetation is different from other examples but not in having more montane flora. Their vegetation is no more different than most other pools are from each other.

Similar Ecological Systems:
- Central Interior Highlands and Appalachian Sinkhole and Depression Pond (CES202.018)
- North-Central Appalachian Acidic Swamp (CES202.604)--replaces CES202.336 to the north?
- Piedmont Hardpan Woodland and Forest (CES202.268)

Related Concepts:
- Pin Oak - Sweetgum: 65 (Eyre 1980) Finer
- Sweetgum - Willow Oak: 92 (Eyre 1980) Finer
- Upland Swamp Glades (Wharton 1978) Finer
- Water Tupelo - Swamp Tupelo: 103 (Eyre 1980) Finer
- Willow Oak - Water Oak - Diamondleaf (Laurel) Oak: 88 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs in small, shallow basins or gentle swales on flat to rolling upland sites, and occasionally in depressions on narrow, steeper ridgetops. Soils have a dense clay hardpan or occasionally bedrock which limits internal drainage. Rainwater accumulates in the basins and persists through the wet season, occasionally persisting all year. Only a few kinds of rock are known to form these depressions. Most examples occur on soils derived from mafic rocks such as gabbro or diabase, but a few occur over slates or mafic to felsic tuffs where a dense clay hardpan has formed, and a few occur over unfractured bedrock. Some sites in Georgia have soils with shrink-swell tendencies which allow for both wetness and extreme dryness and inhibit the survival of trees, promoting an open woodland structure (Edwards et al. 2013). Examples in North Carolina may lack trees in the deepest water parts of basins. A few occur over bedrock of other kinds. Rock chemistry affects soil chemistry and influences variation in vegetation, but hydroperiod is a more important influence.

Vegetation: Vegetation consists either of swamps dominated by wetland oaks, or of more open-canopy pools with sparse trees and with substantial shrub or herbaceous vegetation. Swamps are most often dominated by *Quercus phellos*, with a substantial minority dominated by *Quercus lyrata* and a few having *Quercus bicolor*, *Quercus michauxii*, or other species. Examples that have been logged or cleared may be dominated by *Acer rubrum* or *Liquidambar styraciflua*. Lower strata are generally sparse in the swamps, often just a few shrubs such as *Vaccinium* spp., patches of *Smilax*, and a few wetland herbs. Open ponds may have the same canopy species on the edges, but a few have *Nyssa sylvatica* or other wetland species. The lower strata are better developed in the open pools, with *Cephalanthus occidentalis*, *Leucothoe racemosa*, *Vaccinium* spp., or other wetland species occurring as thickets along the edge or scattered in the interior. Large *Smilax* tangles sometimes occur. Herbs are usually still sparse or patchy, but may include dense beds of

various graminoids or ferns, as well as scattered clumps. *Sphagnum* is sometimes extensive in parts of the pools. These isolated seasonal wetlands are often important breeding sites for amphibians.
Dynamics: The dynamics of water levels are the most important factor in these systems, differentiating them from the surrounding uplands and differentiating the various communities within the system. These wetlands typically have very small watersheds, and input of water comes largely from rainfall. Variation in rainfall patterns will drive variation in duration of flooding, though most upland depression swamps have an outlet that limits water depth. Fire may be naturally rare in some examples of these systems, such as in North Carolina. Though they could naturally be exposed to fires occurring in the surrounding uplands, standing water and lack of continuous fuel would limit fires to the edges, expect perhaps very rarely in early fall. Other examples in South Carolina and Georgia are naturally prone drying out and to fire, and have an open woodland structure with a grassy understory, typical of wet flatwoods which naturally burned (Edwards et al. 2013). Presumably important as a dynamic process is the migration of amphibians, which concentrate in these systems for breeding. Ecosystem dynamics may be strongly affected by the suitability of surrounding uplands for amphibian adult habitat.

Component Associations:
- *Cephalanthus occidentalis - (Leucothoe racemosa) / Carex joorii* Shrubland (CEGL004075, G1)
- *Leucothoe racemosa - Vaccinium fuscatum - Smilax walteri* Shrubland (CEGL004533, G1?)
- *Liquidambar styraciflua - Acer rubrum / Carex* spp. - *Sphagnum* spp. Forest (CEGL007388, G2G3Q)
- *Nyssa biflora / Cephalanthus occidentalis - Leucothoe racemosa* Forest (CEGL004550, G1)
- *Quercus palustris - Quercus bicolor / Viburnum prunifolium / Leersia virginica - Impatiens capensis* Forest (CEGL004643, G2)
- *Quercus phellos - Quercus (michauxii, shumardii) - Fraxinus americana / (Quercus oglethorpensis) / Zephyranthes atamasca* Gabbro Upland Depression Forest (CEGL008484, G2?)
- *Quercus phellos / Carex (albolutescens, intumescens, joorii) / Climacium americanum* Forest (CEGL007403, G2G3)
- *Scirpus cyperinus - Dulichium arundinaceum / Sphagnum* spp. Herbaceous Vegetation (CEGL004134, G1Q)

SPATIAL CHARACTERISTICS

Spatial Summary: Small-patch system, occurring as isolated bodies surrounded by upland systems. Open pools are usually less than one acre, while swamps may be up to several acres in size.
Size: Occurs as small patches. Pools are usually less than one acre, and may be substantially smaller. Swamps range up to several acres, a few to ten or more acres. Most examples occur as isolated patches, but a few occur as small groups. Extensive mafic rock areas may support a number of swamps, but most are probably not close enough together to be treated as single occurrences. Most remaining examples are of natural size.
Adjacent Ecological Systems:
- Piedmont Hardpan Woodland and Forest (CES202.268)
- Southern Piedmont Dry Oak-(Pine) Forest (CES202.339)

Adjacent Ecological System Comments: Most examples are surrounded by Southern Piedmont Dry Oak-(Pine) Forest (CES202.339) or Piedmont Hardpan Woodland and Forest (CES202.268).

DISTRIBUTION

Range: This system ranges throughout the Piedmont, from Virginia to Alabama. A few examples attributable to this system are found in the adjacent Southern Blue Ridge.
Divisions: 202:C
Nations: US
Subnations: AL, GA, MD, NC, SC, VA
Map Zones: 54:C, 57:C, 59:C, 60:C, 61:C
TNC Ecoregions: 51:C, 52:C, 59:?

SOURCES

References: Comer et al. 2003, Edwards et al. 2013, Eyre 1980, Wharton 1978
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723169#references
Description Author: M.P. Schafale, mod. M. Pyne and C. Nordman
Version: 14 Jan 2014 **Stakeholders:** East, Southeast
Concept Author: M. Schafale **ClassifResp:** Southeast

RED RIVER LARGE FLOODPLAIN FOREST (CES203.065)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Forest and Woodland (Treed)
Non-Diagnostic Classifiers: Riverine / Alluvial [Brownwater]
National Mapping Codes: ESLF 9319

CONCEPT

Summary: This floodplain forest system is specifically restricted to the main stem of the Red River in the West Gulf Coastal Plain and Upper West Gulf Coastal Plain of southwestern Arkansas, adjacent Texas, and Louisiana. Several distinct plant communities can be recognized within this system that may be related to the array of different geomorphic features present within the floodplain. Some of the major geomorphic features associated with different community types within the system include natural levees, point bars, meander scrolls, oxbows, and sloughs. The vegetation generally includes forests dominated by bottomland hardwood species and other trees tolerant of flooding, including bald-cypress and water tupelo. Herbaceous and shrub vegetation may also be present in certain areas. Some canopy trees that may occur in examples of this system include *Betula nigra, Platanus occidentalis, Fraxinus pennsylvanica, Celtis laevigata, Liquidambar styraciflua, Ulmus americana, Nyssa biflora, Populus deltoides, Salix nigra*, and *Quercus texana*. Components with longer hydroperiods may contain *Quercus lyrata, Gleditsia aquatica, Carya aquatica, Nyssa aquatica*, and *Taxodium distichum*. Smaller trees include *Quercus similis, Quercus sinuata var. sinuata, Ulmus crassifolia*, and *Carpinus caroliniana*. Shrubs include *Alnus serrulata, Forestiera acuminata, Planera aquatica, Cephalanthus occidentalis, Ilex decidua, Crataegus viridis, Sabal minor*, and *Itea virginica*. Herbs are limited due to the length of flooding, but some examples are *Boehmeria cylindrica, Mikania scandens*, and *Lysimachia radicans*. Typical floating aquatic plants include *Nelumbo lutea, Nuphar advena, Nymphaea odorata*, and *Lemna minor*.
Classification Comments: This system is generally similar in concept to West Gulf Coastal Plain Large River Floodplain Forest (CES203.488) but is distinct both from it and from the floodplain forests of the Mississippi River Alluvial Plain primarily because of the difference in magnitude between the typical large rivers (such as the Trinity, Neches, and Sabine), on the one hand, and the Mississippi River on the other. In Arkansas (at least), this system is most closely affiliated with the "Billyhaw-Perry-Portland" Soil Association (MUID=AR033 in STATSGO).
Similar Ecological Systems:
- West Gulf Coastal Plain Large River Floodplain Forest (CES203.488)

Related Concepts:
- Baldcypress - Tupelo: 102 (Eyre 1980) Finer
- Baldcypress: 101 (Eyre 1980) Finer
- Black Willow: 95 (Eyre 1980) Finer
- Cottonwood: 63 (Eyre 1980) Finer
- Overcup Oak - Water Hickory: 96 (Eyre 1980) Finer
- Red River: Floodplain Deciduous Shrubland (5106) [CES203.065.6] (Elliott 2011) Finer
- Red River: Floodplain Evergreen Shrubland (5105) [CES203.065.5] (Elliott 2011) Finer
- Red River: Floodplain Hardwood / Evergreen Forest (5103) [CES203.065.3] (Elliott 2011) Finer
- Red River: Floodplain Harwood Forest (5104) [CES203.065.3] (Elliott 2011) Finer
- Red River: Floodplain Herbaceous Wetland (5107) [CES203.065.7] (Elliott 2011) Finer
- Red River: Floodplain Seasonally Flooded Hardwood Forest (5114) [CES203.065.14] (Elliott 2011) Finer
- Red River: Floodplain Wet Prairie (5117) [CES203.065.17] (Elliott 2011) Finer
- River Birch - Sycamore: 61 (Eyre 1980) Finer
- Silver Maple - American Elm: 62 (Eyre 1980) Finer
- Sugarberry - American Elm - Green Ash: 93 (Eyre 1980) Finer
- Swamp Chestnut Oak - Cherrybark Oak: 91 (Eyre 1980) Finer
- Sweetgum - Willow Oak: 92 (Eyre 1980) Finer
- Sycamore - Sweetgum - American Elm: 94 (Eyre 1980) Finer
- Water Tupelo - Swamp Tupelo: 103 (Eyre 1980) Finer
- Willow Oak - Water Oak - Diamondleaf (Laurel) Oak: 88 (Eyre 1980) Finer

DESCRIPTION

Environment: Some of the major geomorphic features associated with different community types within the system include natural levees, point bars, meander scrolls, oxbows, and sloughs (Sharitz and Mitsch 1993). The "flatwoods" of the upper terraces within the floodplain are a different system. The geology is Quaternary alluvial deposits. Landforms include the floodplains of the Red River and its major tributaries. Some local topographic variation exists and includes terraces and oxbows. The soils include loams and other

bottomland soils (Elliott 2011).

Vegetation: The vegetation generally includes forests dominated by bottomland hardwood species and other trees tolerant of flooding, including *Taxodium distichum* and *Nyssa aquatica*. Herbaceous and shrub vegetation may also be present in certain areas. Riverfront sites, and newly exposed or disturbed sites, are occupied by *Platanus occidentalis, Populus deltoides, Salix nigra, Betula nigra, Acer negundo,* and *Fraxinus pennsylvanica*. Some portions of the system are seasonally flooded, and these may contain species such as *Quercus lyrata, Carya aquatica, Taxodium distichum, Nyssa aquatica, Nyssa biflora, Quercus phellos, Gleditsia aquatica*, and *Planera aquatica*. Less frequently flooded areas may be dominated by numerous hardwood species, including *Liquidambar styraciflua, Quercus nigra, Quercus phellos, Quercus shumardii, Quercus macrocarpa, Quercus michauxii, Quercus falcata, Carya illinoinensis, Celtis laevigata, Ulmus alata, Ulmus americana, Ulmus crassifolia, Ulmus rubra, Gleditsia triacanthos, Nyssa sylvatica,* and *Fraxinus pennsylvanica*. In addition, *Juniperus virginiana, Pinus taeda,* and, to a lesser extent, *Pinus echinata* may also be found in the canopy. A midstory component may include young individuals of the overstory, as well as *Quercus similis, Quercus sinuata var. sinuata, Carpinus caroliniana, Ostrya virginiana, Acer rubrum, Sassafras albidum, Maclura pomifera,* and *Morus rubra*. The wetland shrub *Cephalanthus occidentalis* may dominate some open sites within the floodplain. In addition to these species, shrubs such as *Alnus serrulata, Forestiera acuminata, Crataegus viridis, Crataegus marshallii, Callicarpa americana, Ilex decidua, Sabal minor, Itea virginica,* and *Arundinaria gigantea* may be found in the understory of forests, as well as the exotic shrub *Ligustrum sinense*. Numerous woody vines may be encountered, including *Smilax rotundifolia, Brunnichia ovata, Berchemia scandens, Lonicera japonica, Ampelopsis arborea,* and *Toxicodendron radicans*. Herbaceous species may be present in the understory of forest, occur as marshy areas, or occupy herbaceous-dominated sites on areas less frequently flooded. *Saururus cernuus, Nymphaea odorata, Rhynchospora* spp., *Carex* spp., *Dichanthelium* spp., *Chasmanthium* spp., *Juncus* spp., *Leersia* sp., *Geum canadense, Sanicula canadensis, Woodwardia areolata, Boehmeria cylindrica, Mikania scandens*, and *Polygonum* spp. are among the herbaceous species that may be commonly encountered in this system. Typical floating aquatic plants include *Nelumbo lutea, Nuphar advena, Nymphaea odorata,* and *Lemna minor* (Elliott 2011). The forests of the Red River are thought to differ from those of other systems because of the greater presence of "riverfront" species (P. Faulkner pers. comm.). More information is needed, including a review of the affiliations of associations to this system versus West Gulf Coastal Plain Large River Floodplain Forest (CES203.488).

Dynamics: This system is maintained by natural large river hydrological processes (e.g., meanders, flooding, backswamps, natural levees). Occasional, long duration flooding can cause the loss of canopy over large areas. This canopy decline and reproductive failure can create late-seral open stands. Duration of flooding varies with the placement of a site in the landscape and is a dominant process affecting vegetation on a given site. Meandering rivers are dynamic and change course, eroding into the floodplain and depositing new point bars, thus creating new habitat for early-seral plant communities. Changes in hydrology due to the activities of beaver are also an important ecological process in bottomland hardwood forests. Beaver activity causes changes in hydrology, and this is an important ecological process in bottomland hardwood forests; the effects are poorly understood at the landscape level, especially in the presettlement context. Beaver impoundments kill trees (sometimes over large areas) but may also create open water habitat, cypress-tupelo stands, or cause stand replacement. In addition to periodic flooding, the dominant ecological process in bottomland hardwood forests is the formation of windfall gaps, which can occur on the local scale (a single mature canopy tree) as well as the landscape scale (tornadoes or hurricanes). When canopy trees fall, seedlings in the understory are released and compete for a spot in the canopy. This leads to dense areas of herbaceous and woody vegetation in windfall gaps of all sizes. This is a major process in forest regeneration in bottomland hardwood forests. This system is also bordered by a number of upland communities from which fire would have occasionally burned down into the bottoms, especially in drought years.

Component Associations:

- *Betula nigra - Platanus occidentalis / Alnus serrulata / Boehmeria cylindrica* Forest (CEGL007312, G4G5)
- *Forestiera acuminata - (Planera aquatica, Cephalanthus occidentalis)* Shrubland (CEGL003911, G3?)
- *Fraxinus pennsylvanica - Ulmus americana - Celtis laevigata / Ilex decidua* Forest (CEGL002427, G4G5)
- *Gleditsia aquatica - Carya aquatica* Forest (CEGL007426, G3?)
- *Nelumbo lutea* Herbaceous Vegetation (CEGL004323, G4?)
- *Nuphar advena - Nymphaea odorata* Herbaceous Vegetation (CEGL002386, G4G5)
- *Nyssa aquatica - Nyssa biflora* Forest (CEGL007429, G4G5)
- *Nyssa aquatica* Forest (CEGL002419, G4G5)
- *Planera aquatica* Forest (CEGL007394, G4?)
- *Platanus occidentalis - Liquidambar styraciflua - (Ulmus americana) / (Crataegus viridis)* Forest (CEGL007335, G3G4)
- *Populus deltoides - Salix nigra / Mikania scandens* Forest (CEGL007346, G4G5)
- *Quercus lyrata - Carya aquatica - (Quercus texana) / Forestiera acuminata* Forest (CEGL002423, G3?)
- *Quercus lyrata - Liquidambar styraciflua / Forestiera acuminata* Forest (CEGL002424, G4?)
- *Quercus phellos - (Quercus similis) - Ulmus crassifolia* Forest (CEGL007921, G3G4)
- *Quercus phellos - Liquidambar styraciflua / Ilex decidua - Carpinus caroliniana / Lysimachia radicans* Forest (CEGL007370, G3?)
- *Quercus sinuata var. sinuata - Ulmus crassifolia / Sabal minor* Red River Bottomland Forest (CEGL004130, G1G2)
- *Salix nigra* Large River Floodplain Forest (CEGL007410, G3G5)
- *Taxodium distichum - (Nyssa aquatica) / Forestiera acuminata - Planera aquatica* Forest (CEGL002421, G3G5)
- *Taxodium distichum - Nyssa aquatica - Acer rubrum / Itea virginica* Forest (CEGL007422, G4?)
- *Taxodium distichum / Lemna minor* Forest (CEGL002420, G4G5)
- *Taxodium distichum* West Gulf Coastal Plain Lakeshore Woodland (CEGL008497, G2G3)

Spatial Characteristics

Adjacent Ecological Systems:
- West Gulf Coastal Plain Nonriverine Wet Hardwood Flatwoods (CES203.548)
- West Gulf Coastal Plain Pine-Hardwood Flatwoods (CES203.278)

Adjacent Ecological System Comments: What are the flatwoods in the Red River area really?

Distribution

Range: This system is restricted to the main stem of the Red River in the West Gulf Coastal Plain and Upper West Gulf Coastal Plain of southwestern Arkansas, adjacent Texas, and Louisiana. Its range is conceptually coincident with the vast majority of Subsection 234Ai of Keys et al. (1995), excluding the portion of 234Ai within TNC Ecoregion 42 (Mississippi River Alluvial Plain). Its range is also coincident with EPA Ecoregion 35g (Red River Bottomlands) (EPA 2004). The portion of the Red River to the west (231Em of Keys et al. 1995) is treated as part of West Gulf Coastal Plain Large River Floodplain Forest (CES203.488).
Divisions: 203:C
Nations: US
Subnations: AR, LA, TX
Map Zones: 37:C, 98:C
USFS Ecomap Regions: 231E:CC, 232F:CC
TNC Ecoregions: 40:C, 41:C

Sources

References: Elliott 2011, EPA 2004, Eyre 1980, Foti pers. comm., Harris 1989, Keys et al. 1995, Kuchler 1964, Post 1969, Sharitz and Mitsch 1993, Southeastern Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.754556#references
Description Author: R. Evans and T. Foti, mod. M. Pyne, L. Elliott, J. Teague
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: M. Pyne, R. Evans, T. Foti **ClassifResp:** Southeast

ROCKY MOUNTAIN LOWER MONTANE-FOOTHILL RIPARIAN WOODLAND AND SHRUBLAND (CES306.821)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Short (<5 yrs) Flooding Interval; Short (50-100 yrs) Persistence; Montane [Lower Montane]; Riverine / Alluvial; Mineral: W/ A-Horizon <10 cm; Unconsolidated
Non-Diagnostic Classifiers: Circumneutral Water; Floodplain; Forest and Woodland (Treed); Shrubland (Shrub-dominated); Stream terrace (undifferentiated); Valley bottom; Temperate [Temperate Continental]; Braided channel or stream; Drainage bottom (undifferentiated)
National Mapping Codes: ESLF 9156

CONCEPT

Summary: This ecological system is found throughout the Rocky Mountain and Colorado Plateau regions within a broad elevational range from approximately 900 to 2800 m. This system often occurs as a mosaic of multiple communities that are tree-dominated with a diverse shrub component. It is dependent on a natural hydrologic regime, especially annual to episodic flooding. Occurrences are found within the flood zone of rivers, on islands, sand or cobble bars, and immediate streambanks. It can form large, wide occurrences on mid-channel islands in larger rivers or narrow bands on small, rocky canyon tributaries and well-drained benches. It is also typically found in backwater channels and other perennially wet but less scoured sites, such as floodplains swales and irrigation ditches. In some locations, occurrences extend into moderately high intermountain basins where the adjacent vegetation is sage steppe. Dominant trees may include *Acer negundo, Populus angustifolia, Populus deltoides, Populus fremontii, Pseudotsuga menziesii, Picea pungens, Salix amygdaloides*, or *Juniperus scopulorum*. Dominant shrubs include *Acer glabrum, Alnus incana, Betula occidentalis, Cornus sericea, Crataegus rivularis, Forestiera pubescens, Prunus virginiana, Rhus trilobata, Salix monticola, Salix drummondiana, Salix exigua, Salix irrorata, Salix lucida, Shepherdia argentea*, or *Symphoricarpos* spp. Exotic trees of *Elaeagnus angustifolia* and *Tamarix* spp. are common in some stands. Generally, the upland vegetation surrounding this riparian system is different and ranges from grasslands to forests. In the Wyoming Basins, the high-elevation *Populus angustifolia*-dominated rivers are included here, including along the North Platte, Sweetwater, and Laramie rivers. In these situations, *Populus angustifolia* is extending down into the sage steppe zone of the basins.
Classification Comments: This system is physiognomically diverse; because of relatively rapid spatial and temporal shifts in structure and composition, it was too complex to split into different, structurally defined systems (e.g., a shrubland system and a woodland system). This riparian system has been applied to the Green, Yampa, and Colorado rivers (upstream of the Grand Canyon) on the Colorado Plateau. Within and below the Grand Canyon is classified as North American Warm Desert Riparian Woodland and Shrubland (CES302.753). More research is needed to determine if creating a Colorado Plateau riparian woodland and shrubland system is ecologically justified.
Related Concepts:
- Aspen: 217 (Eyre 1980) Intersecting
- Blue Spruce: 216 (Eyre 1980) Intersecting. Blue spruce commonly occurs in riparian zones
- Cottonwood - Willow: 235 (Eyre 1980) Broader
- Riparian (422) (Shiflet 1994) Broader

DESCRIPTION

Environment: This system is dependent on a natural hydrologic regime, especially annual to episodic flooding. It is found within the flood zone of rivers, on islands, sand or cobble bars, and immediate streambanks. It can form large, wide occurrences on mid-channel islands in larger rivers or narrow bands on small, rocky canyon tributaries and well-drained benches. It is also typically found in backwater channels and other perennially wet but less scoured sites, such as floodplains swales and irrigation ditches. It may also occur in upland areas of mesic swales and hillslopes below seeps and springs. The climate of this system is continental with typically cold winters and hot summers. Surface water is generally high for variable periods. Soils are typically alluvial deposits of sand, clays, silts and cobbles that are highly stratified with depth due to flood scour and deposition. Highly stratified profiles consist of alternating layers of clay loam and organic material with coarser sand or thin layers of sandy loam over very coarse alluvium. Soils are fine-textured with organic material over coarser alluvium. Some soils are more developed due to a slightly more stable environment and greater input of organic matter.
Vegetation: Dominant trees may include *Acer negundo, Populus angustifolia, Populus deltoides, Populus fremontii, Pseudotsuga menziesii, Picea pungens, Salix amygdaloides*, or *Juniperus scopulorum*. Dominant shrubs include *Acer glabrum, Alnus incana, Betula occidentalis, Cornus sericea, Crataegus rivularis, Forestiera pubescens, Prunus virginiana, Rhus trilobata, Salix monticola, Salix drummondiana, Salix exigua, Salix irrorata, Salix lucida, Shepherdia argentea*, or *Symphoricarpos* spp. Exotic trees of *Elaeagnus angustifolia* and *Tamarix* spp. are common in some stands. Generally, the upland vegetation surrounding this riparian system is different and ranges from grasslands to forests.
Dynamics: This ecological system contains early-, mid- and late-seral riparian plant associations. It also contains non-obligate

riparian species. Cottonwood communities are early-, mid- or late-seral, depending on the age class of the trees and the associated species of the occurrence (Kittel et al. 1999b). Cottonwoods, however, do not reach a climax stage as defined by Daubenmire (1952). Mature cottonwood occurrences do not regenerate in place, but regenerate by "moving" up and down a river reach and regeneration is often associated with flooding events. Over time a healthy riparian area supports all stages of cottonwood communities (Kittel et al. 1999b).

Component Associations:
- *Acer negundo - Alnus incana ssp. tenuifolia* Forest (CEGL005940, G3?)
- *Acer negundo - Alnus oblongifolia* Forest (CEGL005383, GNR)
- *Acer negundo - Celtis laevigata var. reticulata* Woodland (CEGL002599, GNR)
- *Acer negundo - Ostrya knowltonii* Woodland (CEGL002342, GNR)
- *Acer negundo - Populus angustifolia / Cornus sericea* Forest (CEGL000627, G2)
- *Acer negundo / Betula occidentalis* Woodland (CEGL000936, G1G2)
- *Acer negundo / Brickellia (grandiflora, longifolia)* Woodland (CEGL002692, GNR)
- *Acer negundo / Cornus sericea* Forest (CEGL000625, G3?)
- *Acer negundo* / Disturbed Understory Woodland (CEGL002693, GNR)
- *Acer negundo / Equisetum arvense* Forest (CEGL000626, G2?)
- *Acer negundo / Prunus virginiana* Forest (CEGL000628, G3)
- *Acer negundo / Quercus gambelii* Woodland (CEGL002797, GNR)
- *Acer negundo / Rhus trilobata* Woodland (CEGL002750, GNR)
- *Artemisia cana / Juncus balticus* Shrubland (CEGL005998, GNR)
- *Betula occidentalis / Purshia tridentata / Hesperostipa comata* Shrubland (CEGL001084, G1)
- *Carex pellita* Herbaceous Vegetation (CEGL001809, G3)
- *Carex praegracilis* Herbaceous Vegetation (CEGL002660, G3G4)
- *Distichlis spicata* Herbaceous Vegetation (CEGL001770, G5)
- *Eleocharis palustris* Herbaceous Vegetation (CEGL001833, G5)
- *Equisetum (arvense, variegatum)* Herbaceous Vegetation (CEGL005148, GNR)
- *Equisetum hyemale* Herbaceous Vegetation (CEGL002760, G3)
- *Equisetum laevigatum* Herbaceous Vegetation (CEGL002241, GNR)
- *Forestiera pubescens* Shrubland (CEGL001168, G1G2)
- *Fraxinus anomala* Woodland (CEGL002752, GUQ)
- *Juncus balticus* Herbaceous Vegetation (CEGL001838, G5)
- *Juniperus scopulorum / Cornus sericea* Woodland (CEGL000746, G4)
- *Juniperus scopulorum* Woodland (CEGL003550, GNR)
- *Leymus cinereus - Distichlis spicata* Herbaceous Vegetation (CEGL001481, G3)
- *Phalaris arundinacea* Western Herbaceous Vegetation (CEGL001474, G5)
- *Phragmites australis* Western North America Temperate Semi-natural Herbaceous Vegetation (CEGL001475, G5)
- *Pinus ponderosa / Alnus incana* Woodland (CEGL002638, G2)
- *Pinus ponderosa / Cornus sericea* Woodland (CEGL000853, G3)
- *Pinus ponderosa / Crataegus douglasii* Woodland (CEGL000855, G1)
- *Pinus ponderosa / Forestiera pubescens* Woodland (CEGL005384, GNR)
- *Pinus ponderosa / Juglans major* Woodland (CEGL000858, G2)
- *Populus angustifolia - Juniperus scopulorum* Woodland (CEGL002640, G2G3)
- *Populus angustifolia - Picea pungens / Alnus incana* Woodland (CEGL000934, G3)
- *Populus angustifolia - Pinus ponderosa* Woodland (CEGL000935, G4Q)
- *Populus angustifolia - Populus deltoides - Salix amygdaloides* Forest (CEGL000656, GUQ)
- *Populus angustifolia - Pseudotsuga menziesii* Woodland (CEGL002641, G3)
- *Populus angustifolia / Acer grandidentatum* Forest (CEGL000646, G2G3)
- *Populus angustifolia / Alnus incana* Woodland (CEGL002642, G3)
- *Populus angustifolia / Betula occidentalis* Woodland (CEGL000648, G3)
- *Populus angustifolia / Cornus sericea* Woodland (CEGL002664, G4)
- *Populus angustifolia / Crataegus rivularis* Woodland (CEGL002644, G2?)
- *Populus angustifolia / Lonicera involucrata* Forest (CEGL000650, GUQ)
- *Populus angustifolia / Prunus virginiana* Woodland (CEGL000651, G2Q)
- *Populus angustifolia / Rhus trilobata* Woodland (CEGL000652, G3)
- *Populus angustifolia / Rosa woodsii* Forest (CEGL000653, G2G3)
- *Populus angustifolia / Salix (monticola, drummondiana, lucida)* Woodland (CEGL002645, G3)
- *Populus angustifolia / Salix drummondiana - Acer glabrum* Woodland (CEGL002646, G2?)
- *Populus angustifolia / Salix exigua* Woodland (CEGL000654, G4)
- *Populus angustifolia / Salix irrorata* Woodland (CEGL002647, G2)
- *Populus angustifolia / Salix ligulifolia - Shepherdia argentea* Woodland (CEGL000655, G1)
- *Populus angustifolia / Symphoricarpos (albus, occidentalis, oreophilus)* Woodland (CEGL002648, G2Q)
- *Populus angustifolia* Sand Dune Forest (CEGL002643, G1)

- *Populus deltoides (ssp. wislizeni, ssp. monilifera) / Artemisia tridentata* Woodland (CEGL005966, G2G3)
- *Populus deltoides (ssp. wislizeni, ssp. monilifera) / Distichlis spicata* Woodland (CEGL000939, G2)
- *Populus deltoides (ssp. wislizeni, ssp. monilifera) / Salix exigua* Woodland (CEGL002685, G3)
- *Populus deltoides - (Salix amygdaloides) / Salix (exigua, interior)* Woodland (CEGL000659, G3G4)
- *Populus deltoides / Symphoricarpos occidentalis* Woodland (CEGL000660, G2G3)
- *Populus deltoides ssp. wislizeni / Acer negundo* Woodland (CEGL002336, GNR)
- *Populus deltoides ssp. wislizeni* / Disturbed Understory Woodland (CEGL003810, GNR)
- *Populus deltoides ssp. wislizeni / Rhus trilobata* Woodland (CEGL000940, G2)
- *Populus fremontii - Salix gooddingii* Woodland (CEGL000944, G2)
- *Populus fremontii / Acer negundo* Forest (CEGL000662, G2Q)
- *Populus fremontii / Artemisia tridentata* Woodland (CEGL005365, GNR)
- *Populus fremontii / Betula occidentalis* Wooded Shrubland (CEGL002981, GNR)
- *Populus fremontii / Ericameria nauseosa* Woodland (CEGL002465, GNR)
- *Populus fremontii / Leymus triticoides* Woodland (CEGL002756, GNR)
- *Populus fremontii* / Mesic Forbs Woodland (CEGL002470, GNR)
- *Populus fremontii* / Mesic Graminoids Woodland (CEGL002473, GNR)
- *Populus fremontii / Salix exigua* Forest (CEGL000666, GNR)
- *Populus fremontii / Salix geyeriana* Woodland (CEGL000943, G3?)
- *Pseudotsuga menziesii / Betula occidentalis* Woodland (CEGL002639, G3?)
- *Pseudotsuga menziesii / Cornus sericea* Woodland (CEGL000899, G4)
- *Rhus trilobata* Intermittently Flooded Shrubland (CEGL001121, G3)
- *Salix amygdaloides* Woodland (CEGL000947, G3)
- *Salix eastwoodiae / Carex aquatilis* Shrubland (CEGL001195, G2)
- *Salix eastwoodiae / Carex utriculata* Shrubland (CEGL001196, G2?)
- *Salix eastwoodiae* Shrubland (CEGL001194, G2Q)
- *Salix exigua - Salix ligulifolia* Shrubland (CEGL002655, G2G3)
- *Salix exigua - Salix lucida ssp. caudata* Shrubland (CEGL001204, G2)
- *Salix exigua* / Barren Shrubland (CEGL001200, G5)
- *Salix exigua / Elymus X pseudorepens* Shrubland (CEGL001198, G3)
- *Salix exigua / Equisetum arvense* Shrubland (CEGL001201, G3?)
- *Salix exigua* / Mesic Forbs Shrubland (CEGL001202, G2)
- *Salix exigua* / Mesic Graminoids Shrubland (CEGL001203, G5)
- *Salix gooddingii / Salix exigua* Woodland (CEGL003778, GNR)
- *Salix irrorata* Shrubland (CEGL001214, GNR)
- *Salix lasiolepis - Cornus sericea / Rosa woodsii* Shrubland (CEGL003453, G2G3)
- *Salix lasiolepis* / Barren Ground Shrubland (CEGL001216, G3?)
- *Salix lasiolepis / Rosa woodsii* / Mixed Herbs Shrubland (CEGL001217, G3Q)
- *Salix ligulifolia* Shrubland (CEGL001218, G2G3)
- *Salix lutea / Leymus cinereus* Shrubland (CEGL005322, GNR)
- *Salix lutea* Shrubland (CEGL003780, GNR)
- *Shepherdia argentea* Shrubland (CEGL001128, G3G4)
- *Spartina gracilis* Herbaceous Vegetation (CEGL001588, GU)
- *Spartina pectinata* Western Herbaceous Vegetation (CEGL001476, G3?)

DISTRIBUTION

Range: This system is found throughout the lower montane Rocky Mountain and Colorado Plateau regions within a broad elevation range from approximately 900 to 2800 m. It is also found in the island mountain ranges of central and eastern Montana.
Divisions: 304:C; 306:C
Nations: US
Subnations: AZ, CO, ID, MT, NM, NV, OR, SD, UT, WY
Map Zones: 8:?, 9:C, 13:C, 15:C, 16:C, 17:P, 18:C, 20:C, 21:C, 22:C, 23:C, 24:C, 25:C, 26:C, 27:C, 28:C, 29:C, 33:C
USFS Ecomap Regions: 313A:CC, 313B:CC, 313D:CC, 315A:CC, 315H:CC, 321A:CC, 331B:CC, 331D:CP, 331F:CC, 331G:CC, 331H:CC, 331I:CC, 331J:CC, 331K:C?, 331N:CP, 341A:CC, 341B:CC, 341C:CC, 341F:CC, 342A:CC, 342D:CC, 342E:CC, 342F:CC, 342G:CC, 342J:CC, M313A:CC, M313B:CC, M331A:CC, M331B:CC, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M331J:CC, M332A:CC, M332G:CC, M341B:CC, M341C:CC
TNC Ecoregions: 6:P, 8:C, 9:C, 11:C, 18:C, 19:C, 20:C, 21:C, 25:C, 26:C

SOURCES

References: Baker 1988, Baker 1989a, Baker 1989b, Baker 1990, Bales et al. 2006, CNHP 2010b, Comer et al. 2002, Comer et al. 2003, Comer et al. 2013a, Crowe and Clausnitzer 1997, Daubenmire 1952, Elmore and Kauffman 1994, Eyre 1980, Flenniken et al. 2001, Karl et al. 2009, Kittel et al. 1999b, Knowles et al. 2006, Kovalchik 1987, Kovalchik 1993, Manning and Padgett 1995, Merritt and Wohl 2002, Muldavin et al. 2000a, Nachlinger et al. 2001, Neely et al. 2001, Padgett et al. 1989, Parsons et al. 2005, Patten 1998, Peterson et al. 2008, Rondeau pers. comm., Shiflet 1994, Stewart et al. 2004, Stromberg et al. 2010a, Szaro 1989, Tuhy et al. 2002,

Tuhy pers. comm., Walford 1996, Walford et al. 1997, Walford et al. 2001, WNHP 2011

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722852#references

Description Author: M.S. Reid, mod. G. Kittel

Version: 14 Jan 2014 **Stakeholders:** Canada, Midwest, West

Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

ROCKY MOUNTAIN SUBALPINE-MONTANE RIPARIAN SHRUBLAND (CES306.832)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Short (<5 yrs) Flooding Interval; RM Subalpine/Montane Riparian Woodland; Short (50-100 yrs) Persistence; Montane [Upper Montane]; Montane [Montane]; Shrubland (Shrub-dominated); Riverine / Alluvial; Broad-Leaved Deciduous Shrub
Non-Diagnostic Classifiers: Circumneutral Water; Erosional stream terrace; Floodplain; Montane [Lower Montane]; Stream terrace (undifferentiated); Valley bottom; Alluvial terrace; Temperate [Temperate Continental]; Mineral: W/ A-Horizon <10 cm; Drainage bottom (undifferentiated)
National Mapping Codes: ESLF 9187

CONCEPT

Summary: This system is found throughout the Rocky Mountain cordillera from New Mexico north into Montana and northwestern Alberta, and also occurs in mountainous areas of the Intermountain West region and Colorado Plateau. These are montane to subalpine riparian shrublands occurring as narrow bands of shrubs lining streambanks and alluvial terraces in narrow to wide, low-gradient valley bottoms and floodplains with sinuous stream channels. Generally, the system is found at higher elevations, but can be found anywhere from 1500-3475 m, and may occur at even lower elevations in the Canadian Rockies. Occurrences can also be found around seeps, fens, and isolated springs on hillslopes away from valley bottoms. Many of the plant associations found within this system are associated with beaver activity. This system often occurs as a mosaic of multiple communities that are shrub- and herb-dominated and includes above-treeline, willow-dominated, snowmelt-fed basins that feed into streams. The dominant shrubs reflect the large elevational gradient and include *Alnus incana, Betula glandulosa, Betula occidentalis, Cornus sericea, Salix bebbiana, Salix boothii, Salix brachycarpa, Salix drummondiana, Salix eriocephala, Salix geyeriana, Salix monticola, Salix planifolia*, and *Salix wolfii*. Generally the upland vegetation surrounding these riparian systems are of either conifer or aspen forests.
Related Concepts:
- Barclay's willow - Arrow-leaved groundsel (ESSFdc2/Sc03) (Steen and Coupe 1997) Intersecting
- Riparian (422) (Shiflet 1994) Broader
- Willow - Sedge (ESSFxc/10) (Steen and Coupe 1997) Intersecting

Component Associations:
- *Acer glabrum* Drainage Bottom Shrubland (CEGL001062, G4?)
- *Alnus incana - Betula occidentalis* Shrubland (CEGL001142, G2G3)
- *Alnus incana - Salix (monticola, lucida, ligulifolia)* Shrubland (CEGL002651, G3)
- *Alnus incana - Salix drummondiana* Shrubland (CEGL002652, G3)
- *Alnus incana / Athyrium filix-femina* Shrubland (CEGL002628, G3)
- *Alnus incana / Calamagrostis canadensis* Shrubland (CEGL001143, G3Q)
- *Alnus incana / Carex (aquatilis, deweyana, lenticularis, luzulina, pellita)* Shrubland (CEGL001144, G3)
- *Alnus incana / Carex scopulorum var. prionophylla* Shrubland (CEGL000122, G1)
- *Alnus incana / Cornus sericea* Shrubland (CEGL001145, G3G4)
- *Alnus incana / Equisetum arvense* Shrubland (CEGL001146, G3)
- *Alnus incana / Glyceria striata* Shrubland (CEGL000228, G3)
- *Alnus incana / Lysichiton americanus* Shrubland (CEGL002629, G3)
- *Alnus incana* / Mesic Forbs Shrubland (CEGL001147, G3)
- *Alnus incana* / Mesic Graminoids Shrubland (CEGL001148, G3)
- *Alnus incana / Ribes (inerme, hudsonianum, lacustre)* Shrubland (CEGL001151, G3)
- *Alnus incana / Scirpus microcarpus* Shrubland (CEGL000481, G2G3)
- *Alnus incana / Spiraea douglasii* Shrubland (CEGL001152, G3)
- *Alnus incana / Symphoricarpos albus* Shrubland (CEGL001153, G3G4)
- *Alnus incana* Shrubland (CEGL001141, GNRQ)
- *Alnus incana ssp. tenuifolia - Salix irrorata* Shrubland (CEGL002687, G3)
- *Alnus oblongifolia / Symphoricarpos oreophilus* Forest (CEGL001063, GU)
- *Alnus viridis ssp. sinuata / Athyrium filix-femina - Cinna latifolia* Shrubland (CEGL001156, G4)
- *Betula glandulosa* / Mesic Forbs - Mesic Graminoids Shrubland (CEGL002653, G3G4)
- *Betula occidentalis - Dasiphora fruticosa ssp. floribunda* Shrubland (CEGL001083, G2Q)
- *Betula occidentalis / Cornus sericea* Shrubland (CEGL001161, G3)
- *Betula occidentalis / Maianthemum stellatum* Shrubland (CEGL001162, G4?)
- *Betula occidentalis* / Mesic Graminoids Shrubland (CEGL002654, G3)

- *Betula occidentalis* Shrubland (CEGL001080, G3G4)
- *Cornus sericea / Galium triflorum* Shrubland (CEGL001166, G3?)
- *Cornus sericea / Heracleum maximum* Shrubland (CEGL001167, G3)
- *Cornus sericea* Rocky Mountain Shrubland (CEGL001165, G4Q)
- *Corylus cornuta* Shrubland (CEGL002903, G3)
- *Dasiphora fruticosa ssp. floribunda / Deschampsia caespitosa* Shrubland (CEGL001107, G4)
- *Fraxinus anomala* Woodland (CEGL002752, GUQ)
- *Ribes lacustre - Ribes hudsonianum / Cinna latifolia* Shrubland (CEGL003445, G2)
- *Ribes lacustre - Ribes hudsonianum / Glyceria striata* Shrubland (CEGL003446, G2G3)
- *Ribes lacustre / Mertensia ciliata* Shrubland (CEGL001172, G1G2Q)
- *Salix (boothii, geyeriana) / Carex aquatilis* Shrubland (CEGL001176, G3)
- *Salix bebbiana* / Mesic Graminoids Shrubland (CEGL001174, G3)
- *Salix bebbiana* Shrubland (CEGL001173, G3?)
- *Salix boothii - Salix eastwoodiae / Carex nigricans* Shrubland (CEGL002607, G3)
- *Salix boothii - Salix geyeriana / Carex angustata* Shrubland (CEGL001185, G2)
- *Salix boothii - Salix geyeriana* Shrubland (CEGL001184, GU)
- *Salix boothii - Salix lemmonii* Shrubland (CEGL001186, G3)
- *Salix boothii / Calamagrostis canadensis* Shrubland (CEGL001175, G3G4Q)
- *Salix boothii / Carex nebrascensis* Shrubland (CEGL001177, G4G5)
- *Salix boothii / Carex utriculata* Shrubland (CEGL001178, G4)
- *Salix boothii / Deschampsia caespitosa - Geum rossii* Shrubland (CEGL002904, G4)
- *Salix boothii / Equisetum arvense* Shrubland (CEGL002671, G3)
- *Salix boothii / Maianthemum stellatum* Shrubland (CEGL001187, G3Q)
- *Salix boothii* / Mesic Forbs Shrubland (CEGL001180, G3)
- *Salix boothii* / Mesic Graminoids Shrubland (CEGL001181, G3?)
- *Salix brachycarpa / Carex aquatilis* Shrubland (CEGL001244, G2G3)
- *Salix brachycarpa* / Mesic Forbs Shrubland (CEGL001135, G4)
- *Salix candida / Carex utriculata* Shrubland (CEGL001188, G2)
- *Salix commutata / Carex scopulorum* Shrubland (CEGL001189, G3)
- *Salix commutata* / Mesic Graminoid Shrubland (CEGL003497, GNR)
- *Salix drummondiana / Calamagrostis canadensis* Shrubland (CEGL002667, G3)
- *Salix drummondiana / Carex scopulorum var. prionophylla* Shrubland (CEGL001584, G2G3)
- *Salix drummondiana / Carex utriculata* Shrubland (CEGL002631, G4)
- *Salix drummondiana* / Mesic Forbs Shrubland (CEGL001192, G4)
- *Salix eriocephala / Ribes aureum - Rosa woodsii* Shrubland (CEGL001233, G3)
- *Salix geyeriana - Salix eriocephala* Shrubland (CEGL001213, GU)
- *Salix geyeriana - Salix lemmonii / Carex aquatilis var. dives* Shrubland (CEGL001212, G3)
- *Salix geyeriana - Salix monticola / Calamagrostis canadensis* Shrubland (CEGL001247, G3)
- *Salix geyeriana - Salix monticola* / Mesic Forbs Shrubland (CEGL001223, G3)
- *Salix geyeriana / Calamagrostis canadensis* Shrubland (CEGL001205, G5)
- *Salix geyeriana / Carex aquatilis* Shrubland (CEGL001206, G3)
- *Salix geyeriana / Carex utriculata* Shrubland (CEGL001207, G5)
- *Salix geyeriana / Deschampsia caespitosa* Shrubland (CEGL001208, G4)
- *Salix geyeriana* / Mesic Forbs Shrubland (CEGL002666, G3)
- *Salix geyeriana* / Mesic Graminoids Shrubland (CEGL001210, G3?)
- *Salix glauca / Deschampsia caespitosa* Shrubland (CEGL001137, G4)
- *Salix lemmonii* / Mesic-Tall Forbs Shrubland (CEGL002771, G3?)
- *Salix lemmonii / Rosa woodsii* Shrubland (CEGL002772, G3)
- *Salix ligulifolia* Shrubland (CEGL001218, G2G3)
- *Salix lucida ssp. caudata / Rosa woodsii* Shrubland (CEGL002621, G3)
- *Salix lucida ssp. caudata* Shrubland (CEGL001215, G3Q)
- *Salix lutea / Calamagrostis canadensis* Shrubland (CEGL001219, G3?)
- *Salix lutea / Carex utriculata* Shrubland (CEGL001220, G4)
- *Salix lutea* / Mesic Forbs Shrubland (CEGL002774, G3?)
- *Salix lutea / Rosa woodsii* Shrubland (CEGL002624, G3)
- *Salix monticola / Angelica ampla* Shrubland (CEGL001221, GNR)
- *Salix monticola / Calamagrostis canadensis* Shrubland (CEGL001222, G3)
- *Salix monticola / Carex aquatilis* Shrubland (CEGL002656, G3)
- *Salix monticola / Carex utriculata* Shrubland (CEGL002657, G3)
- *Salix monticola* / Mesic Forbs Shrubland (CEGL002658, G4)
- *Salix monticola* / Mesic Graminoids Shrubland (CEGL002659, G3)
- *Salix monticola* Thicket Shrubland (CEGL001139, G2Q)

- *Salix planifolia / Calamagrostis canadensis* Shrubland (CEGL001225, G4)
- *Salix planifolia / Caltha leptosepala* Shrubland (CEGL002665, G4)
- *Salix planifolia / Carex aquatilis* Shrubland (CEGL001227, G5)
- *Salix planifolia / Carex scopulorum* Shrubland (CEGL001229, G4)
- *Salix planifolia / Deschampsia caespitosa* Shrubland (CEGL001230, G2G3)
- *Salix planifolia* / Mesic Forbs Shrubland (CEGL002893, G4)
- *Salix planifolia* Shrubland (CEGL001224, G4)
- *Salix wolfii / Carex aquatilis* Shrubland (CEGL001234, G4)
- *Salix wolfii / Carex microptera* Shrubland (CEGL001235, G3Q)
- *Salix wolfii / Carex nebrascensis* Shrubland (CEGL001236, G3Q)
- *Salix wolfii / Carex utriculata* Shrubland (CEGL001237, G4)
- *Salix wolfii / Deschampsia caespitosa* Shrubland (CEGL001238, G3)
- *Salix wolfii / Fragaria virginiana* Shrubland (CEGL001239, G4?)
- *Salix wolfii* / Mesic Forbs Shrubland (CEGL001240, G3)
- *Salix wolfii / Swertia perennis - Pedicularis groenlandica* Shrubland (CEGL001242, G2)
- *Vaccinium caespitosum - (Salix farriae) / Danthonia intermedia* Dwarf-shrubland (CEGL000484, G1G2)

DISTRIBUTION

Range: This system is found throughout the Rocky Mountain cordillera from New Mexico north into Montana and the Canadian Rockies of Alberta and British Columbia (including the isolated "island" mountain ranges of central and eastern Montana), and also occurs in mountainous areas of the Intermountain West and Colorado Plateau.
Divisions: 304:C; 306:C
Nations: CA, US
Subnations: AB, AZ, BC, CO, ID, MT, NM, NV, OR, SD, UT, WA, WY
Map Zones: 1:C, 6:?, 7:?, 8:?, 9:C, 10:C, 12:C, 15:?, 16:C, 17:P, 18:C, 19:C, 20:C, 21:C, 22:C, 23:C, 24:C, 25:C, 26:P, 27:C, 28:C, 29:C
USFS Ecomap Regions: 313A:CC, 313B:CC, 313D:CC, 315A:P?, 315H:PP, 321A:PP, 331A:C?, 331B:C?, 331J:CC, 341A:CP, 341B:CP, 341C:CP, 341D:CP, 341F:CC, 342A:CC, 342B:CP, 342C:CC, 342D:CC, 342E:CC, 342F:CC, 342G:CC, 342H:CC, 342J:CC, M242C:CP, M242D:CC, M261E:CC, M313A:CC, M313B:CC, M331A:CC, M331B:CC, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M331J:CC, M332A:CC, M332B:CC, M332D:CC, M332E:CC, M332F:CC, M332G:CC, M333A:CC, M333B:CC, M333C:CC, M333D:CC, M341B:CC, M341C:CC
TNC Ecoregions: 6:P, 7:C, 8:C, 9:C, 11:C, 18:C, 19:C, 20:C, 21:C, 25:C, 26:C, 68:C

SOURCES

References: Baker 1988, Baker 1989a, Baker 1989b, Baker 1990, Comer et al. 2002, Comer et al. 2003, Crowe and Clausnitzer 1997, Kittel 1993, Kittel 1994, Kittel et al. 1996, Kittel et al. 1999a, Kittel et al. 1999b, Kovalchik 1987, Kovalchik 1993, Kovalchik 2001, Manning and Padgett 1995, Muldavin et al. 2000a, Nachlinger et al. 2001, NCC 2002, Neely et al. 2001, Padgett 1982, Padgett et al. 1988b, Padgett et al. 1989, Rondeau 2001, Steen and Coupe 1997, Szaro 1989, Tuhy et al. 2002, Walford 1996, Willoughby 2007
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722841#references
Description Author: NatureServe Western Ecology Team
Version: 31 Mar 2010 **Stakeholders:** Canada, Midwest, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

ROCKY MOUNTAIN SUBALPINE-MONTANE RIPARIAN WOODLAND (CES306.833)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Short (<5 yrs) Flooding Interval; RM Subalpine/Montane Riparian Shrubland; Montane [Upper Montane]; Montane [Montane]; Forest and Woodland (Treed); Riverine / Alluvial
Non-Diagnostic Classifiers: Circumneutral Water; Floodplain; Montane [Lower Montane]; Stream terrace (undifferentiated); Valley bottom; Temperate [Temperate Continental]; Needle-Leaved Tree; Broad-Leaved Deciduous Tree; Drainage bottom (undifferentiated)
National Mapping Codes: ESLF 9171

CONCEPT

Summary: This riparian woodland system is comprised of seasonally flooded forests and woodlands found at montane to subalpine elevations of the Rocky Mountain cordillera, from southern New Mexico north into Montana, and west into the Intermountain region and the Colorado Plateau. It occurs throughout the interior of British Columbia and the eastern slopes of the Cascade Mountains. This system contains the conifer and aspen woodlands that line montane streams. These are communities tolerant of periodic flooding and high water tables. Snowmelt moisture in this system may create shallow water tables or seeps for a portion of the growing season. Stands typically occur at elevations between 1500 and 3300 m (4920-10,830 feet), farther north elevation ranges between 900 and 2000 m. This is confined to specific riparian environments occurring on floodplains or terraces of rivers and streams, in V-shaped, narrow valleys and canyons (where there is cold-air drainage). Less frequently, occurrences are found in moderate-wide valley bottoms on large floodplains along broad, meandering rivers, and on pond or lake margins. Dominant tree species vary across the latitudinal range, although it usually includes *Abies lasiocarpa* and/or *Picea engelmannii*; other important species include *Pseudotsuga menziesii*, *Picea pungens*, *Picea engelmannii X glauca*, *Populus tremuloides*, and *Juniperus scopulorum*. Other trees possibly present but not usually dominant include *Alnus incana*, *Abies concolor*, *Abies grandis*, *Pinus contorta*, *Populus angustifolia*, *Populus balsamifera ssp. trichocarpa*, and *Juniperus osteosperma*.

Similar Ecological Systems:
- Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland (CES306.804)

Related Concepts:
- Blue Spruce: 216 (Eyre 1980) Intersecting. Blue spruce commonly occurs in riparian zones
- Engelmann Spruce - Subalpine Fir: 206 (Eyre 1980) Intersecting. Engelmann spruce occurs as as a dominant in riparian zones.
- ER Engelmann Spruce Riparian (Ecosystems Working Group 1998) Broader
- Riparian (422) (Shiflet 1994) Broader

Component Associations:
- *Abies concolor - Acer negundo / Alnus incana ssp. tenuifolia* Forest (CEGL005367, GNR)
- *Abies concolor - Picea pungens - Populus angustifolia / Acer glabrum* Forest (CEGL000255, G2)
- *Abies lasiocarpa - Picea engelmannii / Alnus incana* Forest (CEGL000296, G5)
- *Abies lasiocarpa - Picea engelmannii / Alnus viridis ssp. sinuata* Forest (CEGL000297, G4)
- *Abies lasiocarpa - Picea engelmannii / Mertensia ciliata* Forest (CEGL002663, G5)
- *Abies lasiocarpa - Picea engelmannii / Oplopanax horridus* Forest (CEGL000322, G3)
- *Abies lasiocarpa - Picea engelmannii / Salix drummondiana* Forest (CEGL000327, G5)
- *Abies lasiocarpa - Picea engelmannii / Streptopus amplexifolius* Forest (CEGL000336, G4)
- *Abies lasiocarpa / Carex aquatilis* Forest (CEGL002636, G4)
- *Abies lasiocarpa / Trautvetteria caroliniensis* Forest (CEGL000339, G3)
- *Picea engelmannii - Populus angustifolia / Heracleum maximum* Forest (CEGL000367, G3G4)
- *Picea engelmannii / Caltha leptosepala* Forest (CEGL000357, G3?)
- *Picea engelmannii / Carex angustata* Forest (CEGL000359, G3)
- *Picea engelmannii / Carex scopulorum var. prionophylla* Woodland (CEGL002630, G3)
- *Picea engelmannii / Cornus sericea* Woodland (CEGL002677, G3)
- *Picea engelmannii / Eleocharis quinqueflora* Woodland (CEGL000361, G3)
- *Picea engelmannii / Salix drummondiana* Woodland (CEGL005843, G2G3)
- *Picea engelmannii / Senecio triangularis* Forest (CEGL000376, G3Q)
- *Picea glauca* Alluvial Black Hills Forest (CEGL002057, G2G3)
- *Picea pungens / Alnus incana* Woodland (CEGL000894, G3)
- *Picea pungens / Betula occidentalis* Woodland (CEGL002637, G2)
- *Picea pungens / Cornus sericea* Woodland (CEGL000388, G4)
- *Picea pungens / Dasiphora fruticosa ssp. floribunda* Woodland (CEGL000396, G2G3)
- *Picea pungens / Equisetum arvense* Woodland (CEGL000389, G3?)

- *Pinus contorta / Calamagrostis canadensis* Forest (CEGL000138, G5)
- *Pinus contorta / Carex (aquatilis, angustata)* Woodland (CEGL000140, G4Q)
- *Pinus contorta / Cornus sericea* Woodland (CEGL005929, G2G3)
- *Pinus contorta / Deschampsia caespitosa* Forest (CEGL000147, G3)
- *Populus balsamifera ssp. trichocarpa - Picea engelmannii / Equisetum arvense* Forest (CEGL005907, G2?)
- *Populus balsamifera ssp. trichocarpa - Populus tremuloides* - Conifer / *Calamagrostis canadensis* Forest (CEGL005909, G2?)
- *Populus balsamifera ssp. trichocarpa - Populus tremuloides* - Conifer / *Cornus sericea* Forest (CEGL005905, G2G3)
- *Populus balsamifera ssp. trichocarpa - Populus tremuloides* - Conifer / *Heracleum maximum* Forest (CEGL005910, G2?)
- *Populus tremuloides - Abies lasiocarpa - Picea engelmannii / Streptopus amplexifolius* Forest (CEGL005908, G2G3)
- *Populus tremuloides / Alnus incana - Salix* spp. Forest (CEGL001082, G4)
- *Populus tremuloides / Alnus incana / Betula nana - Ribes* spp. Forest (CEGL001149, G1)
- *Populus tremuloides / Alnus incana* Forest (CEGL001150, G3)
- *Populus tremuloides / Betula occidentalis* Forest (CEGL002650, G3)
- *Populus tremuloides / Calamagrostis canadensis* Forest (CEGL000574, G3)
- *Populus tremuloides / Carex aquatilis var. aquatilis* Forest (CEGL003442, G1?)
- *Populus tremuloides / Carex obnupta* Forest (CEGL003371, G2)
- *Populus tremuloides / Carex pellita* Forest (CEGL000577, G2)
- *Populus tremuloides / Cornus sericea* Forest (CEGL000582, G4)
- *Populus tremuloides / Corylus cornuta* Forest (CEGL000583, G3)
- *Populus tremuloides / Equisetum arvense* Forest (CEGL000584, G4)
- *Populus tremuloides / Quercus gambelii / Symphoricarpos oreophilus* Forest (CEGL000598, GNR)
- *Populus tremuloides / Ranunculus alismifolius* Forest (CEGL000599, G2?)
- *Populus tremuloides / Ribes montigenum* Forest (CEGL000600, G2)
- *Populus tremuloides / Salix drummondiana* Forest (CEGL002902, G3G4)
- *Populus tremuloides / Senecio bigelovii var. bigelovii* Forest (CEGL000590, G1?)
- *Populus tremuloides / Veratrum californicum* Forest (CEGL000621, G3?)
- *Populus tremuloides* Canyon Formation Forest (CEGL000576, GUQ)

DISTRIBUTION

Range: This system is found at montane to subalpine elevations of the Rocky Mountain cordillera, from southern New Mexico north into Montana, Alberta and British Columbia, and west into the Intermountain region and the Colorado Plateau.
Divisions: 204:P; 304:C; 306:C
Nations: CA, US
Subnations: AB, AZ, BC, CO, ID, MT, NM, NV, OR, SD, UT, WA, WY
Map Zones: 1:C, 6:P, 7:?, 9:C, 10:C, 12:C, 16:P, 17:P, 18:P, 19:C, 20:C, 21:C, 22:C, 23:C, 24:C, 25:C, 26:P, 27:C, 28:C, 29:C
USFS Ecomap Regions: 313B:CC, 331A:C?, 331J:CC, 341A:CP, 341D:CP, 341F:CP, 341G:CC, 342A:CC, 342B:CP, 342C:CC, 342D:CC, 342E:CP, 342F:CC, 342G:CC, 342H:CC, 342I:CC, 342J:CC, M242C:CC, M242D:CC, M261E:CC, M331A:CC, M331B:CC, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M331J:CC, M332A:CC, M332B:CC, M332D:CC, M332E:CC, M332F:CC, M332G:CC, M333A:CC, M333B:CC, M333C:CC, M333D:CC, M341A:CC, M341D:CC
TNC Ecoregions: 4:P, 6:P, 7:C, 8:C, 9:C, 11:C, 18:C, 19:C, 20:C, 21:C, 25:C, 68:C

SOURCES

References: Baker 1988, Baker 1989a, Baker 1989b, Baker 1990, Comer et al. 2002, Comer et al. 2003, Crowe and Clausnitzer 1997, Ecosystems Working Group 1998, Kittel 1993, Kittel et al. 1994, Kittel et al. 1995, Kittel et al. 1999a, Kittel et al. 1999b, Kovalchik 1987, Kovalchik 1993, Kovalchik 2001, Manning and Padgett 1995, Muldavin et al. 2000a, Nachlinger et al. 2001, NCC 2002, Neely et al. 2001, Padgett 1982, Padgett et al. 1988b, Padgett et al. 1989, Rondeau 2001, Tuhy et al. 2002
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722840#references
Description Author: NatureServe Western Ecology Team, mod. R. Crawford
Version: 09 Feb 2005 **Stakeholders:** Canada, Midwest, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

SOUTH FLORIDA BAYHEAD SWAMP (CES411.366)

CLASSIFIERS

Classification Status: Standard

Primary Division: Caribbean (411)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Non-Diagnostic Classifiers: Forest and Woodland (Treed); Depressional; Broad-Leaved Evergreen Tree
National Mapping Codes: ESLF 9317

CONCEPT

Summary: This ecological system consists of stands of predominately broad-leaved hardwoods which are emergent amidst marshes of the south Florida Everglades region. These areas are often called "tree islands" as they occur on slightly elevated sites above the low-relief marshes. Loveless, writing in 1959, considered them to be "perhaps the most striking botanical feature in the Everglades." Individual islands often have a characteristic shape depending upon the size; large islands are often teardrop-shaped, smaller islands are circular. Patches range in size from one-quarter acre to 300 acres or more. These islands often form an abrupt ecotone with adjacent fire-prone marshes. Fires enter bayhead swamps only under extreme drought conditions and may kill much of the bayhead vegetation and heavily reduce peat accumulation. If left long unburned, bayheads may succeed to hardwood hammocks.

Related Concepts:
- Baldcypress: 101 (Eyre 1980) Finer
- Baygall (FNAI 1990) Undetermined
- Cabbage Palmetto: 74 (Eyre 1980) Finer
- Hydric Hammock (FNAI 1990) Undetermined
- Sweetbay - Swamp Tupelo - Redbay: 104 (Eyre 1980) Finer
- Tropical Hardwoods: 105 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs on sites elevated above surrounding marshes; they are inundated 2-6 months during the year, and often found on Gandy Peat soils (Gunderson and Loftus 1993). Tree islands in the northern Everglades occur on acidic, deep peat sites, while southern examples are higher in pH, and shallower peat. Individual islands often have a characteristic shape depending upon the size; large islands are often teardrop-shaped, smaller islands are circular (Loveless 1959, Gunderson and Loftus 1993). Patches range in size from one-quarter acre to 300 acres or more.
Vegetation: Although plant communities in this system have quite similar floristic composition across the Everglades region, there are suggestions that pH and peat depth vary between northern and southern examples, factors which may influence species composition (Loveless 1959). Stands often support a luxuriant ground layer of ferns.
Dynamics: These islands often form an abrupt ecotone with adjacent marshes. Although fires often burn through the marshes, they enter bayhead swamps only under extreme drought conditions. Under these conditions, fires may kill much of the bayhead vegetation and heavily reduce peat accumulation. If left long unburned, bayheads may succeed to hardwood hammocks. Bayheads in some areas are inundated 2-6 months during the year (Gunderson and Loftus 1993), but hydroperiods may vary from 1-4 months in the northern to middle part of Taylor Slough; small, higher areas within a bayhead may never be under water (Olmstead et al. 1980b).

Component Associations:
- *Conocarpus erectus - Metopium toxiferum - Acoelorraphe wrightii / Chrysobalanus icaco* Forest (CEGL007057, G1?)
- *Magnolia virginiana - Persea palustris - Chrysobalanus icaco / Acrostichum danaeifolium - Nephrolepis exaltata* Forest (CEGL007015, G1)
- *Magnolia virginiana - Persea palustris - Chrysobalanus icaco / Cladium mariscus ssp. jamaicense* Woodland (CEGL007016, G1)
- *Quercus laurifolia - Sabal palmetto / Myrsine floridana - Psychotria nervosa* Forest (CEGL007060, G1?)
- *Rhizophora mangle - Taxodium distichum - Metopium toxiferum / Chrysobalanus icaco / Apteria aphylla* Forest (CEGL007454, G1)
- *Roystonea elata - Taxodium distichum - Quercus laurifolia / Psychotria nervosa / Nephrolepis* spp. Forest (CEGL007455, G1)
- *Taxodium distichum / Persea palustris - Fraxinus caroliniana - Chrysobalanus icaco / Blechnum serrulatum* Forest (CEGL007440, G2?)

DISTRIBUTION

Range: Endemic to south Florida.
Divisions: 411:C
Nations: US
Subnations: FL
Map Zones: 56:C
TNC Ecoregions: 54:C

SOURCES

References: Brandt et al. 2003, Comer et al. 2003, Eyre 1980, FNAI 1990, Gunderson and Loftus 1993, Landfire 2007a, Loveless 1959, Olmsted et al. 1980b, Ugarte et al. 2006, Wade et al. 1980

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723150#references

Description Author: R. Evans, mod. M. Pyne and C. Nordman

Version: 14 Jan 2014

Concept Author: R. Evans

Stakeholders: Southeast

ClassifResp: Southeast

SOUTH FLORIDA CYPRESS DOME (CES411.365)

CLASSIFIERS

Classification Status: Standard

Primary Division: Caribbean (411)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Depressional
Non-Diagnostic Classifiers: Forest and Woodland (Treed); Isolated Wetland [Partially Isolated]
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2447; ESLF 9116; ESP 1447

CONCEPT

Summary: This system is found primarily in the Everglades and Big Cypress regions. This system consists of small forested wetlands in poorly drained depressions which are underlain by an impervious layer that impedes drainage and traps precipitation. *Taxodium ascendens* is the dominant tree, with the oldest and largest individuals characteristically occupying the center, and smaller and younger individuals around the margins. Pools of stagnant, highly acidic water may stand in the center of these depressions ranging from 1-4 feet in depth, but becoming increasingly shallow along the margins. The understory flora is typified by species with tropical affinities. These ponds are important for many wildlife species.

Related Concepts:

- Dome Swamp (FNAI 1990) Broader
- Pondcypress: 100 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs in areas of low relief, occupying poorly drained to permanently wet depressions. Pools of stagnant, highly acidic water may stand in the center of these depressions ranging from 1-4 feet in depth, but becoming increasingly shallow along the margins.

Vegetation: In addition to *Taxodium ascendens*, other taxa that may be present include *Annona glabra, Chrysobalanus icaco, Ficus aurea, Persea palustris*, and *Bacopa caroliniana*.

Dynamics: Cypress domes get their common name from the unique dome-shaped appearance in which trees in the center are higher than those around the sides (Monk and Brown 1965). The water draws down more frequently along the edges than in the deeper center. This allows for more frequent recruitment of *Taxodium ascendens* seedlings along the edges, which are also exposed to more frequent wildland fire than the center of the ponds which remain flooded for longer durations. These two factors are reflected in the presence of large trees in the center and smaller trees closer to the edges of the ponds.

Component Associations:

- *Taxodium ascendens / Annona glabra - Cephalanthus occidentalis - Morella cerifera - Salix caroliniana* Forest (CEGL007415, G2?)
- *Taxodium ascendens / Annona glabra / Bacopa caroliniana* Forest (CEGL007414, G2?)
- *Taxodium ascendens / Chrysobalanus icaco - Ficus aurea - Persea palustris* Forest (CEGL007416, G2?)

DISTRIBUTION

Range: Endemic to south Florida.
Divisions: 411:C
Nations: US
Subnations: FL
Map Zones: 56:C
USFS Ecomap Regions: 411A:CC
TNC Ecoregions: 54:C

SOURCES

References: Comer et al. 2003, Eyre 1980, FNAI 1990, FNAI 2010a, Monk and Brown 1965
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723151#references
Description Author: R. Evans, mod. M. Pyne and C.W. Nordman
Version: 14 Jan 2014
Concept Author: R. Evans
Stakeholders: Southeast
ClassifResp: Southeast

SOUTH FLORIDA DWARF CYPRESS SAVANNA (CES411.290)

CLASSIFIERS

Classification Status: Standard

Primary Division: Caribbean (411)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Woody-Herbaceous; Extensive Wet Flat
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2445; ESLF 9114; ESP 1445

CONCEPT

Summary: The scrub or dwarf cypress system covers extensive areas of south Florida, especially in the Big Cypress Swamp region of southwest Florida. These stunted stands of *Taxodium ascendens* grow on shallow sands or marl soils above limestone bedrock. Individual trees are usually quite small and widely scattered, with canopy coverage ranging from 30-45% (Flohrschutz 1978). The understory shares much overlap with wet prairies of the region (Drew and Schomer 1984) and is dominated by the following genera: *Rhynchospora*, *Cyperus*, *Muhlenbergia*, and *Cladium*. The open, stunted aspect is maintained in part by stresses imposed by extreme seasonal water level changes and low-nutrient soils (Anonymous 1978). Ewel (1990b) suggests a hydroperiod of approximately 6 months for this type.
Classification Comments: Related vegetation occurs in north Florida on clay soils of Tates Hell Swamp.
Related Concepts:
- Marl Prairie (FNAI 1990) Broader
- Pondcypress: 100 (Eyre 1980) Finer

Component Associations:
- *Taxodium ascendens / Muhlenbergia filipes - Rhynchospora microcarpa* Woodland (CEGL003681, G3)
- *Taxodium ascendens / Paspalum monostachyum - Rhynchospora microcarpa - Cladium mariscus ssp. jamaicense* Woodland (CEGL003996, G2G3)
- *Taxodium ascendens / Rhynchospora microcarpa - Schizachyrium rhizomatum - Muhlenbergia filipes* Woodland (CEGL003997, G2G3)

DISTRIBUTION

Range: Endemic to south Florida.
Divisions: 411:C
Nations: US
Subnations: FL
Map Zones: 56:C
USFS Ecomap Regions: 411A:CC
TNC Ecoregions: 54:C

SOURCES

References: Anonymous 1978, Comer et al. 2003, Drew and Schomer 1984, Ewel 1990b, Flohrschutz 1978, Lodge 1994
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723198#references
Description Author: R. Evans
Version: 14 Dec 2004
Concept Author: R. Evans
Stakeholders: Southeast
ClassifResp: Southeast

SOUTH FLORIDA HYDRIC HAMMOCK (CES411.273)

CLASSIFIERS

Classification Status: Standard

Primary Division: Caribbean (411)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
National Mapping Codes: ESLF 4330

CONCEPT

Summary: This system includes wet hardwood-dominated hammocks occupying flat lowlands in extreme southern Florida. Examples are underlain by limestone substrate. They are wetlands with high water tables and/or ponded surface water, and often mucky soils. Although often found within or adjacent to floodplains, examples of this system are only infrequently subject to overbank flooding. Like other hydric hammocks of Florida, the vegetation is characterized by mixed hardwood species. *Quercus virginiana, Sabal palmetto*, and *Acer rubrum* may be diagnostic, but the flora tends to include some tropical elements that are absent from more northern examples.
Classification Comments: This concept apparently includes low hammocks of Taylor Alexander (A. Johnson pers. comm.).
Related Concepts:
- Cabbage Palmetto: 74 (Eyre 1980) Finer
- Hydric Hammock (FNAI 1990) Broader
- Prairie Hammock (FNAI 1990) Finer

DESCRIPTION

Environment: Examples of this system are associated with limestone-rich sites in southern Florida, often adjacent to floodplains.
Vegetation: Like other hydric hammocks of Florida, the vegetation is characterized by mixed hardwood species (FNAI 1997), although examples of this type have somewhat depauperate canopies when compared with more northern examples (A. Johnson pers. comm.). *Quercus virginiana, Sabal palmetto*, and *Acer rubrum* may be diagnostic; but the flora tends to include some tropical elements that are absent from more northern examples.
Dynamics: The major natural disturbances in hydric hammocks are flooding, fire, grazing or browsing by white tailed deer (*Odocoileus virginianus*) and feral hogs (*Sus scrofa*), and wind damage (Vince et al. 1989). While fires are infrequent in hydric hammocks, fire scars are apparent at many sites, preserved on the trunks of *Sabal palmetto*, which can survive even severe fires (Vince et al. 1989).

Component Associations:
- *Quercus laurifolia - Sabal palmetto / Myrsine floridana - Psychotria nervosa* Forest (CEGL007060, G1?)
- *Sabal palmetto - Quercus laurifolia - Quercus virginiana - Magnolia virginiana - Ulmus americana* Forest (CEGL004674, G2G3)
- *Sabal palmetto - Quercus virginiana - Ulmus americana - Ficus aurea / Acrostichum danaeifolium - Nephrolepis exaltata* Forest (CEGL004409, G2?)

DISTRIBUTION

Range: Endemic to south Florida.
Divisions: 411:C
Nations: US
Subnations: FL
Map Zones: 56:C
TNC Ecoregions: 54:C

SOURCES

References: Alexander 1967, Eyre 1980, FNAI 1990, FNAI 1997, FNAI 2010a, Johnson, A. pers. comm., Southeastern Ecology Working Group n.d., Vince et al. 1989
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.732403#references
Description Author: R. Evans, mod. C. Nordman
Version: 14 Jan 2014
Concept Author: R. Evans and A. Johnson
Stakeholders: Southeast
ClassifResp: Southeast

SOUTH FLORIDA MANGROVE SWAMP (CES411.289)

CLASSIFIERS

Classification Status: Standard

Primary Division: Caribbean (411)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Forest and Woodland (Treed); Tidal / Estuarine
National Mapping Codes: ESLF 9304

CONCEPT

Summary: This swamp ecological system of southern Florida occurs along intertidal and supratidal shorelines. The primary species comprising this system are *Rhizophora mangle*, *Avicennia germinans*, *Laguncularia racemosa*, and *Conocarpus erectus*, each with essentially tropical affinities and poor survival in cold temperatures. This system attains best development in low wave-energy, depositional environments. Examples occur on soils generally saturated with brackish water at all times and which become inundated during high tides. The brackish environment tends to limit competition from other species. At least three broad variants of this system can be recognized: riverine mangrove forests, fringe mangrove forests, and basin mangrove forests; all are included here.
Classification Comments: Although at least three broad variants of this system can be recognized, i.e., riverine mangrove forests, fringe mangrove forests, and basin mangrove forests (Lugo et al. 1988), all are included here for now.
Related Concepts:
- Mangrove: 106 (Eyre 1980) Finer
- Tidal Swamp (FNAI 1990) Equivalent

DESCRIPTION

Environment: Mangroves are essentially tropical species that occur only infrequently in areas where the average annual temperature is below 19 degrees Celsius; fluctuations greater than 10 degrees Celsius and short-duration freezes are detrimental to all species. Low-temperature stress leads to decreased height, leaf area, and increased tree density (Odum and McIvor 1990). *Avicennia* is apparently the most cold hardy species, extending as far north as the Gulf Coast (Sherrod and McMillan 1985) and on the Atlantic Coast nearly to the Florida stateline (30 degrees N latitude) (Savage 1972, Odum et al. 1982). *Rhizophora* and *Laguncularia* reach approximately 29 degrees N latitude on both coasts of Florida (Rehm 1976, Teas 1977, Odum et al. 1982). However, the northern limits of all species fluctuate due to short-term climatic swings making exact delineations impossible. Mangroves are also affected by substrate type and wave energy, with best development in low wave-energy, depositional environments; high wave energy prevents establishment and may destroy their shallow root systems (Odum and McIvor 1990). Examples occur on soils generally saturated with brackish water at all times, and which become inundated during high tides (FNAI 1990). The species sometimes sort along salinity gradients, with *Rhizophora* limited to salinities below 60-65 ppt, while *Avicennia* and *Laguncularia* tolerate levels above 80-95 ppt [see references in Odum and McIvor (1990)]. The species employ different strategies to cope with fluctuations and extremes in salinity. Red mangroves exclude salt by a reverse osmosis process, while black and white mangroves use salt glands to excrete excess salts. However, most species may use combined strategies of salt exclusion and excretion (Albert 1975).
Vegetation: The primary species comprising this system are the true mangroves, *Rhizophora mangle*, *Avicennia germinans*, and *Laguncularia racemosa*, as well as the close associate *Conocarpus erectus*. The combined stresses of flooding and salinity tend to result in limited competition (FNAI 1990), lack of plant species richness, and relatively simple stand structure (Mendelssohn and McKee 1988). However, other salt-tolerant species may also be present. Broad classifications of mangroves have included six types (Lugo and Snedaker 1974) and more recently three broad variants (Lugo et al. 1988), i.e., riverine mangrove forests, fringe mangrove forests, and basin mangrove forests [see also Mendelssohn and McKee (1988)].

Component Associations:
- *Acrostichum aureum - (Acrostichum danaeifolium)* Tidal Herbaceous Vegetation (CEGL004899, G3?)
- *Avicennia germinans - (Rhizophora mangle) / Batis maritima* Basin Forest (CEGL007061, G4?)
- *Avicennia germinans / Sarcocornia pacifica* Shrubland (CEGL003802, G3?)
- *Avicennia germinans / Spartina alterniflora* Shrubland (CEGL003801, G2?)
- *Avicennia germinans* Forest (CEGL004827, G5)
- *Conocarpus erectus - (Avicennia germinans) / Borrichia arborescens - Borrichia frutescens / Sporobolus virginicus - Monanthochloe littoralis* Scrub (CEGL003805, G3?)
- *Conocarpus erectus - (Laguncularia racemosa) / Batis maritima - Borrichia frutescens / Sesuvium portulacastrum - Suaeda linearis* Scrub (CEGL003806, G2?)
- *Conocarpus erectus - (Laguncularia racemosa) / Cladium mariscus ssp. jamaicense* Scrub (CEGL003798, G2?)
- *Conocarpus erectus - Metopium toxiferum - Acoelorraphe wrightii / Chrysobalanus icaco* Forest (CEGL007057, G1?)
- *Conocarpus erectus - Rhizophora mangle - Laguncularia racemosa - Metopium toxiferum / Tillandsia* spp. Woodland (CEGL003505, G2)
- *Conocarpus erectus / Sporobolus virginicus - Spartina spartinae* Woodland (CEGL003506, G1?)
- *Conocarpus erectus* Forest (CEGL007600, G3G5)

- *Laguncularia racemosa* Basin Forest (CEGL007063, G3?)
- *Rhizophora mangle - (Avicennia germinans, Laguncularia racemosa) / Acrostichum* spp. Forest (CEGL007067, G2G3)
- *Rhizophora mangle - (Avicennia germinans, Laguncularia racemosa)* Riverine Forest (CEGL007066, G4)
- *Rhizophora mangle - Laguncularia racemosa - Avicennia germinans - Conocarpus erectus / Jacquinia keyensis* Forest (CEGL007053, G2?)
- *Rhizophora mangle / Eleocharis cellulosa* Shrubland (CEGL003800, G3?)
- *Rhizophora mangle* Fringe Forest (CEGL004764, G3G5)
- *Rhizophora mangle* Medium Island Forest (CEGL007603, G5)
- *Rhizophora mangle* Overwash Island Forest (CEGL004765, G3G5)
- *Rhizophora mangle* Scrub (CEGL003803, G5)
- *Sporobolus virginicus - Distichlis spicata* Herbaceous Vegetation (CEGL007663, G5)

DISTRIBUTION

Range: This system is best developed in southern Florida, extending north to approximately 29 degrees N latitude on both coasts.
Divisions: 203:C; 411:C
Nations: US
Subnations: FL
Map Zones: 56:C
TNC Ecoregions: 54:C, 55:C

SOURCES

References: Albert 1975, Comer et al. 2003, FNAI 1990, Lugo and Snedaker 1974, Lugo et al. 1988, Mendelssohn and McKee 1988, Odum and McIvor 1990, Odum et al. 1982, Rehm 1976, Savage 1972, Sherrod and McMillan 1985, Soil Conservation Service 1981a, Teas 1977
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723199#references
Description Author: R. Evans
Version: 17 Mar 2009 **Stakeholders:** Southeast
Concept Author: R. Evans **ClassifResp:** Southeast

SOUTH FLORIDA POND-APPLE/POPASH SLOUGH (CES411.486)

CLASSIFIERS

Classification Status: Standard

Primary Division: Caribbean (411)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: >180-day hydroperiod; Forest and Woodland (Treed); Depressional [Peaty]
National Mapping Codes: ESLF 9195

CONCEPT

Summary: This wetland system of south Florida occupies deep muck soils with long hydroperiods. Examples are dominated by *Fraxinus caroliniana* and/or *Annona glabra*. Aquatic herb species that are also found in other wetland systems of south Florida, such as *Crinum americanum*, *Bacopa caroliniana*, and *Sagittaria graminea*, may also be present (Hilsenbeck et al. 1979, Gunderson and Loope 1982). Examples of this system are important nesting, feeding, and roosting habitats for Everglades wading birds (Hilsenbeck et al. 1979). Large areas of this system that formerly occurred around Lake Okeechobee were cleared for farming around 1900 (Craighead 1971); only small examples still persist in Big Cypress National Preserve and portions of Everglades National Park.
Classification Comments: This system is related to South Florida Slough, Gator Hole and Willow Head (CES411.485) but occupies lower elevations with longer hydroperiods and has different vegetation. As currently conceived, this system includes the pond-apple - willow forests of Hilsenbeck et al. (1979).
Similar Ecological Systems:
- South Florida Slough, Gator Hole and Willow Head (CES411.485)

Related Concepts:
- Slough (FNAI 1990) Broader
- Strand Swamp (FNAI 1990) Undetermined

DESCRIPTION

Environment: Examples occupy some of the deepest muck soils and relatively lowest soil elevations in the Big Cypress National Preserve (Gunderson and Loope 1982).
Dynamics: The successional dynamics of this system are not clearly understood.

Component Associations:
- *Annona glabra - Conocarpus erectus / Acrostichum aureum* Forest (CEGL007617, G2G3)
- *Annona glabra / Crinum americanum - Bacopa caroliniana* Forest (CEGL007055, G1G2)
- *Fraxinus caroliniana / Crinum americanum - Bacopa caroliniana* Forest (CEGL004478, G2G3)

DISTRIBUTION

Range: Endemic to south Florida.
Divisions: 411:C
Nations: US
Subnations: FL
Map Zones: 56:C
TNC Ecoregions: 54:C

SOURCES

References: Comer et al. 2003, Craighead 1971, Gunderson and Loope 1982b, Hilsenbeck et al. 1979
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723100#references
Description Author: R. Evans and C. Nordman
Version: 05 Feb 2003
Concept Author: R. Evans and C. Nordman
Stakeholders: Southeast
ClassifResp: Southeast

SOUTH-CENTRAL INTERIOR / UPPER COASTAL PLAIN WET FLATWOODS (CES203.480)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Forest and Woodland (Treed); Extensive Wet Flat; Broad-Leaved Deciduous Tree
Non-Diagnostic Classifiers: Isolated Wetland [Partially Isolated]
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Deciduous open tree canopy
National Mapping Codes: EVT 2457; ESLF 9126; ESP 1457

CONCEPT

Summary: This system represents predominantly wet flatwoods of limited areas of the most inland portions of the East Gulf Coastal Plain in western Kentucky, as well as related broad, flat areas of the western Interior Low Plateau. This part of the Coastal Plain is referred to as the Jackson Purchase or "Jackson Plain." They tend to be confined to relatively small areas near the eastern flank of the region where loess deposits thin out. Unlike South-Central Interior / Upper Coastal Plain Flatwoods (CES203.479) of the same general region (which is typified by complex microtopography), this system occupies broad flats underlain by fragipans. These fragipans impede the downward migration of water, resulting in wet conditions for portions of the year. Fire was important, probably maintaining relatively open-canopied stands. Stands are dominated by hardwood trees, including *Acer rubrum, Fagus grandifolia, Liquidambar styraciflua, Quercus falcata, Quercus pagoda*, and *Quercus palustris*.
Classification Comments: The primary range of this system is limited areas of the "Jackson Purchase" or "Jackson Plain" of Kentucky and possibly related areas in adjacent western Tennessee, as well as related broad, flat areas of the western Interior Low Plateau. According to Bryant and Martin (1988) the "Flatwoods" portion of the Jackson Purchase (which is primarily where the "Wet Flatwoods" are located in that area) occupies less than 2% of the total area, but localized occurrences could have been present in other parts of the region. These apparently related wet flatwoods in the western end of the Moulton Valley of Alabama are found in northeastern Franklin and extreme western Lawrence counties, from 10 to 20 km east of Russellville. More information is needed. In Alabama, this system is apparently found in the Moulton Valley region (A. Schotz pers. comm. 2006), which is technically part of TNC Ecoregion 50 but ambiguously placed there.
Similar Ecological Systems:
- Interior Highlands Unglaciated Flatwoods (CES202.454)
- South-Central Interior / Upper Coastal Plain Flatwoods (CES203.479)

Related Concepts:
- Flatwoods (Evans 1991) Intersecting
- Pin Oak - Sweetgum: 65 (Eyre 1980) Finer
- Sweetgum - Willow Oak: 92 (Eyre 1980) Finer

DESCRIPTION

Environment: These flatwoods have long been recognized as the primary vegetation type of a distinctive subdivision within the Upper East Gulf Coastal Plain region (Davis 1923, Bryant and Martin 1988), as well as related areas of the western Interior Low Plateau. Within the "Jackson Plain" portion of the Upper East Gulf Coastal Plain, these flatwoods tend to be confined to relatively small areas near the eastern flank of the "Jackson Plain" region where the loess deposits thin out. Like drier *Quercus stellata* flatwoods of these areas (which are typified by microtopographic variation), this system occupies broad flats underlain by fragipans. These fragipans impede the downward migration of water resulting in wet conditions for longer portions of the year. In the Jackson Plain area the soils include Henry silt loam, Routon silt loam (Bryant and Held 2001) and Calloway silt loam (Karathanasis et al. 2003). Fire is probably relatively infrequent in this system (M. Evans pers. comm.). In the Pennyroyal Plain, this system occurs on upland flats and depressions with poor drainage, underlain by limestone; soils include Robertsville silt loam (Chester et al. 1995) and Henry silt loam (M. Evans pers. comm.).
Vegetation: Stands are typically dominated by various combinations of oaks and other hardwoods, including *Quercus pagoda, Quercus stellata, Carya ovata, Prunus serotina, Diospyros virginiana, Ulmus alata, Ulmus americana, Quercus palustris* (Bryant 1999), *Quercus michauxii, Liquidambar styraciflua, Carya* spp., *Nyssa sylvatica*, and *Acer rubrum* (Chester et al. 1995). Most stands of this system have been severely altered or destroyed, and the characteristic herbs are poorly known. *Campsis radicans* may be found, along with *Carex* spp., including *Carex leptalea* and *Carex cherokeensis*. Other herbs may include *Leersia* spp. and *Cardamine bulbosa*. *Quercus phellos* and/or *Quercus lyrata* may also be present in stands of this system in Kentucky (M. Evans pers. comm. 2006). Some stands placed here are dominated by *Quercus falcata* (e.g., at Shiloh National Military Park), others (e.g., in the Moulton Valley of Alabama) by a combination of *Quercus phellos* and *Quercus nigra* (A. Schotz pers. comm. 2006).
Dynamics: Fire was an important but relatively infrequent natural process in this system, probably maintaining relatively open-canopied stands (M. Evans pers. comm.). Under such conditions *Andropogon gerardii* and *Chasmanthium* spp. may have dominated the herbaceous ground cover. Flooding and saturation are part of the natural dynamics. Due to the fragipan, deep rooting of trees is limited and the trees are particularly prone to windthrow during storms. This has helped maintain open woodland conditions.

Component Associations:
- *Quercus falcata* Flatwoods Forest (CEGL004412, G2?)
- *Quercus palustris - (Quercus stellata) - Quercus pagoda / Isoetes* spp. Forest (CEGL002101, G2G3)
- *Quercus phellos - (Quercus lyrata) / Carex* spp. - *Leersia* spp. Forest (CEGL002102, G3G4Q)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- East Gulf Coastal Plain Northern Loess Plain Oak-Hickory Upland (CES203.482)

DISTRIBUTION

Range: The primary range of this system is limited areas of the "Jackson Purchase" or "Jackson Plain" of Kentucky and possibly related areas in adjacent western Tennessee, as well as related broad, flat areas of the western Interior Low Plateau. Examples in the Pennyroyal Plain (of the western Interior Low Plateau) have been known for many years and referred to as "pondywoods" or "crawfishy land" (Chester et al. 1995). They are also known from the Shawnee Hills of Kentucky, on periglacial lakebeds (M. Evans pers. comm. 2006), and related wet flatwoods have been discerned from wetland modeling and confirmed in the Moulton Valley of Alabama (A. Schotz pers. comm. 2006) and are included here. It is assumed to cross the Ohio River into adjacent Indiana.
Divisions: 203:C
Nations: US
Subnations: AL, IL?, IN?, KY, TN
Map Zones: 46:P, 47:C, 48:C, 49:?
USFS Ecomap Regions: 223D:CC, 223E:CC, 223G:CC, 231B:CC, 231H:CC
TNC Ecoregions: 43:C, 44:C, 50:C

SOURCES

References: Bryant 1999, Bryant and Held 2001, Bryant and Martin 1988, Chester et al. 1995, Comer et al. 2003, Davis 1923, Evans 1991, Evans, M. pers. comm., Eyre 1980, Hendricks et al. 1991, Karathanasis et al. 2003, KSNPC 2009, NatureServe Ecology - Southeastern U.S. unpubl. data, NRCS 1996, Schotz pers. comm.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723106#references
Description Author: R. Evans and M. Evans, mod. M. Pyne and C. Nordman
Version: 14 Jan 2014 **Stakeholders:** Midwest, Southeast
Concept Author: R. Evans and M. Evans, mod. M. Pyne **ClassifResp:** Southeast

SOUTHEASTERN COASTAL PLAIN NATURAL LAKESHORE (CES203.044)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Woody-Herbaceous; Depressional [Pond]; Coastal plain
National Mapping Codes: ESLF 9167

CONCEPT

Summary: This system consists of wetland vegetation along large natural lakeshores in the Outer Coastal Plain of the southeastern United States. Natural lakes are generally rare features throughout most of this region. However, examples range northward to the Atlantic Coastal Plain in southeastern Virginia and North Carolina, but no examples are known from South Carolina and Georgia. However examples are present in Florida, where they are apparently found on smaller lakes than those to the north. Hydroperiod remains relatively constant from year to year, especially when compared to smaller limesink depressions of the region. Vegetation may appear to be zonal in relationship to distance from the lakeshore and may range from open water or floating-leaved aquatics in the deeper waters of the lakes, to emergent marsh zones along the edges. In some cases there are wet hardwood swamps present.
Classification Comments: This system is related to Southern Atlantic Coastal Plain Depression Pondshore (CES203.262) which is found primarily on limesink depressions that are smaller in scale and have greater hydrologic fluctuation. This system is also related to Atlantic Coastal Plain Clay-Based Carolina Bay Wetland (CES203.245) in that some of the natural lake basins it occurs on are thought to be Carolina bays (Bennett and Nelson 1991).
Similar Ecological Systems:
- Atlantic Coastal Plain Clay-Based Carolina Bay Wetland (CES203.245)
- Southern Atlantic Coastal Plain Depression Pond (CES203.262)

Related Concepts:
- Baldcypress: 101 (Eyre 1980) Finer
- Basin Marsh (FNAI 2010a) Intersecting
- Basin Swamp (FNAI 2010a) Intersecting
- Clastic Upland Lake (FNAI 1990) Intersecting
- Flatwoods/Prairie/Marsh Lake (FNAI 1990) Intersecting
- Lacustrine (FNAI 2010a) Intersecting
- Open Water Lake (Bennett and Nelson 1991) Finer
- Sinkhole Lake (FNAI 1990) Intersecting

DESCRIPTION

Environment: Occurs along the edges of lakes, where the water is flooded for long durations, but may dry out during dry summer months, or during drought.
Dynamics: Long hydroperiod flooding is characteristic of these wetlands which occur along the shore of coastal plain natural lakes. Most of these habitats are naturally nutrient-poor.

Component Associations:
- *Adiantum capillus-veneris / Concocephalum salebrosum* Herbaceous Vegetation (CEGL004515, G1Q)
- *Cyrilla racemiflora - Lyonia lucida* Shrubland (CEGL003844, G3?)
- *Liquidambar styraciflua / Persea palustris* Forest (CEGL004481, G1)
- *Nuphar sagittifolia - Eriocaulon aquaticum* Lakeshore Herbaceous Vegetation (CEGL004297, G1)
- *Nymphaea odorata - Nuphar advena - (Nymphoides aquatica, Xyris smalliana)* Herbaceous Vegetation (CEGL004326, G3?)
- *Panicum hemitomon - Eleocharis equisetoides - Rhynchospora inundata* Herbaceous Vegetation (CEGL004127, G3)
- *Panicum hemitomon - Juncus* spp. Coastal Plain Lakeshore Herbaceous Vegetation (CEGL004307, G1)
- *Panicum hemitomon - Pluchea (camphorata, rosea) - Ludwigia* spp. Herbaceous Vegetation (CEGL007792, G3)
- *Taxodium distichum - Liquidambar styraciflua - Platanus occidentalis / Asimina triloba* Forest (CEGL004424, G1?)
- *Taxodium distichum - Taxodium ascendens / Panicum hemitomon - Sclerolepis uniflora* Woodland (CEGL004465, G1)
- *Taxodium distichum - Taxodium ascendens / Panicum hemitomon* Woodland (CEGL004466, G3?)
- *Taxodium distichum / Cephalanthus occidentalis / Juncus repens* Woodland (CEGL004653, G1?)

DISTRIBUTION

Range: This system is found in the Outer Coastal Plain of Virginia (apparently from a single site, Lake Drummond) and North Carolina, apparently absent from South Carolina and Georgia, but examples are present in Florida (i.e., Ocean Pond on Osceola National Forest).
Divisions: 203:C
Nations: US

Subnations: FL, GA?, NC, SC?, VA
Map Zones: 55:C, 56:C, 58:C, 60:C, 99:C
USFS Ecomap Regions: 232C:CC, 232D:CC, 232G:CC, 232I:CC, 232L:CC
TNC Ecoregions: 53:?, 55:C, 57:C

SOURCES

References: Bennett and Nelson 1991, Comer et al. 2003, Eyre 1980, FNAI 2010a
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722665#references
Description Author: M. Schafale and R. Evans
Version: 06 Feb 2014 **Stakeholders:** East, Southeast
Concept Author: M. Schafale and R. Evans **ClassifResp:** Southeast

SOUTHEASTERN GREAT PLAINS FLOODPLAIN FOREST (CES205.710)

CLASSIFIERS

Classification Status: Standard

Primary Division: Eastern Great Plains (205)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Deep (>15 cm) Water; Intermediate (5-25 yrs) Flooding Interval; Forest and Woodland (Treed); Herbaceous; Riverine / Alluvial
National Mapping Codes: ESLF 4160

CONCEPT

Summary: This ecological system is found in the floodplains of medium and larger rivers of the East Central Texas Plains, Texas Blackland Prairie Regions, Crosstimbers, and the southeastern edge of the Central Great Plains (Level 3 Ecoregions 33, 32, 29 and 27 respectively). Alluvial soils and sedimentation processes typify this system. Periodic, intermediate flooding and deposition (every 5-25 years) dominates the formation and maintenance of this system. Dominant communities within this system range from floodplain forests to wet meadows to gravel/sand flats; however, they are linked by underlying soils and the flooding regime. Canopy dominants may include *Carya illinoinensis, Ulmus crassifolia, Ulmus americana, Celtis laevigata, Quercus nigra, Platanus occidentalis, Acer negundo, Quercus macrocarpa, Morus rubra, Fraxinus pennsylvanica, Salix nigra*, and Sapindus *saponaria var. drummondii (= Sapindus drummondii)*. Overgrazing and/or overbrowsing may influence recruitment of overstory species and composition of the understory and herbaceous layers. Shrub species may include *Callicarpa americana, Ilex decidua, Sideroxylon lanuginosum, Diospyros virginiana, Juniperus virginiana, Cornus drummondii*, and *Viburnum rufidulum*, which may occur as dense patches following disturbance, but are otherwise generally fairly sparse. Vines such as *Berchemia scandens, Campsis radicans, Vitis* spp., *Parthenocissus quinquefolia*, and *Ampelopsis arborea* may be conspicuous. Herbaceous cover includes *Elymus virginicus, Verbesina virginica, Chasmanthium latifolium, Chasmanthium sessiliflorum, Tripsacum dactyloides, Symphyotrichum drummondii var. texanum, Geum canadense, Sanicula canadensis, Panicum virgatum, Galium* spp., and *Carex* sp. Herbaceous cover may be quite high, especially in situations where shrub cover is low. The environment and vegetation of this system become generally and correspondingly drier from east to west with moister representatives (such as communities containing *Quercus phellos, Quercus pagoda, Quercus alba*, and *Quercus lyrata*) occurring along the eastern and northeastern margins of the range. Representatives of this system may vary in the openness of the habitat and physiognomy.
Classification Comments: More data are needed to determine if this system should be split and a new system developed for the southern parts of Ecoregion 32 and 33 (*sensu* EPA; Griffith et al. 2004), south of the Brazos or Colorado rivers. Further field investigation is needed to better develop the association-level information for this system. This system grades into Edwards Plateau Floodplain (CES303.651) but can be distinguished by the absence or low cover of western species such as *Juglans major, Juglans microcarpa, Juniperus ashei, Mahonia trifoliolata (= Berberis trifoliolata), Sapindus saponaria var. drummondii*, and the presence or higher cover of more eastern species such as *Maclura pomifera, Ilex decidua, Ilex vomitoria, Quercus nigra, Ulmus americana*, and *Juniperus virginiana*. Species common in both systems include *Ulmus crassifolia, Carya illinoinensis, Platanus occidentalis*, and *Celtis laevigata*. More information is need to better differentiate these systems.

Along the Red River and a few of its tributaries, thin bands of riparian vegetation occurring on sandy floodplain terraces, bluffs and sandbars are significantly different in species composition from riparian communities elsewhere in the region. The floodplains of the Red River have been recognized as a separate system (Red River Large Floodplain Forest (CES203.065)). Occurrences may include *Salix* spp. (especially *Salix exigua*), *Acer saccharinum* (which probably does not occur in any other basin in Texas), *Juniperus virginiana*, and *Populus deltoides*. Adjacent slopes and higher floodplain terraces support woodlands of *Juniperus virginiana, Quercus macrocarpa, Quercus shumardii, Quercus muehlenbergii, Fraxinus texensis, Cornus drummondii*, and *Viburnum rufidulum*.
Similar Ecological Systems:
- Edwards Plateau Floodplain Terrace (CES303.651)
- Western Great Plains Floodplain (CES303.678)

Related Concepts:
- Central Texas: Floodplain Baldcypress Swamp (1824) [CES205.710.24] (Elliott 2011) Finer
- Central Texas: Floodplain Deciduous Shrubland (1806) [CES205.710.6] (Elliott 2011) Finer
- Central Texas: Floodplain Evergreen Forest (1801) [CES205.710.1] (Elliott 2011) Finer
- Central Texas: Floodplain Evergreen Shrubland (1805) [CES205.710.5] (Elliott 2011) Finer
- Central Texas: Floodplain Hardwood / Evergreen Forest (1803) [CES205.710.3] (Elliott 2011) Finer
- Central Texas: Floodplain Hardwood Forest (1804) [CES205.710.4] (Elliott 2011) Finer
- Central Texas: Floodplain Herbaceous Vegetation (1807) [CES205.710.7] (Elliott 2011) Finer
- Central Texas: Floodplain Herbaceous Wetland (1817) [CES205.710.17] (Elliott 2011) Finer
- Central Texas: Floodplain Live Oak Forest (1802) [CES205.710.2] (Elliott 2011) Finer
- Central Texas: Floodplain Seasonally Flooded Hardwood Forest (1814) [CES205.710.14] (Elliott 2011) Finer
- Silver Maple - American Elm: 62 (Eyre 1980) Finer
- Sugarberry - American Elm - Green Ash: 93 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occupies relatively broad flats at low topographic positions, along large streams where alluvial deposition dominates. Rivers such as the Sulphur (and tributaries such as White Oak and Cuthand creeks), Sabine (and Lake Fork), Trinity (and its major tributaries), Navasota, and portions of the Lower and Middle Brazos (and its major tributaries), Colorado, Guadalupe, Lavaca, Navidad, and San Antonio rivers may support this system. The geological setting is Quaternary Alluvium (Elliott 2011). It is found in the floodplains of medium and larger rivers of the East Central Texas Plains, Texas Blackland Prairie Regions, Cross Timbers, and the southeastern edge of the Central Great Plains (Level 3 Ecoregions 33, 32, 29 and 27, respectively, *sensu* Griffith et al. (2004)). Bottomland Ecological Sites (including Loamy, Sandy, and Clayey) characterize this system. Soils are primarily alluvial and range from sandy to dense clays.

Vegetation: Dominant communities within this system range from floodplain forests to wet meadows to gravel/sand flats; however, they are linked by underlying soils and the flooding regime. Canopy dominants may include *Carya illinoinensis, Fraxinus americana, Quercus nigra, Ulmus crassifolia, Celtis laevigata, Ulmus americana, Quercus fusiformis* or *Quercus virginiana, Platanus occidentalis, Acer negundo, Gleditsia triacanthos, Quercus macrocarpa, Morus rubra, Fraxinus pennsylvanica*, and *Sapindus saponaria var. drummondii*. Especially along river margins, species such as *Platanus occidentalis, Populus deltoides*, and *Salix nigra* may dominate. In this eastern part of the range of the system, *Liquidambar styraciflua, Quercus phellos*, and *Betula nigra* may also be commonly encountered. Seasonally flooded sites, especially within the Trinity River basin, may have *Quercus lyrata* as an overstory component. Overgrazing and/or overbrowsing may influence recruitment of overstory species and composition of the understory and herbaceous layers. Shrub species may include *Callicarpa americana, Cephalanthus occidentalis, Ilex decidua, Ilex vomitoria, Sideroxylon lanuginosum, Diospyros virginiana, Vaccinium arboreum, Juniperus virginiana, Cornus drummondii*, and *Viburnum rufidulum* which may occur as dense patches following disturbance, but are otherwise generally fairly sparse. In the southern expressions of the system, other shrubs such as *Prosopis glandulosa, Acacia farnesiana, Diospyros texana*, and *Condalia hookeri* may be commonly encountered. Vines such as *Berchemia scandens, Campsis radicans, Vitis* spp., *Parthenocissus quinquefolia, Toxicodendron radicans, Smilax bona-nox*, and *Ampelopsis arborea* may be conspicuous. Herbaceous cover includes *Elymus virginicus, Verbesina virginica, Chasmanthium latifolium, Chasmanthium sessiliflorum, Carex cherokeensis, Tripsacum dactyloides, Symphyotrichum drummondii var. texanum, Calyptocarpus vialis, Geum canadense, Sanicula canadensis, Ambrosia trifida, Panicum virgatum, Galium* spp., *Teucrium canadense*, and *Carex* spp. Wetter sites may contain species such as *Zizaniopsis miliacea, Rhynchospora* spp., *Eleocharis* spp., *Nymphaea odorata*, and *Peltandra virginica*. In early-successional states, growth rates among species are variable with species such as *Acer negundo* having rapid growth rate and species such as *Quercus macrocarpa* growing more slowly. There may be an open canopy resulting from flood events and rare fire events. The environment and vegetation of this system become generally and correspondingly drier from east to west with moister representatives (such as communities containing *Quercus phellos, Quercus pagoda, Quercus alba*, and *Quercus lyrata*) occurring along the eastern and northeastern margins of the range. Non-native grasses that may dominate these sites include *Cynodon dactylon, Bothriochloa ischaemum var. songarica*, and *Sorghum halepense*. Herbaceous cover may be quite high, especially in situations where shrub cover is low. The non-native trees *Triadica sebifera* and *Melia azedarach* may be present.

Dynamics: Periodic and intermediate flooding is the most significant process controlling this system and is expected every 5 to 25 years. Grazing and conversion to agriculture can significantly impact this system and can lead to the degradation or extirpation of the majority of prairie and wet meadow communities from this system. Fire occurs infrequently relative to surrounding systems. Fuels tend to stay moister due to shady conditions and low topographic position. Other disturbances include ice storm/blowdowns, which are capable of setting back small to large patches; as well as beaver pond flooding, which even though a small-patch event, is expected to cycle throughout the forest over the long term, perhaps at a scale of hundreds or thousands of years.

Component Associations:

- *Fraxinus pennsylvanica - Ulmus crassifolia - Celtis laevigata* Forest (CEGL004618, GNR)
- *Quercus macrocarpa - Carya illinoinensis / Cornus drummondii - Frangula caroliniana* Forest (CEGL004196, GNR)
- *Ulmus americana - Celtis (laevigata, occidentalis) - Fraxinus pennsylvanica* Forest (CEGL002090, G3?)
- *Ulmus crassifolia - Carya illinoinensis - Celtis laevigata / Chasmanthium sessiliflorum - Carex cherokeensis* Forest (CEGL002388, G2G3)

SPATIAL CHARACTERISTICS

Spatial Summary: The scale of occurrences is wider and longer than the equivalent riparian system and can be hundreds to the low tens of thousands of acres.

Adjacent Ecological Systems:

- Central Texas Coastal Prairie River Floodplain (CES203.713)
- Southeastern Great Plains Riparian Forest (CES205.709)

Adjacent Ecological System Comments: The equivalent riparian woodland/forest system occurs along upper reaches of streams where streamflows become intermittent and alluvial deposits are thinner. Like other wooded wetland systems, this tends to blend into riparian systems as streams become smaller upstream.

DISTRIBUTION

Range: This system is found along major river floodplains in the East Central Texas Plains, Texas Blackland Prairie Regions, Crosstimbers, and the southeastern edge of the Central Great Plains (Level 3 Ecoregions 33, 32, 29 and 27, respectively, *sensu* Griffith et al. (2004)). Rivers such as the Sulphur (and tributaries such as White Oak and Cuthand creeks), Sabine (and Lake Fork), Trinity (and its major tributaries), Navasota, portions of the Lower and Middle Brazos rivers (and major tributaries), portions of the middle

and upper Red River, and portions of the Guadalupe, Colorado, and San Antonio rivers downstream of the Edwards Plateau ecoregion may support this system.
Divisions: 205:C; 303:C
Nations: US
Subnations: OK, TX
Map Zones: 32:C, 35:C, 36:C, 37:C
USFS Ecomap Regions: 255Ac:CCP, 255Ad:CCC, 255Af:CCC, 255Ba:CCC, 255Ca:CCC, 255Cc:CCC, 255Cd:CCC, 255Ea:CCC, 255Eb:CCC, 255Ec:CCC, 255Ed:CCC, 255Ee:CCC, 315Cb:CCP, 315Ed:CCC, 315Ga:CCC
TNC Ecoregions: 32:C

SOURCES

References: Eidson pers. comm., Elliott 2011, Eyre 1980, Griffith et al. 2004, Southeastern Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.806778#references
Description Author: M. Pyne and J. Teague
Version: 24 Feb 2011 **Stakeholders:** Southeast
Concept Author: J. Eidson, M. Pyne, L. Elliott and J. Teague **ClassifResp:** Southeast

SOUTHEASTERN GREAT PLAINS RIPARIAN FOREST (CES205.709)

CLASSIFIERS

Classification Status: Standard

Primary Division: Eastern Great Plains (205)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Forest and Woodland (Treed); Shrubland (Shrub-dominated); Woody-Herbaceous; Herbaceous; Streambed; Flood Scouring
National Mapping Codes: ESLF 4159

CONCEPT

Summary: This ecological system occurs in various situations along small and intermittent streams in the East Central Texas Plains, Texas Blackland Prairie Regions, Crosstimbers, and the southeastern edge of the Central Great Plains (Level 3 Ecoregions 33, 32, 29 and 27, respectively, *sensu* Griffith et al. (2004)). Some trees that may be present in stands of this system include *Celtis laevigata var. laevigata, Celtis laevigata var. reticulata, Platanus occidentalis, Quercus nigra, Quercus phellos, Amorpha fruticosa, Forestiera acuminata, Acer saccharinum, Sapindus saponaria, Salix nigra, Fraxinus pennsylvanica, Gleditsia triacanthos, Carya illinoinensis*, and *Ulmus crassifolia*. The environment and vegetation of this system become generally and correspondingly drier from east to west with moister representatives (such as communities containing *Quercus nigra*) occurring in the eastern parts of the range. Representatives of this system typically occur in stream-scoured situations and vary in the openness of the habitat and physiognomy.
Classification Comments: More data are needed to determine if this system should be split and a new system developed for the southern parts of Ecoregion 32 and 33 (sensu EPA; Griffith et al. 2004), south of the Brazos or Colorado rivers. Further field investigation is needed to better develop the association-level information for this system.
Similar Ecological Systems:
- Edwards Plateau Riparian (CES303.652)
- North American Warm Desert Riparian Woodland and Shrubland (CES302.753)
- West Gulf Coastal Plain Small Stream and River Forest (CES203.487)
- Western Great Plains Riparian (CES303.956)

Related Concepts:
- Central Texas: Riparian Deciduous Shrubland (1906) [CES205.709.6] (Elliott 2011) Finer
- Central Texas: Riparian Evergreen Forest (1901) [CES205.709.1] (Elliott 2011) Finer
- Central Texas: Riparian Evergreen Shrubland (1905) [CES205.709.5] (Elliott 2011) Finer
- Central Texas: Riparian Hardwood / Evergreen Forest (1903) [CES205.709.3] (Elliott 2011) Finer
- Central Texas: Riparian Hardwood Forest (1904) [CES205.709.4] (Elliott 2011) Finer
- Central Texas: Riparian Herbaceous Vegetation (1907) [CES205.709.7] (Elliott 2011) Finer
- Central Texas: Riparian Herbaceous Wetland (1917) [CES205.709.17] (Elliott 2011) Finer
- Central Texas: Riparian Live Oak Forest (1902) [CES205.709.2] (Elliott 2011) Finer

DESCRIPTION

Environment: This system occurs on minor intermittent streams and tributaries throughout the East Central Texas Plains, Texas Blackland Prairies, Cross Timbers, and the southeastern edge of the Central Great Plains (Level 3 Ecoregions 33, 32, 29 and 27 respectively, sensu Griffith et al. (2004)). As defined, this system occupies buffer zones of headwater streams, and soils develop in place over a variety of geologic surfaces (Elliott 2011). It is found along medium to very small, intermittent to ephemeral drainages. These include the valleys and drainages along headwater streams of the Sulphur, Sabine, Navasota, Brazos, upper Trinity rivers, and middle portions of the Guadalupe and San Antonio river basins, typically in areas with erosional processes dominating over alluvial deposition. In the Trinity River basin, occurrences were mapped upstream of approximately the Leon/Madison countyline, near the confluence with Cobb Creek. This type is ubiquitous throughout, but species composition and flood regimes are variable and are thought to be dependent on soil and geologic substrates. Generally, these are less thick alluvium than in floodplain terraces. By definition, this system is mapped along drainages upstream of the Bottomland Ecoclasses, so they will be mapped on soils of the surrounding uplands.
Vegetation: Trees that may be present in stands of this system include *Celtis laevigata, Ulmus crassifolia, Platanus occidentalis, Populus deltoides, Quercus fusiformis, Quercus nigra, Quercus phellos, Sapindus saponaria var. drummondii, Salix nigra, Fraxinus americana, Fraxinus pennsylvanica, Gleditsia triacanthos, Prosopis glandulosa*, and *Carya illinoinensis*. Height of vegetation is variable on an east-to-west moisture gradient. To the east, *Quercus falcata* and *Liquidambar styraciflua* may become important components of the overstory. To the east, evergreen-dominated occurrences may contain *Pinus taeda* or *Pinus echinata*, as well as *Juniperus virginiana*. The shrub layer development is variable, sometimes with species such as *Amorpha fruticosa, Forestiera acuminata, Ilex decidua, Ilex vomitoria, Sideroxylon lanuginosum, Juniperus virginiana, Diospyros virginiana, Cornus drummondii, Condalia hookeri, Acacia farnesiana*, and/or *Viburnum rufidulum*. A few sites may be shrub-dominated without an overstory canopy, containing species such as *Forestiera acuminata, Cephalanthus occidentalis, Acacia farnesiana*, or *Sesbania drummondii*. Herbaceous cover is also variable, depending on overstory and shrub canopies and recent flooding history. Herbaceous species may include

Andropogon glomeratus, Panicum virgatum, Elymus virginicus, Verbesina virginica, Chasmanthium latifolium, Chasmanthium sessiliflorum, Tripsacum dactyloides, Symphyotrichum drummondii var. texanum, Clematis pitcheri, Amphiachyris dracunculoides, Ambrosia psilostachya, Geum canadense, Sanicula canadensis, Justicia americana Galium spp., and *Carex* spp. Upland species such as *Schizachyrium scoparium, Nassella leucotricha,* and *Sorghastrum nutans* may be common. Herbaceous species may occur as clumps or as a continuous herbaceous layer, this being controlled by soil development. Some early-successional stands may have *Amorpha fruticosa* as a dominant woody species, comprising up to 50% of the canopy cover. Woody vines such as *Smilax bona-nox, Toxicodendron radicans, Ampelopsis arborea*, and *Vitis* spp. may be common.

The environment and characteristics of the vegetation of this system become drier from east to west, with moister representatives (such as communities containing *Quercus nigra*) occurring in the eastern parts of the range. There are many plant communities which make up this system; *Amorpha* is typical in some locales. It is likely that other communities have a shrubby successional stage which may include *Forestiera acuminata, Prunus rivularis,* and tree seedlings and saplings of later-successional communities (J. Eidson pers. comm. 2007). Non-native grass species that may be common to dominant on these sites include *Arundo donax, Cynodon dactylon,* and *Sorghum halepense*. The non-native species such as *Ligustrum* spp. and *Triadica sebifera* may be commonly encountered (Elliott 2011).

Dynamics: These are flashy streams, and flooding rather than fire will be the dominant process in this system. Fuels in this system are variable, and fire-return interval is partially determined by that of the adjacent and surrounding matrix upland system, where fuels are present.

Spatial Characteristics

Adjacent Ecological Systems:

- Southeastern Great Plains Floodplain Forest (CES205.710)
- Western Great Plains Riparian (CES303.956)

Distribution

Range: This system is found along major river floodplains in the East Central Texas Plains, Texas Blackland Prairie Regions, Crosstimbers, and the southeastern edge of the Central Great Plains (Level 3 Ecoregions 33, 32, 29 and 27, respectively, *sensu* Griffith et al. (2004)). Occurrences of this system occupy drainages of the Sulphur (and tributaries such as White Oak and Cuthand creeks), Sabine (and Lake Fork), Trinity (and its major tributaries), Navasota, and portions of the Lower and Middle Brazos rivers (and major tributaries).

Divisions: 205:C; 303:C
Nations: US
Subnations: OK, TX
Map Zones: 32:C, 35:C, 36:C, 37:C
USFS Ecomap Regions: 255Ac:CCP, 255Ad:CCC, 255Af:CCC, 255Ba:CCC, 255Ca:CCC, 255Cc:CCC, 255Cd:CCC, 255Ea:CCC, 255Eb:CCC, 255Ec:CCC, 255Ed:CCC, 255Ee:CCC, 315Cb:CCP, 315Ed:CCC, 315Ga:CCC
TNC Ecoregions: 32:C

Sources

References: Eidson pers. comm., Elliott 2011, Griffith et al. 2004, Southeastern Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.806782#references
Description Author: M. Pyne and J. Teague, mod. L. Elliott
Version: 18 Feb 2011 **Stakeholders:** Southeast
Concept Author: J. Eidson, M. Pyne, L. Elliott and J. Teague **ClassifResp:** Southeast

SOUTHERN AND CENTRAL APPALACHIAN BOG AND FEN (CES202.300)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Fen; Shrubland (Shrub-dominated); Depressional; Bog
Non-Diagnostic Classifiers: Graminoid
National Mapping Codes: ESLF 9309

CONCEPT

Summary: This system consists of wetlands associated with flat sites in the Southern Blue Ridge, Central Appalachians, Cumberland Mountains, and possibly upper Piedmont and adjacent Ridge and Valley. These sites occur at elevations below 1220 m (4000 feet) in poorly drained bottomlands on soils which are often saturated and mucky. Wetness results from a combination of groundwater input, seepage from adjacent slopes, rainfall and impeded drainage. The amount of seepage water input is variable among examples, and these wetlands are typically primarily depressional. Vegetation is at least partially open, with herbaceous-dominated areas as well as shrub thickets and often forested zones. Vegetation is a complex of zones or patches with a mix of physiognomies. The wettest areas have herbaceous vegetation dominated by *Carex* spp., usually with abundant *Sphagnum*. Scattered trees and shrubs may be present in the herbaceous zones. Most examples also have a dense shrub zone around the edges. Some examples have forested zones as well, around the edges or as a matrix in which numerous small herbaceous openings are embedded. Characteristic tree species are *Tsuga canadensis, Acer rubrum, Nyssa sylvatica,* and *Pinus rigida*. Characteristic tree species are *Tsuga canadensis, Acer rubrum, Nyssa sylvatica,* and *Pinus rigida*. Characteristic shrubs include *Rhododendron maximum, Alnus serrulata, Viburnum nudum var. cassinoides,* and *Toxicodendron vernix*.
Classification Comments: This system includes communities known locally as either "bogs" or "fens," but it is uncertain as to how their hydrology and soils relate to the definitions of these terms as used in other regions. Bogs are typically defined as rainwater-fed peatlands, and fens as groundwater-fed peatlands, ranging from poor to rich, with from weakly minerotrophic to strongly minerotrophic groundwater, respectively. In the Southern Appalachians, there are a few examples with obvious calcareous groundwater input, but more often the vegetation and flora are more characteristic of northern poor fens than either "bogs" or northern "rich fens," although mossy peat layers may be relatively thin. All of these wetland associations are placed in the same system despite the variation in vegetation dominance and uncertainly about the hydrology and soils.

This system is distinguished from Southern Appalachian Seepage Wetland (CES202.317) by patterns of flora and vegetation. Though both systems have heterogeneous and variable vegetation, they share few or no associations. The setting also differs, with Southern and Central Appalachian Bog and Fen (CES202.300) occurring on flat sites such as valley bottoms, where impeded drainage is important, while the seeps occur on sloping sites where water flow is freer and more groundwater flow is needed to create a wetland. High-elevation wetlands in West Virginia are placed in High Allegheny Wetland (CES202.069).

Similar Ecological Systems:
- High Allegheny Wetland (CES202.069)
- Southern Appalachian Seepage Wetland (CES202.317)

Related Concepts:
- Appalachian Bog (Fleming et al. 2006) Intersecting
- Mafic Fen / Seep (Fleming et al. 2006) Intersecting
- Mountain and Piedmont Bog (Wharton 1978) Broader
- Southern Appalachian Bog (Schafale and Weakley 1990) Intersecting

DESCRIPTION

Environment: This system occurs in patches in flat valley bottoms, usually on the outer edges of stream floodplains at elevations below 1220 m (4000 feet). The soil is saturated most or all of the year, at least in the wettest parts, and may be very mucky. Although sites rarely flood, wetness results from a combination of groundwater input, rainfall, seepage from adjacent slopes, and impeded drainage. The groundwater is usually highly acidic and low in dissolved bases, but one or a few examples have somewhat calcareous water input because groundwater flows through mafic rock substrates. Overland flow and stream flooding are presumably only rare events. The geologic substrate is usually alluvium. Often, but not always, there is an adjacent slope with a seep at its base or some visible microtopographic feature, such as a stream levee or ridge, that impedes water drainage out of the area. Some occurrences have substantial microtopography of abandoned stream channels or ridge-and-swale systems that pond water in low areas.
Vegetation: Vegetation is a complex of zones or patches with a mix of physiognomies. The wettest areas have herbaceous vegetation dominated by *Carex* spp., usually with abundant *Sphagnum*. Scattered trees and shrubs may be present in the herbaceous zones. Most examples also have a dense shrub zone around the edges. Some examples have forest zones as well, around the edges or as a matrix in which numerous small herbaceous openings are embedded. Characteristic tree species are *Tsuga canadensis, Acer rubrum, Nyssa sylvatica,* and *Pinus rigida*. Characteristic shrubs include *Rhododendron maximum, Alnus serrulata, Viburnum nudum var. cassinoides,* and *Toxicodendron vernix*. A number of plant species are shared with northern bogs, including some that are disjunct

long distances and occur in the south only in bogs. Other species are narrow endemics, such as *Sarracenia rubra ssp. jonesii*. In the more southern examples, some species are shared with bog communities in the Coastal Plain. The very rare richer fen examples have very distinctive vegetation, sharing a number of species with northern rich fens.

Dynamics: The natural dynamics of this system are not well known and are subject to debate. The factors that created and naturally maintain this system are unclear. Most examples show a strong tendency at present for shrubs and trees to increase in density in the open areas, threatening to eliminate the characteristic herb species. This suggests that an important process has been altered or lost. One hypothesis is that bogs are an ephemeral feature developing from abandoned beaver ponds. Another hypothesis is that they result from a narrow combination of moisture and nutrient conditions, which have been widely altered in an obscure way that has changed ecosystem stability. The cattle grazing that was nearly universal in examples of this system in the past appears to have delayed woody succession but may also have altered the natural characteristics. Fire is sometimes considered as a factor, but most examples do not appear flammable enough to burn. Besides woody encroachment, bogs may be altered by changes in adjacent drainage, such as entrenchment by streams.

Component Associations:

- *Acer rubrum - Fraxinus pennsylvanica / Lindera benzoin / Osmunda regalis - Pedicularis lanceolata* Forest (CEGL007046, G1?)
- *Acer rubrum var. trilobum - Nyssa sylvatica / Osmunda cinnamomea - Chasmanthium laxum - Carex intumescens / Sphagnum lescurii* Forest (CEGL007443, G3?)
- *Alnus serrulata - Kalmia carolina - Rhododendron catawbiense - Spiraea alba / Carex folliculata - Lilium grayi* Shrubland (CEGL003915, G1G2)
- *Alnus serrulata - Lindera benzoin / Scutellaria lateriflora - Thelypteris noveboracensis* Shrubland (CEGL003909, G2?)
- *Alnus serrulata - Rhododendron arborescens / Sarracenia oreophila - Rhynchospora rariflora* Shrubland (CEGL003914, G1)
- *Alnus serrulata - Rhododendron viscosum - Rhododendron maximum / Juncus gymnocarpus - Chelone cuthbertii* Shrubland (CEGL003916, G1G2)
- *Alnus serrulata - Viburnum nudum var. nudum - Chamaedaphne calyculata / Woodwardia areolata - Sarracenia rubra ssp. jonesii* Shrubland (CEGL003918, G1)
- *Alnus serrulata / Sanguisorba canadensis - Calamagrostis canadensis* Shrubland (CEGL004252, G1)
- *Alnus serrulata / Sanguisorba canadensis - Parnassia grandifolia - Helenium brevifolium* Shrubland (CEGL003917, G1)
- *Carex (atlantica, echinata, leptalea, lurida) - Solidago patula* Herbaceous Vegetation (CEGL004156, G1)
- *Carex atlantica - Rhynchospora alba - Parnassia asarifolia / Sphagnum warnstorfii* Herbaceous Vegetation (CEGL004157, G1)
- *Carex atlantica - Solidago patula var. patula - Lilium grayi / Sphagnum bartlettianum* Herbaceous Vegetation (CEGL004158, G1)
- *Carex canescens - Eriophorum virginicum / Sphagnum* spp. Herbaceous Vegetation (CEGL006549, GNR)
- *Carex echinata - Solidago uliginosa / Sphagnum* spp. Herbaceous Vegetation (CEGL008534, G2?)
- *Carex gynandra - Platanthera clavellata - Drosera rotundifolia - Carex ruthii - Carex atlantica / Sphagnum* spp. Herbaceous Vegetation (CEGL007697, G2)
- *Carex gynandra - Scirpus cyperinus - Eriophorum virginicum - Osmunda cinnamomea* Herbaceous Vegetation (CEGL007771, G2)
- *Carex stricta - Caltha palustris - Oxypolis rigidior - Symphyotrichum puniceum* Herbaceous Vegetation (CEGL008461, G1?)
- *Cladium mariscoides - Sanguisorba canadensis / Sphagnum subsecundum* Herbaceous Vegetation (CEGL004167, G1)
- *Dulichium arundinaceum - Carex folliculata - Juncus* spp. Herbaceous Vegetation (CEGL006552, GNR)
- *Juncus effusus* Seasonally Flooded Herbaceous Vegetation (CEGL004112, G5)
- *Physocarpus opulifolius - Alnus serrulata / Osmunda regalis - Parnassia grandifolia - Eryngium integrifolium* Shrubland (CEGL007048, G1?)
- *Picea rubens - (Tsuga canadensis) / Rhododendron maximum* Saturated Forest (CEGL006277, G2?)
- *Pinus rigida / Osmunda cinnamomea - Carex stricta - Eriophorum virginicum / Sphagnum* spp. Woodland (CEGL007056, G1)
- *Pinus rigida / Toxicodendron vernix / Gaylussacia baccata / Symplocarpus foetidus* Woodland (CEGL003667, G1)
- *Pinus strobus - Acer rubrum / Spiraea alba var. latifolia / Sanguisorba canadensis* Woodland (CEGL004994, G1)
- *Rhododendron (maximum, catawbiense) - Ilex collina - Salix sericea / Carex trisperma - Eriophorum virginicum* Shrubland (CEGL003913, G1)
- *Rhododendron maximum / Sphagnum* spp. Shrubland (CEGL003849, G2G3Q)
- *Spiraea alba var. latifolia - Cornus racemosa / Calamagrostis canadensis - Sanguisorba canadensis - Carex scoparia* Shrub Herbaceous Vegetation (CEGL006249, G1)
- *Tsuga canadensis - Acer rubrum - (Liriodendron tulipifera, Nyssa sylvatica) / Rhododendron maximum / Sphagnum* spp. Forest (CEGL007565, G2)

SPATIAL CHARACTERISTICS

Spatial Summary: Small-patch system, from one to several acres in size.

Size: Occurs as small patches, from about one acre to several acres. The largest examples are swamp forest-bog complexes that may cover 10 or more acres. Except for the small openings in the swamp forest-bog complexes, bog and fen patches tend to occur singly or in small clusters only.

Adjacent Ecological Systems:

- Southern and Central Appalachian Cove Forest (CES202.373)
- Southern Appalachian Northern Hardwood Forest (CES202.029)

Adjacent Ecological System Comments: Usually associated with Southern and Central Appalachian Cove Forest (CES202.373).

DISTRIBUTION

Range: This system ranges from the southern Appalachians of northern Georgia and South Carolina north to Virginia. It is also found in the Cumberland Mountains of Kentucky.
Divisions: 202:C
Nations: US
Subnations: GA, KY, NC, SC, TN, VA
Map Zones: 53:C, 54:C, 57:C, 59:C, 61:C
TNC Ecoregions: 50:C, 51:C, 52:?, 59:C

SOURCES

References: Comer et al. 2003, Evans, M. pers. comm., Fleming et al. 2006, Richardson and Gibbons 1993, Schafale and Weakley 1990, Wharton 1978
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723191#references
Description Author: M. Schafale and R. Evans, mod. M. Pyne, S. Gawler, C. Nordman
Version: 14 Jan 2014 **Stakeholders:** East, Southeast
Concept Author: M. Schafale and R. Evans **ClassifResp:** Southeast

SOUTHERN ATLANTIC COASTAL PLAIN LARGE RIVER FLOODPLAIN FOREST (CES203.066)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Forest and Woodland (Treed); Riverine / Alluvial [Brownwater]
National Mapping Codes: ESLF 9313

CONCEPT

Summary: This system represents a geographic subset of Southern Floodplain Forest. Examples may be found along large rivers of the Atlantic Coastal Plain, especially the Roanoke, Great Pee Dee, Congaree/Santee, Savannah, and Altamaha rivers. Several distinct plant communities can be recognized within this system that may be related to the array of different geomorphologic features present within the floodplain. Some of the major geomorphic features associated with different community types include natural levees, point bars, meander scrolls, oxbows, and sloughs. Vegetation generally includes forests dominated by bottomland hardwood species and other trees tolerant of flooding. However, herbaceous and shrub vegetation may be present in certain areas as well.
Classification Comments: This system has some overlap in associations with CES203.489, but many more are not in common. In addition "...most, if not all, associations in the system are shared with Atlantic Coastal Plain Small Brownwater River Floodplain Forest (CES203.250). The main difference is in the scale of landscape pattern, but the extent and relief of fluvial landforms like natural levees and backswamps and the general flooding dynamics also differ" (M. Schafale pers. comm.).
Similar Ecological Systems:
- Atlantic Coastal Plain Blackwater Stream Floodplain Forest (CES203.247)
- Atlantic Coastal Plain Brownwater Stream Floodplain Forest (CES203.248)
- Atlantic Coastal Plain Small Blackwater River Floodplain Forest (CES203.249)
- Atlantic Coastal Plain Small Brownwater River Floodplain Forest (CES203.250)
- East Gulf Coastal Plain Large River Floodplain Forest (CES203.489)--East Gulf equivalent.
- Northern Atlantic Coastal Plain Riverine Peat Swamp (CES203.070)

Related Concepts:
- Baldcypress - Tupelo: 102 (Eyre 1980) Finer
- Baldcypress: 101 (Eyre 1980) Finer
- Black Willow: 95 (Eyre 1980) Finer
- Cottonwood: 63 (Eyre 1980) Finer
- Live Oak: 89 (Eyre 1980) Finer
- Loblolly Pine - Hardwood: 82 (Eyre 1980) Finer
- Loblolly Pine: 81 (Eyre 1980) Finer
- Overcup Oak - Water Hickory: 96 (Eyre 1980) Finer
- River Birch - Sycamore: 61 (Eyre 1980) Finer
- Silver Maple - American Elm: 62 (Eyre 1980) Finer
- Sugarberry - American Elm - Green Ash: 93 (Eyre 1980) Finer
- Swamp Chestnut Oak - Cherrybark Oak: 91 (Eyre 1980) Finer
- Sweetgum - Willow Oak: 92 (Eyre 1980) Finer
- Sycamore - Sweetgum - American Elm: 94 (Eyre 1980) Finer
- Water Tupelo - Swamp Tupelo: 103 (Eyre 1980) Finer
- Willow Oak - Water Oak - Diamondleaf (Laurel) Oak: 88 (Eyre 1980) Finer

DESCRIPTION

Environment: This system represents a geographic subset of Kuchler's (1964) Southern Floodplain Forest. Examples of this system are generally forested with stands of bottomland hardwood species and other trees tolerant of flooding. Local composition varies depending upon actual position within the floodplain, disturbance history, and underlying soils and geology. Some of the major geomorphic features associated with different community types include natural levees, point bars, meander scrolls, oxbows, and sloughs (Sharitz and Mitsch 1993). Although most examples of this system may be thought of as acidic, some examples of this system flow through regions with sufficient calcareous influence to effect vegetation composition.
Vegetation: Trees dominating stands of this system can include *Acer negundo, Acer rubrum var. rubrum, Acer rubrum var. drummondii, Acer saccharinum, Betula nigra, Carya aquatica, Celtis laevigata, Fraxinus caroliniana, Fraxinus pennsylvanica, Liquidambar styraciflua, Liriodendron tulipifera, Nyssa aquatica, Nyssa biflora, Nyssa ogeche, Platanus occidentalis, Populus deltoides, Quercus laurifolia, Quercus michauxii, Salix nigra,* and *Ulmus americana*. Some disturbed stands may contain *Pinus taeda*. Shrubs and small trees can include *Alnus serrulata, Asimina triloba, Carpinus caroliniana, Cephalanthus occidentalis, Cornus foemina, Decodon verticillatus, Hypericum prolificum, Ilex decidua, Itea virginica, Lindera benzoin, Lyonia lucida, Planera aquatica, Sabal minor, Salix caroliniana, Sebastiania fruticosa,* and *Arundinaria gigantea ssp. gigantea*. Vines can include *Ampelopsis arborea,*

Vitis spp., and others. Herbs can include *Boehmeria cylindrica, Carex abscondita, Carex albolutescens, Carex bromoides, Carex grayi, Carex intumescens, Carex joorii, Carex lupulina, Carex retroflexa, Chasmanthium laxum, Commelina virginica, Glyceria septentrionalis, Hydrocotyle ranunculoides, Leersia lenticularis, Lemna minor, Onoclea sensibilis, Saururus cernuus, Typha latifolia*, and *Zizaniopsis miliacea*, as well as the epiphytes *Tillandsia bartramii* and *Tillandsia usneoides*, and the aquatic exotic *Alternanthera philoxeroides*.

Dynamics: In pre-European settlement forests, community diversity in these bottomland systems was much more complex than in the modified landscapes of today. Fire, beaver activity, and flooding of varied intensity and frequency created a mosaic whose elements included canebrake, grass and young *Betula-Platanus* beds on reworked gravel or sand bars, beaver ponds, and grass-sedge meadows in abandoned beaver clearings, as well as the streamside zones and mixed hardwood and/or pine forests that make up more than 95% of the land cover that exists today.

When flooded, these systems may have a substantial aquatic faunal component, with high densities of invertebrates, and may play an important role in the life cycle of fish in the associated river. Unusually long or deep floods may stress vegetation or act as a disturbance for some species. Larger floods cause local disturbance by scouring and depositing sediment along channels and occasionally causing channel shifts. There are two general types of floods: occasional catastrophic, prolonged floods (due to beaver activity or other severe event); and more frequent repeated minor flooding (i.e., several minor floods within a 10-year period).

Except for primary successional communities such as bars, most forests exist naturally as multi-aged old-growth forests driven by gap-phase regeneration. Windthrow is probably the most important cause of gaps, and is the primary cause of mortality in bottomlands. Major storms or hurricanes occurring at approximately 20-year intervals would have impacted whole stands. Fire is of limited importance in lower, wetter areas, but was historically important in the higher terraces.

The dominant ecological processes in bottomland hardwood forests are windfall gaps and periodic flooding. Windfall gaps occur on the local scale (a single mature canopy tree) as well as the landscape scale (tornadoes or hurricanes). When canopy trees fall, seedlings in the understory are released and compete for a spot in the canopy. This leads to dense areas of herbaceous and woody vegetation in windfall gaps of all sizes. This is a major process in forest regeneration in bottomland hardwood forests.

Flooding is more frequent on the lower terraces but frequently floods higher terraces (Wharton et al. (1982) zones IV and V). Catastrophic floods can cause the loss of canopy over large areas. Canopy decline and reproductive failure can create late-seral open stands. Duration of flooding varies with the placement of a site in the landscape and is a dominant process affecting vegetation on a given site. Flooding can deposit alluvium or scour the ground, depending on the landscape position of a site and the severity of the flood event.

Fire is infrequent on the lower terraces, but was frequent historically on older terraces outside the floodplain, and also crept into the floodplains. Putnam (1951 as cited in Wharton et al. 1982) states that a serious fire season occurs on an average of about every 5 to 8 years in the bottomland hardwood forests of the Mississippi Alluvial Plain. It is conjectured that Native Americans maintained canebrakes by deliberate fall burning. Infrequent, mild surface fires would occur in the system; however, they would not alter species composition or structure.

Changes in hydrology due to the activities of beaver are also an important ecological process in bottomland hardwood forests. Beaver impoundments kill trees (sometimes over large areas) and may create open water habitat, cypress-tupelo stands, or cause stand replacement. Meandering streams are dynamic and frequently change course, eroding into the floodplain and depositing new point bars, thus creating new habitat for early-seral plant communities. In addition, insect outbreaks would occur infrequently in closed canopy states.

Component Associations:

- *Acer negundo* Forest (CEGL005033, G4G5)
- *Acer saccharinum / Leersia lenticularis - Commelina virginica* Forest (CEGL007727, G3?)
- *Arundinaria gigantea ssp. gigantea* Shrubland (CEGL003836, G2?)
- *Betula nigra - Platanus occidentalis / Alnus serrulata / Boehmeria cylindrica* Forest (CEGL007312, G4G5)
- *Betula nigra / Salix nigra / Hypericum prolificum - Ampelopsis arborea* Forest (CEGL007794, G3?)
- *Celtis laevigata - Fraxinus pennsylvanica - Acer negundo - (Juglans nigra) / Asimina triloba / Carex grayi* Forest (CEGL004740, G3G5)
- *Cephalanthus occidentalis / Carex* spp. - *Lemna* spp. Southern Shrubland (CEGL002191, G4)
- *Decodon verticillatus* Seasonally Flooded Shrubland (CEGL003905, G4)
- *Fraxinus pennsylvanica - Quercus laurifolia - Quercus lyrata - Carya aquatica* Forest (CEGL004695, G3G4)
- *Fraxinus pennsylvanica - Ulmus americana / Carpinus caroliniana / Boehmeria cylindrica* Forest (CEGL007806, G4?)
- *Fraxinus pennsylvanica / Leersia lenticularis - Carex lupulina* Forest (CEGL007728, G2G3)
- *Liquidambar styraciflua - Liriodendron tulipifera / Onoclea sensibilis* Forest (CEGL007329, G4)
- *Liquidambar styraciflua - Quercus (laurifolia, nigra) - (Pinus taeda) / Arundinaria gigantea / Carex abscondita* Forest (CEGL007732, G3G4)
- *Nelumbo lutea* Herbaceous Vegetation (CEGL004323, G4?)
- *Nyssa aquatica - Nyssa biflora* Forest (CEGL007429, G4G5)
- *Nyssa aquatica* Forest (CEGL002419, G4G5)
- *Nyssa biflora - Acer rubrum var. rubrum / Lyonia lucida* Forest (CEGL007864, G3G4)
- *Nyssa ogeche - (Nyssa biflora, Taxodium ascendens)* Forest (CEGL007392, G4)
- *Nyssa ogeche - Nyssa aquatica* Forest (CEGL007393, G3)

- *Pinus taeda - Liquidambar styraciflua - Nyssa biflora* Temporarily Flooded Forest (CEGL004606, G4)
- *Pinus taeda* Temporarily Flooded Forest (CEGL007142, G4?)
- *Planera aquatica* Forest (CEGL007394, G4?)
- *Platanus occidentalis - Celtis laevigata - Fraxinus pennsylvanica / Lindera benzoin - Ilex decidua / Carex retroflexa* Forest (CEGL007730, G4?)
- *Polygonum* spp. - *Phanopyrum gymnocarpon* Seasonally Flooded Herbaceous Vegetation (CEGL008555, G4)
- *Populus deltoides - Salix caroliniana* Forest (CEGL007343, G4G5)
- *Populus deltoides - Salix nigra / Mikania scandens* Forest (CEGL007346, G4G5)
- *Populus deltoides / Acer negundo / Boehmeria cylindrica* Forest (CEGL007731, G3G5)
- *Quercus laurifolia - Quercus lyrata / Carpinus caroliniana - Persea palustris / Vaccinium elliottii* Forest (CEGL004737, G4?)
- *Quercus laurifolia - Quercus michauxii - Liquidambar styraciflua / Carpinus caroliniana* Forest (CEGL004678, G3G4)
- *Quercus lyrata - Carya aquatica* Forest (CEGL007397, G4G5)
- *Quercus lyrata - Liquidambar styraciflua* Forest (CEGL008583, G3G4)
- *Quercus lyrata - Quercus laurifolia - Taxodium distichum / Saururus cernuus* Forest (CEGL004735, G3G5)
- *Quercus michauxii / Carpinus caroliniana - Ilex opaca / Leucothoe racemosa* Forest (CEGL007737, G2G3)
- *Quercus virginiana - (Pinus taeda) / (Sabal minor, Serenoa repens)* Forest (CEGL007039, G3G4)
- *Salix caroliniana* Temporarily Flooded Coastal Plain Shrubland (CEGL007052, G4?)
- *Salix nigra - Fraxinus pennsylvanica* Forest (CEGL007734, G3G4)
- *Salix nigra* Large River Floodplain Forest (CEGL007410, G3G5)
- *Salix nigra* Temporarily Flooded Shrubland (CEGL003901, G4?)
- *Scirpus cyperinus* Seasonally Flooded Southern Herbaceous Vegetation (CEGL003866, G4)
- *Taxodium distichum - Betula nigra / Cyrilla racemiflora - Sebastiania fruticosa* Forest (CEGL004505, G3?)
- *Taxodium distichum - Fraxinus pennsylvanica - Quercus laurifolia / Acer rubrum / Saururus cernuus* Forest (CEGL007719, G3G4)
- *Taxodium distichum - Nyssa aquatica - Acer rubrum / Itea virginica* Forest (CEGL007422, G4?)
- *Taxodium distichum - Nyssa aquatica - Nyssa biflora / Fraxinus caroliniana / Itea virginica* Forest (CEGL007432, G3G4)
- *Taxodium distichum - Nyssa aquatica / Fraxinus caroliniana* Forest (CEGL007431, G5?)
- *Taxodium distichum - Nyssa biflora / Fraxinus caroliniana / Lyonia lucida* Forest (CEGL004733, G3G4)
- *Taxodium distichum - Nyssa biflora / Sabal palmetto / Tillandsia (bartramii, usneoides)* Forest (CEGL003850, G3G4)
- *Taxodium distichum - Nyssa ogeche* Forest (CEGL003841, G3G4)
- *Taxodium distichum / Lemna minor* Forest (CEGL002420, G4G5)
- *Typha latifolia* Southern Herbaceous Vegetation (CEGL004150, G5)
- *Zizaniopsis miliacea* Coastal Plain Slough Herbaceous Vegetation (CEGL004139, G4?)

DISTRIBUTION

Range: This system is found on the Atlantic Coastal Plain, from North Carolina south to Georgia, especially (from north to south) the Roanoke, Great Pee Dee, Congaree/Santee, and Savannah rivers. This includes Omernik Level 4 Ecoregions 63n, 65p, 75i (in part) (EPA 2004).
Divisions: 203:C
Nations: US
Subnations: GA, NC, SC
Map Zones: 55:C, 58:C
USFS Ecomap Regions: 232C:CC, 232H:CC, 232I:CC, 232J:CC
TNC Ecoregions: 56:C, 57:C

SOURCES

References: Allen 1997, EPA 2004, Eyre 1980, Foti 2001, Harris 1989, Kuchler 1964, Landfire 2007a, Putnam 1951, Schafale pers. comm., Sharitz and Mitsch 1993, Southeastern Ecology Working Group n.d., Wharton et al. 1982
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.754563#references
Description Author: M. Pyne and M. Schafale, mod. C.W. Nordman and M. Pyne
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: M. Pyne, M. Schafale **ClassifResp:** Southeast

SOUTHERN ATLANTIC COASTAL PLAIN NONRIVERINE SWAMP AND WET HARDWOOD FOREST (CES203.304)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Forest and Woodland (Treed); Extensive Wet Flat; Needle-Leaved Tree; Broad-Leaved Tree
Non-Diagnostic Classifiers: Organic Peat (>40 cm); Mineral: W/ A-Horizon >10 cm
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Mixed evergreen-deciduous closed tree canopy
National Mapping Codes: EVT 2501; ESLF 9310; ESP 1501

CONCEPT

Summary: This system consists of poorly drained, organic or mineral soil flats of the outer Atlantic Coastal Plain. These areas are saturated by rainfall and seasonal high water tables without influence of river or tidal flooding. Fire is generally infrequent but may be important for some associations. Vegetation consists of hardwood or mixed forests of *Taxodium distichum, Nyssa* spp., bottomland oaks, *Acer rubrum*, or other wetland trees of similar tolerance. The lower strata have affinities with pocosin or baygall systems rather than the river floodplain systems that have affinities with the canopy. The combination of hardwood/deciduous canopy dominants and nonriverine, non-seepage hydrology distinguishes this system from other Coastal Plain systems. Stands with a high cover of *Chamaecyparis thyoides* formerly occupied much of the acreage of this system. This phase is presently only present in high-quality examples, and it helps distinguish this system from other Coastal Plain systems. Disturbed and fire-disrupted examples (those dominated by *Nyssa* spp., bottomland oaks, *Acer rubrum*) may be hard to distinguish from other wetland forests based purely on canopy composition.
Classification Comments: This system contains two to three distinctive subgroups within it. A wetter group has communities containing significant amounts of *Taxodium* or *Nyssa*. A drier group has communities with *Quercus* as a significant component. Within this group the calcareous association (CEGL007316) is very distinctive floristically.

The combination of canopy species with nonriverine hydrology distinguishes this system from all others. This system is distinguished from the various floodplain systems, with which the canopy shares affinities, by the distinctive hydrology and the differences in nutrient dynamics and other ecosystem process that follow from it. The overall flora is usually distinct and reflects these differences in nutrient status. The invertebrate fauna is likely very distinct. This system is distinguished from Atlantic Coastal Plain Peatland Pocosin and Canebrake (CES203.267), which can share organic soils and a number of shrub and herb species, by the canopy dominants and the lack of *Pinus serotina* and evergreen hardwoods as major canopy components. Fire frequency is an important difference. It is unclear if fire frequency determines the difference in vegetation or if the different flammability of the vegetation determines the fire regime.

The boundary between this system and Southern Coastal Plain Hydric Hammock (CES203.501) of Florida and Georgia may need clarification. Similarly, the boundary between this and Northern Atlantic Coastal Plain Basin Peat Swamp (CES203.522) has not been precisely delineated. Great Dismal Swamp is included with this system (CES203.304).

Similar Ecological Systems:
- Atlantic Coastal Plain Peatland Pocosin and Canebrake (CES203.267)
- Northern Atlantic Coastal Plain Basin Peat Swamp (CES203.522)--replaces this system to the north (both are found in Virginia and in mapzone 60).
- Southern Atlantic White-cedar Peatland Forest (CES203.068)
- Southern Coastal Plain Nonriverine Basin Swamp (CES203.384)

Related Concepts:
- Atlantic White-Cedar: 97 (Eyre 1980) Finer
- Baldcypress - Tupelo: 102 (Eyre 1980) Finer
- Live Oak: 89 (Eyre 1980) Finer
- Loblolly Pine - Hardwood: 82 (Eyre 1980) Finer
- Non-alluvial swamp forest (Nelson 1986) Finer
- Peatland Atlantic White Cedar Forest (Schafale 2003b) Finer
- Peatland Atlantic White Cedar Forest (Schafale and Weakley 1990) Finer
- Swamp Chestnut Oak - Cherrybark Oak: 91 (Eyre 1980) Finer
- Sweetbay - Swamp Tupelo - Redbay: 104 (Eyre 1980) Finer
- Sweetgum - Willow Oak: 92 (Eyre 1980) Finer
- Water Tupelo - Swamp Tupelo: 103 (Eyre 1980) Finer
- Willow Oak - Water Oak - Diamondleaf (Laurel) Oak: 88 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs on flat areas of the outer Atlantic Coastal Plain from southeastern Virginia to Georgia, where soils are seasonally to nearly semipermanently saturated because of low relief, poor soil drainage, and seasonal high water table. The largest

areas are on broad interfluvial flats, but substantial areas occur on organic deposits in drowned river valleys in the Embayed Region of North Carolina and Virginia, beyond the reach of the influence of wind tides. Hydrology is dominated by rainfall and sheetflow, and overbank flooding, tidal flooding, and seepage are a secondary influence, if at all. Soils may be loamy to clayey, or may be shallow to deep organic. A distinctive small subset has soils with limestone near the surface, influencing soil chemistry. Natural fire is infrequent in this system, and varies from a minor to a significant influence on vegetational composition and structure. Infrequency of fire may be an important factor in differentiating this system from Atlantic Coastal Plain Peatland Pocosin and Canebrake (CES203.267) and the various wet longleaf pine forest systems. In a phase or component of this system on mucky peat soils (Terric or Typic Medisaprists) up to 3 m deep and occasionally on mucky sand or wet mineral soils with an organic epipedon, *Chamaecyparis thyoides* was the most common dominant species; it occurred in a fire-generated patch mosaic in which the various patch dominants are a variable combination of *Acer rubrum, Chamaecyparis thyoides, Nyssa biflora, Pinus serotina*, and *Taxodium*, most frequently *Taxodium ascendens*. While this is fire-dominated, it is only found in substantially fire-sheltered portions of the landscape where scarps or water bodies prevent easy access by fire, resulting in a long fire-return interval. The original vegetation constituted a true shifting mosaic. The original extent was up to 1 million acres of which at least 400,000 acres were Atlantic white-cedar in Mapzones 58 and 60. This is a long-interval, fire-dependent, forested peatland with its greatest extent found on the Pamlico Terrace of Virginia and North Carolina. The largest sites lie at less than 9 m (30 feet) above sea level (C. Frost pers. comm.).

Vegetation: Vegetation is a closed-canopy forest of wetland trees. The wetter sites are dominated by combinations of *Taxodium distichum, Nyssa biflora*, and occasionally *Nyssa aquatica, Pinus taeda, Chamaecyparis thyoides, Liquidambar styraciflua*, and *Liriodendron tulipifera*. Less wet sites have canopies of wetland oaks such as *Quercus laurifolia, Quercus michauxii*, and *Quercus pagoda*. Most communities have a well-developed shrub layer that has more floristic affinities with pocosins or baygalls than with river floodplain communities that have similar canopies. The shrub layer is usually dominated by *Clethra alnifolia, Leucothoe axillaris*, or species shared with pocosins. The herb layer is not usually well-developed but may be dense where shrubs are atypically sparse. Wetland ferns, such as *Osmunda regalis* and *Woodwardia areolata*, and *Carex* spp. usually dominate. In the Atlantic white-cedar-related phase of this system, stands that regenerated from crown fire often have nearly pure cover of *Chamaecyparis thyoides*. The most common subcanopy species are *Acer rubrum, Persea palustris*, and *Magnolia virginiana*. Typical shrubs include *Ilex glabra, Ilex coriacea, Leucothoe racemosa, Itea virginica*, and *Lyonia lucida*. Herbs, chiefly ferns and sedges, are typically sparse, but mosses may be common (C. Frost pers. comm.).

Dynamics: Fire is an important influence in a subset of this system. Communities dominated by *Chamaecyparis thyoides* depend on fire for regeneration of the canopy trees. The occurrence of fires on the time scale of several decades to a century or more may determine the mosaic of *Chamaecyparis thyoides* forests and other associations. Some areas may once have been canebrakes, with dominance of *Arundinaria* determined by more frequent fire. In the oak-dominated communities and in wetter *Taxodium* and *Nyssa* communities, fire is probably of little ecological significance because the vegetation is not flammable. Without fire as a major factor, most communities probably occur naturally as old-growth multi-aged forests dominated by gap-phase regeneration. Hurricanes may create larger canopy gaps, and sometimes cause more extensive damage. Examples in drowned river valleys are subject to influence by rising sea level and can be expected to evolve into tidal swamp systems, sometimes fairly quickly.

In specific relation to the *Chamaecyparis thyoides*-dominated phase of this system, succession pathways depend on water table depth at time of replacement fire. Having the water table at the surface results in regeneration of *Chamaecyparis thyoides* from the seedbank. If the water table is slightly to moderately below the surface, the seedbank is destroyed and succession is dominated by some combination of *Acer rubrum, Nyssa biflora, Pinus taeda*, and related taxa. If the water table is well below the surface, the seedbank is destroyed and a deeper hole is created in the peat. In this case, succession is dominated by *Taxodium distichum* and a deeper water area is created with *Chamaecyparis thyoides* only on the edge.

Component Associations:

- *Arundinaria gigantea ssp. gigantea* Shrubland (CEGL003836, G2?)
- *Arundinaria gigantea ssp. tecta* Shrubland (CEGL003843, G1)
- *Carya cordiformis - Quercus pagoda - Quercus shumardii - Carya myristiciformis / Sabal minor - Cornus asperifolia* Forest (CEGL007316, G1)
- *Chamaecyparis thyoides / Persea palustris / Lyonia lucida - Ilex coriacea* Forest (CEGL006146, G2)
- *Liquidambar styraciflua - Acer rubrum - (Nyssa biflora) / Woodwardia virginica* Forest (CEGL007848, G2G3)
- *Nyssa aquatica - Nyssa biflora* Forest (CEGL007429, G4G5)
- *Nyssa biflora - Acer rubrum var. trilobum - Liriodendron tulipifera / Magnolia virginiana - Asimina triloba / Clethra alnifolia* Forest (CEGL004428, G2)
- *Nyssa biflora - Liquidambar styraciflua - Acer rubrum var. trilobum / Clethra alnifolia* Forest (CEGL004679, G2?)
- *Pinus taeda - Chamaecyparis thyoides - Acer rubrum - Nyssa biflora / Lyonia lucida - Clethra alnifolia* Forest (CEGL007558, G2G3)
- *Quercus laurifolia - Nyssa biflora / Clethra alnifolia - Leucothoe axillaris* Forest (CEGL007447, G2G3)
- *Quercus michauxii - Quercus pagoda / Clethra alnifolia - Leucothoe axillaris* Forest (CEGL007449, G2)
- *Quercus pagoda - Quercus michauxii - Quercus alba / Arundinaria gigantea ssp. tecta - Sabal minor / Chasmanthium laxum* Forest (CEGL007849, G2?)
- *Quercus phellos - Quercus similis - Pinus palustris / Crataegus* spp. / *Carex cherokeensis* Forest (CEGL004831, G1)
- *Quercus virginiana - Quercus nigra - Quercus pagoda - Liquidambar styraciflua / Sabal minor - Ilex vomitoria* Forest (CEGL007851, G1G2Q)
- *Taxodium distichum - Nyssa biflora / Berchemia scandens - Toxicodendron radicans / Woodwardia areolata* Forest

(CEGL004429, G2G3)

Spatial Characteristics

Spatial Summary: Occurs as large patches in the Embayed Region of North Carolina and Virginia, as small patches most other places.

Size: Size distribution may vary across the range. In the Embayed Region of North Carolina and Virginia, this system can cover thousands of contiguous acres. Elsewhere in the region, occurrences tend to be much smaller, usually tens of acres. The drier, oak-dominated associations are now known only from remnants with artificial boundaries. Historical stands ranged in size from the Great Dismal Swamp of Virginia and North Carolina, which included the largest Atlantic white-cedar stand of 112,000 acres, associated with a considerable acreage of swamp blackgum and bald-cypress, as well as smaller peatlands of only a 50-100 acres. The scale of disturbances included fires, ranging in size from 50 to >10,000 acres, and winds, especially those associated with hurricanes, in which effects were more limited, typically consisting of locally intense small blowdowns of a few acres each.

Adjacent Ecological Systems:

- Atlantic Coastal Plain Peatland Pocosin and Canebrake (CES203.267)
- Atlantic Coastal Plain Small Blackwater River Floodplain Forest (CES203.249)
- Southern Atlantic Coastal Plain Mesic Hardwood Forest (CES203.242)
- Southern Atlantic Coastal Plain Tidal Wooded Swamp (CES203.240)

Adjacent Ecological System Comments: May be bordered by tidal swamps, Atlantic Coastal Plain Peatland Pocosin and Canebrake (CES203.267), upland hardwoods, or less frequently by longleaf pine systems.

Distribution

Range: This system ranges from southeastern Virginia to Georgia. This system is most abundant in the Embayed Region of northeastern North Carolina and southeastern Virginia (south of the James River), where it covers large expanses.

Divisions: 203:C
Nations: US
Subnations: GA, NC, SC, VA
Map Zones: 55:C, 58:C, 60:C
USFS Ecomap Regions: 232C:CC, 232H:CC, 232I:CC, 232J:CC
TNC Ecoregions: 56:C, 57:C

Sources

References: Eyre 1980, Frost 1987, Frost pers. comm., Nelson 1986, Schafale 2003b, Schafale and Weakley 1990, Southeastern Ecology Working Group n.d.

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723187#references

Description Author: M. Schafale and R. Evans, mod. M. Pyne and C. Nordman
Version: 14 Jan 2014
Concept Author: M. Schafale and R. Evans
Stakeholders: East, Southeast
ClassifResp: Southeast

SOUTHERN ATLANTIC COASTAL PLAIN TIDAL WOODED SWAMP (CES203.240)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Forest and Woodland (Treed); Tidal / Estuarine
National Mapping Codes: ESLF 9194

CONCEPT

Summary: This system encompasses the tidally flooded areas in lower river floodplains and edges of estuaries of the Atlantic Coastal Plain from southeastern Virginia southward to northern Florida that have sufficiently freshwater and short enough flooding to be able to support tree canopies. *Taxodium*, *Nyssa*, or *Fraxinus* generally dominate. Swamps may be either regularly flooded by lunar tides or irregularly flooded by wind tides.
Classification Comments: This system is distinguished from all adjacent systems by the combination of tidal flooding and tree-dominated vegetation. It is related to East Gulf Coastal Plain Freshwater Tidal Wooded Swamp (CES203.299) but is distinguished because of differences in the tidal flooding regime between the Gulf and Atlantic and because of biogeographic differences.
Similar Ecological Systems:
- East Gulf Coastal Plain Freshwater Tidal Wooded Swamp (CES203.299)
- Northern Atlantic Coastal Plain Tidal Swamp (CES203.282)

Related Concepts:
- Baldcypress - Tupelo: 102 (Eyre 1980) Finer
- Baldcypress: 101 (Eyre 1980) Finer
- Southern Redcedar: 73 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs in lower reaches of river floodplains and along estuary shorelines, in places regularly or irregularly flooded by lunar or wind tides. The water has little salt content, due to distance from the ocean and/or strong freshwater input. Soils may be mineral or organic. Soils are generally permanently saturated even when the tide is low. The transition of the hydrology to flood dominance rather than tidal dominance may be very gradual.
Vegetation: Vegetation is forest or woodland with canopies of the most water-tolerant tree species, generally *Taxodium distichum*, *Nyssa* spp., or *Fraxinus* spp. Lower strata generally are denser and more species-rich than those of river or nonriverine swamps, containing species from those systems as well as a variety of shrubs and herbs shared with freshwater marshes. *Morella cerifera* and *Rosa palustris* are often characteristic.
Dynamics: Regular or irregular tidal flooding with freshwater is the ecological factor that makes this system distinct. These swamps may be regularly flooded at least twice a day for several hours and remain inundated for days during flood or storm events (Wharton et al. 1982, FNAI 1990). River floods may also seasonally affect this system. Wind and flooding are the dominant disturbance agents in this type and this includes wind damage from hurricanes and tornadoes as well as inundation of young stands. Canopy gaps can be created by high winds, such as from nor'easters, tropical storms and hurricanes (Nordman 2013). Infrequent intrusion of saltier water, which is stressful or fatal to many of the plant species, is an important periodic disturbance created by storms. Insect outbreaks would occur infrequently in these closed-canopy forests (Landfire 2007a). This system generally appears to be in a shifting relationship with tidal freshwater marshes of the same region. Most marshes have standing dead trees in them, suggesting they recently were swamps. But, conversely, some marshes are being invaded with trees and may be turning into swamps. Freshwater tidal marshes generally occur at the shallow edge of tidal rivers and streams, where river and tidal flow is high, and the vegetation is affected by the changing meanders of the tidal channel. Rising sea level is driving shifts in the communities of this system, causing upstream non-tidal swamps to develop into this system (as they become subject to tides) and causing parts of this system to turn into brackish marshes. In areas not too strongly affected by saltwater intrusion or drowning by rising sea level, these communities can be expected to exist as old-growth, multi-aged forests.

Component Associations:
- *Acer rubrum / Sambucus canadensis / Ampelopsis arborea - Sicyos angulatus* Forest (CEGL004698, G2)
- *Fraxinus pennsylvanica - (Ulmus americana) - Pinus taeda / Morella cerifera - Juniperus virginiana var. silicicola* Tidal Forest (CEGL004483, G1G2)
- *Juniperus virginiana var. silicicola / Morella cerifera / Kosteletzkya virginica - Bacopa monnieri* Woodland (CEGL007166, G1?)
- *Morella cerifera - Toxicodendron radicans / Spartina bakeri* Shrubland (CEGL004789, G3?)
- *Nuphar sagittifolia* Tidal Herbaceous Vegetation (CEGL006094, G1G2)
- *Nyssa aquatica* Tidal Forest (CEGL008561, G3?)
- *Nyssa biflora - (Taxodium distichum, Nyssa aquatica) / Morella cerifera - Rosa palustris* Tidal Forest (CEGL004484, G3G4)
- *Pinus taeda - Nyssa biflora - Taxodium distichum / Morella cerifera / Osmunda regalis var. spectabilis* Forest (CEGL004651,

G2?)
- *Taxodium distichum - Nyssa biflora - Fraxinus profunda / Peltandra virginica - (Bignonia capreolata)* Tidal Forest (CEGL006850, G3)
- *Taxodium distichum / Carex hyalinolepis* Woodland (CEGL004654, G2?)
- *Taxodium distichum / Typha angustifolia* Woodland (CEGL004231, G2G3)
- *Taxodium distichum / Zizania aquatica - Carex canescens ssp. disjuncta* Woodland (CEGL004655, G1Q)

SPATIAL CHARACTERISTICS

Spatial Summary: Occurrences are generally large patches, ranging to small patches.
Size: Occurrences tend to be wide to narrow bands along rivers, streams, or shorelines. The largest patches, on large rivers, are thousands of acres, broken only by stream channels. Small occurrences are also common, with a zone of this system occurring in most streams that reach the ocean or estuaries.
Adjacent Ecological Systems:
- Atlantic Coastal Plain Blackwater Stream Floodplain Forest (CES203.247)
- Atlantic Coastal Plain Embayed Region Tidal Freshwater Marsh (CES203.259)
- Southern Atlantic Coastal Plain Nonriverine Swamp and Wet Hardwood Forest (CES203.304)
- Southern Atlantic White-cedar Peatland Forest (CES203.068)

Adjacent Ecological System Comments: In most rivers, this system grades upstream to floodplain systems and downstream to fresh or salt marsh systems. In the Embayed Region of North Carolina and Virginia, it often grades to Southern Atlantic Coastal Plain Nonriverine Swamp and Wet Hardwood Forest (CES203.304) inland within peat-filled drowned river valleys.

DISTRIBUTION

Range: This system is found from southeastern Virginia southward to northern Florida along the Atlantic Coast.
Divisions: 203:C
Nations: US
Subnations: FL, GA, NC, SC, VA
Map Zones: 55:C, 58:C, 60:C
USFS Ecomap Regions: 232C:CC, 232I:CC
TNC Ecoregions: 56:C, 57:C

SOURCES

References: Edwards et al. 2013, Eyre 1980, FNAI 1990, Harris 1989, Landfire 2007a, Nordman 2013, Odum et al. 1984, Schafale pers. comm., Southeastern Ecology Working Group n.d., Wharton et al. 1982
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723245#references
Description Author: M. Schafale and R. Evans, mod. M. Pyne
Version: 14 Jan 2014 **Stakeholders:** East, Southeast
Concept Author: M. Schafale and R. Evans **ClassifResp:** Southeast

SOUTHERN ATLANTIC COASTAL PLAIN WET PINE SAVANNA AND FLATWOODS (CES203.536)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Non-Diagnostic Classifiers: Woody-Herbaceous; Extensive Wet Flat
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2450; ESLF 9119; ESP 1450

CONCEPT

Summary: This ecological system of pine-dominated savannas and/or flatwoods is restricted to the Coastal Plain from central South Carolina to northeastern Florida. It was the former matrix system in this region. This general area has been referred to as the Longleaf Pine Wiregrass Savannas region and the Sea Island Flatwoods (EPA Ecoregion 75f). Examples of this system and component community associations share the common features of wet, seasonally saturated, mineral soils and historic exposure to frequent low-intensity fire. They occur on a wide range of soil textures, which is an important factor in distinguishing different associations. The vegetation is naturally dominated by *Pinus palustris* or, on wetter sites, *Pinus elliottii* or less commonly *Pinus serotina*. Understory conditions may be dramatically altered by fire frequency and seasonality. In natural condition (with frequent fires, including some growing-season fire) there tends to be a dense ground cover of herbs and low shrubs; grasses can dominate, but there is often a large diversity of other herbs and shrubs.
Classification Comments: This system is distinguished from Central Atlantic Coastal Plain Wet Longleaf Pine Savanna and Flatwoods (CES203.265) because of substantial biogeographic differences. The break is placed at the Santee River, which approximates the transition between the ranges of *Aristida stricta* and *Aristida beyrichiana*, which are keystone species in the communities where they occur. This corresponds roughly with the geographic break in the upland longleaf pine systems as well. This system is distinguished from Atlantic Coastal Plain Upland Longleaf Pine Woodland (CES203.281) because of that system's more upland character. However, the two systems have much in common, including frequent fire, the same primary dominant canopy tree, and many herbaceous species. They can also occur in the same landscapes. However, floristic differences are well marked, and no associations are shared.
Similar Ecological Systems:
- Central Atlantic Coastal Plain Wet Longleaf Pine Savanna and Flatwoods (CES203.265)
- East Gulf Coastal Plain Near-Coast Pine Flatwoods (CES203.375)

Related Concepts:
- Longleaf Pine - Slash Pine: 83 (Eyre 1980) Finer
- Longleaf Pine: 70 (Eyre 1980) Finer
- Mesic Flatwoods (FNAI 1990) Intersecting
- Pond Pine: 98 (Eyre 1980) Finer
- Pondcypress: 100 (Eyre 1980) Finer
- Slash Pine: 84 (Eyre 1980) Finer
- Wet Flatwoods (FNAI 1990) Intersecting

DESCRIPTION

Environment: This system occurs on wet mineral soil sites, in the middle and outer Coastal Plain. Landforms include low areas in relict beach ridge systems and eolian sand deposits, and poorly drained clayey, loamy, or sandy flats.
Vegetation: The best examples are typically open woodlands naturally dominated by *Pinus palustris* or *Pinus elliottii* and/or *Pinus serotina* on wetter sites. In many areas past logging and subsequent lack of frequent growing-season fire have led to much greater dominance by *Pinus elliottii*. In natural condition, there is typically a dense ground cover of herbs and low shrubs; grasses can dominate, but there is often a large diversity of other herbs and shrubs. The shrubs are mainly *Serenoa repens, Ilex glabra*, and *Ilex coriacea* along with various ericaceous species. These shrub species become especially prominent on sites not frequently burned.
Dynamics: Frequent low-intensity fire is important. Lightning has been an important source of ignition for these fires, especially historically. Disturbances are an important part of the natural functions of wet pine savanna and flatwoods. In order for these habitats to burn frequently (every 2-3 years), there needs to be enough fine fuel, such as needles from *Pinus palustris* trees, healthy populations of native warm-season grasses, and evergreen shrubs with volatile oils in their leaves, such as *Gaylussacia frondosa, Ilex coriacea, Ilex glabra, Lyonia* spp., *Serenoa repens*, and *Vaccinium* spp. The frequent fires promote flowering, seed production, and seed germination of many plants and provide open areas in patches (Van Lear et al. 2005).

Component Associations:
- *Pinus elliottii var. elliottii - Taxodium ascendens / Hypericum brachyphyllum / Sporobolus pinetorum - Dichanthelium scabriusculum* Woodland (CEGL004969, G2?)
- *Pinus elliottii var. elliottii / Serenoa repens - Ilex glabra* Woodland (CEGL003643, G4?)
- *Pinus palustris - (Pinus elliottii var. elliottii) / Sporobolus pinetorum - Oclemena reticulata - (Sporobolus curtissii)* Woodland

(CEGL004967, G2)
- *Pinus palustris - Pinus (serotina, taeda) / Sporobolus curtissii - Muhlenbergia expansa* Woodland (CEGL004085, G1)
- *Pinus palustris - Pinus elliottii var. elliottii / Ctenium aromaticum - Aristida beyrichiana - (Sporobolus floridanus)* Woodland (CEGL004790, G1G2)
- *Pinus palustris - Pinus elliottii var. elliottii / Styrax americanus / Sporobolus floridanus* Woodland (CEGL004497, G1)
- *Pinus palustris - Pinus serotina / Aristida palustris - Sarracenia flava* Woodland (CEGL004498, G1)
- *Pinus palustris - Pinus serotina / Ctenium aromaticum - Muhlenbergia expansa - Rhynchospora latifolia* Woodland (CEGL003660, G1)
- *Pinus palustris - Pinus serotina / Ctenium aromaticum - Scleria pauciflora - Sarracenia flava* Woodland (CEGL004499, G1)
- *Pinus palustris - Pinus serotina / Ilex glabra - Lyonia lucida - (Serenoa repens)* Woodland (CEGL004791, G3G4)
- *Pinus palustris - Pinus serotina / Sporobolus pinetorum - (Aristida stricta) - Eryngium integrifolium* Woodland (CEGL004501, G2)
- *Pinus palustris / Arundinaria gigantea ssp. tecta - Liquidambar styraciflua / Andropogon glomeratus - Sarracenia minor* Woodland (CEGL004495, G1)
- *Pinus palustris / Clethra alnifolia - Gaylussacia frondosa - Quercus pumila / Schizachyrium scoparium* Woodland (CEGL004496, G1)
- *Pinus palustris / Schizachyrium scoparium - Muhlenbergia expansa - Arnoglossum ovatum* Woodland (CEGL004086, G1?)
- *Pinus palustris / Serenoa repens - Ilex glabra* Woodland (CEGL003653, G2G3)
- *Pinus palustris / Serenoa repens - Vaccinium myrsinites / Aristida beyrichiana - Sporobolus curtissii* Woodland (CEGL004486, G2G3)
- *Pinus serotina - (Pinus palustris) / Saccharum* spp. *- Eupatorium semiserratum - Sabatia campanulata* Woodland (CEGL004814, G1?)
- *Quercus phellos - Quercus similis - Pinus palustris / Crataegus* spp. / *Carex cherokeensis* Forest (CEGL004831, G1)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Atlantic Coastal Plain Peatland Pocosin and Canebrake (CES203.267)

DISTRIBUTION

Range: This system is restricted to the Atlantic Coastal Plain from central South Carolina to northeastern Florida. This general area has been referred to as the Longleaf Pine Wiregrass Savannas region (Platt 1999) and the Sea Island Flatwoods (EPA Ecoregion 75f) (Griffith et al. 2001, 2002).
Divisions: 203:C
Nations: US
Subnations: FL, GA, SC
Map Zones: 55:C, 58:C
USFS Ecomap Regions: 232C:CC, 232J:CC
TNC Ecoregions: 56:C

SOURCES

References: Brewer 2008, Christensen 2000, Comer et al. 2003, Eyre 1980, FNAI 1990, Griffith et al. 2001, Griffith et al. 2002, Jensen and Gatrell 2004, Landfire 2007a, NatureServe 2006, NatureServe 2011, Oswalt et al. 2012, Platt 1999, Rheinhardt et al. 2002, Van Lear et al. 2005, Wahlenberg 1946
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723066#references
Description Author: R. Evans and C. Nordman
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: R. Evans and C. Nordman **ClassifResp:** Southeast

SOUTHERN COASTAL PLAIN BLACKWATER RIVER FLOODPLAIN FOREST (CES203.493)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Riverine / Alluvial [Blackwater]
Non-Diagnostic Classifiers: Forest and Woodland (Treed)
National Mapping Codes: ESLF 9340

CONCEPT

Summary: This ecological system occurs along certain river and stream drainages of the southern Coastal Plain of Florida, Alabama, Mississippi, and southwestern Georgia that are characterized by dark waters high in particulate and dissolved organic materials, and that generally lack floodplain development. In most cases these are streams that have their headwaters in sandy portions of the Outer Coastal Plain. Consequently, they carry little mineral sediment or suspended clay particles and are not turbid except after the heaviest rain events. The water is classically dark in color due to concentrations of tannins, particulates, and other materials derived from drainage through swamps or marshes. In comparison with spring-fed rivers and brownwater rivers of the region, this system tends to be much more acidic in nature and generally lacks extensive and continuous floodplains and levees. Steep banks alternating with floodplain swamps are more characteristic. This system includes mixed rivers, with a mixture of blackwater and spring-fed tributaries such as the Suwannee River. Canopy trees typical of this system are obligate to facultative wetland species such as *Taxodium distichum*, *Nyssa aquatica*, and *Chamaecyparis thyoides*.

Classification Comments: A new ecological system is needed for Florida spring-fed streams/rivers, such as the Wakulla River, Ichetucknee River, etc.

Related Concepts:

- Atlantic White-Cedar: 97 (Eyre 1980) Finer
- Baldcypress - Tupelo: 102 (Eyre 1980) Finer
- Baldcypress: 101 (Eyre 1980) Finer
- Bottomland Forest (FNAI 1990) Intersecting
- Floodplain Forest (FNAI 1990) Intersecting
- Floodplain Swamp (FNAI 1990) Intersecting
- Loblolly Pine - Hardwood: 82 (Eyre 1980) Finer
- Loblolly Pine: 81 (Eyre 1980) Finer
- Slash Pine: 84 (Eyre 1980) Intersecting
- Water Tupelo - Swamp Tupelo: 103 (Eyre 1980) Finer

DESCRIPTION

Environment: The rivers in which this system occurs are characterized by dark waters high in particulate and dissolved organic materials, and that generally lack floodplain development. In most cases these are streams that have their headwaters in sandy portions of the Outer Coastal Plain (Smock and Gilinsky 1992). Consequently, they carry little mineral sediment or suspended clay particles and are not turbid except after the heaviest rain events. The water is classically dark in color due to concentrations of tannins, particulates, and other materials derived from drainage through swamps or marshes (FNAI 1990). In comparison with spring-fed rivers and brownwater rivers of the region, this system tends to be much more acidic in nature and generally lacks extensive and continuous floodplain and levees; steep banks alternating with floodplain swamps are more characteristic (FNAI 1990). This system includes mixed rivers, with a mixture of blackwater and spring-fed tributaries such as the Suwannee River.

This is a linear to large-patch ecological system; stands may be contiguous over thousands of acres. The largest examples could be called matrix examples of this ecological system. Examples are by nature linear and tend to be narrow. The Satilla River in Georgia is about 375 km in length and may be the largest example. The lower floodplain is about 2 km across, an approximate size of 750 square km could be used as a working upper bound. There may be limited areas with trees greater than 150 years. Probably there are many stands aged 70-100 years, and many that are younger than 70 years. Stands that have not had extensive timber removal will probably have more woody debris and constitute better habitat for component animal and plant species. Areas that have been logged may become dominated by *Pinus taeda*, *Liquidambar styraciflua*, and *Acer rubrum* with a common shrub being *Morella cerifera*.

Dynamics: Flooding is the most important ecological factor in this system. Frequency and duration of flooding determine the occurrences of different associations and separate the system from other kinds of wetlands. Flooding brings nutrients and excludes non-flood-tolerant species. When flooded, the system may have a substantial aquatic faunal component, with high densities of invertebrates, and may play an important role in the life cycle of fish in the associated river. Unusually long or deep floods may stress vegetation or act as a disturbance for some species. Larger floods cause local disturbance by scouring and depositing sediment along channels, and occasionally causing channel shifts. However, the low gradient and binding of sediment by vegetation generally makes these processes much slower and less frequent than in river systems of most other regions. The areas flooded for the longest durations tend to have high amounts of total organic carbon in the soil and sediments which deplete levels of aquatic dissolved oxygen (Todd et

al. 2010).

Except for primary successional communities such as bars, most forests exist naturally as multi-aged old-growth forests driven by gap-phase regeneration. Windthrow is probably the most important cause of gaps. In addition to periodic flooding, the formation of windfall gaps is a dominant ecological processes in bottomland hardwood forests. Windfall gaps occur from the local scale (a single mature canopy tree) to the landscape scale (effects of tornadoes and hurricanes). When canopy trees fall, seedlings in the understory are released and compete for a spot in the canopy. This leads to dense areas of herbaceous and woody vegetation in windfall gaps of all sizes. This is a major process in forest regeneration in bottomland hardwood forests.

Flooding is more frequent on the lower terraces but frequently floods higher terraces (Wharton et al. (1982) zones IV and V). Catastrophic floods can cause the loss of canopy over large areas. Canopy decline and reproductive failure can create late-seral open stands. Duration of flooding varies with the placement of a site in the landscape and is a dominant process affecting vegetation on a given site. Flooding can deposit alluvium or scour the ground, depending on the landscape position of a site and the severity of the flood event.

Fire is not believed to be important, due to low flammability of much of the vegetation, wetness, and abundance of natural firebreaks. Fire is infrequent on the lower terraces, but was frequent historically on older terraces outside the floodplain and crept into the floodplains. Putnam (1951 as cited in Wharton et al. 1982) states that a serious fire season occurs on an average of about every 5 to 8 years in the bottomland hardwood forests of the Mississippi Alluvial Plain. Some areas of bottomlands apparently were once occupied by canebrakes, which presumably were maintained through deliberate fall burning by Native Americans. Infrequent, mild surface fires would occur in the system; however, they would not alter species composition or structure.

Changes in hydrology due to the activities of beaver are also an important ecological process in bottomland hardwood forests. Beaver impoundments kill trees (sometimes over large areas) and may create open water habitat, cypress-tupelo stands, or cause stand replacement. Meandering streams are dynamic and frequently change course, eroding into the floodplain and depositing new point bars, thus creating new habitat for early-seral plant communities. Insect outbreaks would occur infrequently in closed canopy states.

Component Associations:
- *Chamaecyparis thyoides / Magnolia virginiana - Cliftonia monophylla / Orontium aquaticum - Sphagnum* spp. Forest (CEGL007151, G2G3)
- *Nyssa aquatica - Fraxinus pennsylvanica - Taxodium distichum / Sabal minor* Forest (CEGL008463, GNR)
- *Nyssa aquatica - Nyssa biflora* Forest (CEGL007429, G4G5)
- *Nyssa aquatica* Forest (CEGL002419, G4G5)
- *Nyssa biflora - Acer rubrum var. rubrum / Lyonia lucida* Forest (CEGL007864, G3G4)
- *Nyssa ogeche - (Nyssa biflora, Taxodium ascendens)* Forest (CEGL007392, G4)
- *Nyssa ogeche - Magnolia virginiana / Crinum americanum* Forest (CEGL004704, G3?)
- *Pinus elliottii - Quercus nigra - Chamaecyparis thyoides / Cyrilla racemiflora - Vaccinium* spp. Forest (CEGL008556, G2)
- *Pinus elliottii var. elliottii / Cliftonia monophylla - Cyrilla racemiflora* Woodland (CEGL003638, G2G3Q)
- *Planera aquatica* Forest (CEGL007394, G4?)
- *Quercus laurifolia / Carpinus caroliniana / Justicia ovata* Forest (CEGL007348, G4?)
- *Taxodium distichum - Nyssa aquatica - Acer rubrum / Itea virginica* Forest (CEGL007422, G4?)
- *Taxodium distichum - Nyssa aquatica / Fraxinus caroliniana* Forest (CEGL007431, G5?)
- *Taxodium distichum - Nyssa biflora / Sabal palmetto / Tillandsia (bartramii, usneoides)* Forest (CEGL003850, G3G4)
- *Taxodium distichum - Nyssa ogeche* Forest (CEGL003841, G3G4)
- *Taxodium distichum / Lemna minor* Forest (CEGL002420, G4G5)

DISTRIBUTION

Range: This system is found in the East Gulf Coastal Plain of Alabama, Mississippi, southwestern Georgia, Florida, and adjacent portions of central Florida.
Divisions: 203:C
Nations: US
Subnations: AL, FL, GA, MS
Map Zones: 46:C, 55:C, 56:C
USFS Ecomap Regions: 232B:CC, 232C:CC, 232D:CC, 232G:CC, 232J:CC, 232K:CC, 232L:CC, 234A:CC
TNC Ecoregions: 53:C, 55:C

SOURCES

References: Comer et al. 2003, Eyre 1980, FNAI 1990, Harris 1989, Landfire 2007a, Putnam 1951, Schuster 1974, Sharitz and Mitsch 1993, Smock and Gilinsky 1992, Todd et al. 2010, Wharton et al. 1982
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723093#references
Description Author: R. Evans and A. Schotz, mod. M. Pyne
Version: 14 Jan 2014
Concept Author: R. Evans and A. Schotz
Stakeholders: Southeast
ClassifResp: Southeast

SOUTHERN COASTAL PLAIN HYDRIC HAMMOCK (CES203.501)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Non-Diagnostic Classifiers: Forest and Woodland (Treed); Seepage-Fed Sloping
National Mapping Codes: ESLF 9192

CONCEPT

Summary: This ecological system occupies flat lowlands along the southern and outermost portions of the Coastal Plain of the southeastern United States, usually over limestone substrates. The vegetation of this system is characterized by mixed hardwood species, often with hydric oak species common. In Florida, examples of this system are often found adjacent to the floodplain of spring-fed rivers with relatively constant flows. In some areas, such as the Big Bend region of Florida, they occupy large areas of broad, shallow, mucky or seepy wetlands but generally do not receive overbank flooding. In Alabama, this system is apparently confined to floodplains of the Mobile-Tensaw, where examples are topographically higher than the surrounding floodplains.
Classification Comments: The original name of this system was too geographically restrictive and was broadened to Southern Coastal Plain to better reflect the range of this system. Confirmed in South Atlantic Coastal Plain portion of Florida by Ann Johnson (pers. comm.).
Similar Ecological Systems:
- Southern Coastal Plain Nonriverine Basin Swamp (CES203.384)
- Southern Coastal Plain Spring-run Stream Aquatic Vegetation (CES203.275)

Related Concepts:
- Atlantic White-Cedar: 97 (Eyre 1980) Finer
- Cabbage Palmetto: 74 (Eyre 1980) Finer
- Hydric Hammock (FNAI 1990) Broader

DESCRIPTION

Environment: Examples of this system are associated with limestone-rich sites. Soils may range from sand to clay to organic (FNAI 1990). In Florida, examples of this system are often found adjacent to the floodplain of spring-fed rivers with relatively constant flows. In some areas, such as the Big Bend region of Florida, they occupy large areas of broad, shallow, mucky or seepy wetlands but generally do not receive overbank flooding (A. Johnson pers. comm.). In Alabama, this system is apparently confined to floodplains of the Mobile-Tensaw, where examples are topographically higher than the surrounding floodplains (A. Schotz pers. comm.).
Vegetation: The vegetation of this system is characterized by mixed hardwood species, often with hydric oak species common (FNAI 1997, A. Johnson pers. comm.). Stands may be dominated by a variety of wetland and upland tree species, including *Chamaecyparis thyoides*, *Sabal palmetto*, and *Quercus laurifolia*, as well as *Quercus virginiana*, *Magnolia virginiana*, and *Ulmus americana*. Some shrubs and understory trees include *Ilex cassine* and *Morella cerifera*.
Dynamics: Saturation, but usually not inundation, is characteristic of the hydrology of some hydric hammocks; lower areas generally are prone to more flooding. The distributions of trees within hydric hammocks are influenced by the timing and depth of flooding (Vince et al. 1989). These are sites are only occasionally subject to wildland fire (FNAI 2010a) and are dominated by mixed evergreen and deciduous forest, often with *Sabal palmetto* which is fire-tolerant.

Component Associations:
- *Chamaecyparis thyoides - Sabal palmetto* Forest (CEGL008598, G2)
- *Fagus grandifolia - Pinus glabra - Magnolia grandiflora / Serenoa repens* Forest (CEGL004977, G2G3)
- *Fraxinus caroliniana - Sabal palmetto - Ulmus americana / Cephalanthus occidentalis* Forest (CEGL008592, G3?)
- *Sabal palmetto - Quercus laurifolia - Quercus virginiana - Magnolia virginiana - Ulmus americana* Forest (CEGL004674, G2G3)
- *Sabal palmetto - Quercus virginiana* Saturated Forest (CEGL007040, G3?)
- *Sabal palmetto / Ilex cassine - Morella cerifera* Saturated Woodland (CEGL003527, G3?)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Central Florida Pine Flatwoods (CES203.382)
- Southern Coastal Plain Nonriverine Basin Swamp (CES203.384)

DISTRIBUTION

Range: As currently documented, this system occurs in Florida, Georgia and rarely in southern Alabama. In Alabama, this system is apparently confined to floodplains of the Mobile-Tensaw (A. Schotz pers. comm.).
Divisions: 203:C
Nations: US
Subnations: AL, FL, GA, MS?

Map Zones: 55:C, 56:C, 99:C
USFS Ecomap Regions: 232B:CC, 232C:CC, 232D:CC, 232G:CC, 232J:CC, 232K:CC, 232L:CC
TNC Ecoregions: 53:C, 55:C, 56:C

SOURCES

References: Comer et al. 2003, Eyre 1980, FNAI 1990, FNAI 1997, FNAI 2010a, Johnson, A. pers. comm., Schotz pers. comm., Vince et al. 1989

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723087#references

Description Author: R. Evans, mod. C.W. Nordman and M. Pyne
Version: 14 Jan 2014
Concept Author: R. Evans

Stakeholders: Southeast
ClassifResp: Southeast

SOUTHERN COASTAL PLAIN NONRIVERINE BASIN SWAMP (CES203.384)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Forest and Woodland (Treed); Herbaceous; Depressional
Non-Diagnostic Classifiers: Isolated Wetland [Partially Isolated]; Organic Peat (>40 cm)
National Mapping Codes: ESLF 9323

CONCEPT

Summary: This ecological system occupies large, seasonally inundated basins with peaty substrates in the southern and outermost portions of the Coastal Plain of the southeastern United States. These basins are nonriverine and do not receive overbank flooding. The southern limit of this system extends into central Florida, especially along the Atlantic Coast in Volusia and Brevard counties. Examples are generally forested; the vegetation is characterized by *Taxodium distichum, Nyssa biflora*, evergreen "bay" shrubs, and/or mixed hardwoods. Emergent *Pinus elliottii* may also be present. Some characteristic shrubs include *Cliftonia monophylla, Cyrilla racemiflora, Lyonia lucida*, and *Smilax laurifolia*.
Classification Comments: Manifestations of this in the Atlantic and Gulf coastal plains are not differentiated at this time. There may be some minor floristic differences, particularly between the northernmost and southernmost examples, but these are not thought to warrant any subdivision of the type. Examples of this system differ from Southern Coastal Plain Hydric Hammock (CES203.501) by the absence of oaks (especially swamp laurel oak and live oak) and other less flood-tolerant species such as sweetgum (A. Johnson pers. comm.). In addition, this type is found in basins with peaty substrates as opposed to limestone-influenced substrates.
Similar Ecological Systems:
- Northern Atlantic Coastal Plain Basin Swamp and Wet Hardwood Forest (CES203.520)--has a similar name but only comes south to Virginia.
- Southern Atlantic Coastal Plain Nonriverine Swamp and Wet Hardwood Forest (CES203.304)
- Southern Atlantic White-cedar Peatland Forest (CES203.068)
- Southern Coastal Plain Hydric Hammock (CES203.501)

Related Concepts:
- Baldcypress - Tupelo: 102 (Eyre 1980) Finer
- Basin Swamp (FNAI 1990) Equivalent
- Pond Pine: 98 (Eyre 1980) Finer
- Sweetbay - Swamp Tupelo - Redbay: 104 (Eyre 1980) Finer
- Water Tupelo - Swamp Tupelo: 103 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occupies large, seasonally inundated basins with peaty substrates. These basins are nonriverine and do not receive overbank flooding. Even though the ecological system tends to occur in large basins, the basin may become full of water, and then there will be some flowout. This is due to high rainfall, and probably is more common in winter, when evapotranspiration is lower than summer. During periods of drought, the amount of water flowing out of a basin swamp may be quite low or none at all, and parts of the basin may become dry. The water tends to be nutrient-poor and acidic, and often it appears tea-colored from tannins in the water (called blackwater).
Vegetation: Examples are generally forested; the vegetation is characterized by *Taxodium distichum, Nyssa biflora*, evergreen "bay" shrubs, and/or mixed hardwoods (FNAI 1997). Emergent *Pinus elliottii* may also be present. Some characteristic shrubs include *Cliftonia monophylla, Cyrilla racemiflora, Lyonia lucida*, and *Smilax laurifolia*. Some examples (e.g., Okefenokee Swamp) have extensive open herbaceous areas dominated by various combinations of *Panicum hemitomon, Sagittaria* spp., *Dulichium arundinaceum, Sarracenia* spp., *Carex glaucescens, Carex striata, Orontium aquaticum, Woodwardia virginica, Eriophorum virginicum, Eriocaulon compressum*, and *Peltandra virginica*. In addition, other floating and emergent aquatic plants are present including *Nuphar orbiculata (= Nuphar lutea ssp. orbiculata), Nymphaea odorata ssp. odorata, Nymphoides aquatica, Habenaria repens*, and *Utricularia* spp.(Wharton 1978). These herbaceous zones are called "prairies" or "sphagnum bogs" depending on their composition.
Dynamics: The primary source of water in basin swamps is local rainfall, with additional input from runoff and seepage from the surrounding uplands (FNAI 2010a). Flooding is a regular dynamic process. These basins are prone to long periods of inundation with limited waterflow. The deep parts of basin swamps may go without fire for decades or even centuries, while the drier outer edges can be more susceptible to frequent fire. Basin swamps within mesic flatwoods will burn more frequently than basin swamps within a matrix of mesic or hydric hammock. Without fire, bay shrubs and hardwoods increase in density and peat accumulates more rapidly. *Taxodium* and *Pinus* trees are tolerant of light surface fires, but muck fires burning into the peat can kill the trees, lower the ground surface, and transform a swamp into a pond, lake, marsh, or shrub bog (FNAI 2010).

Component Associations:

- *Chamaecyparis thyoides - Pinus elliottii var. elliottii / Nyssa biflora - Acer rubrum var. trilobum / Serenoa repens* Forest (CEGL007145, G2)
- *Cliftonia monophylla / Lyonia lucida - Smilax laurifolia* Forest (CEGL007042, G4)
- *Nuphar orbiculata* Herbaceous Vegetation (CEGL004327, G3)
- *Nymphoides aquatica* Herbaceous Vegetation (CEGL004621, GNR)
- *Nyssa biflora - Magnolia virginiana - (Pinus elliottii var. elliottii) / Morella (caroliniensis, inodora)* Forest (CEGL007156, G4?)
- *Nyssa biflora / Ilex myrtifolia / Carex glaucescens - Eriocaulon compressum* Forest (CEGL004720, G2G3)
- *Panicum hemitomon - Pontederia cordata* Herbaceous Vegetation (CEGL004461, G3G4)
- *Pinus elliottii var. elliottii / Cliftonia monophylla - Cyrilla racemiflora* Woodland (CEGL003638, G2G3Q)
- *Pinus elliottii var. elliottii / Lyonia lucida / Sarracenia minor var. okefenokeensis - Nymphaea odorata - Sphagnum* spp. Wooded Herbaceous Vegetation (CEGL004230, GNR)
- *Pinus serotina - Pinus elliottii var. elliottii / Cliftonia monophylla - Cyrilla racemiflora* Woodland (CEGL003674, G3?Q)
- *Pinus serotina / Lyonia lucida - Ilex glabra - (Cyrilla racemiflora)* Shrubland (CEGL003846, G3)
- *Taxodium distichum - Nyssa biflora - Acer rubrum - Magnolia virginiana* Saturated Forest (CEGL003804, G2G3)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Southern Coastal Plain Hydric Hammock (CES203.501)

Adjacent Ecological System Comments: Southern Coastal Plain Hydric Hammock (CES203.501) may occur upslope.

DISTRIBUTION

Range: This system is found in the southern portions of the Atlantic and East Gulf coastal plains, extending down the Florida peninsula. The southern limit of this system extends into central Florida along the Atlantic Coast in Volusia and Brevard counties (A. Johnson pers. comm.).
Divisions: 203:C
Nations: US
Subnations: AL, FL, GA, LA?, MS, SC
Map Zones: 55:C, 56:C, 58:C, 99:C
USFS Ecomap Regions: 232B:CC, 232C:CC, 232D:CC, 232G:CC, 232J:CC, 232K:CC, 232L:CC
TNC Ecoregions: 53:C, 55:C, 56:C, 57:C

SOURCES

References: Comer et al. 2003, Eyre 1980, FNAI 1990, FNAI 1997, FNAI 2010a, Fowlkes et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723132#references
Description Author: R. Evans, mod. M. Pyne and C. Nordman
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: R. Evans **ClassifResp:** Southeast

SOUTHERN COASTAL PLAIN NONRIVERINE CYPRESS DOME (CES203.251)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Forest and Woodland (Treed); Depressional; Needle-Leaved Tree
Non-Diagnostic Classifiers: Isolated Wetland [Partially Isolated]
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2460; ESLF 9129; ESP 1460

CONCEPT

Summary: This system consists of small forested wetlands, typically dominated by *Taxodium ascendens*, often with a dome-shaped appearance in which trees in the center of the depression are taller than those around the exterior. Examples are known from the Southern Coastal Plain (Omernik Ecoregion 75 and adjacent 65) of Florida and Georgia, extending into Alabama, Mississippi and Louisiana. Examples occupy poorly drained depressions which are most often embedded in a matrix of pine flatwoods or mesic to dry pine woodlands. The oldest and largest individual trees typically occupy the center of these domed wetlands, with smaller and younger individuals around the margins. Pools of stagnant, highly acidic water may stand in the center of these depressions ranging from 30-120 cm (1-4 feet) in depth, but becoming increasingly shallow along the margins. These sites are underlain by an impervious clay pan which impedes drainage and perches precipitation. Depending on fire regime and hydroperiod, some examples may have thick (50-100 cm) organic layers. In addition to *Taxodium ascendens*, other woody species may include *Cephalanthus occidentalis, Clethra alnifolia, Hypericum chapmanii, Hypericum myrtifolium, Ilex myrtifolia, Leucothoe racemosa, Liquidambar styraciflua, Lyonia lucida, Morella cerifera, Nyssa biflora*, and *Styrax americanus*.
Classification Comments: The original range of this system was thought to include only the East Gulf Coastal Plain (TNC Ecoregion 53) and was named accordingly. Examples were later confirmed in central Florida (TNC Ecoregion 55) and the South Atlantic Coastal Plain portion of Florida (A. Johnson pers. comm.) (TNC Ecoregion 56), whereupon the name was broadened to Southern Coastal Plain Nonriverine Cypress Dome. Cypress "stringers" are included here as well; these are more-or-less linear features that are parts of disconnected drainageways that arise in a pine flatwoods landscape (e.g., CEGL007419). The vegetation of the "stringers" is somewhat analogous to that of the edges of the true "dome swamps."
Related Concepts:
- Dome Swamp (FNAI 1990) Undetermined
- Pondcypress: 100 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs in areas of low relief, occupying poorly drained to permanently wet depressions in uplands such as pine flatwoods or mesic to dry pine woodlands. Pools of stagnant, highly acidic water may stand in the center of these depressions ranging from 30-120 cm (1-4 feet) in depth, but becoming increasingly shallow along the margins (Monk and Brown 1965). Some examples may have thick (50-100 cm) organic layers (Drew et al. 1998). Some of the depressions are fed by groundwater, while others are dependent on local precipitation.
Vegetation: According to Drew et al. (1998), dominant plant taxa include *Taxodium ascendens, Nyssa biflora, Cephalanthus occidentalis, Liquidambar styraciflua, Clethra alnifolia, Lyonia lucida*, and *Styrax americanus*. A few less typical upland depression ponds in Florida dominated by *Nyssa sylvatica* are also accommodated in this system for now (A. Johnson pers. comm.). Other species found in this system can include *Nyssa ursina, Hypericum chapmanii, Hypericum myrtifolium, Ilex myrtifolia, Leucothoe racemosa, Morella cerifera, Lobelia floridana, Polygala cymosa, Carex striata*, and *Carex turgescens*.
Dynamics: Cypress domes get their common name from the dome-shaped appearance in which trees in the center are taller than those around the sides (Monk and Brown 1965). The water draws down more frequently along the shallow margins than in the deeper center. This allows for more frequent recruitment of *Taxodium ascendens* seedlings along the edges, which are also exposed to more frequent wildland fire than the center of the ponds which remain flooded for longer durations. These two factors are reflected in the presence of large trees in the center and smaller trees closer to the edges of the ponds (FNAI 2010a), and greater amounts of herbaceous graminoid plants along the margins of the depression. Where fires are more frequent, open herbaceous vegetation is favored. Without periodic fires *Taxodium ascendens* may become less dominant as hardwood or bay canopy species increase and peat accumulates. *Taxodium ascendens* has fairly thick, fire-resistant bark and is tolerant of light surface fires; however, the seedlings and small *Taxodium ascendens* trees are vulnerable to fire (FNAI 2010a). When the forest canopy is harvested, the disturbed vegetation can transition to an herbaceous graminoid-dominated wetland, such as represented by the ecological systems East Gulf Coastal Plain Depression Pond (CES203.558) or Southern Atlantic Coastal Plain Depression Pond (CES203.262). Transitions like this can also occur in response to the natural disturbance dynamics of Coastal Plain depressions, in which the influences of flooding, hurricanes and occasional wildland fire (or lack of fire) can lead to vegetation transition from wooded to herbaceous, or without canopy disturbance, succession from herbaceous to wooded or wetland forest vegetation.

Component Associations:

- *Carex striata var. striata - Xyris fimbriata - Lachnanthes caroliana* Herbaceous Vegetation (CEGL007718, G2G3)
- *Crataegus aestivalis* Forest (CEGL004639, G2G3)
- *Hypericum chapmanii - Ilex myrtifolia - (Nyssa ursina)* Shrubland (CEGL003867, G1)
- *Nyssa biflora / Ilex myrtifolia / Carex glaucescens - Eriocaulon compressum* Forest (CEGL004720, G2G3)
- *Taxodium ascendens - Nyssa biflora / Carex striata - Rhynchospora (careyana, cephalantha, microcephala)* Stringer Woodland (CEGL004089, G3)
- *Taxodium ascendens / (Nyssa biflora) / Leucothoe racemosa - Lyonia lucida - Morella cerifera* Depression Forest (CEGL007420, G3)
- *Taxodium ascendens / Aristida palustris* Depression Woodland (CEGL004090, G2G3)
- *Taxodium ascendens / Carex striata - Iris tridentata - (Woodwardia virginica)* Depression Woodland (CEGL004087, G3)
- *Taxodium ascendens / Ilex myrtifolia / Carex (striata, turgescens)* Stringer Forest (CEGL007419, G3?Q)
- *Taxodium ascendens / Ilex myrtifolia / Hypericum myrtifolium / Lobelia floridana - Polygala cymosa* Woodland (CEGL004959, G3)
- *Taxodium ascendens / Ilex myrtifolia* Depression Forest (CEGL007418, G3?)

DISTRIBUTION

Range: Examples are known from the Southern Coastal Plain (Omernik Ecoregion 75 and adjacent 65) (EPA 2004) of Florida and Georgia, extending into Alabama, Mississippi and Louisiana.
Divisions: 203:C
Nations: US
Subnations: AL, FL, GA, LA, MS
Map Zones: 55:C, 56:C, 99:C
USFS Ecomap Regions: 232B:CC, 232C:CC, 232D:CC, 232G:CC, 232J:CC, 232K:CC, 232L:CC, 234A:CC
TNC Ecoregions: 53:C, 55:C, 56:C

SOURCES

References: Comer et al. 2003, Drew et al. 1998, EPA 2004, Eyre 1980, FNAI 1990, FNAI 2010a, Johnson, A. pers. comm., Monk and Brown 1965
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723234#references
Description Author: R. Evans, mod. M. Pyne and C. Nordman
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: R. Evans **ClassifResp:** Southeast

SOUTHERN COASTAL PLAIN SEEPAGE SWAMP AND BAYGALL (CES203.505)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Forest and Woodland (Treed); East Gulf Coastal Plain; Seepage-Fed Sloping; Broad-Leaved Evergreen Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Mixed evergreen-deciduous open tree canopy
National Mapping Codes: EVT 2461; ESLF 9130; ESP 1461

CONCEPT

Summary: This wetland system consists of forested wetlands in acidic, seepage-influenced habitats of the East Gulf and Atlantic coastal plains, extending from Mississippi and the Florida Parishes of Louisiana east into southern Georgia and central Florida. These are mostly evergreen forests generally found at the base of slopes or other habitats where seepage flow is concentrated. Resulting moisture conditions are saturated or even inundated. The vegetation is characterized by *Magnolia virginiana* and *Nyssa biflora*. Examples occur in the outer portions of the Coastal Plain within the range of *Persea palustris*, and where *Magnolia virginiana* is an important or even dominant species. To the north this system grades into East Gulf Coastal Plain Northern Seepage Swamp (CES203.554), where evergreen species are largely replaced by deciduous species in the canopy. Due to excessive wetness, these habitats are normally protected from fire except those which occur during extreme droughty periods. These environments are prone to long-duration standing water, and tend to occur on highly acidic, nutrient-poor soils.
Classification Comments: Some authors have treated *Persea palustris* (of wetlands) and *Persea borbonia* (of uplands) as one taxon under a broadly conceived *Persea borbonia*. We recognize the two distinct taxa, following Godfrey (1988), Kartesz (1999) and Weakley (2005).
Similar Ecological Systems:
- Atlantic Coastal Plain Streamhead Seepage Swamp, Pocosin and Baygall (CES203.252)
- East Gulf Coastal Plain Northern Seepage Swamp (CES203.554)

Related Concepts:
- Atlantic White-Cedar: 97 (Eyre 1980) Finer
- Baygall (FNAI 1990) Undetermined
- Bayhead Swamp (Smith 1996a) Intersecting
- Pond Pine: 98 (Eyre 1980) Finer
- Sweetbay - Swamp Tupelo - Redbay: 104 (Eyre 1980) Finer

DESCRIPTION

Environment: These wetlands may occur in poorly developed upland drainages, narrow ravine bottoms, bases of steepheads, and small headwaters stream bottoms. In most cases, these wetlands are embedded in uplands with deep sandy soils. When this system is associated with streams, they tend to be low-gradient, with narrow, often braided channels and diffuse drainage patterns. Habitat also includes baygall vegetation in oval depressions (Carolina bays) in southern Georgia (e.g., in Liberty and Long counties, Georgia).
Vegetation: The vegetation is characterized by *Magnolia virginiana* and *Nyssa biflora*. Examples occur in the outer portions of the Coastal Plain within the range of *Persea palustris*, and where *Magnolia virginiana* is an important or even dominant species. Dominant trees in some stands may include *Quercus laurifolia, Liquidambar styraciflua*, and *Liriodendron tulipifera*. In addition, some stands may be dominated by *Cyrilla racemiflora* and/or *Cliftonia monophylla*. Other shrubs include *Ilex coriacea, Leucothoe axillaris, Lyonia lucida, Morella caroliniensis, Morella inodora*, and *Viburnum nudum var. nudum*. Herbs include *Carex atlantica ssp. capillacea, Carex glaucescens, Carex lonchocarpa, Chasmanthium ornithorhynchum, Polygala cymosa, Solidago patula var. strictula*, and *Sphagnum* spp.
Dynamics: Due to excessive wetness, these habitats are normally protected from fire except those which occur during extreme droughty periods. These environments are prone to long-duration standing water and tend to occur on highly acidic, nutrient-poor soils and saturated peat (FNAI 2010a). This system occurs in landscapes that had frequent fire in the past, but the wetness usually limited fire spread, creating an infrequent fire-return interval. While infrequent, fire intensity varies among associations; those dominated by evergreen shrubs such as *Ilex, Lyonia, Illicium, Cliftonia, Gaylussacia, Persea, Morella, Arundinaria*, and *Cyrilla* and with *Pinus serotina* or *Chamaecyparis thyoides* can produce intense canopy fire when they burn (especially when ladder fuels are present), while others probably experience only low-intensity surface fires because of low flammability. When severe drought has allowed the peat to dry, wildfire can burn out the peat. If shrubs survive, they will resprout, but if the roots of shrubs are killed, the site may respond to the intense fire and transition to herbaceous marsh or eventually *Taxodium - Nyssa* swamp vegetation (FNAI 2010a).

Component Associations:
- *(Pinus elliottii) / Cyrilla racemiflora - Persea palustris - Magnolia virginiana - Smilax laurifolia* Shrubland (CEGL004974, G2?)
- *Chamaecyparis thyoides - Pinus elliottii var. elliottii / Nyssa biflora - Acer rubrum var. trilobum / Serenoa repens* Forest (CEGL007145, G2)
- *Cyrilla racemiflora - Cliftonia monophylla* Scrub (CEGL003847, G4)

- *Gordonia lasianthus - Magnolia virginiana - Persea palustris / Sphagnum* spp. Forest (CEGL007044, G4)
- *Liquidambar styraciflua - Quercus laurifolia / Magnolia virginiana / Carex lonchocarpa* Forest (CEGL004631, G3G4)
- *Liriodendron tulipifera - Nyssa biflora - Magnolia virginiana / Toxicodendron vernix - Morella caroliniensis / Osmunda regalis* Forest (CEGL004772, G3G4)
- *Magnolia virginiana - Nyssa biflora - Magnolia grandiflora / Ilex coriacea - Viburnum nudum var. nudum / Solidago patula var. strictula* Forest (CEGL007473, G2G3)
- *Magnolia virginiana - Nyssa biflora / Carpinus caroliniana / Thelypteris noveboracensis - Athyrium filix-femina* Forest (CEGL004722, G3G4)
- *Magnolia virginiana - Persea palustris / Lyonia lucida* Forest (CEGL007049, G3?)
- *Magnolia virginiana / Illicium floridanum* Forest (CEGL007047, G2)
- *Nyssa biflora - (Acer rubrum) / Ilex opaca / Leucothoe axillaris / Carex atlantica ssp. capillacea* Forest (CEGL004427, G2G3)
- *Nyssa biflora - Acer rubrum var. trilobum - Liriodendron tulipifera / Ilex coriacea - Lyonia lucida* Forest (CEGL004645, G3)
- *Nyssa biflora - Magnolia virginiana - (Pinus elliottii var. elliottii) / Morella (caroliniensis, inodora)* Forest (CEGL007156, G4?)
- *Pinus elliottii var. elliottii - Magnolia virginiana - Taxodium ascendens - Nyssa biflora / Polygala cymosa - Carex glaucescens* Forest (CEGL007556, G2G3)
- *Pinus serotina - Pinus elliottii var. elliottii / Cliftonia monophylla - Cyrilla racemiflora* Woodland (CEGL003674, G3?Q)
- *Quercus laurifolia - Magnolia virginiana - Nyssa biflora / Chasmanthium ornithorhynchum* Forest (CEGL007472, G2?)

DISTRIBUTION

Range: This system occurs in the East Gulf and Atlantic coastal plains, extending from Mississippi and the Florida Parishes of Louisiana east into the outer Coastal Plain of southern Georgia and into central Florida.
Divisions: 203:C
Nations: US
Subnations: AL, FL, GA, LA, MS
Map Zones: 55:C, 56:C, 99:C
USFS Ecomap Regions: 231H:CC, 232B:CC, 232C:CC, 232D:CC, 232G:CC, 232J:CC, 232K:CC, 232L:CC, 234A:CC
TNC Ecoregions: 43:C, 53:C, 55:C, 56:C

SOURCES

References: Comer et al. 2003, Eyre 1980, FNAI 1990, FNAI 2010a, Godfrey 1988, Kartesz 1999, Smith 1996a, Weakley 2005
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723083#references
Description Author: R. Evans and M. Pyne, mod. C. Nordman
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: R. Evans and M. Pyne **ClassifResp:** Southeast

SOUTHERN PIEDMONT LARGE FLOODPLAIN FOREST (CES202.324)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Riverine / Alluvial
Non-Diagnostic Classifiers: Forest and Woodland (Treed)
National Mapping Codes: ESLF 9324

CONCEPT

Summary: This ecological system consists of vegetated communities along Piedmont rivers, south of the James River in Virginia, where flooding and flood-related environmental factors affect vegetational composition and dynamics. Well-developed examples of this system occur in the Triassic basins. The vegetation includes both non-forested bar and scour communities and the more extensive forested floodplain communities. Forests are generally differentiated by depositional landforms such as levees, sloughs, ridges, terraces, and abandoned channel segments. The system is affected by flooding through wetness, scouring, deposition of material, and input of nutrients. Piedmont floodplain systems are generally quite distinct from Coastal Plain ones, with steeper river gradients, harder rocks and more limited floodplain development. The near absence of *Taxodium distichum, Nyssa* spp., and other species of the Coastal Plain corresponds well to the geologic boundary in most places.
Classification Comments: This system is distinguished from Southern Piedmont Small Floodplain and Riparian Forest (CES202.323) by having well-developed fluvial landforms which differentiate vegetation. The smaller rivers are less differentiated both because the fluvial landforms are smaller and because the flooding regime is more variable. This system is distinguished from upland systems by the significant presence of plants indicative of alluvial or bottomland settings. This suite of species is absent or occurs incidentally in upland sites.

Piedmont floodplain systems are generally quite distinct from those of the Coastal Plain, with more limited development of floodplains and depositional features, because of the steeper river gradients and harder rocks. The near absence of *Taxodium distichum, Nyssa* spp., and other species largely confined to the Coastal Plain corresponds well to the geologic boundary in most places. The floodplains on Triassic sediments have some similarity to those in the Coastal Plain because of their more extensive floodplain development. The break with South-Central Interior Large Floodplain (CES202.705) is less sharp. The presence of Appalachian mesophytic species is often the best indicator.

Distinctive subgroups within this system, which could potentially be the basis for further subdivision, include the Triassic Basin floodplains and the distinction between forests and non-forested communities. The non-forested communities, maintained by periodic severe disturbance, have very different dynamics as well as vegetation structure, but are always associated with the forests and share the flooding regime. Triassic Basin floodplains have large floodplains with small streams. They likely have differences in flooding regime, including longer duration of flooding. Swamp forests, where periods of standing water are an important environmental influence, occupy larger portions of Triassic Basin floodplains than of other floodplains.
Similar Ecological Systems:
- South-Central Interior Large Floodplain (CES202.705)
- Southern Piedmont Mesic Forest (CES202.342)
- Southern Piedmont Small Floodplain and Riparian Forest (CES202.323)

Related Concepts:
- Cabbage Palmetto: 74 (Eyre 1980) Finer
- Live Oak: 89 (Eyre 1980) Finer
- Loblolly Pine - Hardwood: 82 (Eyre 1980) Finer
- Loblolly Pine: 81 (Eyre 1980) Finer
- Swamp Chestnut Oak - Cherrybark Oak: 91 (Eyre 1980) Finer

DESCRIPTION

Environment: Examples of this ecological system occur near rivers, on floodplains and terraces affected by river flooding and on emergent bars and banks within channels. The site usually includes distinct depositional landforms, including levees, sloughs, ridges, terraces, and abandoned channel segments. The relative extent of these features varies among the stretches of different rivers depending on factors such as channel morphology (Edwards et al. 2013). The substrate is primarily alluvium. Soils are usually sandy to loamy, but include local clayey and gravelly areas. Soils are generally fertile, among the most nutrient-rich in the Piedmont region. Emergent and vegetated bars of gravel to cobbles are included here as well, as are scoured bedrock areas. Floods are generally of short duration, and wetness is a major influence only within channels and where water is ponded in local depressions. The geologic substrate may be of any kind, but geological substrates in the Piedmont are primarily acidic. A special case is the soft Triassic sedimentary rocks of the Piedmont, where even small streams develop large floodplains with well-developed fluvial landforms and therefore fall into this category.
Vegetation: Most of the extent of the system is forest vegetation. The forest canopy is usually dominated by a mix of characteristic

alluvial and bottomland species such as *Platanus occidentalis, Betula nigra, Acer negundo, Celtis laevigata, Fraxinus pennsylvanica, Liquidambar styraciflua, Quercus michauxii*, and *Quercus pagoda*. Some more widespread species such as *Liriodendron tulipifera* and *Acer rubrum* are also abundant. Mesophytic species such as *Fagus grandifolia* are a component on the driest areas. Successional areas are often dominated by *Pinus taeda, Pinus virginiana, Liquidambar styraciflua*, or *Liriodendron tulipifera*. Lower strata in the forests are similarly dominated by bottomland species, but may contain more mesophytic species. *Lindera benzoin, Xanthorhiza simplicissima, Elymus hystrix, Elymus canadensis, Chasmanthium latifolium*, and *Boehmeria cylindrica* are among the characteristic species. Non-forested vegetation is generally limited to small patches or bands along the channel, and is quite variable in structure and composition. Partly submerged bars may be dominated by *Justicia americana*. Frequently reworked gravel bars may be dominated by young *Salix nigra, Platanus occidentalis*, or *Betula nigra*, or they may have sparse vegetation of a wide variety of annual and perennial herbs of weedy habits. The few extensive bedrock-scour areas in gorges have distinctive vegetation dominated by perennial herbs rooted in pockets and crevices.

Dynamics: The distinctive dynamics of river flooding are presumably the primary reason for the distinctive vegetation of this system, though not all of the factors are well known. The large rivers have the largest watersheds in the region, but the gradients of most of these rivers limit floods to fairly short duration. Flooding is most common in the winter, but may occur in other seasons. The sorting of plant communities by depositional landforms of different height suggest that wetness or depth of flood waters may be of significance, though it has much less influence than in the Coastal Plain. Flood waters have significant energy, and scouring and reworking of sediment are an important factor in bar and bank communities. However, in the forested floodplains, flood disturbances that kill established woody plants are rare, and canopy population dynamics are dominated by windthrow. In addition to disturbance, floods bring nutrient input, deposit sediment, and disperse plant seeds.

Wind disturbance is at least as important in this system as other Piedmont forests, perhaps more important than in uplands because of frequently wet and less dense soils and more shallowly-rooted trees. Fire does not appear to be a dominant factor, and most floodplain vegetation is not very flammable. However, historical references to canebrakes dominated by *Arundinaria gigantea* suggest that fire may have once been more possible and more important in at least some portions.

These systems are commonly subject to a variety of indirect modern human influences beyond those that affect most forests. A large fraction of the large Piedmont rivers have been dammed, and power generation and regulation of waterflow create unnatural flood regimes. Extensive erosion of uplands, caused by poor agricultural practices dating back to colonial times, transported large amounts of sediment into floodplains (Edwards et al. 2013). As in uplands, large floodplains often have substantial areas in cultivation. River bottoms were the focus of agriculture among Native Americans, so some of these systems have a long history of human clearing. A number of exotic plant species have invaded floodplains, more than in any other Piedmont system. These include *Ligustrum sinense*, which can form extensive and continuous stands in the understories of floodplain forests (Edwards et al. 2013).

Component Associations:
- *Acer rubrum - Fraxinus pennsylvanica / Saururus cernuus* Forest (CEGL006606, G3G4)
- *Acer saccharinum - Acer negundo / Ageratina altissima - Laportea canadensis - (Elymus virginicus)* Forest (CEGL006217, G4)
- *Alnus serrulata* Southeastern Seasonally Flooded Shrubland (CEGL008474, G4)
- *Carpinus caroliniana - Ilex decidua* Shrubland (CEGL006484, G1?)
- *Eragrostis hypnoides - Ludwigia palustris - Lindernia dubia - Cyperus squarrosus* Herbaceous Vegetation (CEGL006483, G3)
- *Eupatorium serotinum - Polygonum (lapathifolium, punctatum, pensylvanicum)* Herbaceous Vegetation (CEGL006481, GNR)
- *Fagus grandifolia - Acer barbatum / Asimina triloba / Toxicodendron radicans / Carex blanda* Forest (CEGL007321, G3?)
- *Fraxinus pennsylvanica - Platanus occidentalis - Celtis laevigata / Chasmanthium latifolium* Piedmont River Levee Forest (CEGL007013, G3G4)
- *Justicia americana* Herbaceous Vegetation (CEGL004286, G4G5)
- *Liquidambar styraciflua - Quercus (phellos, nigra, alba) / Carpinus caroliniana* Forest (CEGL007006, G3G4)
- *Pinus taeda - Quercus (phellos, nigra, laurifolia)* Temporarily Flooded Forest (CEGL007551, GNR)
- *Platanus occidentalis - Acer negundo - Juglans nigra / Asimina triloba / Mertensia virginica* Forest (CEGL004073, G4)
- *Platanus occidentalis - Betula nigra - Salix (caroliniana, nigra)* Woodland (CEGL003896, G4G5)
- *Quercus pagoda - Quercus phellos - Quercus lyrata - Quercus michauxii / Chasmanthium latifolium* Forest (CEGL007356, G2?)
- *Quercus phellos - Quercus (palustris, lyrata) / Ilex decidua / Carex typhina - (Carex grayi)* Forest (CEGL006498, G3?)
- *Quercus shumardii - Quercus michauxii - Quercus nigra / Acer barbatum - Tilia americana var. heterophylla* Forest (CEGL008487, G3)

SPATIAL CHARACTERISTICS

Spatial Summary: Naturally a large patch system, occurring in narrow to broad linear patches along rivers. Widespread heavy human alteration has left mostly small patch remnants, with only a few large patches.

Size: Examples probably originally extended for miles along rivers, forming patches of hundreds to thousands of acres. Intense modern human alteration has made this a rare system, with examples now mostly limited to small patches. Some examples of hundreds to over 1000 acres remain.

Adjacent Ecological Systems:
- Piedmont Seepage Wetland (CES202.298)
- Southern Piedmont Cliff (CES202.386)
- Southern Piedmont Mesic Forest (CES202.342)

Adjacent Ecological System Comments: Always associated with a riverine aquatic system. Usually bordered by Southern Piedmont

Mesic Forest (CES202.342). Some adjacent uplands may have drier systems, and locally may have rock outcrop systems.

DISTRIBUTION

Range: This system is widespread in the Piedmont, from Alabama to southern Virginia. The northern boundary in Virginia is not well-determined, but roughly corresponds with the James River.
Divisions: 202:C
Nations: US
Subnations: AL, GA, NC, SC, VA
Map Zones: 54:C, 59:C, 61:C
USFS Ecomap Regions: 231A:CC, 231I:CC
TNC Ecoregions: 52:C, 57:C

SOURCES

References: Comer et al. 2003, Edwards et al. 2013, Eyre 1980, Harris 1989, Sharitz and Mitsch 1993
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723177#references
Description Author: M. Schafale and R. Evans
Version: 06 Feb 2014 **Stakeholders:** East, Southeast
Concept Author: M. Schafale and R. Evans **ClassifResp:** Southeast

SOUTHERN PIEDMONT SMALL FLOODPLAIN AND RIPARIAN FOREST (CES202.323)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Riverine / Alluvial
Non-Diagnostic Classifiers: Forest and Woodland (Treed)
National Mapping Codes: ESLF 9312

CONCEPT

Summary: This ecological system consists of vegetated communities along streams and small rivers in the Piedmont of the southeastern United States where flooding and flood-related environmental factors affect vegetation composition and dynamics. The vegetation includes both non-forested bar and scour communities, as well as more extensive forested floodplain communities. The forests of these smaller floodplains and bottomlands are not differentiated by depositional landforms such as levees, sloughs, ridges, terraces, and abandoned channel segments, because these features are small and flooding regimes are variable. The system is affected by flooding through wetness, scouring, deposition of material, and input of nutrients. Piedmont floodplain systems are generally quite distinct from Coastal Plain ones, with steeper river gradients, harder rocks and more limited floodplain development. The near absence of *Taxodium distichum, Nyssa* spp., and other species of the Coastal Plain corresponds well to the geologic boundary in most places.
Classification Comments: This system is distinguished from Southern Piedmont Large Floodplain Forest (CES202.324) by lacking well-developed fluvial landforms which differentiate vegetation. The smaller rivers are less differentiated both because the fluvial landforms are smaller and because the flooding regime is more variable. The large floodplains created by small streams in Triassic sediments are included with Southern Piedmont Large Floodplain Forest (CES202.324). Both of the Piedmont floodplain systems are distinguished from upland systems by the significant presence of plants indicative of alluvial or bottomland settings. This suite of species is absent or occurs incidentally in upland sites.

Piedmont floodplain systems are generally quite distinct from those of the Coastal Plain, with more limited development of floodplains and depositional features, because of the steeper river gradients and harder rocks. The near absence of *Taxodium distichum, Nyssa* spp., and other species largely confined to the Coastal Plain corresponds well to the geologic boundary in most places. The break with South-Central Interior Large Floodplain (CES202.705) is less sharp. The presence of Appalachian mesophytic species is often the best indicator. The floodplains of the westernmost Piedmont generally belong to South-Central Interior Large Floodplain (CES202.705).

Similar Ecological Systems:
- Piedmont Seepage Wetland (CES202.298)
- South-Central Interior Large Floodplain (CES202.705)
- Southern Piedmont Large Floodplain Forest (CES202.324)
- Southern Piedmont Mesic Forest (CES202.342)

Related Concepts:
- Black Willow: 95 (Eyre 1980) Finer
- Cabbage Palmetto: 74 (Eyre 1980) Finer
- Live Oak: 89 (Eyre 1980) Finer
- Loblolly Pine - Hardwood: 82 (Eyre 1980) Finer
- Swamp Chestnut Oak - Cherrybark Oak: 91 (Eyre 1980) Finer
- Sycamore - Sweetgum - American Elm: 94 (Eyre 1980) Finer

DESCRIPTION

Environment: Examples occur on moderately to very high-gradient streams over a wide range of elevations, near streams and small rivers, on floodplains and terraces affected by river flooding and includes emergent bars and banks within channels. Depositional landforms, including levees, sloughs, ridges, terraces, and abandoned channel segments may be present, but occur less frequently and are smaller than the scale of the communities of the floodplain. Fine-scale alluvial floodplain features are abundant. The substrate is primarily alluvium. Soils are usually sandy to loamy, but include local clayey and gravelly areas. Soils are generally fertile, among the most nutrient-rich in the Piedmont region. Alluvial soils may be as important a factor as ongoing flooding in differentiating these systems from adjacent uplands. Emergent and vegetated bars of gravel to cobbles occur occasionally but are generally not extensive or as distinctive as they are on larger rivers. Floods are generally of short duration, and wetness is a major influence only within channels and where water is ponded in local depressions. The geologic substrate may be of any kind, but areas on Triassic sediments tend to have large floodplain systems even on fairly small streams.
Vegetation: Almost all of the extent of the system is naturally forested. The forest canopy is usually a mix of mesophytic and widespread species such as *Liriodendron tulipifera, Liquidambar styraciflua*, and *Acer rubrum*, along with characteristic alluvial and bottomland species such as *Platanus occidentalis, Betula nigra, Acer negundo, Celtis laevigata, Fraxinus pennsylvanica, Liquidambar styraciflua, Quercus michauxii*, and *Quercus pagoda*. *Fagus grandifolia* may be present in drier portions, mixed with the other

species. Successional areas are often strongly dominated by *Pinus taeda, Pinus virginiana, Liquidambar styraciflua*, or *Liriodendron tulipifera*. Lower strata in the forests may be either primarily of mesophytic species shared with moist uplands systems, or a mix of mesophytic and bottomland species. Non-forested vegetation is generally limited to very small patches or bands along the channel, and seldom forms distinct communities.

Dynamics: The distinctive dynamics of stream flooding are presumably the primary reason for the distinctive vegetation of this system, though not all of the factors are well known. Small rivers and streams with small watersheds have more variable flooding regimes that larger rivers. Floods tend to be of short duration and unpredictably variable as to season and depth. Flood waters may have significant energy in higher gradient systems, but scouring and reworking of sediment rarely affect more than small patches. They are important in maintaining the small non-forested patches. In the forested floodplains, flood disturbances that kill established woody plants are rare, and canopy population dynamics are dominated by windthrow. In addition to disturbance, floods bring nutrient input, deposit sediment, and disperse plant seeds.

In pre-European settlement forests, community diversity in these streamside systems was much more complex than in the modified landscapes of today. Fire, beaver activity, and flooding of varied intensity and frequency created a mosaic whose elements included canebrake, grass and young *Betula-Platanus* beds on reworked gravel or sand bars, beaver ponds, and grass-sedge meadows in abandoned beaver clearings, as well as the streamside zones and mixed hardwood and/or pine forests that make up more than 95% of the land cover that exists today.

Flooding is the major process affecting the vegetation, with the substrate more rapidly drained than in flat floodplain areas. The higher gradients of most of these streams and rivers limit floods to fairly short duration. Flooding is most common in the winter, but may occur in other seasons particularly in association with hurricanes, tornados, or microbursts from thunderstorms. Flood waters may have significant energy in higher gradient systems, but scouring and reworking of sediment are important in maintaining the small non-forested patches of the bar and bank communities. Flooding can act as a replacement disturbance in areas where beavers impounded a channel or in rare years with severe prolonged flood events. There are two general types of floods: occasional catastrophic, prolonged floods (due to beaver activity or other severe event); and more frequent repeated minor flooding (i.e., several minor floods within a 10-year period).

The wind disturbance associated with flooding is very significant along small streams because of wet and less dense soils and shallow-rooted trees. Canopy tree mortality from more common windstorms would have resulted in tree-by-tree or small group replacement. Windthrow is the primary cause of mortality in bottomlands. Major storms or hurricanes occurring at approximately 20-year intervals would have impacted whole stands. Tornado tracks can be found passing across uplands and bottomlands [see one such indicated on a map of Umstead State Park, Raleigh, NC], leaving narrow swaths of felled trees (Landfire 2007a). The majority of windthrow in the Piedmont seems to have been the result of hurricanes and tornadoes spawned by them. Even though the Piedmont is removed from the coast by 25 to over 100 miles, extensive windthrow occurred in middle-aged and old-growth trees in Piedmont bottomlands following Hurricane Fran in 1996 (Xi et al. 2008). Bottomland *Quercus* species, even though seemingly in more sheltered positions, were much more heavily affected than hardwoods on adjacent uplands. Gaps as large as one hectare were seen intermixed in areas with extensive single-tree windthrow. Windthrow may also occur because of thunderstorm microbursts or tornados. In addition, ice damage is an infrequent but potentially catastrophic disturbance.

Component Associations:

- *Acer rubrum - Fraxinus pennsylvanica / Saururus cernuus* Forest (CEGL006606, G3G4)
- *Alnus serrulata* Southeastern Seasonally Flooded Shrubland (CEGL008474, G4)
- *Betula nigra - Platanus occidentalis* Forest (CEGL002086, G5)
- *Carex torta* Herbaceous Vegetation (CEGL004103, G3G4)
- *Fagus grandifolia - Quercus alba / Kalmia latifolia - Rhododendron canescens - Symplocos tinctoria* Forest (CEGL008551, G3?)
- *Hymenocallis coronaria - Justicia americana* Herbaceous Vegetation (CEGL004285, G1)
- *Justicia americana* Herbaceous Vegetation (CEGL004286, G4G5)
- *Liquidambar styraciflua - Liriodendron tulipifera / Lindera benzoin / Arisaema triphyllum* Forest (CEGL004418, G4)
- *Liquidambar styraciflua - Liriodendron tulipifera / Onoclea sensibilis* Forest (CEGL007329, G4)
- *Liquidambar styraciflua - Quercus (phellos, nigra, alba) / Carpinus caroliniana* Forest (CEGL007006, G3G4)
- *Liriodendron tulipifera - Acer (rubrum, negundo) - (Platanus occidentalis) / Carpinus caroliniana / Polygonum virginianum* Forest (CEGL006492, G4)
- *Liriodendron tulipifera - Quercus alba - (Liquidambar styraciflua) / Ilex opaca / Polystichum acrostichoides* Piedmont Small Stream Forest (CEGL004900, G3G4)
- *Platanus occidentalis - Acer negundo - Juglans nigra / Asimina triloba / Mertensia virginica* Forest (CEGL004073, G4)
- *Platanus occidentalis - Celtis laevigata - Fraxinus pennsylvanica / Lindera benzoin - Ilex decidua / Carex retroflexa* Forest (CEGL007730, G4?)
- *Podostemum ceratophyllum* Herbaceous Vegetation (CEGL004331, G3G5)
- *Quercus phellos - Quercus (palustris, lyrata) / Ilex decidua / Carex typhina - (Carex grayi)* Forest (CEGL006498, G3?)
- *Quercus phellos - Quercus alba - (Quercus michauxii) - Carya carolinae-septentrionalis* Small Stream Forest (CEGL004042, G2)
- *Quercus shumardii - Quercus michauxii - Quercus nigra / Acer barbatum - Tilia americana var. heterophylla* Forest (CEGL008487, G3)
- *Salix nigra* Temporarily Flooded Shrubland (CEGL003901, G4?)
- *Schizachyrium scoparium - Solidago plumosa* Herbaceous Vegetation (CEGL004459, G1)

Spatial Characteristics

Spatial Summary: Naturally a small- to medium-patch or narrow linear system, following streams.
Size: Examples probably originally extended for miles in branching networks of smaller stream systems, and might extend for miles along the larger streams. Patches might be hundreds and potentially even thousands of contiguous acres, but most intact remnants are 100 acres or less.
Adjacent Ecological Systems:

- Piedmont Seepage Wetland (CES202.298)
- Southern Piedmont Cliff (CES202.386)
- Southern Piedmont Mesic Forest (CES202.342)

Adjacent Ecological System Comments: Always associated with an intermittent stream, perennial stream, or small river aquatic system. Usually bordered by Southern Piedmont Mesic Forest (CES202.342). Some adjacent uplands may have drier systems, and locally may have rock outcrop systems.

Distribution

Range: This system is widespread in the Piedmont, from Alabama to southern Virginia. The northern boundary in Virginia is roughly the watershed of the James River.
Divisions: 202:C
Nations: US
Subnations: AL, GA, NC, SC, VA
Map Zones: 49:P, 54:C, 59:C, 61:C
TNC Ecoregions: 52:C

Sources

References: Comer et al. 2003, Eyre 1980, Glenn 1911, Ireland et al. 1939, Landfire 2007a, Mulholland and Lenat 1992, Wharton 1978, Xi et al. 2008
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723178#references
Description Author: M. Schafale and R. Evans, mod. M. Pyne
Version: 14 Jan 2014 **Stakeholders:** East, Southeast
Concept Author: M. Schafale and R. Evans **ClassifResp:** Southeast

SOUTHWEST FLORIDA PERCHED BARRIERS TIDAL SWAMP AND LAGOON (CES203.540)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Forest and Woodland (Treed); Tidal / Estuarine [Haline]
National Mapping Codes: ESLF 9347

CONCEPT

Summary: This system includes tidal wetlands along the western coast of Florida from approximately Tampa Bay south to Charlotte Harbor. In this region, instead of the tidal marshes found to the north, these are mangrove forests with canopies up to 10 m tall (Montague and Wiegert 1990). Odum and McIvor (1990) show a diagram displaying the community zonation present in this system at Tampa Bay. A narrow high marsh zone of *Batis* and *Juncus* grades into low swamps with *Laguncularia racemosa, Avicennia germinans*, and *Rhizophora mangle*. Interpretation of the vegetation is difficult due to extensive human alteration. For example, Lewis et al. (1979) estimated that 44% loss of intertidal vegetation in the Tampa Bay region had taken place.
Classification Comments: The use of the term "perched" in the name refers to the elevated nature of the barrier islands, which are built on remnant limestone reefs.
Related Concepts:
- Mangrove: 106 (Eyre 1980) Finer

Component Associations:
- *Avicennia germinans / Spartina alterniflora* Shrubland (CEGL003801, G2?)
- *Conocarpus erectus - (Laguncularia racemosa) / Batis maritima - Borrichia frutescens / Sesuvium portulacastrum - Suaeda linearis* Scrub (CEGL003806, G2?)

DISTRIBUTION

Range: Endemic to south Florida.
Divisions: 203:C
Nations: US
Subnations: FL
Map Zones: 56:C
USFS Ecomap Regions: 232D:CC, 411A:CC
TNC Ecoregions: 55:C

SOURCES

References: Comer et al. 2003, Lewis et al. 1979, Montague and Wiegert 1990, Odum and McIvor 1990
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723062#references
Description Author: R. Evans
Version: 06 Feb 2003
Concept Author: R. Evans
Stakeholders: Southeast
ClassifResp: Southeast

TAMAULIPAN CLOSED DEPRESSION WETLAND (CES301.197)

CLASSIFIERS

Classification Status: Standard

Primary Division: Madrean Semidesert (301)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Intermittent Flooding; Lowland [Lowland]; Woody-Herbaceous; Depression
National Mapping Codes: ESLF 9392

CONCEPT

Summary: This ecological system occupies small, internally drained basins or depressions occurring over various substrates. It occurs over various geologic formations, but is primarily concentrated over the Lissie and Goliad formations and the South Texas Sandsheet south of the Nueces River, as well as other eolian sands. The sites may be locally referred to as potholes, lagunas, lagunitas, ponds, or copitas. Occurrences are local and appear to be unrelated to underlying strata, though in some cases they may result from solution of underlying caliche bedrock. The soils are a matrix of sandy substrates; the depressions that characterize the system are typically lined by clays or clay loams. Lakebed Ecological Sites typify the occurrences. These basins are typically lined by clay or clay loam soils which tend to hinder drainage, resulting in moist conditions over extended periods. Characteristic woody species surrounding these basins include *Acacia farnesiana, Parkinsonia aculeata*, and *Prosopis glandulosa*, which make up a relatively sparse woodland canopy at a height of about 6 m. *Celtis laevigata, Celtis pallida (= Celtis ehrenbergiana)*, and *Ulmus crassifolia* may sometimes be present. Shrubs of these species, and other species such as *Condalia hookeri, Lycium carolinianum, Heimia salicifolia*, and *Sideroxylon celastrinum*, may be present but typically do not occur as a dense shrub layer. *Sesbania drummondii* is often encountered, particularly in areas with reduced woodland canopy where water may stand for extended periods. The herbaceous layer within the woodland may commonly contain species such as *Urochloa maxima, Chloracantha spinosa, Clematis drummondii*, and *Teucrium cubense*. Toward the center of the basin, woody cover is reduced, or often absent, and the herbaceous layer is often dominated by *Cynodon dactylon*, but may also be characterized by a number of sedge species of the genera *Eleocharis* (including *Eleocharis quadrangulata* and *Eleocharis palustris*) and *Cyperus* (including *Cyperus articulatus, Cyperus acuminatus*, and *Cyperus squarrosus*), as well as *Schoenoplectus saximontanus*. Numerous other species may be present, including *Paspalum distichum, Setaria parviflora, Eragrostis spicata, Calyptocarpus vialis, Eryngium nasturtiifolium, Eclipta prostrata, Phyla nodiflora, Soliva mutisii, Rorippa teres, Lindernia dubia, Rotala ramosior, Bacopa rotundifolia, Heteranthera limosa, Echinodorus berteroi, Echinodorus tenellus, Sagittaria longiloba, Nymphaea elegans, Marsilea macropoda, Lemna* sp., and *Wolffia* sp.
Classification Comments: This system is called a closed depression wetland (a wooded herbaceous wetland) because calling it a woodland/shrubland may be misleading.
Similar Ecological Systems:
- Tamaulipan Ramadero (CES301.992)
- Western Great Plains Closed Depression Wetland (CES303.666)

DESCRIPTION

Environment: This ecological system is found in local internally draining basins or depressions. It occurs over various geologic formations, from eolian sands, to the Lissie Formation, to the Goliad Formation. Occurrences are local and appear to be unrelated to underlying strata, though in some cases they may result from solution of underlying caliche bedrock. The sites may be locally referred to as potholes, lagunas, lagunitas, ponds, or copitas. Occurrences are local and appear to be unrelated to underlying strata, though in some cases they may result from solution of underlying caliche bedrock. The soils are a matrix of sandy substrates; the depressions that characterize the system are typically lined by clays or clay loams. Lakebed Ecological Sites typify the occurrences. These basins are typically lined by clay or clay loam soils which tend to hinder drainage, resulting in moist conditions over extended periods.
Vegetation: Characteristic woody species surrounding these basins include *Acacia farnesiana, Parkinsonia aculeata*, and *Prosopis glandulosa*, which make up a relatively sparse woodland canopy at a height of about 6 m. *Celtis laevigata, Celtis pallida (= Celtis ehrenbergiana)*, and *Ulmus crassifolia* may sometimes be present. Shrubs of these species, and other species such as *Condalia hookeri, Lycium carolinianum*, and *Sideroxylon celastrinum*, may be present but typically do not occur as a dense shrub layer. *Sesbania drummondii* is often encountered, particularly in areas with reduced woodland canopy where water may stand for extended periods. The herbaceous layer within the woodland may commonly contain species such as *Urochloa maxima, Chloracantha spinosa, Clematis drummondii*, and *Teucrium cubense*. Toward the center of the basin, woody cover is reduced, or often absent, and the herbaceous layer is often dominated by *Cynodon dactylon*, but may also be characterized by a number of sedge species of the genera *Eleocharis* (including *Eleocharis quadrangulata* and *Eleocharis palustris*) and *Cyperus* (including *Cyperus articulatus, Cyperus acuminatus*, and *Cyperus squarrosus*), as well as *Schoenoplectus saximontanus*. Numerous other species may be present, including *Paspalum distichum, Setaria parviflora, Calyptocarpus vialis, Eryngium nasturtiifolium, Eclipta prostrata, Phyla nodiflora, Soliva mutisii, Rorippa teres, Lindernia dubia, Rotala ramosior, Bacopa rotundifolia, Heteranthera limosa, Echinodorus berteroi, Echinodorus tenellus, Sagittaria longiloba, Nymphaea elegans, Marsilea macropoda, Lemna* sp., and *Wolffia* sp.
Dynamics: This ecological system is primarily driven by hydrological processes. It occurs on sites that are seasonally to semipermanently flooded, usually retaining water into the growing season, drying completely only in drought years. Increases in

precipitation and/or runoff can dilute the salt concentration and allow for less salt-tolerant species to occur.

Component Associations:
- *Acacia farnesiana - (Prosopis glandulosa)* Woodland (CEGL002131, G5)
- *Acacia farnesiana - Parkinsonia aculeata* Temporarily Flooded Forest (CEGL007755, G4)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Central and South Texas Coastal Fringe Forest and Woodland (CES203.464)
- Tamaulipan Mixed Deciduous Thornscrub (CES301.983)
- Tamaulipan Savanna Grassland (CES301.985)

DISTRIBUTION

Range: This closed depression ecological system occurs on the fringes of the South Texas Sandsheet and extends into the Tamaulipan Thornscrub, Gulf Coastal Prairies and Lower Rio Grande Valley regions.
Divisions: 301:C
Nations: MX, US
Subnations: MXCO(MX), MXNU(MX), MXTM(MX), TX
Map Zones: 36:C
USFS Ecomap Regions: 255Da:CCC, 315Ea:CCC, 315Eb:CCC, 315Ef:CCC
TNC Ecoregions: 30:C, 31:C

SOURCES

References: Landfire 2007a, Southeastern Ecology Working Group n.d., TNC 2013
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.868810#references
Description Author: L. Elliott, mod. K.A. Schulz
Version: 14 Jan 2014 **Stakeholders:** Latin America, Southeast
Concept Author: L. Elliott **ClassifResp:** Southeast

TAMAULIPAN FLOODPLAIN (CES301.990)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Madrean Semidesert (301)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Intermediate (5-25 yrs) Flooding Interval; Lowland [Lowland]; Forest and Woodland (Treed); Tropical/Subtropical [Tropical Xeric]; Riverine / Alluvial
Non-Diagnostic Classifiers: Broad-Leaved Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Deciduous open tree canopy
National Mapping Codes: EVT 2467; ESLF 9136; ESP 1467

CONCEPT

Summary: This ecological system is limited to riparian areas of the lower Rio Grande Valley and Rio Corona in southern Texas and northeastern Mexico. Stands occur on riverbanks, floodplains and deltas. Stands are generally deciduous woodlands or forests with tree height reaching to 15 m. Canopy cover is variable, but sometimes reaches near 100%. The canopy may have a conspicuous (sometimes dominant to codominant) evergreen component of species such as *Ebenopsis ebano* and *Ehretia anacua*. Dominant species of the overstory canopy often include one or more of the following: *Celtis laevigata, Ulmus crassifolia, Fraxinus berlandieriana, Prosopis glandulosa, Acacia farnesiana, Diospyros texana, Leucaena pulverulenta, Celtis pallida (= Celtis ehrenbergiana), Sapindus saponaria var. drummondii, Ebenopsis ebano, Ehretia anacua,* and *Parkinsonia aculeata*. These woodlands are a unique mix of species from southeastern North America and subtropical Central America and are often dominated by *Acacia farnesiana, Diospyros texana, Ebenopsis ebano, Ehretia anacua, Fraxinus berlandieriana,* or *Ulmus crassifolia*, and many other tree species present to locally dominant. The highly variable understory is dependent on canopy density and may include dense shrub or herbaceous layers.

Similar Ecological Systems:
- Rio Grande Delta Thorn Woodland (CES301.716)

Related Concepts:
- Black Willow: 95 (Eyre 1980) Finer
- Chihuahuan Thorn Forest (Jahrsdoerfer and Leslie 1988) Intersecting
- Mid-Delta Thorn Forest (Jahrsdoerfer and Leslie 1988) Finer
- Mid-Valley Riparian Woodland (Jahrsdoerfer and Leslie 1988) Finer
- South Texas: Floodplain Deciduous Shrubland (7406) [CES301.990.6] (Elliott 2011) Finer
- South Texas: Floodplain Evergreen Forest and Woodland (7402) [CES301.990.2] (Elliott 2011) Finer
- South Texas: Floodplain Evergreen Shrubland (7405) [CES301.990.5] (Elliott 2011) Finer
- South Texas: Floodplain Grassland (7407) [CES301.990.7] (Elliott 2011) Finer
- South Texas: Floodplain Hardwood Forest and Woodland (7404) [CES301.990.4] (Elliott 2011) Finer
- South Texas: Floodplain Herbaceous Wetland (7417) [CES301.990.17] (Elliott 2011) Finer
- South Texas: Floodplain Mixed Deciduous / Evergreen Forest and Woodland (7403) [CES301.990.3] (Elliott 2011) Finer
- Upper Valley Flood Forest (Jahrsdoerfer and Leslie 1988) Finer

DESCRIPTION

Environment: Stands of this ecological system occur on riverbanks, floodplains, deltas and other riparian areas of the lower Rio Grande Valley and Rio Corona in southern Texas and northeastern Mexico. The geology is Quaternary alluvium. Landforms are floodplains of rivers and large creeks where sediment is deposited. The topography is relatively level with some relief associated with levees and depressions developed from meanders of the waterway, or historical meanders of the Rio Grande (Resaca). It is typically found on alluvial soils of the Bottomland Ecological Sites, including loamy, clayey, and sandy. The Lowland Ecological Site type also supports this system. This ecological system occurs along rivers and major drainages in south Texas from the central portion of the Nueces River south to northeastern Mexico and west to the vicinity of Del Rio, Texas.

Vegetation: Stands of this system are generally deciduous woodlands or forests with tree heights reaching to 15 m. Canopy cover is variable but sometimes reaches near 100%. The canopy may have a conspicuous (sometimes dominant to codominant) evergreen component of species such as *Ebenopsis ebano* and *Ehretia anacua*. Dominant species of the overstory canopy often include one or more of the following: *Celtis laevigata, Ulmus crassifolia, Fraxinus berlandieriana, Prosopis glandulosa, Acacia farnesiana, Diospyros texana, Leucaena pulverulenta, Celtis pallida (= Celtis ehrenbergiana), Sapindus saponaria var. drummondii, Ebenopsis ebano, Ehretia anacua,* and *Parkinsonia aculeata* (Elliott 2011). In northern portions of the range of this system, particularly within the Nueces River drainage, *Carya illinoinensis* and *Quercus fusiformis* may be conspicuous components of the overstory. Forests and woodlands may have significant shrub cover, including saplings of the overstory species in addition to species such as *Zanthoxylum fagara, Condalia hookeri, Forestiera angustifolia, Sideroxylon* spp., *Aloysia gratissima, Acacia greggii var. wrightii, Malpighia glabra, Guajacum angustifolium, Ziziphus obtusifolia,* and *Amyris texana*. Other shrub species, such as *Buddleja sessiliflora, Phaulothamnus spinescens, Lippia alba,* and *Amyris madrensis* may be encountered in southern expressions of the system. *Salix nigra*

may dominate sites, especially at river's edge and wet sites. Riverbanks and other sites with a reduced overstory canopy (either from disturbance or prolonged inundation) may also be shrub-dominated, often with one or few species such as *Baccharis neglecta, Baccharis salicifolia, Arundo donax, Sesbania drummondii*, or *Cephalanthus occidentalis*, and *Salix exigua, Mimosa asperata*, or *Cephalanthus salicifolius* in the lower Rio Grande Valley (Elliott 2011). The herbaceous layer is typically not well-developed, but may include species such as *Chloris pluriflora (= Trichloris pluriflora), Setaria scheelei, Panicum virgatum, Paspalum langei, Paspalum lividum (= Paspalum denticulatum), Carex crus-corvi, Cyperus articulatus, Rivina humilis, Calyptocarpus vialis, Chromolaena odorata, Teucrium cubense, Urtica chamaedryoides, Parietaria pensylvanica, Verbesina microptera, Chloracantha spinosa, Parthenium confertum*, and *Malvaviscus arboreus var. drummondii*. Vines such as *Serjania brachycarpa, Cocculus diversifolius, Clematis drummondii*, and *Cissus trifoliata* are frequently encountered, and *Tillandsia usneoides* often drapes the branches of overstory species. Non-native grasses such as *Cynodon dactylon, Urochloa maxima, Pennisetum ciliare, Bothriochloa ischaemum var. songarica*, and *Bromus catharticus* are often present to dominant, and sometimes to the exclusion of most other herbaceous species (Elliott 2011).

Dynamics: Stands occur as linear patches along much of the lower Rio Grande and occupy large patches on the delta (Landfire 2007a). Key ecological processes are succession and disturbance. Disturbance was primarily flooding and, to a lesser extent, fire may have occurred within these woodlands and forests. Occurrence of patches of *Phragmites* spp. may have provided adequate fuel to carry fire to the canopy. Floods may have been annual and were primarily depositional floods rather than scouring floods (Landfire 2007a). Long-term succession would occur due to deposition and development of this system into more upland characteristics of another system (Landfire 2007a). Extreme floods may have occurred in association with hurricanes. Freezes would have had significant impacts on the largely tropical/subtropical species, though these impacts more directly affect riparian woodlands where tropical species are more common. Drought would also affect this system, and may provide the unusual opportunity for fire to carry in the system (Landfire 2007a).

This system was modeled as part of the Tamaulipan Riparian Systems group by Landfire (2007a) using three classes: early-, mid- and late-seral. Fire frequency may be over-emphasized in this model for this system, as other ecologists suggest fire less frequent historically.

The early-seral class (0-12 years): Herbaceous cover following 1000-year scouring flood and replacement fire in mid-seral class. Herbaceous cover of sedges and rushes develops as sedimentation produces an adequate substrate not continually flooded to allow development of cover. Areas of *Phragmites* spp. may occur in areas where fires would have occurred. Replacement fire-return interval is approximately 10 years in this class due to the fine fuel (Landfire 2007a).

Mid-seral class (13-20 years): Low canopy cover of trees. Shrub layer well-developed, but composition is similar to the understory of late-seral class. Scouring floods associated with river channel migration on the delta is modeled as encountering a site every 1000 years, taking the class back to early-seral. Replacement fire is modeled as occurring at a similar MFRI to surface fires in mid-seral class (30 years). *Celtis laevigata* is developing as a canopy but still occurs with low cover (Landfire 2007a).

The late-seral class (21+ years): Dominated by *Celtis laevigata* with 60-100% canopy, with *Ulmus crassifolia, Celtis pallida, Mimosa pigra*, and *Condalia hookeri* in the midstory, and other shrubs in the understory. Scouring floods modeled as occurring every 1000 years take class back to early-seral. Hurricane of sufficient strength to take out the canopy is modeled as occurring every 50 years, takes class back to mid-seral. Maintenance surface fires occur every 30 years (Landfire 2007a).

Component Associations:
- *Acacia farnesiana - (Prosopis glandulosa)* Woodland (CEGL002131, G5)
- *Acacia farnesiana - Parkinsonia aculeata* Temporarily Flooded Forest (CEGL007755, G4)
- *Celtis laevigata - Ulmus crassifolia - (Fraxinus berlandieriana) / Rivina humilis - Chromolaena odorata* Forest (CEGL007752, G1G2)
- *Celtis laevigata - Ulmus crassifolia - (Fraxinus* spp.) / *Celtis pallida / Elymus virginicus* Forest (CEGL007782, G3G4)
- *Ebenopsis ebano - Ehretia anacua / Condalia hookeri* Forest (CEGL002054, G1)
- *Ebenopsis ebano - Phaulothamnus spinescens* Scrub (CEGL002169, G2)
- *Phragmites australis* Riverbank Herbaceous Vegetation (CEGL004115, G3)
- *Salix interior / Phragmites australis* Temporarily Flooded Shrubland (CEGL007753, GNR)
- *Salix nigra - Celtis laevigata var. laevigata / Baccharis neglecta* Forest (CEGL007754, GNR)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Central Texas Coastal Prairie River Floodplain (CES203.713)
- Rio Grande Delta Thorn Woodland (CES301.716)
- Tamaulipan Ramadero (CES301.992)
- Tamaulipan Saline Thornscrub (CES301.711)

DISTRIBUTION

Range: This system encompasses vegetation of riparian areas of the lower Rio Grande Valley and Rio Corona in southern Texas and northeastern Mexico.
Divisions: 301:C
Nations: MX, US
Subnations: MXCO(MX), MXNU(MX), MXTM(MX), TX

Map Zones: 36:C
USFS Ecomap Regions: 255D:PP, 315E:CC
TNC Ecoregions: 30:C, 31:P

SOURCES

References: Comer et al. 2003, Correll and Johnston 1970, Diamond 1987, Elliott 2011, Eyre 1980, Jahrsdoerfer and Leslie 1988, Landfire 2007a, Lonard and Judd 2002, McLendon 1991, TNC 2013, Webster 2001

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722715#references

Description Author: J. Teague and M. Pyne, mod. L. Elliott
Version: 14 Jan 2014 **Stakeholders:** Latin America, Southeast
Concept Author: NatureServe Western Ecology Team **ClassifResp:** Southeast

TAMAULIPAN PALM GROVE RIPARIAN FOREST (CES301.991)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Madrean Semidesert (301)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Lowland [Lowland]; Forest and Woodland (Treed); Tropical/Subtropical [Tropical Xeric]; Riverine / Alluvial; Palm Tree; Sabal mexicana
National Mapping Codes: ESLF 9152

CONCEPT

Summary: This ecological system is limited to riparian areas along the lower Rio Grande and Rio Corona in southern Texas and northeastern Mexico. Stands occur on riverbanks and floodplains. The characteristic species are the neotropical *Sabal mexicana* with *Ebenopsis ebano, Ehretia anacua, Leucaena pulverulenta*, and many other riparian species such as *Acacia farnesiana, Diospyros texana, Fraxinus berlandieriana*, or *Ulmus crassifolia*. The understory is dominated by neotropical species.
Related Concepts:
- Sabal Palm Forest (Jahrsdoerfer and Leslie 1988) Equivalent
- South Texas: Palm Grove (7502) [CES301.991] (Elliott 2011) Equivalent

DESCRIPTION

Environment: Stands of this ecological system occur on riverbanks and floodplains in riparian areas along the lower Rio Grande and Rio Corona in southern Texas and northeastern Mexico. The geologic substrate is Quaternary alluvium. It is currently found on levees and resaca margins and adjacent lower sites near the current Rio Grande channel (Elliott 2011). It was historically more widespread within the Rio Grande delta. Soils are Loamy or Clayey Bottomland Ecological Sites. This system is currently limited to relatively small groves (typically less than 20 hectares) of Sabal mexicana (sometimes referred to as Sabal texana) located on loamy or clayey bottomland soils, such as those of the Rio Grande, Zalla, and Matamoros series, on the Rio Grande Delta and near the Rio Grande itself in Cameron County, Texas, and similar sites in adjacent Mexico. These often occupy slight elevations along the margins of resacas or old river terraces, but may also occur on level sites. The system may have once occurred along the Rio Grande more than 120 km from its mouth, but is now limited to a few sites near the Gulf of Mexico, with a few small stands identified in extreme southern Hidalgo County, Texas (Elliott 2011).
Vegetation: This system is currently limited to relatively small groves (typically less than 20 hectares) of *Sabal mexicana* (sometimes referred to as *Sabal texana*). These forests and woodlands often have a canopy dominated by *Sabal mexicana*, or may share dominance with other floodplain species such as *Ebenopsis ebano, Celtis laevigata, Leucaena pulverulenta, Ulmus crassifolia, Ehretia anacua*, and *Fraxinus berlandieriana*. *Prosopis glandulosa, Sapindus saponaria var. drummondii*, and *Diospyros texana* are often present in the subcanopy (Elliott 2011). The canopy of these forests may reach a height of 15 m, and the subcanopy (to 10 m) may be composed of some of the species mentioned above. The shrub layer can be patchy with some areas extremely dense and containing species such as *Zanthoxylum fagara, Malpighia glabra, Celtis pallida (= Celtis ehrenbergiana), Erythrina herbacea, Ziziphus obtusifolia, Randia rhagocarpa, Parkinsonia aculeata, Havardia pallens, Chiococca alba, Iresine palmeri*, and members of the canopy and subcanopy, and other areas relatively open. In some situations the ground may be covered with a layer of dead palm fronds, restricting the development of an herbaceous layer. In other areas, species including, but not limited to, *Leersia monandra, Salvia coccinea, Petiveria alliacea, Rivina humilis, Plumbago scandens, Tamaulipa azurea, Cocculus diversifolius*, and *Malvaviscus arboreus* may be present in the herbaceous layer (Elliott 2011).
Dynamics: Fire may have been an important process in these forests as the sites may become extremely dry and a significant, if patchy, layer of palm thatch may be present. These forests appear to differ from other forests dominated by *Sabal mexicana* further to the south. Martinez-Ojeda and GonzÃ¡lez-Medrano (1977) describe a site of limited distribution in the northern part of the Sierra de San JosÃ© de las Rusias in the Municipio of Soto La Marina in Tamaulipas, Mexico. It occurs at higher altitudes and on Oligocene geologic formations. Their brief description suggests that this is likely different in composition and process from the presently described system. Lopez and Dirzo (2007) describe a site further south in Vera Cruz that also seems to differ relative to composition. Palm groves were once common in the lower Rio Grande Valley 80 miles from the Gulf of Mexico, but have since largely been converted to agriculture.

The major process in this system was flooding. Freezes can have significant impacts on canopy species such as *Ebenopsis, Sabal* and *Leucaena pulverulenta* in the delta. Hurricanes may not significantly affect dense ebony/anacua forest, except through flood effects. Lengthy droughts (lasting 10 years) can influence this system, but most species are drought-tolerant. Infrequent fires may also occur (Landfire 2007a).

Component Associations:
- *Sabal mexicana - Ebenopsis ebano* Forest (CEGL002056, G2)

DISTRIBUTION

Range: This ecological system is limited to riparian areas along the lower Rio Grande and Rio Corona in southern Texas and

northeastern Mexico.
Divisions: 301:C
Nations: MX, US
Subnations: MXTM(MX), TX
Map Zones: 36:C
USFS Ecomap Regions: 255D:PP, 315E:CC
TNC Ecoregions: 30:C, 31:P

SOURCES

References: Comer et al. 2003, Diamond 1987, Elliott 2011, Gehlbach 1981, Jahrsdoerfer and Leslie 1988, Landfire 2007a, Lopez and Dirzo 2007, Martinez-Ojeda and GonzÃ¡lez-Medrano 1977, TNC 2013, Vora 1990, Vora and Messerly 1990, Webster 2001
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722714#references
Description Author: J. Teague and M. Pyne, mod. L. Elliott
Version: 14 Jan 2014 **Stakeholders:** Latin America, Southeast
Concept Author: NatureServe Western Ecology Team **ClassifResp:** Southeast

TAMAULIPAN RAMADERO (CES301.992)

CLASSIFIERS

Conf.: 3 - Weak **Classification Status:** Standard
Primary Division: Madrean Semidesert (301)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Intermittent Flooding; Lowland [Lowland]; Shrubland (Shrub-dominated); Arroyo; Tropical/Subtropical [Tropical Xeric]; Riverine / Alluvial
National Mapping Codes: ESLF 9158

CONCEPT

Summary: This Tamaulipan riparian shrubland system is restricted to drainages in upland areas or ramaderos of southern Texas and adjacent Mexico that are intermittently flooded. Typical stands have a closed canopy (relative to the surrounding landscape) from 5 to 10 m in height. The overstory canopy is typically dominated by species such as *Prosopis glandulosa, Acacia farnesiana, Celtis pallida (= Celtis ehrenbergiana)*, and/or *Parkinsonia aculeata*. In addition, *Celtis laevigata* and/or *Ebenopsis ebano* may also be present in the canopy. Some sites have a relatively open subcanopy, but more commonly the shrub layer is thick, sometimes impenetrable, and varies in height from 1 to 5 m. Species commonly encountered in the shrub layer include *Aloysia gratissima, Phaulothamnus spinescens, Celtis pallida, Condalia hookeri, Forestiera angustifolia, Diospyros texana, Ziziphus obtusifolia, Koeberlinia spinosa, Malpighia glabra, Zanthoxylum fagara, Opuntia engelmannii var. lindheimeri, Guajacum angustifolium, Colubrina texensis,* and *Amyris texana*. Ground cover can be sparse or, in more open stands, may have a fairly continuous grassy cover.
Classification Comments: The Ramadero of Jahrsdoerfer and Leslie (1988) is equivalent to this system concept, but could be considered narrower if more information on how it occurs elsewhere in Mexico can be obtained. Not much more information is likely to be found because this system is not sampled very often. Intermittent drainages (arroyos and ramaderos) are not sampled that often because of scale and variability issues. More information is needed to fully characterize this system.
Similar Ecological Systems:
- Edwards Plateau Limestone Shrubland (CES303.041)
- Tamaulipan Closed Depression Wetland (CES301.197)

Related Concepts:
- Ramadero (Jahrsdoerfer and Leslie 1988) Equivalent
- South Texas: Ramadero Dense Shrubland (7605) [CES301.992.5] (Elliott 2011) Finer
- South Texas: Ramadero Evergreen Woodland (7602) [CES301.992.2] (Elliott 2011) Finer
- South Texas: Ramadero Shrubland (7606) [CES301.992.6] (Elliott 2011) Finer
- South Texas: Ramadero Woodland (7604) [CES301.992.4] (Elliott 2011) Finer

DESCRIPTION

Environment: This Tamaulipan riparian shrubland system is restricted to drainages in upland areas or ramaderos (isolated strips of dense brush associated with arroyos) that are intermittently flooded. This is a widespread system on various geologic strata. It is typically found in upland drainages in various landscapes. Drainages are extremely flashy from runoff from surrounding landscape. These sites are infrequently flooded during local rainfall events, but because they accumulate runoff, they tend to be slightly more mesic in this otherwise xeric landscape. Soils are various upland soils (but not Bottomland ecological site types). These are sometimes mapped specifically as Ramadero Ecological Site. These woodlands are found along drainages (locally known as ramaderos) that are extremely flashy and are infrequently and briefly flooded during local rain events. The soils are typically clay loams or sandy clay loams
Vegetation: Moisture accumulation due to the topographic position of these woodlands promotes the development of a closed canopy (relative to the surrounding landscape) from 5 to 10 m in height. The overstory canopy is typically dominated by species such as *Prosopis glandulosa, Acacia farnesiana, Celtis pallida (= Celtis ehrenbergiana)*, and/or *Parkinsonia aculeata*. In addition, *Celtis laevigata* and/or *Ebenopsis ebano* may also be present in the canopy. Some sites have a relatively open subcanopy, but more commonly the shrub layer is thick, sometimes impenetrable, and varies in height from 1 to 5 m (Elliott 2011). Species commonly encountered in the shrub layer include *Aloysia gratissima, Phaulothamnus spinescens, Celtis pallida, Condalia hookeri, Forestiera angustifolia, Diospyros texana, Ziziphus obtusifolia, Koeberlinia spinosa, Malpighia glabra, Zanthoxylum fagara, Opuntia engelmannii var. lindheimeri, Guajacum angustifolium, Colubrina texensis*, and *Amyris texana*. Ground cover can be sparse or, in more open stands, may have a fairly continuous grassy cover. Species encountered in the herbaceous layer include *Clematis drummondii, Parietaria pensylvanica, Salvia coccinea, Calyptocarpus vialis, Rivina humilis, Malvastrum americanum, Ruellia* sp., and *Verbesina microptera*. Grasses include *Chloris pluriflora (= Trichloris pluriflora), Bothriochloa barbinodis, Bouteloua curtipendula, Setaria scheelei, Setaria vulpiseta (= Setaria macrostachya), Setaria leucopila, Chloris cucullata, Digitaria californica, Pappophorum bicolor, Bouteloua trifida, Buchloe dactyloides (= Bouteloua dactyloides),* and *Hilaria belangeri*. The introduced grasses *Pennisetum ciliare, Urochloa maxima,* and *Cynodon dactylon* often dominate these sites, sometimes to the near exclusion of other herbaceous cover (Elliott 2011). This system may merge downstream with Tamaulipan Floodplain (CES301.990).
Dynamics: Intermittent fluvial processes define this system, which are often associated with rapid sheet and gully flow that scours

the channel bottoms.

Component Associations:
- *Acacia farnesiana - (Prosopis glandulosa)* Woodland (CEGL002131, G5)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Tamaulipan Floodplain (CES301.990)

Adjacent Ecological System Comments: This system may merge downstream with Tamaulipan Floodplain (CES301.990).

DISTRIBUTION

Range: This system occurs in southern Texas and adjacent Mexico.
Divisions: 301:C
Nations: MX, US
Subnations: MXCO(MX), MXNU(MX), MXTM(MX), TX
Map Zones: 36:C
USFS Ecomap Regions: 315E:CC
TNC Ecoregions: 30:C

SOURCES

References: Comer et al. 2003, Elliott 2011, Jahrsdoerfer and Leslie 1988
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722713#references
Description Author: L. Elliott
Version: 25 Feb 2011 **Stakeholders:** Latin America, Southeast
Concept Author: NatureServe Western Ecology Team **ClassifResp:** Southeast

WEST GULF COASTAL PLAIN LARGE RIVER FLOODPLAIN FOREST (CES203.488)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Forest and Woodland (Treed); West Gulf Coastal Plain; Riverine / Alluvial [Brownwater]; Broad-Leaved Deciduous Tree
National Mapping Codes: ESLF 9197

CONCEPT

Summary: This system represents a geographic subset of Kuchler's (1964) Southern Floodplain Forest found west of the Mississippi River. Examples may be found along large rivers of the West Gulf Coastal Plain and Upper West Gulf Coastal Plain, especially the Trinity, Neches, Sabine, and others. Several distinct plant communities can be recognized within this system that may be related to the array of different geomorphic features present within the floodplain. Some of the major geomorphic features associated with different community types include natural levees, point bars, meander scrolls, oxbows, and sloughs. Vegetation generally includes forests dominated by bottomland hardwood species and other trees tolerant of flooding, including bald-cypress and water tupelo. Some other trees which may be associated with examples of this system include *Acer rubrum var. drummondii, Betula nigra, Carya aquatica, Celtis laevigata, Fraxinus pennsylvanica, Liquidambar styraciflua, Platanus occidentalis, Gleditsia aquatica, Nyssa aquatica, Nyssa biflora, Pinus taeda, Populus deltoides, Quercus laurifolia, Quercus lyrata, Quercus michauxii, Quercus nigra, Quercus pagoda, Quercus phellos, Quercus similis, Quercus texana, Salix nigra, Ulmus americana*, and *Ulmus crassifolia*. Smaller areas of herbaceous- and shrub-dominated vegetation may also be present in certain areas. Shrubs and small trees include *Alnus serrulata, Arundinaria gigantea, Carpinus caroliniana, Cephalanthus occidentalis, Clethra alnifolia, Cornus foemina, Crataegus viridis, Forestiera acuminata, Ilex decidua, Itea virginica, Morella cerifera, Planera aquatica, Sabal minor*, and *Sebastiania fruticosa*. Vines may include *Berchemia scandens* and *Smilax bona-nox*. Herbaceous species may include *Boehmeria cylindrica, Carex complanata, Carex debilis, Carex intumescens, Carex joorii, Leersia virginica, Lycopus virginicus, Mikania scandens, Saccharum baldwinii*, and *Typha latifolia*. Aquatic and floating herbs include *Lemna minor, Nelumbo lutea, Nuphar advena (= Nuphar lutea ssp. advena)*, and *Nymphaea odorata*.

Classification Comments: It is unclear to what system the Brazos and Colorado rivers belong. A new system is apparently required to accommodate these and other rivers in the Coastal Plain south and west of Galveston Bay. Or would they go into West Gulf Coastal Plain Near-Coast Large River Swamp (CES203.459)?

Similar Ecological Systems:
- Red River Large Floodplain Forest (CES203.065)
- West Gulf Coastal Plain Small Stream and River Forest (CES203.487)

Related Concepts:
- Baldcypress - Tupelo: 102 (Eyre 1980) Finer
- Baldcypress: 101 (Eyre 1980) Finer
- Black Willow: 95 (Eyre 1980) Finer
- Cottonwood: 63 (Eyre 1980) Finer
- Floodplain Hardwood Forest (Marks and Harcombe 1981) Finer
- Overcup Oak - Water Hickory: 96 (Eyre 1980) Finer
- Pineywoods: Bottomland Baldcypress Swamp (4924) [CES203.448.24] (Elliott 2011) Finer
- Pineywoods: Bottomland Deciduous Successional Shrubland (4906) [CES203.448.6] (Elliott 2011) Finer
- Pineywoods: Bottomland Evergreen Successional Shrubland (4905) [CES203.448.5] (Elliott 2011) Finer
- Pineywoods: Bottomland Herbaceous Wetland (4907) [CES203.448.7] (Elliott 2011) Finer
- Pineywoods: Bottomland Seasonally Flooded Hardwood Forest (4914) [CES203.448.14] (Elliott 2011) Finer
- Pineywoods: Bottomland Temporarily Flooded Hardwood Forest (4904) [CES203.448.4] (Elliott 2011) Finer
- Pineywoods: Bottomland Temporarily Flooded Live Oak Forest (4902) [CES203.488.2] (Elliott 2011) Finer
- Pineywoods: Bottomland Temporarily Flooded Mixed Pine / Hardwood Forest (4903) [CES203.448.3] (Elliott 2011) Finer
- Pineywoods: Bottomland Wet Prairie (4917) [CES203.448.17] (Elliott 2011) Finer
- River Birch - Sycamore: 61 (Eyre 1980) Finer
- Sugarberry - American Elm - Green Ash: 93 (Eyre 1980) Finer
- Swamp Chestnut Oak - Cherrybark Oak: 91 (Eyre 1980) Finer
- Swamp Cypress Tupelo Forest (Marks and Harcombe 1981) Finer
- Sweetbay - Swamp Tupelo - Redbay: 104 (Eyre 1980) Finer
- Sweetgum - Willow Oak: 92 (Eyre 1980) Finer
- Sycamore - Sweetgum - American Elm: 94 (Eyre 1980) Finer
- Water Tupelo - Swamp Tupelo: 103 (Eyre 1980) Finer
- Willow Oak - Water Oak - Diamondleaf (Laurel) Oak: 88 (Eyre 1980) Finer

DESCRIPTION

Environment: Some of the major geomorphic features associated with different community types within this system include natural levees, point bars, meander scrolls, oxbows, and sloughs (Sharitz and Mitsch 1993). This system typically occupies Quaternary Alluvial geology along major rivers including the Trinity (downstream of Cobb Creek), Neches, Angelina, Sabine, Sulphur, and San Jacinto, and a few of their major tributaries. Landforms include broad floodplains with significant development of bottomland soils. These areas include an array of local geomorphic features such as natural levees, point bars, meander scrolls, oxbows, terraces, and sloughs. This system occupies soils of various textures derived from alluvial processes of the associated rivers. The hydrology of these soils is variable, including temporary, seasonal, and semipermanent flooding regimes.

Vegetation: This system is typically represented by forests that vary relative to the flooding regime, which is often controlled by local topographic variation and proximity to a river. Swamps are typically represented by forests of *Taxodium distichum*, with other species such as *Nyssa aquatica*, *Gleditsia aquatica*, and *Carya aquatica* also present. Some semipermanently flooded sites may also be dominated by *Planera aquatica*. Floating aquatics, such as *Lemna minor*, *Potamogeton* spp., *Ceratophyllum demersum*, and *Nymphaea odorata*, may also be present at those sites. *Quercus lyrata* is characteristic of seasonally flooded bottomlands, but numerous other species are also important components of the canopy, including *Taxodium distichum, Quercus phellos, Fraxinus pennsylvanica, Liquidambar styraciflua, Nyssa biflora, Fraxinus caroliniana*, and *Quercus similis*. Commonly encountered, and sometimes dominant, species of temporarily flooded sites include *Liquidambar styraciflua, Quercus nigra*, and *Fraxinus pennsylvanica*. Numerous other species, such as *Quercus laurifolia, Quercus michauxii, Quercus pagoda, Quercus phellos, Quercus texana, Celtis laevigata, Acer rubrum var. drummondii, Ulmus crassifolia, Ulmus americana*, and *Carya illinoinensis*, may also be important components of the canopy. *Platanus occidentalis, Populus deltoides, Betula nigra*, and *Salix nigra* are more conspicuous as early-successional species along the riverfront. Understory and shrub cover is variable but is typically relatively low, particularly in more frequently flooded sites and sites with significant overstory canopy. The understory may have small individuals of the overstory, as well as species such as *Alnus serrulata, Arundinaria gigantea, Carpinus caroliniana, Ilex decidua, Ilex opaca, Callicarpa americana, Crataegus viridis, Crataegus marshallii, Crataegus opaca, Styrax americanus, Sebastiania fruticosa (= Ditrysinia fruticosa), Sambucus canadensis (= Sambucus nigra ssp. canadensis), Clethra alnifolia, Cornus foemina, Forestiera acuminata, Ilex decidua, Itea virginica, Morella cerifera*, and/or *Sabal minor*. Where the overstory canopy is open, *Planera aquatica, Cephalanthus occidentalis*, or *Forestiera acuminata* may form dense stands. Woody vines that may be encountered include *Berchemia scandens, Smilax bona-nox, Vitis rotundifolia, Toxicodendron radicans*, and *Campsis radicans*. Herbaceous species may include *Boehmeria cylindrica, Saururus cernuus, Saccharum baldwinii, Elymus virginicus, Onoclea sensibilis, Carex cherokeensis, Carex complanata, Carex intumescens, Carex joorii, Carex debilis*, other *Carex* species, *Chasmanthium latifolium, Chasmanthium sessiliflorum, Justicia ovata, Bidens aristosa, Panicum hemitomon, Leersia virginica, Lycopus virginicus, Mikania scandens, Saccharum baldwinii, Typha latifolia*, and numerous others. *Pinus taeda* may be found, particularly on some better-drained sites and where it has been planted. *Triadica sebifera* sometimes invades this system. Aquatic and floating herbs include *Lemna minor, Nelumbo lutea, Nuphar advena (= Nuphar lutea ssp. advena)*, and *Nymphaea odorata*.

Component Associations:

- *Arundinaria gigantea ssp. gigantea* Shrubland (CEGL003836, G2?)
- *Betula nigra - Liquidambar styraciflua - Platanus occidentalis - Quercus nigra* Forest (CEGL007898, G4Q)
- *Betula nigra - Platanus occidentalis / Alnus serrulata / Boehmeria cylindrica* Forest (CEGL007312, G4G5)
- *Forestiera acuminata - (Planera aquatica, Cephalanthus occidentalis)* Shrubland (CEGL003911, G3?)
- *Fraxinus pennsylvanica - Ulmus americana - Celtis laevigata / Ilex decidua* Forest (CEGL002427, G4G5)
- *Gleditsia aquatica - Carya aquatica* Forest (CEGL007426, G3?)
- *Nelumbo lutea* Herbaceous Vegetation (CEGL004323, G4?)
- *Nuphar advena - Nymphaea odorata* Herbaceous Vegetation (CEGL002386, G4G5)
- *Nyssa aquatica - Nyssa biflora* Forest (CEGL007429, G4G5)
- *Nyssa aquatica* Forest (CEGL002419, G4G5)
- *Planera aquatica* Forest (CEGL007394, G4?)
- *Platanus occidentalis - Liquidambar styraciflua - (Ulmus americana) / (Crataegus viridis)* Forest (CEGL007335, G3G4)
- *Populus deltoides - Salix nigra / Ilex vomitoria* Forest (CEGL004613, G3?)
- *Populus deltoides - Salix nigra / Mikania scandens* Forest (CEGL007346, G4G5)
- *Quercus laurifolia - Liquidambar styraciflua - Nyssa biflora - Acer rubrum / Sabal minor* Forest (CEGL007804, G3?)
- *Quercus laurifolia - Quercus (lyrata, phellos) - Nyssa biflora* West Gulf Floodplain Forest (CEGL003854, G3?)
- *Quercus lyrata - Carya aquatica - (Quercus texana) / Forestiera acuminata* Forest (CEGL002423, G3?)
- *Quercus lyrata - Liquidambar styraciflua / Forestiera acuminata* Forest (CEGL002424, G4?)
- *Quercus michauxii - Liquidambar styraciflua - Quercus texana - Quercus lyrata* Forest (CEGL007906, G3G4)
- *Quercus nigra - Liquidambar styraciflua - (Pinus taeda) / Ilex opaca - Vaccinium fuscatum / Carex debilis* Temporarily Flooded Forest (CEGL007984, G4?)
- *Quercus nigra - Quercus phellos - (Pinus taeda) / Crataegus marshallii / Smilax smallii* Forest (CEGL007985, G5)
- *Quercus pagoda / Ulmus crassifolia - Celtis laevigata / Carex cherokeensis* Forest (CEGL007952, G2G3)
- *Quercus palustris - (Quercus lyrata) - Fraxinus pennsylvanica / Acer rubrum var. drummondii / Carex* spp. Forest (CEGL008597, G3?)
- *Quercus phellos - (Quercus lyrata) / Carex joorii - Saccharum baldwinii* Floodplain Forest (CEGL008469, G2G3)
- *Quercus phellos - (Quercus similis) - Ulmus crassifolia* Forest (CEGL007921, G3G4)

- *Quercus phellos - Liquidambar styraciflua / Ilex decidua - Carpinus caroliniana / Lysimachia radicans* Forest (CEGL007370, G3?)
- *Quercus phellos - Quercus nigra / Sabal minor - Sebastiania fruticosa* Forest (CEGL007869, G2G3)
- *Quercus texana - Celtis laevigata - Ulmus (americana, crassifolia) - (Gleditsia triacanthos)* Forest (CEGL004619, G4G5)
- *Salix nigra* Large River Floodplain Forest (CEGL007410, G3G5)
- *Taxodium distichum - (Nyssa aquatica) / Forestiera acuminata - Planera aquatica* Forest (CEGL002421, G3G5)
- *Taxodium distichum - Nyssa aquatica - Acer rubrum / Itea virginica* Forest (CEGL007422, G4?)
- *Taxodium distichum / Lemna minor* Forest (CEGL002420, G4G5)
- *Taxodium distichum* West Gulf Coastal Plain Lakeshore Woodland (CEGL008497, G2G3)
- *Typha latifolia* Southern Herbaceous Vegetation (CEGL004150, G5)

DISTRIBUTION

Range: This system occurs along large rivers of the West and Upper West Gulf coastal plains, especially the Trinity, Neches, Sabine, and others, as well as the portion of the Red River represented by Keys et al. (1995) (231Em) at the Oklahoma-Texas border.
Divisions: 203:C
Nations: US
Subnations: AR, LA, OK, TX
Map Zones: 37:C, 44:C, 98:C
TNC Ecoregions: 31:C, 40:C, 41:C

SOURCES

References: Comer et al. 2003, Elliott 2011, Eyre 1980, Keys et al. 1995, Kuchler 1964, Marks and Harcombe 1981, Sharitz and Mitsch 1993
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723098#references
Description Author: R. Evans and T. Foti, mod. M. Pyne and L. Elliott
Version: 17 Feb 2011 **Stakeholders:** Midwest, Southeast
Concept Author: R. Evans and T. Foti **ClassifResp:** Southeast

WEST GULF COASTAL PLAIN NEAR-COAST LARGE RIVER SWAMP (CES203.459)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: West Gulf Coastal Plain; Riverine / Alluvial; Tidal / Estuarine
Non-Diagnostic Classifiers: Forest and Woodland (Treed)
National Mapping Codes: ESLF 9314

CONCEPT

Summary: These swamp forests are found along rivers flowing through the Gulf Coast Prairies and Marshes region of the Outer Coastal Plain of western Louisiana and adjacent Texas. Included are areas where the rivers enter bays and estuaries along the northern Gulf of Mexico that are somewhat tidally influenced. This is restricted to Vermillion Bay in Louisiana west to and including Galveston Bay and Trinity Bay in Texas. Stands of vegetation included in this system are typically dominated by *Taxodium distichum, Nyssa aquatica*, or perhaps a combination of these species. These are forested areas in an area primarily dominated by marshes. Other species are usually more minor components of the canopy, including *Fraxinus pennsylvanica, Acer negundo*, and the exotic tree *Triadica sebifera*. These swamps are typically interspersed with marshes of the coastal region.

Related Concepts:
- Baldcypress: 101 (Eyre 1980) Finer
- Gulf Coast: Near-Coast Baldcypress Swamp (5004) [CES203.459] (Elliott 2011) Equivalent
- Water Tupelo - Swamp Tupelo: 103 (Eyre 1980) Finer

DESCRIPTION

Environment: The environment of this system consists of rivers flowing through the Gulf Coast Prairies and Marshes ecoregion of the Outer Coastal Plain of western Louisiana and adjacent Texas. This includes somewhat tidally-influenced areas where the rivers enter bays and estuaries along the northern Gulf of Mexico. The geological substrate consists of Quaternary alluvium deposited within the Beaumont/Deweyville surfaces. Landforms include the large river floodplains of the Sabine, Neches, and Trinity rivers near the coast, often with some tidal influence. Typical soils include bottomland soils of the near-coast region. Stands are generally distributed downstream of Interstate Highway 10 (a coincidental landmark for the distribution of this system). On the Neches River, this is nearly coincident with the area downstream of the confluence with Pine Island Bayou (Elliott 2011).

Vegetation: Stands of vegetation included in this system are typically dominated by *Taxodium distichum, Nyssa aquatica*, or perhaps a combination of these species. These are forested areas in an area primarily dominated by marshes. Other species are usually more minor components of the canopy, including *Fraxinus pennsylvanica, Acer negundo*, and the exotic tree *Triadica sebifera*. These swamps are typically interspersed with marshes of the coastal region (Elliott 2011).

Component Associations:
- *Taxodium distichum / Lemna minor* Forest (CEGL002420, G4G5)

DISTRIBUTION

Range: This system is found along rivers flowing through the Gulf Coast Prairies and Marshes (TNC Ecoregion 31) of the Outer Coastal Plain of western Louisiana and adjacent Texas. This is restricted to EPA 34g (Texas-Louisiana Coastal Marshes) from Vermillion Bay in Louisiana west to, and including Galveston Bay and Trinity Bay in Texas (EPA 2004).
Divisions: 203:C
Nations: US
Subnations: LA, TX
Map Zones: 36:C, 37:C, 98:C
USFS Ecomap Regions: 232E:CC, 255D:CC
TNC Ecoregions: 31:C

SOURCES

References: Comer et al. 2003, Elliott 2011, EPA 2004, Eyre 1980
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723127#references
Description Author: J. Teague and R. Evans, mod. M. Pyne and L. Elliott
Version: 17 Feb 2011
Concept Author: J. Teague and R. Evans
Stakeholders: Southeast
ClassifResp: Southeast

WEST GULF COASTAL PLAIN NONRIVERINE WET HARDWOOD FLATWOODS (CES203.548)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Forest and Woodland (Treed); West Gulf Coastal Plain; Hardpan; Depressional; Silt Soil Texture
Non-Diagnostic Classifiers: Isolated Wetland [Partially Isolated]
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: EVT 2506; ESLF 9350; ESP 1506

CONCEPT

Summary: This ecological system represents predominantly wet hardwood flatwoods of the West Gulf Coastal Plain of southern Arkansas, eastern Texas, and western Louisiana. Examples may be somewhat more common in the inland portions of the region but are also found in the Outer Coastal Plain as well. These areas are usually found on Pleistocene high terraces (EPA Ecoregion 35c) primarily associated with the Red and Mississippi rivers that are located above the current floodplain. The hydrology is controlled by local rainfall events and not by overbank flooding. Soils are fine-textured, and hardpans may be present in the subsurface. The limited permeability of these soils contributes to perched water tables during fairly substantial portions of the year (when precipitation is greatest and evapotranspiration is lowest). Saturation occurs not from overbank flooding but typically whenever precipitation events occur. The local landscape is often a complex of ridges and swales, usually occurring in close proximity. There is vegetation variability related to soil texture and moisture and disturbance history. Most examples support hardwood forests or swamps, which are often heavily oak-dominated. Important species are tolerant of inundation. They include *Quercus michauxii, Quercus phellos, Quercus laurifolia*, and *Liquidambar styraciflua*, with sparse coverage of wetland herbs such as *Carex glaucescens*. Some swales support unusual pockets of *Fraxinus caroliniana* and *Crataegus* spp. Some examples can contain *Pinus taeda*.
Classification Comments: This system may grade upslope into West Gulf Coastal Plain Pine-Hardwood Flatwoods (CES203.278) and down into West Gulf Coastal Plain Flatwoods Pond (CES203.547). Apparently, this system occurs within the historic range of longleaf pine [see USFS ecomap attributions]. Within this range, more information is needed to identify the toposequence between longleaf pine-dominated flatwoods/savannas/uplands and hardwood/loblolly-dominated flatwoods. The distribution of this system in the South Central Plains Flatwoods and Southern Tertiary Uplands (EPA 35e and f) needs to be better defined.
Similar Ecological Systems:
- Interior Highlands Unglaciated Flatwoods (CES202.454)
- Lower Mississippi River Flatwoods (CES203.193)
- West Gulf Coastal Plain Flatwoods Pond (CES203.547)
- West Gulf Coastal Plain Pine-Hardwood Flatwoods (CES203.278)

Related Concepts:
- Baldcypress - Tupelo: 102 (Eyre 1980) Finer
- Flatland Hardwood Forest (Marks and Harcombe 1981) Undetermined
- Pineywoods: Wet Hardwood Flatwoods (3704) [CES203.548] (Elliott 2011) Equivalent
- Sweetgum - Willow Oak: 92 (Eyre 1980) Finer
- Water Tupelo - Swamp Tupelo: 103 (Eyre 1980) Finer
- Willow Oak - Water Oak - Diamondleaf (Laurel) Oak: 88 (Eyre 1980) Finer

DESCRIPTION

Environment: This system is found on the wettest inclusions of Pleistocene terraces in the West Gulf Coastal Plain of southern Arkansas, eastern Texas, and western Louisiana. The geology of this system is similar to that of West Gulf Coastal Plain Pine-Hardwood Flatwoods (CES203.278), being associated with high Pleistocene terraces of the Lissie and upper Beaumont formations, as well as the Quaternary Fluviatile Terrace Deposits to the north. In terms of landforms, this system represents the lowest topographic position within the level to very gently undulating terraces occupied by flatwoods. Hydrology is controlled by local rainfall, not overbank flooding of nearby streams. Soils are fine-textured, with an impermeable subsurface horizon, which leads to a perched water table. Because of the lower topographic position of these flatwoods, saturated soil conditions tend to occur over extended periods of the year (Elliott 2011).
Vegetation: This system represents the wetter end of the wooded toposequence of the flatwoods and occurs within low positions of swales and other wet circumstances. Stands are closed-canopy forests, typically dominated by deciduous hardwoods, including *Quercus michauxii*. Important species are tolerant of inundation. The canopy is often dominated by *Quercus phellos, Quercus laurifolia, Quercus lyrata, Quercus nigra, Quercus michauxii, Ulmus alata*, and *Liquidambar styraciflua*. *Pinus taeda* may be present in the canopy. *Triadica sebifera* is a commonly encountered non-native species invading this system. The understory and herbaceous layers of this system are not well-developed, as the canopy tends to be closed (Elliott 2011). There is sparse coverage of wetland herbs such as *Carex glaucescens*. Some swales support unusual pockets of *Fraxinus caroliniana* and *Crataegus* spp. Some examples can contain *Pinus taeda*.

Dynamics: The predominant ecological processes affecting this system are related to soil texture and moisture and disturbance history. These are wetlands that hold standing water for variable periods during the year after rainfall events. The wettest examples were likely not affected to a large degree by fires; however, they are often embedded in pyrogenic landscapes which did burn frequently (R. Evans pers. obs., T. Foti pers. comm.). The difference in the dynamics between this system and the "non-wet" (dry-mesic, xero-hydric) flatwoods of the region (CES203.278) is their different structure: the wetter type occurs as a closed forest, the dry/mesic one as a more open forest or woodland (with an open canopy, a full herbaceous expression, and few shrubs). The fire regime is different as well: the xero-hydric type is short-interval, low-intensity, low-severity versus medium- to long-interval, low-intensity, high-severity for the wet one (D. Zollner pers. comm. 2006).

Component Associations:
- *(Quercus laurifolia) / Crataegus opaca - Crataegus viridis* Forest (CEGL007386, G1)
- *Fraxinus caroliniana* Seasonally Flooded Forest (CEGL004753, G2G3)
- *Nyssa biflora - Quercus laurifolia / Sphagnum* spp. Depression Forest (CEGL007390, G3?)
- *Quercus laurifolia - Liquidambar styraciflua - Nyssa biflora - Acer rubrum / Sabal minor* Forest (CEGL007804, G3?)
- *Quercus laurifolia - Quercus phellos - Quercus nigra / Viburnum dentatum - (Sebastiania fruticosa) / Carex glaucescens* Upper West Gulf Flatwoods Forest (CEGL007961, G2G3)
- *Quercus lyrata - Quercus phellos - Ulmus americana / Rhynchospora* spp. Forest (CEGL007549, G2G3)
- *Quercus phellos - Quercus similis / Crataegus marshallii - Crataegus spathulata / Chasmanthium laxum* Forest (CEGL007363, G3?)
- *Quercus phellos / Chasmanthium laxum - Carex (flaccosperma, intumescens) - Hymenocallis liriosme* Flatwoods Forest (CEGL007371, G3G4)
- *Quercus phellos / Chasmanthium laxum* Forest (CEGL008576, G3?)
- *Taxodium distichum - Nyssa biflora - Magnolia virginiana - Acer rubrum* Forest (CEGL007902, G2?)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Red River Large Floodplain Forest (CES203.065)
- West Gulf Coastal Plain Flatwoods Pond (CES203.547)
- West Gulf Coastal Plain Pine-Hardwood Flatwoods (CES203.278)

Adjacent Ecological System Comments: This system may grade upslope into West Gulf Coastal Plain Pine-Hardwood Flatwoods (CES203.278) and down into West Gulf Coastal Plain Flatwoods Pond (CES203.547).

DISTRIBUTION

Range: This system is found in the West Gulf Coastal Plain, Upper West Gulf Coastal Plain, and Mississippi River Alluvial Plain (P. Faulkner pers. comm.).
Divisions: 203:C
Nations: US
Subnations: AR, LA, TX
Map Zones: 36:?, 37:C, 44:C, 45:C, 98:C
USFS Ecomap Regions: 231E:CC, 232F:CC
TNC Ecoregions: 31:?, 40:C, 41:C, 42:C

SOURCES

References: Comer et al. 2003, Elliott 2011, Evans, R. pers. comm., Eyre 1980, Foti pers. comm., Marks and Harcombe 1981, Zollner pers. comm.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723054#references
Description Author: R. Evans, mod. M. Pyne, J. Teague, L. Elliott
Version: 17 Feb 2011 **Stakeholders:** Midwest, Southeast
Concept Author: R. Evans **ClassifResp:** Southeast

WEST GULF COASTAL PLAIN SEEPAGE SWAMP AND BAYGALL (CES203.372)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: West Gulf Coastal Plain; Seepage-Fed Sloping; Broad-Leaved Tree
Non-Diagnostic Classifiers: Shrubland (Shrub-dominated)
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Mixed evergreen-deciduous open tree canopy
National Mapping Codes: EVT 2462; ESLF 9131; ESP 1462

CONCEPT

Summary: This West Gulf Coastal Plain ecological system consists of forested wetlands (often densely wooded) in acidic, seepage influenced wetland habitats. These wetlands may occur in poorly developed upland drainages, toeslopes, and small headwaters stream bottoms. These environments are prone to long duration standing water, and tend to have highly acidic, nutrient-poor soils. The vegetation is characterized by an overstory of *Magnolia virginiana, Nyssa sylvatica, Nyssa biflora,* and *Acer rubrum,* although there is some variation according to latitude. Understory vegetation throughout the region consistently supports the vines *Smilax laurifolia* and *Smilax walteri*, and a dense abundance of ferns, such as *Osmunda cinnamomea, Osmunda regalis var. spectabilis*, and *Woodwardia areolata*. In most cases, these wetlands are embedded in uplands with deep sandy soils, recharge areas for this wetland system. When these communities are associated with streams, they tend to be low gradient, with narrow, often braided channels and diffuse drainage patterns. Due to excessive wetness, these habitats are normally protected from fire except those which occur during extreme droughty periods. The limited examples in Oklahoma are somewhat depauperate and lack some of the more southern and eastern taxa (e.g., *Magnolia virginiana, Nyssa biflora*).

Related Concepts:

- Bay-Gallberry Holly Bogs (Ajilvsgi 1979) Equivalent
- Oklahoma Acid Hillside Seep (Hoagland 2000) Equivalent
- Pineywoods: Seepage Swamp and Baygall (3604) [CES203.372] (Elliott 2011) Equivalent
- Sweetbay - Swamp Tupelo - Redbay: 104 (Eyre 1980) Finer
- Sweetgum - Willow Oak: 92 (Eyre 1980) Finer
- Wetland Baygall Shrub Thicket (Marks and Harcombe 1981) Equivalent
- Willow Oak - Water Oak - Diamondleaf (Laurel) Oak: 88 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs on saturated soils associated with springs and seepage flow in a variety of landscape positions. In the Outer Coastal Plain, these settings tend to be low landscape positions typically along low-gradient creeks, headwaters of drainages, or local depressions (Elliott 2011). The low-gradient creek channels tend to be highly meandering, often with multiple channels and extremely shallow banks. Nixon et al. (1983a) measured stream depths of 0.3-0.6 m and widths of less than 1 m in a study of this system. Inner Coastal Plain examples tend to be embedded within deep sandy slopes and uplands, and may also occur in association with flatwoods drainages (Martin et al. 1990, Martin and Smith 1991, Smith 1996a, Singhurst pers. comm. 2013). It may occur on a range of geological formations, including intermediate to high Pleistocene terraces, Eocene sands, the Catahoula Formation, and the Wilcox Formation. Soils are typically sandy to loamy soils, often with an impermeable subsurface layer that restricts water percolation. These sites are typically semipermanently saturated. These are typically soils of medium to strong acidity, with low available nutrients and significant organic accumulation (Elliott 2011). The deep, poorly drained, strongly acidic, loamy fine sand soils have high organic matter content (Brooks et al. 1993). Van Kley (1999a) indicates that these habitats, sometimes mapped as the Betis soil series and Guyton soil complex, are notably low in calcium and magnesium. Soils of other examples may be mapped as Lovelady (Arenic Glossudalf), Rentzel (Arenic Plinthaquic Paleudult), Corrigan (Typic Albaqualf), Melhomes (Humaqueptic Psammaquent), and Osier (Typic Psammaquent). This system is known from the Pleistocene Terraces and Tertiary uplands in Louisiana, Texas, Arkansas and to a limited extent in Oklahoma. Geologic formations where this system occurs include: Bentley (Intermediate Pleistocene Terraces), Willis (High Pleistocene Terraces), Fleming (Miocene), Catahoula (Oligocene), Cockfield (Eocene), Sparta (Eocene), Carrizo (Eocene), Wilcox (Eocene), Queen City (Eocene) and possibly the Vicksburg (Oligocene) and other formations.

Vegetation: Examples of this system are characterized by overstory species such as *Magnolia virginiana, Nyssa biflora*, and *Acer rubrum*. Other species in the overstory may include *Fraxinus pennsylvanica, Quercus nigra, Liquidambar styraciflua,* and *Quercus laurifolia*. A well-developed woody understory is often present and includes species such as *Morella caroliniensis, Itea virginica, Persea palustris, Rhododendron prinophyllum, Rhododendron canescens, Ilex decidua, Vaccinium fuscatum, Ilex opaca, Toxicodendron vernix, Viburnum nudum, Morella cerifera, Alnus serrulata, Smilax laurifolia*, and *Vitis rotundifolia*. There is some variation with latitude. Southerly examples generally consist of broad-leaved evergreen forests, while more northerly examples support more mixed evergreen-deciduous forests. In addition, evergreen species are especially pronounced in the shrub layer of southern examples. Southern expressions of the type are more likely to have *Ilex coriacea* and/or *Cyrilla racemiflora*. The herbaceous

layer is often dominated by ferns such as *Woodwardia areolata, Osmunda regalis, Osmunda cinnamomea,* and *Athyrium filix-femina*. *Carex* spp., *Rhynchospora* spp., and *Eleocharis* spp. are also frequently encountered. *Sphagnum* occurs in patches throughout, and other bryophytes are common. The rare species *Bartonia texana* may be encountered in this system, along with other interesting forbs such as *Burmannia biflora* and *Apteria aphylla* (Elliott 2011).
Dynamics: This system is maintained by groundwater seepage. Soils have high available water capacity and surface runoff is very slow to ponded. This ecological system is embedded within fire-maintained systems. The role of fire in this system was probably minimal except during droughts or in narrow occurrences where fire may have maintained an example of this system dominated by *Arundinaria gigantea*.

Component Associations:
- *(Magnolia virginiana) / Ilex coriacea - Morella caroliniensis* Shrubland (CEGL003530, G3?)
- *Acer rubrum (var. drummondii) - Nyssa* spp. - *Liquidambar styraciflua - Quercus nigra / Osmunda* spp. Saturated Forest (CEGL007982, G3?)
- *Dichanthelium scoparium - Boehmeria cylindrica / Sphagnum* spp. - *Polytrichum commune* Herbaceous Vegetation (CEGL004916, G2Q)
- *Magnolia virginiana - Nyssa (biflora, sylvatica) - Acer rubrum / Morella caroliniensis / Woodwardia areolata* Forest (CEGL007904, G3?)
- *Nyssa (biflora, sylvatica) - Magnolia virginiana - Quercus laurifolia / Cyrilla racemiflora - Ilex coriacea - Rhododendron oblongifolium* Forest (CEGL007474, G3?)
- *Quercus laurifolia - (Quercus nigra, Nyssa biflora) / Diospyros virginiana* Forest (CEGL007871, G3?)
- *Viburnum nudum var. nudum - Morella cerifera - Smilax laurifolia* Shrubland (CEGL007874, G1?)

DISTRIBUTION

Range: This system is restricted to eastern Texas, western Louisiana, southern Arkansas, and extreme southeastern Oklahoma.
Divisions: 203:C
Nations: US
Subnations: AR, LA, OK, TX
Map Zones: 37:C, 44:P, 98:C
USFS Ecomap Regions: 231E:CC, 232F:CC, 234C:PP, 234E:PP
TNC Ecoregions: 40:C, 41:C

SOURCES

References: Ajilvsgi 1979, Brooks et al. 1993, Comer et al. 2003, Elliott 2011, Eyre 1980, Hoagland 2000, LDWF 2005, Marks and Harcombe 1981, Martin and Smith 1991, Nixon et al. 1983a, Smith 1996a, Soil Conservation Service 1990, Van Kley 1999a
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723144#references
Description Author: R. Evans, mod. M. Pyne, J. Teague, L. Elliott
Version: 14 Jan 2014 **Stakeholders:** Midwest, Southeast
Concept Author: R. Evans **ClassifResp:** Southeast

WEST GULF COASTAL PLAIN SMALL STREAM AND RIVER FOREST (CES203.487)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Intermittent Flooding; Forest and Woodland (Treed); West Gulf Coastal Plain; Riverine / Alluvial
National Mapping Codes: ESLF 9196

CONCEPT

Summary: This is a predominantly forested system of the West Gulf Coastal Plain associated with small rivers and creeks. In contrast to West Gulf Coastal Plain Large River Floodplain Forest (CES203.488), examples of this system have fewer major geomorphic floodplain features. Those features that are present tend to be smaller and more closely intermixed with one another, resulting in less obvious vegetational zonation. Bottomland hardwood tree species are typically important and diagnostic, although mesic hardwood species are also present in areas with less inundation, such as upper terraces and possibly second bottoms. As a whole, flooding occurs annually, but the water table usually is well below the soil surface throughout most of the growing season. Areas impacted by beaver impoundments are also included in this system. Stands of this system are typically dominated by hardwood tree species such as *Liquidambar styraciflua, Quercus nigra, Celtis laevigata, Fraxinus pennsylvanica, Betula nigra, Quercus laurifolia, Ulmus americana, Ulmus crassifolia, Ulmus alata, Ulmus rubra, Quercus michauxii, Quercus texana, Quercus pagoda, Quercus falcata, Platanus occidentalis, Diospyros virginiana, Gleditsia triacanthos,* and *Acer rubrum*. Wetter sites tend to be dominated by more flood-tolerant species such as *Taxodium distichum, Nyssa aquatica, Gleditsia aquatica, Carya aquatica, Quercus lyrata, Quercus similis, Planera aquatica,* and *Quercus phellos*.

Similar Ecological Systems:
- Southeastern Great Plains Riparian Forest (CES205.709)
- West Gulf Coastal Plain Large River Floodplain Forest (CES203.488)

Related Concepts:
- Baldcypress: 101 (Eyre 1980) Finer
- Cottonwood: 63 (Eyre 1980) Finer
- Floodplain Hardwood Pine Forest (Marks and Harcombe 1981) Intersecting
- Loblolly Pine - Hardwood: 82 (Eyre 1980) Finer
- Loblolly Pine: 81 (Eyre 1980) Finer
- Overcup Oak - Water Hickory: 96 (Eyre 1980) Finer
- Pineywoods: Small Stream and Riparian Baldcypress Swamp (4824) [CES203.487.24] (Elliott 2011) Finer
- Pineywoods: Small Stream and Riparian Deciduous Successional Shrubland (4806) [CES203.487.6] (Elliott 2011) Finer
- Pineywoods: Small Stream and Riparian Evergreen Successional Shrubland (4805) [CES203.487.5] (Elliott 2011) Finer
- Pineywoods: Small Stream and Riparian Herbaceous Wetland (4807) [CES203.487.7] (Elliott 2011) Finer
- Pineywoods: Small Stream and Riparian Live Oak Temporarily Flooded Forest (4802) [CES203.487.2] (Elliott 2011) Finer
- Pineywoods: Small Stream and Riparian Seasonally Flooded Hardwood Forest (4814) [CES203.487.14] (Elliott 2011) Finer
- Pineywoods: Small Stream and Riparian Temporarily Flooded Hardwood Forest (4804) [CES203.487.4] (Elliott 2011) Finer
- Pineywoods: Small Stream and Riparian Temporarily Flooded Mixed Forest (4803) [CES203.487.3] (Elliott 2011) Finer
- Pineywoods: Small Stream and Riparian Wet Prairie (4817) [CES203.487.17] (Elliott 2011) Finer
- River Birch - Sycamore: 61 (Eyre 1980) Finer
- Sugarberry - American Elm - Green Ash: 93 (Eyre 1980) Finer
- Swamp Chestnut Oak - Cherrybark Oak: 91 (Eyre 1980) Finer
- Sweetgum - Willow Oak: 92 (Eyre 1980) Finer
- Willow Oak - Water Oak - Diamondleaf (Laurel) Oak: 88 (Eyre 1980) Finer

DESCRIPTION

Environment: This system is associated with small rivers and creeks in the West Gulf Coastal Plain. It largely occurs on Quaternary alluvium, but may also be found on other mapped geologic surfaces on drainages lacking significant alluvial development. This system occupies small rivers, streams, creeks, and upland drainages. These sites tend to be higher in the watershed where less depositional activity occurs. The local geomorphological variation tends to be less than in West Gulf Coastal Plain Large River Floodplain Forest (CES203.488). Soils are bottomland soils on small streams. A minority of sites are seasonally or semipermanently flooded (Elliott 2011).

Vegetation: Stands of this system are typically dominated by hardwood tree species such as *Liquidambar styraciflua, Quercus nigra, Celtis laevigata, Fraxinus pennsylvanica, Betula nigra, Quercus laurifolia, Ulmus americana, Ulmus crassifolia, Ulmus alata, Ulmus rubra, Quercus michauxii, Quercus texana, Quercus pagoda, Quercus falcata, Platanus occidentalis, Diospyros virginiana, Gleditsia triacanthos,* and *Acer rubrum*. Wetter sites tend to be dominated by more flood-tolerant species such as *Taxodium distichum, Nyssa aquatica, Gleditsia aquatica, Carya aquatica, Quercus lyrata, Quercus similis, Planera aquatica*, and *Quercus phellos*. In addition,

Pinus taeda, *Pinus elliottii*, and/or *Juniperus virginiana* may be present in the canopy, or occur as a subcanopy stratum. Rarely, *Fagus grandifolia*, *Magnolia virginiana*, *Quercus alba*, *Quercus muehlenbergii*, and/or *Pinus palustris* may appear with *Chasmanthium sessiliflorum* in mesic, upper terrace examples. Shrubs may form dense patches with species such as *Cephalanthus occidentalis* or *Planera aquatica* being typical. Other shrubs and understory trees may include (depending on length of hydroperiod) *Carpinus caroliniana*, *Ostrya virginiana*, *Cornus obliqua*, *Crataegus marshallii*, *Ilex opaca*, *Ilex decidua*, *Ilex vomitoria*, *Salix nigra*, *Morus rubra*, *Sabal minor*, *Morella cerifera*, *Callicarpa americana*, *Itea virginica*, *Alnus serrulata*, *Maclura pomifera*, and *Vaccinium fuscatum*. In addition, *Arundinaria gigantea* may be present. Woody vines may be conspicuous and may include *Berchemia scandens*, *Brunnichia ovata*, *Ampelopsis arborea*, *Smilax bona-nox*, and *Toxicodendron radicans*. Some herbs may include *Ambrosia trifida*, *Bidens aristosa*, *Boehmeria cylindrica*, *Carex cherokeensis*, *Carex debilis*, *Carex digitalis*, *Carex joorii*, *Chasmanthium latifolium*, *Chasmanthium laxum*, *Dichanthelium* spp., *Elymus virginicus*, *Geum canadense*, *Glyceria striata*, *Leersia virginica*, *Panicum virgatum*, *Paspalum floridanum*, *Polygonum hydropiperoides*, *Tripsacum dactyloides*, and *Xanthium strumarium*. Early-successional woodlands may be mapped as shrublands, due to reduced woody cover. These sites may be dominated by early-successional species such as *Salix nigra*, *Gleditsia triacanthos*, *Platanus occidentalis*, or *Ulmus alata*. Non-native woody species that may be present include *Triadica sebifera*, *Lonicera japonica*, and *Ligustrum* spp. Non-native herbs such as *Cynodon dactylon*, *Lolium perenne*, *Paspalum notatum*, and *Sorghum halepense* may be dominant in disturbed examples (Elliott 2011).

Component Associations:
- *Betula nigra - Liquidambar styraciflua - Platanus occidentalis - Quercus nigra* Forest (CEGL007898, G4Q)
- *Fagus grandifolia - Magnolia virginiana - (Pinus palustris) / Chasmanthium sessiliflorum* Sandhill Streamhead Forest (CEGL007976, G2G3)
- *Fagus grandifolia - Pinus taeda - (Liquidambar styraciflua, Magnolia grandiflora, Quercus alba)* Small Stream Forest (CEGL007320, G3)
- *Fagus grandifolia - Quercus (laurifolia, nigra) - Pinus taeda* Forest (CEGL008574, G3?)
- *Maclura pomifera - Diospyros virginiana / Glyceria striata - (Carex cherokeensis)* Woodland (CEGL007779, G2?)
- *Magnolia grandiflora - Fagus grandifolia - Quercus alba - Pinus taeda* Forest (CEGL007903, G3G4)
- *Pallavicinia lyellii - Sphagnum* sp. Nonvascular Vegetation (CEGL004779, G3)
- *Pinus taeda - Liquidambar styraciflua - Quercus (nigra, phellos) / Carpinus caroliniana - Crataegus marshallii* Stream Bottom Forest (CEGL004911, G3)
- *Pinus taeda - Quercus phellos - Quercus nigra* Forest (CEGL007910, G4)
- *Pinus taeda* Temporarily Flooded Forest (CEGL007142, G4?)
- *Populus deltoides - Salix nigra / Ilex vomitoria* Forest (CEGL004613, G3?)
- *Quercus laurifolia - Liquidambar styraciflua - Nyssa biflora - Acer rubrum / Sabal minor* Forest (CEGL007804, G3?)
- *Quercus michauxii - Quercus nigra - Pinus taeda / Carpinus caroliniana* Forest (CEGL007901, G3?)
- *Quercus muehlenbergii - Liquidambar styraciflua / (Arundinaria gigantea) / Carex cherokeensis - Chasmanthium latifolium* Mesic Riparian Forest (CEGL007780, G3?)
- *Quercus nigra - Liquidambar styraciflua - (Pinus taeda) / Ilex opaca - Vaccinium fuscatum / Carex debilis* Temporarily Flooded Forest (CEGL007984, G4?)
- *Quercus nigra - Quercus phellos / Carya myristiciformis - Sabal minor / Carex cherokeensis* Forest (CEGL007954, G2G3)
- *Quercus pagoda - Liquidambar styraciflua - Pinus taeda* Forest (CEGL007899, G3?)
- *Quercus pagoda - Quercus similis - Carya glabra - Quercus sinuata var. sinuata / Crataegus triflora* Forest (CEGL007359, G1)
- *Quercus pagoda / Ulmus crassifolia - Celtis laevigata / Carex cherokeensis* Forest (CEGL007952, G2G3)
- *Quercus texana - Quercus lyrata* Forest (CEGL007407, G3G4)
- *Taxodium distichum - Fraxinus pennsylvanica* Gallery Forest (CEGL007928, G2Q)
- *Taxodium distichum* West Gulf Coastal Plain Lakeshore Woodland (CEGL008497, G2G3)
- *Ulmus americana - Fraxinus pennsylvanica - Celtis laevigata / Glyceria striata - (Carex cherokeensis)* Riparian Blackland Woodland (CEGL007778, G1?)
- *Ulmus crassifolia - Celtis laevigata - (Ulmus rubra) / Carex digitalis - Geum canadense* Forest (CEGL007950, G2G3)

DISTRIBUTION

Range: West Gulf Coastal Plain.
Divisions: 203:C
Nations: US
Subnations: AR, LA, OK, TX
Map Zones: 36:?, 37:C, 44:C, 98:C
TNC Ecoregions: 31:P, 40:C, 41:C

SOURCES

References: Comer et al. 2003, Elliott 2011, Eyre 1980, Marks and Harcombe 1981
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723099#references
Description Author: R. Evans, mod. M. Pyne and L. Elliott
Version: 17 Feb 2011
Concept Author: R. Evans
Stakeholders: Midwest, Southeast
ClassifResp: Southeast

WEST GULF COASTAL PLAIN WET LONGLEAF PINE SAVANNA AND FLATWOODS (CES203.191)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Forest and Woodland (Treed); West Gulf Coastal Plain; Extensive Wet Flat; Very Short Disturbance Interval; Needle-Leaved Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2451; ESLF 9120; ESP 1451

CONCEPT

Summary: This system was the historical matrix vegetation of the outer (seaward) portions of the West Gulf Coastal Plain between the coastal prairies and the inner coastal plain in Louisiana and eastern Texas within the range of longleaf pine. These areas are characterized by poorly drained upland soils with high and highly fluctuating water tables. In natural condition, monospecific stands of *Pinus palustris* and species-rich herbaceous layers characterize this system. Other species in the canopy include *Quercus stellata, Quercus marilandica, Nyssa sylvatica, Quercus laurifolia, Quercus falcata*, and *Liquidambar styraciflua*. Shrubs are typically limited in distribution within the system to local topographic highs and include species such as *Morella cerifera, Ilex vomitoria, Symplocos tinctoria, Cyrilla racemiflora*, and others. Widespread alterations following European settlement, including changes to natural fire regimes, have produced drastic changes to this system, and few large examples are extant. Examples appear to be somewhat more common in western Louisiana than in eastern Texas.
Classification Comments: In Louisiana, two Natural Heritage communities (variants) of this system are recognized (Smith 1996b). These two variants are the longleaf pine flatwoods (which are mesic to dry-mesic [non-wetland] stands) and the true pine savannas which occupy poorly drained and seasonally saturated/flooded depressional areas and low flats. These two types form an interdigitated mosaic (Smith 1996b), which constitutes this system as here described and defined.
Similar Ecological Systems:
- West Gulf Coastal Plain Pine-Hardwood Flatwoods (CES203.278)
- West Gulf Coastal Plain Stream Terrace Sandyland Longleaf Pine Woodland (CES203.891)
- West Gulf Coastal Plain Upland Longleaf Pine Forest and Woodland (CES203.293)

Related Concepts:
- Longleaf Pine - Slash Pine: 83 (Eyre 1980) Finer
- Longleaf Pine: 70 (Eyre 1980) Finer
- Longleaf-Blackgum Savannahs (Ajilvsgi 1979) Equivalent
- Pond Pine: 98 (Eyre 1980) Finer
- Wetland Pine Savanna (Marks and Harcombe 1981) Undetermined

DESCRIPTION

Environment: This system represents the presumed matrix vegetation on relatively recent (Pleistocene) geologic formations within the range of longleaf pine in the outer (seaward) portions of the West Gulf Coastal Plain between the coastal prairies and the inner coastal plain in Louisiana and eastern Texas. In Louisiana, these are mapped as the Intermediate Terrace and the upper Prairie Terrace (Snead and McCulloh 1984), and in Texas as the Lissie Formation and the upper Beaumont Formation (Sellards et al. 1932). The Intermediate Terrace of Snead and McCulloh (1984) includes terraces formerly designated as the Montgomery, Irene, and most of the Bentley. These areas are characterized by poorly drained upland soils with high water tables (Bridges and Orzell 1989a). Landforms include mesic to seasonally saturated low areas and flats, on level to gently rolling uplands. Microtopographic variation is provided by the presence of swales and pimple mounds. Soils are sandy to silty loams that are strongly acidic, nutrient poor, and low in organic constituents. Typically these soils are hydric, with seasonal fluctuations between saturation and droughtiness (Elliott 2011). Within the range of longleaf pine, this system is bounded on the landward side by West Gulf Coastal Plain Upland Longleaf Pine Forest and Woodland (CES203.293).
Vegetation: This system may be characterized as having a sparse canopy (under natural fire cycles) dominated by *Pinus palustris*. Other species in the canopy include *Quercus stellata, Quercus marilandica, Nyssa sylvatica, Quercus laurifolia, Quercus falcata*, and *Liquidambar styraciflua*. Shrubs are typically limited in distribution within the system to local topographic highs and include species such as *Morella cerifera, Ilex vomitoria, Symplocos tinctoria, Cyrilla racemiflora*, and others. The herbaceous layer may be highly diverse. Drier sites may be dominated by *Schizachyrium scoparium, Schizachyrium tenerum, Eupatorium rotundifolium*, and others. Wetter sites may not have species showing a clear dominance. Species such as *Liatris* spp., *Xyris* spp., *Rhexia* spp., *Rhynchospora* spp., *Fuirena* spp., *Marshallia graminifolia, Aletris aurea*, and many other species may share dominance in this system. Suppression of fire has lead to increased woody dominance. *Pinus taeda, Pinus elliottii, Liquidambar styraciflua, Nyssa sylvatica*, and *Acer rubrum* may now dominate the canopy of these sites, with a thick understory dominated by *Ilex vomitoria* and *Morella cerifera* (Elliott 2011).
Dynamics: Frequent fires (every 1-4 years), seasonal wetness and low nutrient availability of this ecological system inhibit the

establishment of woody understory species and maintain a sparse canopy of longleaf pine (Stambaugh et al. 2011a and others). This frequent fire regime is necessary to maintain the open savanna condition and provides bare ground for *Pinus palustris* regeneration. Current examples must be managed with prescribed fire. Fires are usually low in intensity overall, consuming only shrubs and herbs, but will occasionally kill patches of young pine regeneration and rarely kill individual older trees. Historically, individual fires covered extensive areas. This high fire frequency is dependent on the presence of fine fuels in the form of grasses and other graminoids. Prescribed fire has been used as an attempt to reverse the effects of decades of fire suppression. However, the results of these attempts have been mixed. Uncertainty remains over the frequency of burning necessary to restore fire-dependent ecosystems; however, a return frequency of every 2-5 years appears best. Application of burns is often too infrequent, allowing woody understory species to crowd out longleaf or, in hardwood forests, oaks, beeches and other dominant trees. Similarly, burns are ineffective if applied at the wrong life stage of plants or at the wrong point in the growing season. An example: late-spring to early-summer burns favor longleaf and associated herbaceous plants, whereas late-season or winter burns favor woody shrubs. However, prescribed burns, properly applied, are a crucial restoration and management tool in the pyrogenic longleaf pine ecosystems. Canopy gaps are created by fire mortality, lightning, and windthrow from hurricanes and tornados.

Component Associations:
- *Pinus palustris / Eryngium integrifolium - Rhynchospora* spp. - (*Ctenium aromaticum*) Woodland (CEGL003646, G2G3)
- *Pinus palustris / Rhynchospora elliottii - Lobelia flaccidifolia - Platanthera nivea - (Helenium drummondii)* Woodland (CEGL007802, G2G3)
- *Pinus palustris / Schizachyrium scoparium - Schizachyrium tenerum - Silphium gracile* Woodland (CEGL003581, G2)
- *Pinus palustris / Sporobolus silveanus - Muhlenbergia capillaris - Chaetopappa asteroides* Woodland (CEGL003654, G1)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Texas-Louisiana Coastal Prairie (CES203.550)
- West Gulf Coastal Plain Upland Longleaf Pine Forest and Woodland (CES203.293)

DISTRIBUTION

Range: This system is endemic to western Louisiana and eastern Texas, and examples appear to be somewhat more common in western Louisiana.
Divisions: 203:C
Nations: US
Subnations: LA, TX
Map Zones: 37:C, 98:C
USFS Ecomap Regions: 232Ea:CCC, 232Fa:CCC, 232Fb:CCC, 232Fe:CCC, 232Ff:CCC
TNC Ecoregions: 31:C, 41:C

SOURCES

References: Ajilvsgi 1979, Bridges and Orzell 1989a, Comer et al. 2003, Elliott 2011, Eyre 1980, LDWF 2005, Marks and Harcombe 1981, McWilliams and Lord 1988, Sellards et al. 1932, Smith 1993, Smith 1996b, Snead and McCulloh 1984, Stambaugh et al. 2011a, Van Lear et al. 2005
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723249#references
Description Author: R. Evans, mod. M. Pyne, L. Elliott, J. Teague
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: R. Evans **ClassifResp:** Southeast

WESTERN CANADIAN BOREAL BLACK SPRUCE BOG AND DWARF-TREE PEATLAND (CES103.799)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Boreal (103)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Saturated Soil; Forest and Woodland (Treed); Boreal [Boreal Continental]; Depressional; Organic Peat (>40 cm)
Non-Diagnostic Classifiers: Acidic Water
National Mapping Codes: ESLF 9169

CONCEPT

Summary: These wetlands are found at higher temperate and boreal latitudes of western and central Canada, extending into the Rocky Mountain Division. They form where the rate of peat accumulation exceeds its decomposition, resulting in ombrotrophic and acidic peatlands in which the bog surface is raised above the water table. The surface morphology of the peatland may be more-or-less level, domed, or eccentric. These are primarily depressional wetlands, and secondary bog pools may also be present. While the raised portion defines these bogs, poor-fen vegetation may be present along the perimeter, due to localized groundwater input. Soils are saturated throughout the growing season from groundwater upwelling. The vegetation is dominated by dense to scattered trees with *Picea mariana* and occasionally *Larix laricina*, low ericaceous shrubs, including *Andromeda polifolia, Kalmia polifolia, Ledum groenlandicum, Chamaedaphne calyculata, Empetrum nigrum, Rubus chamaemorus, Vaccinium oxycoccos, Vaccinium vitis-idaea, Vaccinium uliginosum*,, and with patches of graminoids and bryophyte lawns. Common graminoids include *Carex pluriflora, Rhynchospora alba, Eriophorum angustifolium*, and *Calamagrostis canadensis*. *Sphagnum* species are characteristic, including *Sphagnum capillifolium, Sphagnum magellanicum, Sphagnum fuscum, Sphagnum papillosum*, and *Sphagnum cuspidatum*.
Classification Comments: Black spruce bogs and peatlands in Alaska are placed into Western North American Boreal Black Spruce Dwarf-Tree Peatland (CES105.139). It's very likely that these two systems will be combined into one North American boreal black spruce bog and peatland system.
Related Concepts:
- Black Spruce (western type): 204 (Eyre 1980) Broader
- Black Spruce - Lichen (904) (Shiflet 1994) Intersecting

DISTRIBUTION

Range: This system is found at higher temperate and boreal latitudes of western Canada, extending into the Rocky Mountain Division. Its exact distribution needs further clarification.
Divisions: 103:C; 105:C; 204:?; 306:C
Nations: CA, US
Subnations: AB, AK, BC, NT?, SK, YT
TNC Ecoregions: 7:C, 135:P, 136:P, 139:C, 140:C, 141:P, 144:P

SOURCES

References: Comer et al. 2003, Crum 1992, Eyre 1980, Lawrence et al. 2005, NCC 2002, Smith et al. 2007, Stone et al. 2007, Willoughby 2007, Willoughby et al. 2006
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722874#references
Description Author: M.S. Reid
Version: 31 Mar 2010 **Stakeholders:** Canada, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

WESTERN CANADIAN BOREAL MIXED HARDWOOD-CONIFER SWAMP AND FLOODPLAIN (CES103.523)

CLASSIFIERS

Classification Status: Standard

Primary Division: Boreal (103)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Short (<5 yrs) Flooding Interval [Short interval, Spring Flooding]; Forest and Woodland (Treed); Riverine / Alluvial; Flood Scouring
National Mapping Codes: ESLF 9396

CONCEPT

Summary: This ecological system is found throughout western boreal Canada and into central Canada. It is related to both mineral and peatland wetland types, and can occur in widely different landscape settings from mineral-soil floodplains to peatland soil. For this reason swamps have traditionally been harder to identify than other wetland types and are often confused or grouped with other wetland classes. Swamps are distinguished from other wetland types in that they are wooded (treed or shrub) wetlands that are in contact with minerotrophic water in either mineral or peatland soils. An important distinction is that the woody vegetation dominates swamp areas (often in percentages greater than 30% and up to 100% of the canopy) as a result of greater contact with nutrients, aerated soils, and high water availability. The majority of swamps have closed canopies (greater than 50%). This abundance of woody material in swamps provides another important distinction in that the peat is primarily composed of decomposing wooded material (shrub and tree) rather than the *Sphagnum*- or sedge-dominated peat types that comprise the organic layer in poor fens and bogs. Further, peat soils in swamps are fairly well-decomposed as a result of fluctuating water tables that allow for oxygen and decomposition. Important deciduous trees in these swamps and floodplains include *Betula papyrifera, Betula neoalaskana, Populus balsamifera*, and occasionally *Populus tremuloides*. In the eastern region of this type, *Acer negundo, Fraxinus pennsylvanica*, and *Ulmus americana* can occur, but are not typical. The predominant conifer is *Picea glauca*, but other conifers do occur, including *Larix laricina* and sometimes *Picea mariana*. There is often a thicket of short and tall shrubs along with the trees, or sometimes with no trees, including *Alnus incana ssp. tenuifolia, Alnus incana ssp. rugosa (= Alnus rugosa), Cornus sericea, Betula glandulosa, Betula nana, Betula pumila*, several species of *Salix*, and ericaceous shrubs such as *Empetrum nigrum, Vaccinium vitis-idaea, Vaccinium uliginosum*, and others. Sedges, forbs, ferns and mosses are all common to abundant.
Classification Comments: Boreal Canadian floodplain forests and shrublands can be expected to be diverse from west to east, but could be considered as one ecological system? Smith et al. (2007) places *Populus balsamifera*-dominated mineral wetlands along rivers into Deciduous Swamp category. So by their definition, riparian is a type of swamp. Need more information on species composition to write more specific description.

DESCRIPTION

Environment: *Hydrology/Moisture Regime*: Water regime (fluctuating water table) and availability play a significant role in swamps. The water table in swamps fluctuates seasonally, or in some systems bi-yearly, but pools of water are often visible in the hummocky ground surface. Thus, for most of the growing season, the majority of the soil layer is aerated, but water availability is still high in the continually saturated lower portions of the rooting zone. Treed swamps (such as hardwood or mixedwood swamps) in mineral soils are often drier, while swamps that grade into treed fens (tamarack swamps) are wetter. Shrub swamps are almost always wetter than most of the treed swamps, except in some riparian floodplain-associated areas on mineral soils. Moisture regimes for swamps range from hygric to hydric. Flow through swamps is fairly dynamic with good lateral flow through the ground water layer, and fluctuations of this water table allow for aeration of the rooting zone during the growing season. *Soils*: Swamps exist in both peat and mineral soils. Swamps are sometimes termed peatlands but the substrate is from woody (silvic) peat and is well-decomposed. Decomposition is driven by the fluctuating water levels which are absent in *Sphagnum*-derived peatlands. Swamp soils are typically composed of gleysols with mottling in the upper horizons and gleying in the lower horizons. Mottling occurs in a soil that has been inundated with water intermittently (the mottles are iron and manganese oxides). Gleization occurs during the chemical reduction of iron, thus changing the soil colors. Soils with low chromas are indicative of hydric conditions. *Nutrient Regime*: The nutrient regime in swamp wetlands ranges from poor to rich, depending on the amount of contact with dissolved mineral water. Most shrub swamps range from medium to rich.

DISTRIBUTION

Range: This ecological system is found throughout western boreal Canada and into central Canada.
Divisions: 103:C; 105:P
Nations: CA
Subnations: AB, BC, MB, SK
TNC Ecoregions: 135:P, 136:P, 140:C, 141:P

SOURCES

References: Lawrence et al. 2005, Smith et al. 2007, Stone et al. 2007, Thompson and Hansen 2003, Western Ecology Working Group n.d., Willoughby 2007, Willoughby et al. 2006

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.837952#references
Description Author: M.S. Reid
Version: 31 Mar 2010 **Stakeholders:** Canada, West
Concept Author: M.S. Reid **ClassifResp:** West

WESTERN CANADIAN BOREAL SHRUB-SEDGE RICH AND ALKALINE FEN (CES103.872)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Primary Division: Boreal (103)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Eutrophic Water; Depressional [Sinkhole]
Non-Diagnostic Classifiers: Montane; Lowland; Shrubland (Shrub-dominated); Boreal [Boreal Continental]
National Mapping Codes: ESLF 9176

CONCEPT

Summary: This ecological system extends across the western boreal regions of North America, with occurrences in inland British Columbia, east into western Alberta, and north into Yukon Territory. These fens, distributed across glaciated western and central Canada, develop in open basins where bedrock or other substrate influence creates circumneutral to calcareous conditions. They are most abundant in areas of limestone bedrock, and widely scattered in areas where calcareous substrates are scarce. Shore fens, which are peatlands that are occasionally flooded along streams and lakeshores, are also included here because flooding tends to create moderately alkaline conditions. Fens are nutrient-rich and have a thick peat layer that may be floating or submerged. Standing water is usually present. The edge of the basin may be shallow to deep peat over a sloping substrate, where seepage waters provide nutrients. The vegetation may be graminoid-dominated, shrub-dominated, or a patchwork of the two. *Dasiphora fruticosa ssp. floribunda* is a common diagnostic shrub, along with *Betula pumila, Betula glandulosa, Betula nana, Myrica gale, Salix barclayi, Salix candida, Salix maccalliana, Vaccinium macrocarpon*, and *Larix laricina*. The herbaceous flora is usually species-rich and includes calciphilic graminoids and forbs. Dominant species may include *Carex lasiocarpa, Carex diandra, Menyanthes trifoliata, Equisetum fluviatile, Comarum palustre, Calla palustris, Eriophorum angustifolium, Trichophorum caespitosum*, and *Carex aquatilis*. Other common but non-dominant species include *Caltha palustris, Cicuta virosa (= Cicuta mackenzieana), Galium trifidum, Rumex arcticus*, and *Utricularia* spp. Aquatic plants such as *Myriophyllum spicatum, Hippuris vulgaris, Potamogeton* spp., and *Sparganium* spp. may be present *Sphagnum* can dominate the substrate, along with other calciphilic mosses; common indicator bryophytes include *Calliergon trifarium, Limprichtia revolvens, Scorpidium scorpioides, Sphagnum girgensohnii, Sphagnum squarrosum, Sphagnum warnstorfii, Tomentypnum nitens*, and *Campylium stellatum*.
Classification Comments: Fens in Alaska are placed into several other systems. Also fens occurring in the Pacific Northwest coastal regions are placed into North Pacific Bog and Fen (CES204.063). This system is similar to North-Central Interior Shrub-Graminoid Alkaline Fen (CES202.702) and Laurentian-Acadian Alkaline Fen (CES201.585).
Similar Ecological Systems:
- Laurentian-Acadian Alkaline Fen (CES201.585)
- North Pacific Bog and Fen (CES204.063)
- North-Central Interior Shrub-Graminoid Alkaline Fen (CES202.702)

Component Associations:
- *Carex aquatilis* Boreal Herbaceous Vegetation (CEGL005289, GNR)
- *Carex aquatilis var. dives* Herbaceous Vegetation (CEGL001826, G4)
- *Carex cusickii - (Menyanthes trifoliata)* Herbaceous Vegetation (CEGL003332, G2G3)
- *Carex lasiocarpa* Herbaceous Vegetation (CEGL001810, G4?)
- *Menyanthes trifoliata* Herbaceous Vegetation (CEGL003410, G5)
- *Myrica gale / Carex (aquatilis var. dives, utriculata)* Shrubland (CEGL003376, G3)
- *Spiraea douglasii / Carex aquatilis var. dives* Shrubland (CEGL003415, G4)
- *Spiraea douglasii* Shrubland (CEGL001129, G5)

DISTRIBUTION

Range: This system extends across the western and central boreal regions of Canada.
Divisions: 103:C; 105:C; 205:C; 306:P
Nations: CA, US?
Subnations: AB, AK?, BC, MB, NT, SK, YT
TNC Ecoregions: 66:C, 67:C, 78:?, 135:P, 136:P, 139:C, 140:C, 141:C

SOURCES

References: Comer et al. 2003, Mitsch and Gosselink 2000, Smith et al. 2007, Vitt and Chee 1990
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722803#references
Description Author: M.S. Reid
Version: 31 Mar 2010
Stakeholders: Canada, West
Concept Author: G. Kittel and P. Comer
ClassifResp: West

WESTERN GREAT PLAINS FLOODPLAIN (CES303.678)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Western Great Plains (303)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Non-Diagnostic Classifiers: Deep (>15 cm) Water; Long (>25 yrs) Flooding Interval; Floodplain; Forest and Woodland (Treed); Herbaceous; Riverine / Alluvial
National Mapping Codes: ESLF 9153

CONCEPT

Summary: This ecological system is found in the floodplains of medium and large rivers of the western Great Plains. It occurs on the lower reaches of the North and South Platte, Platte, Arkansas, and Canadian rivers, among others. Alluvial soils and periodic, intermediate flooding (every 5-25 years) typify this system. These are the perennial big rivers of the region with hydrologic dynamics largely driven by snowmelt in the mountains, instead of local precipitation events. Dominant communities within this system range from floodplain forests to wet meadows to gravel/sand flats; however, they are linked by underlying soils and the flooding regime. Dominant species include *Populus deltoides* and *Salix* spp. Grass cover underneath the trees is an important part of this system and is a mix of tallgrass species, including *Panicum virgatum* and *Andropogon gerardii*. Sometimes, *Tamarix* spp. and less desirable or exotic grasses and forbs can invade degraded areas within the floodplains, especially in the western portion of the province. These areas are often subjected to heavy grazing and/or agriculture and can be heavily degraded. Groundwater depletion and lack of fire have created additional alterations in species composition. In most cases, the majority of the wet meadow and prairie communities may be extremely degraded or extirpated from examples of this system.
Classification Comments: All the riparian/floodplain/alluvial systems of the Great Plains region need to be revisited for naming conventions, along with better definitions of conceptual boundaries. There is much apparent overlap in their concepts and distribution, and the names add to the confusion. In particular, the difference between "riparian" and "floodplain" usage in the names needs revisiting and possible changing. These systems include Northwestern Great Plains Floodplain (CES303.676), Northwestern Great Plains Riparian (CES303.677), Western Great Plains Floodplain (CES303.678), and Western Great Plains Riparian (CES303.956). Need to review if there needs to be another split of this system into a Central Great Plains floodplain system and a Southern Great Plains floodplain system. Will need to review in conjunction with Northwestern Great Plains Floodplain (CES303.676).
Similar Ecological Systems:
- Northwestern Great Plains Floodplain (CES303.676)
- South-Central Interior Large Floodplain (CES202.705)
- Southeastern Great Plains Floodplain Forest (CES205.710)

Related Concepts:
- Bluestem Prairie (601) (Shiflet 1994) Intersecting
- Bur Oak: 236 (Eyre 1980) Intersecting
- Cottonwood - Willow: 235 (Eyre 1980) Broader
- Cottonwood: 63 (Eyre 1980) Finer
- High Plains: Floodplain Deciduous Shrubland (2506) [CES303.678.8] (Elliott 2011) Finer
- High Plains: Floodplain Hardwood / Juniper Forest (2503) [CES303.678.4] (Elliott 2011) Finer
- High Plains: Floodplain Hardwood Forest (2504) [CES303.678.6] (Elliott 2011) Finer
- High Plains: Floodplain Herbaceous Vegetation (2507) [CES303.678.9] (Elliott 2011) Finer
- High Plains: Floodplain Juniper Forest (2501) [CES303.678.1] (Elliott 2011) Finer
- High Plains: Floodplain Juniper Shrubland (2505) [CES303.678.7] (Elliott 2011) Finer
- High Plains: Floodplain Live Oak Forest (2502) [CES303.678.2] (Elliott 2011) Finer
- Sugarberry - American Elm - Green Ash: 93 (Eyre 1980) Finer
- Western Great Plains Floodplain (Rolfsmeier and Steinauer 2010) Broader

DESCRIPTION

Environment: This system is found primarily in Quaternary alluvium along floodplains of medium and large rivers. Soils are primarily alluvial and range from sandy to dense clays. This system occurs on valley floors of large rivers and perennial streams where significant alluvial deposition occurs, and tends to occupy broad valley bottoms with deep alluvial deposits. In Texas, this system is found within the Clear Fork of the Middle Brazos watersheds and occurs on Loamy Bottomland, Clayey Bottomland, and Draw ecoclasses. Broad alluvial deposits commonly occur and are generally mapped as bottomland soils (Elliott 2011). Water velocity and volume change greatly during the year as rains and snowmelt deliver pulses of water and seasonal droughts (typically including winter in the northern portion of this system's range when most precipitation is frozen) result in low water. Within a short distance on a river floodplain, different soil textures can be found. Within the space of a few years, floods of differing magnitude can deposit sand over silt or vice versa, resulting in complex soil topology.
Vegetation: This system is variable in its expression and can occur as various cover types, including forest, woodland, shrubland, as

well as herbaceous vegetation. Herbaceous variants include marshes, which may develop in the floodplain soils, or mesic prairie dominated by *Andropogon gerardii* and *Panicum virgatum* which also may be conspicuous (Elliott 2011). *Populus deltoides, Sapindus saponaria var. drummondii, Prosopis glandulosa, Salix nigra, Ulmus americana,* and/or *Celtis laevigata* may be important components of forests or woodlands of this system. In parts of Texas, *Juniperus ashei, Juniperus pinchotii*, and/or *Quercus fusiformis* may be present to dominant (Elliott 2011). Species such as *Quercus fusiformis* and *Ulmus americana* occur in the system at the western edge of their range, and may not be represented further west within the range of the system. Shrubland examples may also have *Prosopis glandulosa* and *Salix nigra* as important components. Some shrublands may be dominated by non-native *Tamarix* spp. Herbaceous vegetation may include marshes occupying floodplain sites, with species such as *Schoenoplectus* spp. and/or *Typha* spp. Some sites may be dominated by tallgrass species such as *Andropogon gerardii* and *Panicum virgatum*. Sparsely vegetated areas, such as gravel and sand flats, are also included within this system.

Dynamics: Periodic and intermediate flooding (i.e., every 5-25 years) constitutes the major process influencing this system. Flood frequency depends on precipitation patterns within the watershed and proximity to the main channel. Areas adjacent to the main channel or low islands within the channel are flooded most often, while areas further from the channel or on terraces may only be flooded once every several years. Free-flowing rivers migrate across their floodplain, cutting new channels or eroding the bank on one side while building up the bank on the other, so the flooding regime of any one point in the floodplain will change over time. Flooding redeposits alluvium, eroding some areas and aggrading others, can bury or wash away small plants, and redistributes nutrients, especially in less frequently flooded zones where silt and clay tend to be deposited. These processes open up new areas for colonization. In the newly exposed or reworked areas, there is a common succession sequence of annual herbaceous species followed by shrub *Salix* spp., followed by *Populus deltoides* and *Salix amygdaloides*, followed by a number of trees, including *Acer negundo, Carya illinoinensis, Celtis laevigata, Celtis occidentalis, Fraxinus pennsylvanica,* and *Ulmus americana* (Bellah and Hulbert 1974). This sequence can be reset by major floods and erosion/deposition.

Fire could impact parts of this system. Most of the forests in this system were not fire-prone due to the lack of litter, frequent flooding, and relatively protected landscape position in the river valley with wetlands often near, but forests on higher, coarser soils or wet-mesic prairies on the margins of the floodplain could become dry in late summer and burn, if an ignition source was present.

Component Associations:

- *Carex nebrascensis* Herbaceous Vegetation (CEGL001813, G4)
- *Ericameria nauseosa / Pseudoroegneria spicata* Shrubland (CEGL001330, G3Q)
- Great Plains Riverine Gravel Flats Sparse Vegetation (CEGL005223, GNR)
- *Populus deltoides (ssp. wislizeni, ssp. monilifera) / Distichlis spicata* Woodland (CEGL000939, G2)
- *Populus deltoides (ssp. wislizeni, ssp. monilifera) / Salix exigua* Woodland (CEGL002685, G3)
- *Populus deltoides - (Salix amygdaloides) / Salix (exigua, interior)* Woodland (CEGL000659, G3G4)
- *Populus deltoides - Salix nigra* Woodland (CEGL004919, G3G4Q)
- *Populus deltoides - Ulmus americana - Celtis laevigata* Forest (CEGL002096, G3)
- *Populus deltoides / Carex pellita* Woodland (CEGL002649, G2)
- *Populus deltoides / Muhlenbergia asperifolia* Forest (CEGL000678, G3)
- *Populus deltoides / Panicum virgatum - Schizachyrium scoparium* Woodland (CEGL001454, G2)
- Riverine Sand Flats - Bars Sparse Vegetation (CEGL002049, G4G5)
- *Salix exigua* / Mesic Graminoids Shrubland (CEGL001203, G5)
- *Schoenoplectus acutus - Typha latifolia - (Schoenoplectus tabernaemontani)* Sandhills Herbaceous Vegetation (CEGL002030, G4)
- *Schoenoplectus pungens - Suaeda calceoliformis* Alkaline Herbaceous Vegetation (CEGL002040, G3G4)
- *Schoenoplectus tabernaemontani - Typha* spp. - (*Sparganium* spp., *Juncus* spp.) Herbaceous Vegetation (CEGL002026, G4G5)
- *Spartina pectinata - Eleocharis* spp. - *Carex* spp. Herbaceous Vegetation (CEGL002223, G2G4)
- *Sporobolus airoides* Southern Plains Herbaceous Vegetation (CEGL001685, G3Q)
- *Symphoricarpos occidentalis* Shrubland (CEGL001131, G4G5)
- *Typha (angustifolia, domingensis, latifolia) - Schoenoplectus americanus* Herbaceous Vegetation (CEGL002032, G3G4)
- *Typha (latifolia, angustifolia)* Western Herbaceous Vegetation (CEGL002010, G5)
- *Ulmus (americana, rubra) - Quercus muehlenbergii* Forest (CEGL002091, GNR)
- *Ulmus americana - Celtis (laevigata, occidentalis) - Fraxinus pennsylvanica* Forest (CEGL002090, G3?)

DISTRIBUTION

Range: This system is found along major river floodplains in the southern and central portions of the Western Great Plains Division. This system occurs on the middle to lower reaches of the North and South Platte, Platte, Arkansas, and Canadian rivers, among others. Major river floodplains of eastern Wyoming and Montana are included in Northwestern Great Plains Floodplain (CES303.676) and not this system.

Divisions: 205:C; 303:C

Nations: US

Subnations: CO, KS, NE, OK, TX

Map Zones: 22:C, 25:?, 26:C, 27:C, 28:P, 31:C, 32:C, 33:C, 34:C, 35:C, 36:C, 38:C, 43:C

USFS Ecomap Regions: 251B:CC, 251F:CP, 251H:CC, 315A:CC, 315B:CC, 315F:CC, 331B:CC, 331C:CC, 331H:CC, 331I:CC, 332B:CC, 332C:CC, 332D:CC, 332E:CC, 332F:CC, M331F:C?, M331I:C?

TNC Ecoregions: 27:C, 28:C, 32:C, 33:C, 37:C

SOURCES

References: Bellah and Hulbert 1974, Comer et al. 2003, DeSantis et al. 2012, Elliott 2011, Eyre 1980, Herms et al. 2010, Johnson 1992, Lauver et al. 1999, Rolfsmeier and Steinauer 2010, Shiflet 1994, Steinauer and Rolfsmeier 2000

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722980#references

Description Author: S. Menard and K. Kindscher, mod. K.A. Schulz, L. Elliott, J. Drake

Version: 14 Jan 2014 **Stakeholders:** Midwest, Southeast, West

Concept Author: S. Menard and K. Kindscher **ClassifResp:** Midwest

WESTERN NORTH AMERICAN BOREAL BLACK SPRUCE DWARF-TREE PEATLAND (CES105.139)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Permafrost; Saturated Soil; Toeslope/Valley Bottom; Boreal [Boreal Subcontinental]; Acidic Soil; Organic Peat (>40 cm); Picea mariana
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2621; ESLF 9376; ESP 1621

CONCEPT

Summary: This system occurs in the boreal and boreal transition regions of Alaska in valley bottoms and on abandoned floodplains and includes treed bogs (and poor fens) and other organic-rich lowland black spruce forests. Sites are generally flat to gently sloping terrain, on slopes up to 8 degrees. Soils are poorly drained and acidic, often with a well-developed peat layer. Permafrost is generally present and may form permafrost plateaus supporting the system in boreal Alaska but is generally absent in the boreal transition region. The forest canopy is typically open to woodland and trees are generally stunted. Common species include *Picea mariana, Ledum palustre ssp. decumbens, Ledum groenlandicum, Andromeda polifolia, Betula nana, Empetrum nigrum, Vaccinium vitis-idaea, Vaccinium uliginosum, Chamaedaphne calyculata, Carex pluriflora, Carex* spp., *Eriophorum angustifolium, Calamagrostis canadensis*, and *Sphagnum* spp. The major disturbances in this type are fire and thermokarst collapse.
Classification Comments: This system combines those known as Boreal Transition Lowland Wet Black Spruce and Boreal Lowland Wet Black Spruce by the Alaska Natural Heritage Program.
Related Concepts:
- Black Spruce (western type): 204 (Eyre 1980) Broader
- Black Spruce - Lichen (904) (Shiflet 1994) Intersecting
- I.A.2.f - Black spruce (open) (Viereck et al. 1992) Intersecting
- I.A.3.d - Black spruce (woodland) (Viereck et al. 1992) Intersecting
- II.A.2.a - Black spruce scrub (open) (Viereck et al. 1992) Intersecting
- II.A.3.a - Black spruce scrub (woodland) (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: This system occurs in the boreal and boreal transition regions of Alaska in valley bottoms and on abandoned floodplains and includes treed bogs (and poor fens) and other organic-rich lowland black spruce forests. Sites are generally flat to gently sloping terrain, on slopes up to 8 degrees. Soils are poorly drained and acidic, often with a well-developed peat layer. Permafrost is generally present and may form permafrost plateaus supporting the system in boreal Alaska but is generally absent in the boreal transition region.
Vegetation: The forest canopy is typically open to woodland and trees are generally stunted. Common species include *Picea mariana, Ledum palustre ssp. decumbens, Ledum groenlandicum, Andromeda polifolia, Betula nana, Empetrum nigrum, Vaccinium vitis-idaea, Vaccinium uliginosum, Chamaedaphne calyculata, Carex pluriflora, Carex* spp., *Eriophorum angustifolium, Calamagrostis canadensis*, and *Sphagnum* spp. (DeVelice et al. 1999).
Dynamics: In boreal wetlands the general successional trend is from marsh to fen to treed bog; however, succession is not necessarily directional, and environmental conditions, such as nutrient content and abundance of groundwater, may prevent fens from developing into bogs (Zoltai et al. 1988). Succession begins in shallow ponds or low-lying wetlands formed by processes such as glacial recession and floodplain dynamics (oxbows) or thermokarst. An organic root mat typically develops and is either anchored to the mineral soil or floating on water such as a pond's edge. Over time, peat-forming mosses and sedges may fill in the basin. As the peat layer develops, low and/or dwarf-shrubs become established. Dwarf-trees may establish on the well-developed peat and also around the margin of the peatland.

Many peatlands on the Kenai Lowland formed in kettles after remnant glacial ice melted. In this region there is a trend toward peatlands drying and ponds shrinking and filling in (Klein et al. 2005).

Permafrost degradation leading to collapse scars and thaw ponds is common in boreal Alaska, and studies from the Tanana Flats show areas of widespread degradation (Racine et al. 1998, Jorgenson et al. 2001a, 2001b, 2003). Thaw ponds form when ice-rich permafrost degrades and collapses forming a basin. Aquatic plants rapidly colonize the pond. Over time, marsh plants and sphagnum moss invade creating peatland conditions. This trend is leading to widespread ecosystem conversion in the Tanana Flats (Jorgenson et al. 2001b). If a collapse scar is isolated, succession follows a bog development model, whereas in an open hydrologic setting, succession follows a fen development model. Pond systems may become connected as adjacent permafrost thaws.

Succession to peatlands can also occur through paludification of previously forested landscapes. Restricted drainage from permafrost development (on inactive alluvial terraces, for example) can lead to the establishment of *Sphagnum* spp. or other peat-forming mosses or sedges, and overtime, peatland plants dominate the site.

DISTRIBUTION

Range: This system occurs in lowlands of the boreal and boreal transition regions of Alaska.
Divisions: 105:C; 204:C
Nations: US
Subnations: AK
Map Zones: 69:C, 70:C, 71:C, 72:C, 73:C, 74:C, 75:C, 76:?
TNC Ecoregions: 71:C, 76:C, 77:C, 78:C

SOURCES

References: DeVelice et al. 1999, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817478#references
Description Author: T. Boucher and J. Foote
Version: 11 Aug 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

WESTERN NORTH AMERICAN BOREAL BLACK SPRUCE WET-MESIC SLOPE WOODLAND (CES105.120)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Permafrost; Forest and Woodland (Treed); Boreal [Boreal Subcontinental]; Acidic Soil; Sphagnum spp.; Picea mariana
Non-Diagnostic Classifiers: Montane [Lower Montane]; Lowland [Foothill]; Lowland [Lowland]; Organic Peat (>40 cm)
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2622; ESLF 9377; ESP 1622

CONCEPT

Summary: This system occurs on north-facing slopes underlain by permafrost with low productivity *Picea mariana*. Soils are poorly drained and acidic with a well-developed peat layer. Sites on lower concave slopes and toeslopes are wet, while sites on upper slopes, convex slopes and ridges may be mesic. Common species include *Ledum groenlandicum, Ledum palustre ssp. decumbens, Betula nana, Empetrum nigrum, Vaccinium vitis-idaea, Vaccinium uliginosum, Carex* spp., and *Sphagnum* spp. This system has less *Sphagnum* than Western North American Boreal Black Spruce Dwarf-Tree Peatland (CES105.139). The slope angle is generally greater than 8 degrees.
Classification Comments: This system is known as Boreal North-Facing Black Spruce by the Alaska Natural Heritage Program. Wet black spruce on slopes with slope angle between 0-8 degrees are classified with Western North American Boreal Black Spruce Dwarf-Tree Peatland (CES105.139).
Related Concepts:
- I.A.2.f - Black spruce (open) (Viereck et al. 1992) Intersecting
- I.A.3.d - Black spruce (woodland) (Viereck et al. 1992) Intersecting
- II.A.2.a - Black spruce scrub (open) (Viereck et al. 1992) Intersecting
- II.A.3.a - Black spruce scrub (woodland) (Viereck et al. 1992) Intersecting

DISTRIBUTION

Range: This system occurs on lower to upper north-facing slopes in the boreal region of Alaska.
Divisions: 105:C
Nations: US
Subnations: AK
Map Zones: 69:?, 70:C, 71:C, 72:C, 73:C, 74:C, 76:C
TNC Ecoregions: 76:C, 77:C, 78:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817418#references
Description Author: T. Boucher
Version: 08 Aug 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

WESTERN NORTH AMERICAN BOREAL BLACK SPRUCE-TAMARACK FEN (CES105.121)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Eutrophic Water; Saturated Soil; Lowland [Lowland]; Forest and Woodland (Treed); Toeslope/Valley Bottom; Seepage-Fed Sloping [Peaty]; Depressional [Sinkhole]; Acidic Soil; Organic Peat (>40 cm); Picea mariana - Larix laricina
Non-Diagnostic Classifiers: Montane; Alluvial flat; Boreal [Boreal Continental]
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Mixed evergreen-deciduous open tree canopy
National Mapping Codes: EVT 2623; ESLF 9378; ESP 1623

CONCEPT

Summary: This ecological system occurs in lowlands across boreal Alaska and includes treed fens and other organic-rich lowland black spruce-tamarack forests. Soils are poorly drained and often have a well-developed peat layer. Sites are less acidic than Western North American Boreal Black Spruce Dwarf-Tree Peatland (CES105.139). Sites with at least 40 cm of peat are classified as fens. The forest canopy is typically open to woodland and trees may be stunted. Common species include *Picea mariana, Larix laricina, Betula nana, Ledum groenlandicum, Ledum palustre ssp. decumbens, Empetrum nigrum, Vaccinium vitis-idaea, Vaccinium uliginosum, Chamaedaphne calyculata, Carex* spp., *Eriophorum angustifolium*, and *Sphagnum* spp.
Classification Comments: This system is known as Boreal Wet Black Spruce Tamarack by the Alaska Natural Heritage Program.
Related Concepts:
- I.A.2.h - Black spruce-tamarack (Viereck et al. 1992) Equivalent

DESCRIPTION

Environment: *Larix laricina* is considered a fen indicator in some regions.
Dynamics: There has been a major impact from larch sawfly (*Pristiphora erichsonii*) in Alaska (but not in Canadian populations). There are two models: fire (without thermokarst collapse) and thermokarst collapse. Model is similar to boreal wet black spruce, but with *Larix* as endpoint.

DISTRIBUTION

Range: This system is found in the lowlands of the boreal region of Alaska. The range of *Larix laricina* in Alaska is disjunct from the Canadian population.
Divisions: 105:C
Nations: US
Subnations: AK
Map Zones: 70:C, 71:C, 72:C, 73:C, 74:C, 76:?
TNC Ecoregions: 76:C, 77:C, 78:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817421#references
Description Author: T. Boucher
Version: 10 Dec 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

WESTERN NORTH AMERICAN BOREAL DECIDUOUS SHRUB SWAMP (CES105.122)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Saturated Soil; Shrubland (Shrub-dominated); Muck; Broad-Leaved Deciduous Shrub
Non-Diagnostic Classifiers: Silt Soil Texture
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Deciduous shrubland
National Mapping Codes: EVT 2624; ESLF 9379; ESP 1624

CONCEPT

Summary: Shrub swamps occur throughout the boreal and boreal transition regions of Alaska on poorly drained, fine-textured soil. Depressions with standing water are common throughout the growing season. Soils range from muck to mineral and are relatively nutrient-rich. Some sites have a thin peat layer. The shrub layer is typically dominated by *Alnus incana ssp. tenuifolia*, but *Alnus viridis ssp. sinuata, Salix pulchra*, or *Salix richardsonii (= Salix lanata ssp. richardsonii)* may be dominant or codominant. Common understory species include *Calamagrostis canadensis, Equisetum* spp., *Comarum palustre (= Potentilla palustris)*, and hydrophytic mosses.
Classification Comments: This system is known as Boreal Tall Shrub Swamp by the Alaska Natural Heritage Program.
Similar Ecological Systems:
- Boreal Willow-Alder Swamp Thicket (CES103.524)

Related Concepts:
- II.B.1.f - Shrub swamp (closed) (Viereck et al. 1992) Intersecting
- II.B.2.f - Shrub swamp (open) (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: Shrub swamps occur throughout the boreal and boreal transition regions of Alaska on poorly drained, fine-textured soil. Depressions with standing water are common throughout the growing season. Soils range from muck to mineral and are relatively nutrient-rich. Some sites have a thin peat layer.
Vegetation: The shrub layer is typically dominated by *Alnus incana ssp. tenuifolia*, but *Alnus viridis ssp. sinuata, Salix pulchra*, or *Salix richardsonii (= Salix lanata ssp. richardsonii)* may be dominant or codominant. Common understory species include *Calamagrostis canadensis, Equisetum* spp., *Comarum palustre (= Potentilla palustris)*, and hydrophytic mosses (Viereck et al. 1992).

DISTRIBUTION

Range: This system occurs in lowlands of the boreal and boreal transition regions of Alaska.
Divisions: 105:C
Nations: US
Subnations: AK
Map Zones: 68:?, 69:C, 70:C, 71:C, 72:?, 73:C, 74:C, 75:C
TNC Ecoregions: 71:C, 75:?, 76:C, 77:C, 78:C

SOURCES

References: Viereck et al. 1992, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817424#references
Description Author: T. Boucher
Version: 08 Aug 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

WESTERN NORTH AMERICAN BOREAL LOW SHRUB PEATLAND (CES105.140)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Lowland; Boreal [Boreal Subcontinental]; Muck; Dwarf-Shrub
Non-Diagnostic Classifiers: Shrubland (Shrub-dominated)
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Deciduous shrubland
National Mapping Codes: EVT 2620; ESLF 9380; ESP 1620

CONCEPT

Summary: This ecological system occurs in lowlands of the boreal and boreal transition regions of Alaska and includes low shrub-dominated wetlands. Sites may be bogs, fens, or wetlands. Soils are saturated for at least a portion of the growing season, and permafrost is absent. An organic peat layer is usually present, but peat depth is variable but often less than 40 cm deep. Common species include *Ledum palustre ssp. decumbens, Ledum groenlandicum, Betula nana, Rubus chamaemorus, Vaccinium oxycoccos (= Oxycoccus microcarpos), Myrica gale, Calamagrostis canadensis, Carex aquatilis, Comarum palustre, Salix fuscescens, Salix pulchra, Empetrum nigrum, Chamaedaphne calyculata*, and *Sphagnum* spp. *Myrica gale* and *Chamaedaphne calyculata* indicate fen conditions. This system often occurs in association with other peatland systems.
Classification Comments: This system combines those known as Boreal Transition Wet Low Shrub and Boreal Wet Low Shrub by the Alaska Natural Heritage Program.
Related Concepts:
- II.C.2.d - Shrub birch-ericaceous shrub bog (Viereck et al. 1992) Intersecting
- II.C.2.e - Ericaceous shrub bog (Viereck et al. 1992) Intersecting
- II.C.2.i - Willow-graminoid shrub bog (Viereck et al. 1992) Intersecting
- II.C.2.j - Sweetgale-graminoid bog (Viereck et al. 1992) Intersecting
- III.C.1.a - Wet bryophyte (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: This ecological system occurs in lowlands of the boreal and boreal transition regions of Alaska and includes low shrub-dominated wetlands. Sites may be bogs, fens, or wetlands. Soils are saturated for at least a portion of the growing season, and permafrost is absent. An organic peat layer is usually present, but peat depth is variable but often less than 40 cm deep.
Vegetation: Common species include *Ledum palustre ssp. decumbens, Ledum groenlandicum, Betula nana, Rubus chamaemorus, Vaccinium oxycoccos (= Oxycoccus microcarpos), Myrica gale, Calamagrostis canadensis, Carex aquatilis, Comarum palustre, Salix fuscescens, Salix pulchra, Empetrum nigrum, Chamaedaphne calyculata*, and *Sphagnum* spp. (DeVelice et al. 1999, Jorgenson et al. 2003). *Myrica gale* and *Chamaedaphne calyculata* indicate fen conditions.
Dynamics: In boreal wetlands the general successional trend is from marsh to fen to treed bog; however, succession is not necessarily directional, and environmental conditions, such as nutrient content and abundance of groundwater, may prevent fens from developing into bogs (Zoltai et al. 1988). Succession begins in shallow ponds or low-lying wetlands formed by processes such as glacial recession and floodplain dynamics (oxbows) or thermokarst. An organic root mat typically develops and is either anchored to the mineral soil or floating on water such as a pond's edge. Over time, peat-forming mosses and sedges may fill in the basin. As the peat layer develops, low and/or dwarf-shrubs become established. Dwarf-trees may establish on the well-developed peat and also around the margin of the peatland.

Many peatlands on the Kenai Lowland formed in kettles after remnant glacial ice melted. In this region there is a trend toward peatlands drying and ponds shrinking and filling in (Klein et al. 2005).

Permafrost degradation leading to collapse scars and thaw ponds is common in boreal Alaska, and studies from the Tanana Flats show areas of widespread degradation (Racine et al. 1998, Jorgenson et al. 2001a, 2001b, 2003). Thaw ponds form when ice-rich permafrost degrades and collapses forming a basin. Aquatic plants rapidly colonize the pond. Over time, marsh plants and sphagnum moss invade creating peatland conditions. This trend is leading to widespread ecosystem conversion in the Tanana Flats (Jorgenson et al. 2001b). If a collapse scar is isolated, succession follows a bog development model, whereas in an open hydrologic setting, succession follows a fen development model. Pond systems may become connected as adjacent permafrost thaws.

Succession to peatlands can also occur through paludification of previously forested landscapes. Restricted drainage from permafrost development (on inactive alluvial terraces, for example) can lead to the establishment of *Sphagnum* spp. or other peat-forming mosses or sedges, and overtime, peatland plants dominate the site.

DISTRIBUTION

Range: This system occurs in lowlands of the boreal transition region of Alaska, and lowlands through subalpine in boreal Alaska.
Divisions: 105:C
Nations: US

Subnations: AK
Map Zones: 68:C, 69:C, 70:C, 71:C, 72:P, 73:C, 74:C, 75:C, 76:?
TNC Ecoregions: 71:C, 74:C, 75:C, 76:C, 77:C, 78:C

SOURCES

References: DeVelice et al. 1999, Jorgenson et al. 2003, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817483#references
Description Author: T. Boucher
Version: 11 Aug 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

WESTERN NORTH AMERICAN BOREAL LOW SHRUB-TUSSOCK TUNDRA (CES105.126)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Lowland; Herbaceous; Tussock-forming grasses; Eriophorum vaginatum
Non-Diagnostic Classifiers: Boreal [Boreal Subcontinental]
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Deciduous shrubland
National Mapping Codes: EVT 2628; ESLF 9381; ESP 1628

CONCEPT

Summary: This is a common lowland system dominated by tussock sedges and low shrubs. *Eriophorum vaginatum* is the primary tussock-former in most stands, but *Carex bigelowii* may be the dominant tussock sedge on some sites. Other indicator species include *Betula nana, Salix pulchra, Ledum palustre ssp. decumbens, Ledum groenlandicum, Vaccinium vitis-idaea, Vaccinium uliginosum, Empetrum nigrum,* and *Carex* spp. Grasses, including *Calamagrostis canadensis* and *Arctagrostis* spp., may also be present. Lichens are scarce (with the possible exception of *Peltigera canina*). Sites are often underlain by permafrost. This ecological system is similar to Alaska Arctic Shrub-Tussock Tundra (CES102.180) (and the Tussock Tundra 2 PNV) that occurs in Alaska's arctic and has a longer mean fire-return interval. Geographic location is the best determinant between these two systems.
Classification Comments: This system is known as Boreal Tussock Low Shrub Tundra by the Alaska Natural Heritage Program. It includes two categories of tussock tundra: (1) tussock low shrub (shrub birch and/or willow) and (2) tussock dwarf-shrub lichen; for now we are calling this a drier variant of the low shrub tussock tundra (this may be more common in western and arctic Alaska, and we may split out in arctic and western Alaska discussion). From Witten (2004): "On the drier tussock tundra sites on the Seward Peninsula and western Alaska, *Sphagnum* may be absent or a minor constituent. Conversely, lichens are scarce (with the possible exception of *Peltigera canina*) in boreal and boreal transition Alaska, and may be abundant on the Seward Peninsula and western Alaska sites. Here, lichens may include *Cetraria cucullata, Cetraria islandica, Cladonia* spp., *Cladina rangiferina,* and *Thamnolia subuliformis*."
Similar Ecological Systems:
- Alaska Arctic Shrub-Tussock Tundra (CES102.180)

Related Concepts:
- II.C.2.a - Mixed shrub-sedge tussock tundra (Viereck et al. 1992) Intersecting
- II.C.2.b - Mixed shrub-sedge tussock bog (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: Permafrost is usually present at depths of 30-50 cm. Soils are generally acidic, poorly drained, gleyed, and often with a poorly decomposed organic horizon at the surface, which may constitute most of the active layer. Frost scars are common. Tussock communities occur on gentle slopes, terraces, and old alluvial deposits. Sites are often underlain by silty mineral soils with a surface peat layer 10 to 40 cm thick surrounding the tussocks (Viereck et al. 1992).
Dynamics: The fuel layer in sedge-shrub tussock tundra is dense and continuous and leads to large, fast-spreading fires (Racine et al. 1987, Duchesne and Hawkes 2000). Differences in topography, moisture, vegetation composition, and organic matter depth cause variation in burn severity and lead to a patchy burn pattern (Racine 1979). Fire severity in *Eriophorum* tussock tundra types tends to be light because of the wet soil profile (Wein 1976). Burns in this type usually consume all aerial woody and herbaceous plant material and litter; regeneration is vigorous via rhizomes and root sprouts. In most areas of tussock-shrub tundra on the Seward Peninsula, less than one half of accumulated organic soil layer was removed by fire (Racine 1979). Thaw depths increased to reach into the mineral soil, but were not greatly increased except where organics were removed. Subsidence and thermal erosion following fire are usually minimal in tundra ecosystems (Walker 1996).

Estimates of the mean fire-return interval for tussock tundra ecosystems range from 50-600 years (Racine et al. 1983, Payette et al. 1989). The fire regime of tundra systems are likely variable from one region to another making generalizations difficult (Viereck and Schandelmeier 1980).

On interior and south-central Alaska tussock tundra sites, the thaw pond cycle and paludification are important disturbances. On the Seward Peninsula and western Alaska, frost action creates polygonal ground and other periglacial features and is a widespread, small-scale and continuous disturbance. Change in the arctic and subarctic climate is another source of disturbance that is currently affecting tundra ecosystems.

DISTRIBUTION

Range: This system occurs in lowland through subalpine zones of the boreal and boreal transition (northern portion and higher elevation) regions of Alaska.
Divisions: 105:C
Nations: CA, US

Subnations: AK
Map Zones: 69:C, 70:C, 71:C, 73:C, 74:C, 75:C
TNC Ecoregions: 71:C, 72:C, 74:?, 75:C, 76:C, 77:C, 78:C

SOURCES

References: Duchesne and Hawkes 2000, Heinselman 1981, Payette et al. 1989, Racine 1979, Racine et al. 1983, Racine et al. 1987, Viereck and Schandelmeier 1980, Viereck et al. 1992, Walker 1996, Wein 1976, Western Ecology Working Group n.d., Witten 2004
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817436#references
Description Author: T. Boucher after Witten (2004)
Version: 08 Aug 2008 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

WESTERN NORTH AMERICAN BOREAL LOWLAND LARGE RIVER FLOODPLAIN FOREST AND SHRUBLAND (CES105.117)

CLASSIFIERS

Classification Status: Standard

Primary Division: Montane Boreal (105)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Very Short Flooding Interval [Short interval, Spring Flooding]; Riparian Mosaic [Trees, shrublands, meadows]; Floodplain; Lowland [Lowland]; Boreal [Boreal Subcontinental]
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Mixed evergreen-deciduous open tree canopy
National Mapping Codes: EVT 2615; ESLF 9382; ESP 1615

CONCEPT

Summary: This system includes large floodplains associated with high-volume interior rivers (such as the Yukon, Kuskokwim, Koyukuk, and Tanana rivers). Flooding regime is characterized by large spring floods at ice break-up. Young successional stages are dominated by willow and alder followed by balsam poplar and/or white spruce. Wetland development in abandoned channels is intermixed with succession on more mesic sites [see description for Western North American Boreal Shrub and Herbaceous Floodplain Wetland (CES105.118)]. The active flooding zone is often several km wide. Permafrost is usually absent.
Classification Comments: This system is known as Boreal Large River Floodplain by the Alaska Natural Heritage Program.
Similar Ecological Systems:
- Western North American Boreal Montane Floodplain Forest and Shrubland (CES105.141)

Related Concepts:
- I.A.1.j - White spruce (closed) (Viereck et al. 1992) Intersecting
- I.A.2.e - White spruce (open) (Viereck et al. 1992) Intersecting
- I.B.1.c - Balsam poplar (forest) (Viereck et al. 1992) Intersecting
- I.B.1.g - Quaking aspen-balsam poplar (Viereck et al. 1992) Intersecting
- I.B.2.c - Balsam poplar (black cottonwood) (Viereck et al. 1992) Intersecting
- I.B.3.b - Balsam poplar (woodland) (Viereck et al. 1992) Intersecting
- I.C.1.e - Balsam poplar-white spruce (Viereck et al. 1992) Intersecting
- I.C.2.d - Spruce-balsam poplar (Viereck et al. 1992) Intersecting
- II.B.1.a - Willow (closed) (Viereck et al. 1992) Intersecting
- II.B.1.b - Alder (closed) (Viereck et al. 1992) Intersecting
- II.B.1.d - Alder-willow (closed) (Viereck et al. 1992) Intersecting
- II.B.2.a - Willow (open) (Viereck et al. 1992) Intersecting
- II.B.2.b - Alder (open) (Viereck et al. 1992) Intersecting
- II.B.2.d - Alder-willow (open) (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: This system includes large floodplains associated with high-volume interior rivers (such as the Yukon, Kuskokwim, Koyukuk, and Tanana rivers). Flooding regime is characterized by large spring floods at ice break-up. Wetland development in abandoned channels is intermixed with succession on more mesic sites. The active flooding zone is often several km wide. Permafrost is usually absent. Ice-scour and ice dams are important dynamics that may cause regeneration of willow carrs where scoured by ice.
Vegetation: Primary succession on floodplains begins when new alluvial surfaces are colonized by tree, shrub, and herbaceous species. Common woody species include *Populus balsamifera, Picea glauca, Alnus viridis ssp. sinuata, Alnus incana ssp. tenuifolia, Salix barclayi*, and *Salix alaxensis* (Viereck 1966, Scott 1974, Thilenius 1990, Shephard 1995, Boggs 2000). Common early-seral herbaceous species may include *Lupinus* spp., *Hedysarum* spp., and *Equisetum* spp. The next seral stage includes communities dominated by *Populus balsamifera* and/or *Picea glauca* with an understory of *Alnus viridis ssp. sinuata, Salix* spp., and bryophytes. The tall-shrub component of the early-successional stages diminishes rapidly, probably because of decreased light from the dense tree overstory. *Populus balsamifera* does not regenerate in the understory, and consequently, *Picea glauca* gains dominance in the overstory within 150 years. On older surfaces common shrubs include *Rosa acicularis, Viburnum edule,* and *Linnaea borealis*, and common herbs include *Pyrola* ssp. and *Cornus canadensis*. Feathermosses and lichens such as *Peltigera* spp occur on older surfaces.
Dynamics: Flooding can be caused by snowmelt, precipitation, ice jams and glacial runoff. Different rivers or portions of rivers may be more prone to certain types of flooding. Frequent flooding and channel migration create a pattern of gravel bars and early-successional stages across the valley bottom. Sediment deposition raises the surface of the floodplain over time. As the terrace becomes farther removed from the channel, flooding becomes less frequent. Water availability on terraces plays a major role in community structure and composition. Water inputs are from overbank flow (flooding), groundwater, and precipitation. Fine sediments are trapped when the floodwaters recede; this ongoing sediment input maintains high productivity.

Fire frequency in floodplain systems is less than that of the surrounding terrain because channels can act as firebreaks and early-seral vegetation is less flammable than mature boreal forest.

DISTRIBUTION

Range: This system is found in the boreal region of Alaska.
Divisions: 105:C
Nations: US
Subnations: AK
Map Zones: 68:C, 69:C, 70:C, 71:C, 72:C, 73:C, 74:C, 76:?
TNC Ecoregions: 75:?, 77:C, 78:C

SOURCES

References: Boggs 2000, Scott 1974, Shephard 1995, Thilenius 1990, Viereck 1966, Western Ecology Working Group n.d., Witten 2004
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817409#references
Description Author: T. Boucher
Version: 08 Aug 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

WESTERN NORTH AMERICAN BOREAL MONTANE FLOODPLAIN FOREST AND SHRUBLAND (CES105.141)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Very Short Flooding Interval [Short interval, Spring Flooding]; Riparian Mosaic [Trees, shrublands, meadows]; Floodplain; Montane; Boreal [Boreal Subcontinental]
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Mixed evergreen-deciduous open tree canopy
National Mapping Codes: EVT 2614; ESLF 9383; ESP 1614

CONCEPT

Summary: This system includes glacially-fed and non-glacially-fed rivers and streams throughout the boreal and boreal transition regions of Alaska. It includes the active and inactive portions of the floodplain, but not abandoned floodplains. Soils are alluvial, well-drained and poorly developed. Frequent river channel migration and associated flooding and fluvial processes constitute the major disturbances in this type. On glacially-fed rivers, braided outwash plains occur near the glacier terminus. This portion of the river is characterized by high sediment input and very frequent flooding. Substrates are excessively well-drained and frequently scoured. A high proportion of barren and early-seral landscape classes characterize the outwash plain. Farther downstream (distal outwash), vegetation dominance on the floodplain depends on seral stage and frequency of flooding: later seral stages and wetlands become more common. On rivers and streams without major glacial inputs, flooding and sediment deposition still drive the disturbance cycle; however, the timing and severity of flooding may differ from that on glacial rivers. Both glacially-fed and non-glacially-fed rivers are characterized by young successional stages dominated by willow and alder followed by extensive stands of balsam poplar and/or white spruce. Floodplains range in width from less than 50 m to over 1 km. Large floodplains (several km wide, such as the Yukon) are classified as separate systems. Oxbows and other wet depressions commonly form on the floodplains. Wetland succession and species composition are variable due to diverse environmental conditions such as water depth, substrate, and nutrient input. Wetland classes and succession are described in the floodplain wetlands ecological system.
Classification Comments: This system combines those known as Boreal Transition Floodplain Forest and Shrub and Boreal Floodplain Forest and Shrub by the Alaska Natural Heritage Program.
Similar Ecological Systems:
- Western North American Boreal Lowland Large River Floodplain Forest and Shrubland (CES105.117)

Related Concepts:
- I.A.1.j - White spruce (closed) (Viereck et al. 1992) Intersecting
- I.A.2.e - White spruce (open) (Viereck et al. 1992) Intersecting
- I.B.1.b - Black cottonwood (Viereck et al. 1992) Intersecting
- I.B.1.c - Balsam poplar (forest) (Viereck et al. 1992) Intersecting
- I.B.1.g - Quaking aspen-balsam poplar (Viereck et al. 1992) Intersecting
- I.B.2.c - Balsam poplar (black cottonwood) (Viereck et al. 1992) Intersecting
- I.B.3.b - Balsam poplar (woodland) (Viereck et al. 1992) Intersecting
- I.C.1.e - Balsam poplar-white spruce (Viereck et al. 1992) Intersecting
- I.C.2.d - Spruce-balsam poplar (Viereck et al. 1992) Intersecting
- II.B.1.a - Willow (closed) (Viereck et al. 1992) Intersecting
- II.B.1.b - Alder (closed) (Viereck et al. 1992) Intersecting
- II.B.1.d - Alder-willow (closed) (Viereck et al. 1992) Intersecting
- II.B.2.a - Willow (open) (Viereck et al. 1992) Intersecting
- II.B.2.b - Alder (open) (Viereck et al. 1992) Intersecting
- II.B.2.d - Alder-willow (open) (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: Floodplains range in width from less then 50 m to over 1 km (Viereck et al. 1986, Witten 2004). The substrate is typically well-drained sand, gravel, or cobble, although finer silts and clays can be found on higher terraces, in ponds, on distal floodplains, and in lower energy systems. Permafrost is usually absent. Oxbows and other wet depressions commonly form on the floodplains, and these sites commonly develop into wetlands.
Vegetation: Primary succession on floodplains begins when new alluvial surfaces are colonized by tree, shrub, and herbaceous species. Common woody species include *Populus balsamifera, Picea glauca, Alnus viridis ssp. sinuata, Alnus incana ssp. tenuifolia, Salix barclayi*, and *Salix alaxensis* (Viereck 1966, Scott 1974, Thilenius 1990, Shephard 1995, Boggs 2000). Common early-seral herbaceous species may include *Lupinus* spp., *Hedysarum* spp., *Equisetum* spp., *Calamagrostis canadensis*, and *Chamerion latifolium* (Viereck 1966, Scott 1974, Thilenius 1990, Shephard 1995, Boggs 2000). The next seral stage includes communities dominated by *Populus balsamifera* and/or *Picea glauca* with an understory of *Alnus viridis ssp. sinuata, Salix* spp., and bryophytes. On dry sites the shrub layer may be dominated by *Shepherdia canadensis, Dryas octopetala, Dryas integrifolia*, and fruticose lichens (*Stereocaulon*

spp.). The tall-shrub component of the early-successional stages diminishes rapidly, probably because of decreased light from the dense tree overstory. *Populus balsamifera* does not regenerate in the understory, and consequently, *Picea glauca* gains dominance in the overstory within 150 years. *Rosa acicularis* and *Viburnum edule* are common understory shrubs on older surfaces.
Dynamics: Frequent river channel migration and associated flooding and fluvial processes constitute the major disturbances in this type (Viereck et al. 1986, Walker et al. 1987). Flooding can be caused by snowmelt, precipitation, ice jams, and glacial runoff. Different rivers or portions of rivers may be more prone to certain types of flooding. Frequent flooding and channel migration create a pattern of gravel bars and early-successional stages across the valley bottom. Sediment deposition raises the surface of the floodplain over time. As the terrace becomes farther removed from the channel, flooding becomes less frequent. Water availability on terraces plays a major role in community structure and composition. Water inputs are from overbank flow (flooding), groundwater, and precipitation. Deposits with high permeability become progressively drier as they are vertically and horizontally removed from the active channels.

Vegetation succession on gravel bars can be represented by the following seral stages: barren or herbaceous, willow or willow-alder, alder, poplar or spruce poplar, spruce. Oxbows and other wet depressions commonly form on the floodplains. Wetland succession and species composition are variable due to diverse environmental conditions such as water depth, substrate and nutrient input. Aquatic bed, marsh, and fen communities are common.

Fire frequency in floodplain systems is less than that of the surrounding terrain because channels can act as firebreaks and early-seral vegetation is less flammable than mature boreal forest. The boreal floodplain system burns more frequently than the boreal transition floodplain system, but we don't have specific information on fire frequency.

DISTRIBUTION

Range: This system occurs along glacially-fed and non-glacially-fed rivers and streams throughout the boreal and boreal transition regions of Alaska.
Divisions: 105:C; 204:C
Nations: US
Subnations: AK
Map Zones: 68:C, 69:C, 70:C, 71:C, 72:?, 73:C, 74:C, 75:C, 76:?
TNC Ecoregions: 70:C, 71:C, 75:?, 76:C, 77:C, 78:C, 79:C

SOURCES

References: Boggs 2000, Scott 1974, Shephard 1995, Thilenius 1990, Viereck 1966, Viereck et al. 1986, Walker et al. 1987, Western Ecology Working Group n.d., Witten 2004
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817494#references
Description Author: T. Boucher after Witten (2004)
Version: 12 Aug 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

WESTERN NORTH AMERICAN BOREAL RIPARIAN STRINGER FOREST AND SHRUBLAND (CES105.144)

CLASSIFIERS

Classification Status: Standard

Primary Division: Montane Boreal (105)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Riparian Mosaic; Floodplain; Boreal [Boreal Subcontinental]
Non-Diagnostic Classifiers: Alluvial terrace
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Mixed evergreen-deciduous open tree canopy
National Mapping Codes: EVT 2616; ESLF 9384; ESP 1616

CONCEPT

Summary: This system occurs throughout the boreal and boreal transition regions of Alaska and is characterized by low-energy riparian communities. These riparian zones are typically narrow bands of forest or shrubs along streams in low-gradient and low-volume drainages. Seasonal overbank flooding may occur, but generally it does not result in shifting channels or gravel bar formation. Common species include *Picea glauca*, *Betula papyrifera*, *Populus balsamifera*, *Alnus* spp., *Salix* spp., *Carex* spp., and *Calamagrostis canadensis*.
Classification Comments: This system combines those known as Boreal Transition Riparian Forest and Shrub Stringer and Boreal Riparian Forest and Shrub Stringer by the Alaska Natural Heritage Program.
Similar Ecological Systems:
- North Pacific Shrub Swamp (CES204.865)

Related Concepts:
- I.A.1.j - White spruce (closed) (Viereck et al. 1992) Intersecting
- I.A.2.e - White spruce (open) (Viereck et al. 1992) Intersecting
- I.B.1.c - Balsam poplar (forest) (Viereck et al. 1992) Intersecting
- I.B.1.d - Paper birch (closed) (Viereck et al. 1992) Intersecting
- I.B.2.a - Paper birch (open) (Viereck et al. 1992) Intersecting
- I.B.2.c - Balsam poplar (black cottonwood) (Viereck et al. 1992) Intersecting
- I.C.1.a - Spruce paper birch (Viereck et al. 1992) Intersecting
- I.C.1.b - White spruce-paper birch-balsam poplar (black cottonwood) (Viereck et al. 1992) Intersecting
- I.C.1.e - Balsam poplar-white spruce (Viereck et al. 1992) Intersecting
- I.C.2.a - Spruce-paper birch (open) (Viereck et al. 1992) Intersecting
- I.C.2.c - Paper birch-balsam poplar-spruce (Viereck et al. 1992) Intersecting
- I.C.2.d - Spruce-balsam poplar (Viereck et al. 1992) Intersecting

DESCRIPTION

Dynamics: Fire may set the system back to an earlier successional stage, though fire frequency is lower in riparian zones than in adjacent sites. Wetter sites may be stable (with shrubs such as *Salix* and *Alnus* and wet herbaceous). Succession on better drained sites is similar to Western North American Boreal White Spruce-Hardwood Forest (CES105.106). Use a fire type model for this system since it does not necessarily have a floodplain succession. Narrow spruce-hardwood stringers often act as firebreaks, but many burned during 2004 and 2005 fire seasons.

DISTRIBUTION

Range: This system occurs throughout the boreal and boreal transition regions of Alaska.
Divisions: 105:C; 204:C
Nations: US
Subnations: AK
Map Zones: 68:C, 69:C, 70:C, 71:C, 72:?, 73:C, 74:C, 75:C, 76:C
TNC Ecoregions: 71:C, 72:C, 74:C, 75:?, 76:C, 77:C, 78:C, 79:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817497#references
Description Author: T. Boucher
Version: 12 Aug 2008
Concept Author: Western Ecology Group and Alaska Natural Heritage Program
Stakeholders: West
ClassifResp: West

WESTERN NORTH AMERICAN BOREAL SEDGE-DWARF-SHRUB BOG (CES105.138)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Shrubland (Shrub-dominated); Boreal [Boreal Subcontinental]; Depressional; Eutrophic Soil; Acidic Soil; Organic Peat (>40 cm); Dwarf-Shrub; Graminoid
FGDC Crosswalk: Vegetated, Shrub-dominated, Dwarf-shrubland, Deciduous dwarf-shrubland
National Mapping Codes: EVT 2619; ESLF 9385; ESP 1619

CONCEPT

Summary: This ecological system occurs in the boreal and boreal transition regions of Alaska and is not associated with permafrost processes. It includes bogs and poor fens (systems with little or no groundwater inputs) with thick (>40 cm) peat deposits. Organic soils are acidic and nutrient-poor. Common species include *Vaccinium oxycoccos (= Oxycoccus microcarpos), Andromeda polifolia, Vaccinium uliginosum, Ledum palustre ssp. decumbens, Ledum groenlandicum, Betula nana, Empetrum nigrum, Carex microglochin, Carex rotundata, Carex rariflora, Carex lasiocarpa, Carex limosa, Carex chordorrhiza, Carex livida, Carex pluriflora, Carex pauciflora, Carex stylosa, Carex membranacea, Eriophorum brachyantherum, Eriophorum angustifolium, Rubus chamaemorus*, and *Drosera* spp. *Sphagnum* spp. are usually abundant in the ground layer.
Classification Comments: This system combines those known as Boreal Transition Sedge-Dwarf-Shrub Bog and Boreal Sedge-Dwarf-Shrub Bog by the Alaska Natural Heritage Program. String bogs and ribbed fens are included in this system.
Related Concepts:
- III.A.3.g - Subarctic lowland sedge-shrub wet meadow (Viereck et al. 1992) Intersecting
- III.A.3.j - Subarctic lowland sedge bog meadow (Viereck et al. 1992) Intersecting
- III.A.3.k - Subarctic lowland sedge-moss bog meadow (Viereck et al. 1992) Intersecting
- III.C.1.a - Wet bryophyte (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: This system includes hydrologically closed bogs and poor fens (systems with little or no groundwater inputs) with thick (>40 cm) peat deposits. Organic soils are acidic and nutrient-poor. It includes basin or blanket bogs. Permafrost is usually absent.
Vegetation: Common species include *Vaccinium oxycoccos (= Oxycoccus microcarpos), Andromeda polifolia, Vaccinium uliginosum, Ledum palustre ssp. decumbens, Ledum groenlandicum, Betula nana, Empetrum nigrum, Carex microglochin, Carex rotundata, Carex rariflora, Carex lasiocarpa, Carex limosa, Carex chordorrhiza, Carex livida, Carex pluriflora, Carex pauciflora, Carex stylosa, Carex membranacea, Eriophorum brachyantherum, Eriophorum angustifolium, Rubus chamaemorus*, and *Drosera* spp. (Gracz et al. 2005). *Sphagnum* spp. are usually abundant in the ground layer.
Dynamics: In boreal wetlands the general successional trend is from marsh to fen to treed bog; however, succession is not necessarily directional, and environmental conditions, such as nutrient content and abundance of groundwater, may prevent fens from developing into bogs (Zoltai et al. 1988). Succession begins in shallow ponds or low-lying wetlands formed by processes such as glacial recession and floodplain dynamics (oxbows) or thermokarst. An organic root mat typically develops and is either anchored to the mineral soil or floating on water such as a pond's edge. Over time, peat-forming mosses and sedges may fill in the basin. As the peat layer develops, low and/or dwarf-shrubs become established. Dwarf-trees may establish on the well-developed peat and also around the margin of the peatland.

Many peatlands on the Kenai Lowland formed in kettles after remnant glacial ice melted. In this region there is a trend toward peatlands drying and ponds shrinking and filling in (Klein et al. 2005).

Permafrost degradation leading to collapse scars and thaw ponds is common in boreal Alaska, and studies from the Tanana Flats show areas of widespread degradation (Racine et al. 1998, Jorgenson et al. 2001a, 2001b, 2003). Thaw ponds form when ice-rich permafrost degrades and collapses forming a basin. Aquatic plants rapidly colonize the pond. Over time, marsh plants and sphagnum moss invade creating peatland conditions. This trend is leading to widespread ecosystem conversion in the Tanana Flats (Jorgenson et al. 2001b). If a collapse scar is isolated, succession follows a bog development model, whereas in an open hydrologic setting, succession follows a fen development model. Pond systems may become connected as adjacent permafrost thaws.

Succession to peatlands can also occur through paludification of previously forested landscapes. Restricted drainage from permafrost development (on inactive alluvial terraces, for example) can lead to the establishment of *Sphagnum* spp. or other peat-forming mosses or sedges, and overtime, peatland plants dominate the site.

DISTRIBUTION

Range: This system occurs in lowlands of the boreal and boreal transition regions of Alaska.
Divisions: 105:C
Nations: US

Subnations: AK
Map Zones: 68:C, 69:C, 70:C, 71:C, 72:?, 73:C, 74:C, 75:C, 76:?
TNC Ecoregions: 71:C, 74:C, 75:C, 76:C, 77:C, 78:C

SOURCES

References: Boggs and Sturdy 2005, Gracz et al. 2005, Jorgenson et al. 2001a, Jorgenson et al. 2001b, Jorgenson et al. 2003, Klein et al. 2005, Racine et al. 1998, Western Ecology Working Group n.d., Zoltai et al. 1988

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817475#references

Description Author: T. Boucher and A. Batten
Version: 11 Aug 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

WESTERN NORTH AMERICAN BOREAL SHRUB AND HERBACEOUS FLOODPLAIN WETLAND (CES105.118)

CLASSIFIERS

Classification Status: Standard

Primary Division: Montane Boreal (105)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Bog and Fen Mosaic; Floodplain; Lowland [Lowland]; Boreal [Boreal Subcontinental]
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Deciduous shrubland
National Mapping Codes: EVT 2617; ESLF 9386; ESP 1617

CONCEPT

Summary: This system occurs within the active and inactive portions of floodplains. Wetlands develop on poorly drained deposits, oxbows, and abandoned channels and are often mosaiced with well-drained floodplain vegetation. Frequent river channel migration and associated flooding and fluvial processes constitute the major disturbances. Wetland succession and species composition are variable due to diverse environmental conditions such as water depth, substrate, and nutrient input. Floodplain wetland vegetation includes the following classes: aquatic bed, freshwater marsh, fen, and wet low shrub. These have been described as unique systems in this classification, but because floodplain wetland dynamics differ from wetland dynamics outside the floodplain, we will consider floodplain wetlands a distinct system and model succession accordingly. Wetland succession beginning in open water can proceed through the following wetland classes: aquatic bed, marsh, wet meadow or fen. Over time, fens can succeed to shrub bogs or wet low shrub. At any stage in succession, flooding can set back the vegetation to open water. Less dramatic changes in hydrology (such as an increase in water table from beaver activity) can reverse the direction of succession. Wetlands can also develop through paludification on poorly drained, fine-textured deposits.
Classification Comments: This system is known as Boreal Floodplain Wetland by the Alaska Natural Heritage Program.
Related Concepts:
- II.C.2.f - Shrub birch-willow (open) low (Viereck et al. 1992) Intersecting
- II.C.2.i - Willow-graminoid shrub bog (Viereck et al. 1992) Intersecting
- II.C.2.j - Sweetgale-graminoid bog (Viereck et al. 1992) Intersecting
- III.A.3.a - Wet sedge meadow tundra (Viereck et al. 1992) Intersecting
- III.A.3.b - Wet sedge-grass meadow tundra (Viereck et al. 1992) Intersecting
- III.A.3.c - Wet sedge-herb meadow tundra (Viereck et al. 1992) Intersecting
- III.A.3.d - Fresh sedge marsh (Viereck et al. 1992) Intersecting
- III.A.3.f - Subarctic lowland sedge wet meadow (Viereck et al. 1992) Intersecting
- III.A.3.j - Subarctic lowland sedge bog meadow (Viereck et al. 1992) Intersecting
- III.A.3.k - Subarctic lowland sedge-moss bog meadow (Viereck et al. 1992) Intersecting
- III.B.3.a - Fresh herb marsh (Viereck et al. 1992) Intersecting
- III.B.3.b - Subarctic lowland herb wet meadow (Viereck et al. 1992) Intersecting
- III.B.3.c - Subarctic lowland herb bog meadow (Viereck et al. 1992) Intersecting
- III.D.1.c - Aquatic buttercup (Viereck et al. 1992) Intersecting
- III.D.1.d - Burreed (Viereck et al. 1992) Intersecting
- III.D.1.e - Water milfoil (Viereck et al. 1992) Intersecting
- III.D.1.f - Fresh pondweed (Viereck et al. 1992) Intersecting
- III.D.1.h - Cryptogam (Viereck et al. 1992) Intersecting

DISTRIBUTION

Range: This system is found in the boreal and boreal transition regions of Alaska.
Divisions: 105:C
Nations: US
Subnations: AK
Map Zones: 68:C, 69:C, 70:C, 71:C, 72:C, 73:C, 74:C, 75:C, 76:C
TNC Ecoregions: 71:C, 72:C, 74:C, 75:?, 76:C, 77:C, 78:C, 79:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817412#references
Description Author: T. Boucher
Version: 08 Aug 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

WESTERN NORTH AMERICAN BOREAL WET BLACK SPRUCE-TUSSOCK WOODLAND (CES105.128)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Permafrost; Saturated Soil; Forest and Woodland (Treed); Boreal [Boreal Subcontinental]; Aquic; Tussock-forming grasses; Picea mariana; Eriophorum vaginatum
Non-Diagnostic Classifiers: Lowland [Lowland]; Carex bigelowii
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2630; ESLF 9387; ESP 1630

CONCEPT

Summary: This ecological system is common throughout boreal Alaska on north-facing slopes, gentle hills, and inactive alluvial surfaces underlain by permafrost. Soils are poorly drained and consist of tussocks over peat or mineral soil. *Picea mariana* is the dominant overstory species in an open to woodland canopy. Tussock-forming sedges contribute at least 25% of the vegetation cover. Common understory shrubs include *Betula nana, Ledum palustre ssp. decumbens, Ledum groenlandicum, Vaccinium uliginosum*, and *Vaccinium vitis-idaea*. Herbaceous species include *Eriophorum vaginatum, Carex bigelowii*, and *Rubus chamaemorus*. Mosses may be abundant and include *Sphagnum* spp. and *Hylocomium splendens*.
Classification Comments: This system is known as Boreal Black Spruce Tussock by the Alaska Natural Heritage Program.
Related Concepts:
- I.A.3.d - Black spruce (woodland) (Viereck et al. 1992) Intersecting
- II.A.3.a - Black spruce scrub (woodland) (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: This ecological system is common throughout boreal Alaska on north-facing slopes, gentle hills, and inactive alluvial surfaces underlain by permafrost. Soils are poorly drained and consist of tussocks over peat or mineral soil (Jorgenson et al. 2001a, Boggs and Sturdy 2005).
Vegetation: *Picea mariana* is the dominant overstory species in an open to woodland canopy. Tussock-forming sedges contribute at least 25% of the vegetation cover. Common understory shrubs include *Betula nana, Ledum palustre ssp. decumbens, Ledum groenlandicum, Vaccinium uliginosum,* and *Vaccinium vitis-idaea*. Herbaceous species include *Eriophorum vaginatum, Carex bigelowii,* and *Rubus chamaemorus*. Mosses may be abundant and include *Sphagnum* spp. and *Hylocomium splendens* (Jorgenson et al. 2001a, Boggs and Sturdy 2005).
Dynamics: Two possible disturbance cycles are thermokarst or burn model (grass-tussock sedge, tussock low shrub, black spruce tussock low shrub).

DISTRIBUTION

Range: This system is common throughout lowlands of boreal Alaska.
Divisions: 105:C
Nations: US
Subnations: AK
Map Zones: 69:?, 70:C, 71:C, 73:C, 74:C, 75:C, 76:?
TNC Ecoregions: 76:C, 77:C, 78:C

SOURCES

References: Boggs and Sturdy 2005, Jorgenson et al. 2001a, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817442#references
Description Author: T. Boucher
Version: 08 Aug 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

HERBACEOUS WETLAND

ACADIAN COASTAL SALT MARSH (CES201.578)

CLASSIFIERS

Classification Status: Standard

Primary Division: Laurentian-Acadian (201)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Saltwater (Polyhaline); Tidal / Estuarine; Graminoid; Spartina (patens, alterniflora)
Non-Diagnostic Classifiers: Moderate (100-500 yrs) Persistence; Long (>500 yrs) Persistence; Herbaceous; Organic Peat (>40 cm); Mineral: W/ A-Horizon >10 cm
National Mapping Codes: ESLF 9278

CONCEPT

Summary: This system ranges from northern Massachusetts on the Gulf of Maine north to Newfoundland, along the immediate ocean shore and near estuary mouths, where salinity regime is polyhaline. Sometimes called "salt meadows," these marshes display strong graminoid dominance, with patchy forbs. *Spartina patens* and *Spartina alterniflora* are the major dominants. Characteristic associates include *Puccinellia maritima, Juncus balticus, Plantago maritima var. juncoides (= Plantago juncoides)*, and *Juncus gerardii*. These marshes may be extensive where the local topography allows their development; they are generally not associated with sand beach and dune systems, being more characteristic of the primarily rocky portions of the Gulf of Maine coast. Where the coastal topography becomes more dissected, they are more commonly seen as a fairly narrow fringe along tidal shorelines. These marshes are typically less extensive and with some different floristic elements than the marshes southward along the Atlantic Coast from Cape Cod to Chesapeake Bay.

Similar Ecological Systems:
- Northern Atlantic Coastal Plain Tidal Salt Marsh (CES203.519)

Related Concepts:
- Mixed Graminoid - Forb Saltmarsh (Gawler and Cutko 2010) Finer
- Spartina Saltmarsh (Gawler and Cutko 2010) Finer

DESCRIPTION

Environment: Forms behind barrier beaches or at the outer mouths of tidal rivers where freshwater input is minimal and where vegetation is protected from high-energy wave action. Substrate is organic peat, which can reach 1-2 m in depth in low marsh.
Dynamics: Tidal flooding is regulated by elevation; flooding is diurnal in low marshes, decreasing to more irregular flooding in high marsh and fringing salt shrublands. Ponded water remains in depressions, causing hypersaline conditions and panne formation. In the northern portion of the range, ice-rafting of large boulders creates a barrier, behind which salt marshes form. Ice-scour causes substantial impacts on the structure of salt marshes, causing patches of marsh to be removed. Furrows and ridges are physical features formed by ice movement. Strong onshore wind causes berm development in winter, with a transition to offshore winds in summer that level the berms. Such processes result in a substantial amount of sediment transport. Large amounts of wrack are deposited annually. Geese also impact the marshes (Roberts and Robertson 1986).

Component Associations:
- *Ascophyllum nodosum - Fucus vesiculosus* Tidal Algal Nonvascular Vegetation (CEGL006341, GNR)
- *Ruppia maritima* Acadian/Virginian Zone Temperate Herbaceous Vegetation (CEGL006167, GNR)
- *Salicornia (virginica, bigelovii, maritima) - Spartina alterniflora* Herbaceous Vegetation (CEGL004308, G5)
- *Spartina alterniflora / (Ascophyllum nodosum)* Acadian/Virginian Zone Herbaceous Vegetation (CEGL004192, G5)
- *Spartina patens - Distichlis spicata - (Juncus gerardii)* Herbaceous Vegetation (CEGL006006, G5)

DISTRIBUTION

Range: This system occurs along the coastline of the Gulf of Maine, from northern Massachusetts north and east to Newfoundland, with the northern border at the Strait of Belle Isle between Labrador and Newfoundland.
Divisions: 201:C; 202:C
Nations: CA, US
Subnations: LB, MA, ME, NB, NF, NH, NS
Map Zones: 65:C, 66:C
USFS Ecomap Regions: 211Cb:CCC, 211Db:CCC, 211Dc:CCC, 221Aa:CCC, 221Ak:CCC
TNC Ecoregions: 62:C, 63:C

SOURCES

References: Chapman 1937, Comer et al. 2003, Faber-Langendoen et al. 2011, Gawler and Cutko 2010, Jevrejeva et al. 2010, Kennish 2001, Manomet Center for Conservation Sciences and the National Wildlife Federation 2012, Roberts and Robertson 1986,

Vermeer and Rahmstorg 2009

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723027#references

Description Author: S.C. Gawler, mod. L.A. Sneddon

Version: 14 Jan 2014 **Stakeholders:** Canada, East

Concept Author: S.C. Gawler **ClassifResp:** East

ACADIAN ESTUARY MARSH (CES201.579)

CLASSIFIERS

Classification Status: Standard

Primary Division: Laurentian-Acadian (201)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Brackish (Mesohaline); Tidal / Estuarine; Graminoid; Spartina (patens, alterniflora)
Non-Diagnostic Classifiers: Moderate (100-500 yrs) Persistence; Herbaceous; Organic Peat (>40 cm); Mineral: W/ A-Horizon >10 cm
National Mapping Codes: ESLF 9292

CONCEPT

Summary: This brackish marsh system is found along mesohaline reaches of estuaries of the Gulf of Maine north to southern Newfoundland. Emergent and submergent vegetation characterizes this system. Dominance ranges from extensive grasslands to sparsely vegetated mudflats, all tidally influenced. Characteristic species include *Carex paleacea, Crassula aquatica, Juncus arcticus, Lilaeopsis chinensis, Limosella australis, Samolus valerandi ssp. parviflorus (= Samolus parviflorus), Schoenoplectus robustus, Schoenoplectus tabernaemontani, Spartina pectinata*, and *Triglochin maritima*. These marshes grade into the salt marsh system at the mouth of estuaries. They are typically less extensive and more floristically depauperate than the marshes southward along the Atlantic Coast to Chesapeake Bay.
Classification Comments: Differences between marshes in Division 202 and Division 201 may be sufficient to distinguish them as separate systems; however, data on estuarine marshes in Division 201 (Laurentian-Acadian) is very sketchy and should be better documented before such a split is made.
Similar Ecological Systems:
- Northern Atlantic Coastal Plain Brackish Tidal Marsh (CES203.894)--occurs to the south.
- Northern Atlantic Coastal Plain Fresh and Oligohaline Tidal Marsh (CES203.516)--occurs upriver to the limit of tidal influence.

Related Concepts:
- Brackish Tidal Marsh (Gawler and Cutko 2010) Finer

DESCRIPTION

Environment: This vegetation develops on tidal reaches of large rivers where freshwater from inland alluvial inputs mixes with marine saltwater incursion. Salinity levels are variable but generally range from 0.5 to 18 ppt. These marshes most commonly form on freely drained river levees. The substrate is moderately consolidated peat (Barrett 1989).
Dynamics: Tidal flooding by mesohaline waters; alluvial deposition of sediments forms levees where this vegetation develops.

Component Associations:
- *Alnus (incana ssp. rugosa, serrulata) - Cornus amomum* Shrubland (CEGL006337, GNR)
- *Amaranthus cannabinus* Tidal Herbaceous Vegetation (CEGL006080, G3G5)
- *Sagittaria subulata - Limosella australis* Tidal Herbaceous Vegetation (CEGL004473, G2G4)
- *Schoenoplectus pungens* Tidal Herbaceous Vegetation (CEGL004188, GNR)
- *Stuckenia pectinata - Potamogeton perfoliatus - (Zannichellia palustris)* Tidal Herbaceous Vegetation (CEGL006027, G3G5)
- *Typha angustifolia - Hibiscus moscheutos* Herbaceous Vegetation (CEGL004201, G4G5)

DISTRIBUTION

Range: This system is found along the coastline of the Gulf of Maine, from Cape Cod north and east to southern Newfoundland, extending upstream in estuaries to the brackish water limit.
Divisions: 201:C; 202:C
Nations: CA, US
Subnations: MA, ME, NB, NF, NH, NS
Map Zones: 65:C, 66:C
USFS Ecomap Regions: 211Cb:CCC, 211Db:CCC, 211Dc:CCC, 221Aa:CCC, 221Ak:CCC
TNC Ecoregions: 62:C, 63:C

SOURCES

References: Angradi et al. 2001, Barrett 1989, Comer et al. 2003, Faber-Langendoen et al. 2011, Roberts and Robertson 1986
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723026#references
Description Author: S.C. Gawler, mod. L.A. Sneddon
Version: 14 Jan 2014
Concept Author: S.C. Gawler
Stakeholders: Canada, East
ClassifResp: East

ALASKA ARCTIC COASTAL BRACKISH MEADOW (CES102.210)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Arctic (102)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Estuary; Polar [Polar Hyperoceanic]; Salt Spray; Graminoid; Delta
Non-Diagnostic Classifiers: Marsh; Herbaceous; Mineral: W/ A-Horizon <10 cm
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2712; ESLF 9414; ESP 1712

CONCEPT

Summary: This coastal brackish meadow system typically occurs immediately above tidal marshes in arctic Alaska. It has >25% herbaceous cover and <25% shrub cover. These sites are tidally inundated during storm tides and extreme high tides and, consequently, are brackish. The soils typically lack organics, and permafrost is uncommon. The main indicators on the Yukon-Kuskokwim Delta and the Kotzebue Sound lowlands ecoregions are *Carex rariflora* (>10%), *Calamagrostis deschampsioides*, and *Dendranthema arcticum (= Chrysanthemum arcticum)*. Other common species include *Eriophorum russeolum, Carex ramenskii* (usually present but not dominant), and *Salix ovalifolia*. Additional dominants on the Beaufort Coastal Plain are *Eriophorum angustifolium, Carex aquatilis*, and *Dupontia fisheri*.
Classification Comments: This system is known as Coastal Brackish Meadow by the Alaska Natural Heritage Program.
Related Concepts:
- III.A.3.i - Halophytic sedge wet meadow (Viereck et al. 1992) Broader

DESCRIPTION

Dynamics: This system's disturbance processes and succession have not been described.

DISTRIBUTION

Range: This system occurs along Alaska's arctic coastline, from the Bristol Bay lowlands in southwestern Alaska to the North Slope on the Arctic Ocean.
Divisions: 102:C; 104:C
Nations: US
Subnations: AK
Map Zones: 67:C, 68:C, 72:C, 76:C
TNC Ecoregions: 73:C, 74:C, 75:C, 79:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818277#references
Description Author: K. Boggs
Version: 09 Oct 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKA ARCTIC FRESHWATER AQUATIC BED (CES102.182)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Arctic (102)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Lake; Pond; Herbaceous; Polar [Polar Oceanic]; Aquatic Herb
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - forbland, Hydromorphic-rooted grassland
National Mapping Codes: EVT 2696; ESLF 9415; ESP 1696

CONCEPT

Summary: This system is found throughout arctic Alaska as small patches confined to lakes and ponds. In large bodies of water, it is usually restricted to the littoral region where penetration of light is the limiting factor for growth. Large to small floodplains support the various wetlands that form in oxbows, wet depressions, low-lying areas, and abandoned channels, including freshwater aquatic beds. This system has standing water (typically more than 30 cm deep) with >25% cover of submerged or floating aquatic species, including *Potamogeton* spp., *Sparganium* spp., aquatic *Ranunculus* spp., *Myriophyllum* spp., and *Callitriche* spp.
Classification Comments: This system includes the systems known as Freshwater Aquatic Bed and Floodplain Freshwater Aquatic Bed by the Alaska Natural Heritage Program. The proposed floodplain aquatic bed ecological system will not be mappable from non-floodplain aquatic beds, and will be better treated as a component of this system. For now, aquatic beds found in arctic Alaska floodplains are included in this non-floodplain aquatic bed system.
Similar Ecological Systems:
- Aleutian Freshwater Aquatic Bed (CES105.234)
- North American Boreal Freshwater Aquatic Bed (CES103.125)

Related Concepts:
- III.D.1.a - Pondlily (Viereck et al. 1992) Intersecting
- III.D.1.b - Common marestail (Viereck et al. 1992) Intersecting
- III.D.1.c - Aquatic buttercup (Viereck et al. 1992) Intersecting
- III.D.1.d - Burreed (Viereck et al. 1992) Intersecting
- III.D.1.e - Water milfoil (Viereck et al. 1992) Intersecting
- III.D.1.f - Fresh pondweed (Viereck et al. 1992) Intersecting
- III.D.1.g - Water star-wort (Viereck et al. 1992) Intersecting
- III.D.1.h - Cryptogam (Viereck et al. 1992) Intersecting
- III.D.2.a - Four-leaf marestail (Viereck et al. 1992) Intersecting

DESCRIPTION

Dynamics: Freshwater aquatic beds are early-successional wetlands and will likely be replaced by marshes, wet meadows, fens, or permafrost plateaus. The rate of succession is unclear. In floodplains, primary succession on the Yukon-Kuskokwim Delta may move rapidly from aquatic bed to marsh to wet sedge and, possibly, wet low-tall shrub. An alternate wetland pathway is mesic sites supporting low or tall willows moving to wet low-tall shrub to wet sedge to tussocks, but this last stage is no longer part of floodplain dynamics. Primary succession on the Beaufort Coastal Plain progresses slowly from gravel bars to tall willow (possibly persisting for 300 years) or alder-willow, then to wet low willow (possibly persisting for 500 years). Paludification may lead to wet sedge (possibly persisting for 1000-2000 years), and permafrost formation may lead to tussock tundra, but this last stage is no longer part of the floodplain dynamics.

DISTRIBUTION

Range: This system occurs throughout arctic Alaska, from the Bristol Bay lowlands in southwestern Alaska to the North Slope on the Arctic Ocean.
Divisions: 102:C; 104:C
Nations: US
Subnations: AK
Map Zones: 67:C, 68:C, 69:C, 72:C, 76:C
TNC Ecoregions: 73:C, 74:C, 75:C, 79:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818215#references
Description Author: K. Boggs
Version: 09 Oct 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKA ARCTIC PENDANTGRASS FRESHWATER MARSH (CES102.183)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Arctic (102)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Lowland; Herbaceous; Polar [Polar Oceanic]; Aquic; Arctophila fulva
Non-Diagnostic Classifiers: Lake; Pond; Depressional; Riverine / Alluvial
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2697; ESLF 9416; ESP 1697

CONCEPT

Summary: Freshwater marshes dominated by *Arctophila fulva* occur as small patches throughout arctic Alaska, typically on the margins of ponds and lakes. They are semipermanently flooded, but some have seasonal flooding, and the water depth typically exceeds 10 cm. It is also found on large to small floodplains where various wetlands form in oxbows, wet depressions, low-lying areas, and abandoned channels, including freshwater marshes. Soils are muck or mineral, and water is nutrient-rich. In floodplains, permafrost is absent. This system has standing water with >10% cover of emergent herbaceous vegetation, primarily *Arctophila fulva*. Species diversity is low.
Classification Comments: This system includes those types known as Freshwater Marsh- *Arctophila fulva* and Floodplain Freshwater Marsh by the Alaska Natural Heritage Program. It is proposed to classify a separate floodplain freshwater marsh, but mapping and modeling of that as its own system is difficult. For now, marshes found in arctic Alaska floodplains are included in either this non-floodplain marsh system or in Alaska Arctic Sedge Freshwater Marsh (CES102.184).
Similar Ecological Systems:
- Alaska Arctic Sedge Freshwater Marsh (CES102.184)
- Aleutian Freshwater Marsh (CES105.235)

Related Concepts:
- III.A.3.e - Fresh grass marsh (Viereck et al. 1992) Broader

DESCRIPTION

Dynamics: This system occurs within a variety of successional processes, including thaw lakes, ice-wedge polygons, and oriented lakes. Seral stages and the rate of succession are unclear. In floodplains, primary succession on the Yukon-Kuskokwim Delta may move rapidly from aquatic bed to marsh to wet sedge and, possibly, wet low-tall shrub. An alternate wetland pathway is mesic sites supporting low or tall willows moving to wet low-tall shrub to wet sedge to tussocks, but this last stage is no longer part of floodplain dynamics. Primary succession on the Beaufort Coastal Plain progresses slowly from gravel bars to tall willow (possibly persisting for 300 years) or alder-willow, then to wet low willow (possibly persisting for 500 years). Paludification may lead to wet sedge (possibly persisting for 1000-2000 years), and permafrost formation may lead to tussock tundra, but this last stage is no longer part of the floodplain dynamics.

DISTRIBUTION

Range: This system occurs throughout arctic Alaska, from the Bristol Bay lowlands in southwestern Alaska to the North Slope on the Arctic Ocean.
Divisions: 102:C; 104:C
Nations: CA, US
Subnations: AK
Map Zones: 67:C, 68:C, 69:C, 72:C, 76:C
TNC Ecoregions: 73:C, 74:C, 75:C, 79:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818219#references
Description Author: K. Boggs
Version: 10 Dec 2008 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKA ARCTIC POLYGONAL GROUND TUSSOCK TUNDRA (CES102.204)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Arctic (102)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Ice-Wedge Polygons; Polar [Polar Oceanic]; Shallow Soil; Silt Soil Texture; Graminoid; Tussock-forming grasses
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2707; ESLF 9417; ESP 1707

CONCEPT

Summary: Ice-wedge polygons and the thaw-lake cycle dominate the Beaufort Coastal Plain ecoregion. The ice-wedge polygons generally occur on level surfaces (0- to 2-degree slopes), and the ice wedges may be 2 m wide at the top. Polygon diameter ranges from several to more than 30 m. In addition to the Beaufort Coastal Plain, ice-wedge polygons are a common feature on level ground within foothills and mountains, on glacial drift, lacustrine and floodplain terrace surficial deposits. These sites are cold, poorly drained, and underlain by mesic, silty mineral soils with a shallow surface organic layer surrounding the tussocks. Permafrost is present. Patch size is small to large. This ecological system occurs primarily on high-center polygons. Their centers are commonly mesic, dominated by tussocks, and their perimeters are typically wet, supporting wet sedges. *Eriophorum vaginatum* is the primary tussock-former in most sites, but *Carex bigelowii* may dominate some sites. *Calamagrostis canadensis, Arctagrostis latifolia*, and *Chamerion latifolium* may be common. Shrubs include *Betula nana, Ledum palustre ssp. decumbens*, and *Vaccinium* spp. Common mosses include *Sphagnum* spp., *Polytrichum strictum*, and *Hylocomium splendens*. The wet perimeters typically support *Carex aquatilis* and *Eriophorum angustifolium*.
Related Concepts:
- III.A.2.d - Tussock tundra (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: Ice-wedge polygons and the thaw-lake cycle dominate the Beaufort Coastal Plain ecoregion. The ice-wedge polygons generally occur on level surfaces (0- to 2-degree slopes), and the ice wedges may be 2 m wide at the top. Polygon diameter ranges from several to more than 30 m. In addition to the Beaufort Coastal Plain, ice-wedge polygons are a common feature on level ground within foothills and mountains, on glacial drift, lacustrine and floodplain terrace surficial deposits. These sites are cold, poorly drained, and underlain by mesic, silty mineral soils with a shallow surface organic layer surrounding the tussocks (Viereck et al. 1992). Permafrost is present. Patch size is small to large.
Vegetation: This ecological system occurs primarily on high-center polygons. Their centers are commonly mesic, dominated by tussocks, and their perimeters are typically wet, supporting wet sedges. *Eriophorum vaginatum* is the primary tussock-former in most sites, but *Carex bigelowii* may dominate some sites. *Calamagrostis canadensis, Arctagrostis latifolia*, and *Chamerion latifolium* may be common. Shrubs include *Betula nana, Ledum palustre ssp. decumbens*, and *Vaccinium* spp. Common mosses include *Sphagnum* spp., *Polytrichum strictum*, and *Hylocomium splendens*. The wet perimeters typically support *Carex aquatilis* and *Eriophorum angustifolium*.
Dynamics: Ice-wedge polygons are formed by large ice wedges which grow in thermal contraction cracks in permafrost. High-center polygons indicate that erosion, deposition, or thawing are more prevalent than the up-pushing of the sediments along the sides of the wedge. Ice-wedge polygons are typically part of a spatially coarser thaw-lake cycle.

Most of the land on the Beaufort Coastal Plain (Nowacki et al. (2001) ecoregion 1) is polygonal ground and pond complexes. To be able to model and map polygonal ground systems in this region, first mask out lakes, ponds, floodplains and tidal marshes. Then, use only land with less than a 2-degree slope as being polygonal ground.

DISTRIBUTION

Range: This system is typically found in the lowland regions of arctic Alaska, particularly on the Beaufort Coastal Plain in northern Alaska, and the Kotzebue Sound lowlands of west-central Alaska, but it also occurs in other scattered locations of arctic Alaska where there ice-wedge processes occur.
Divisions: 102:C; 104:C
Nations: CA, US
Subnations: AK
Map Zones: 67:C, 68:C, 69:C, 72:?
TNC Ecoregions: 73:C, 75:C, 79:C

SOURCES

References: Nowacki et al. 2001a, Viereck et al. 1992, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818259#references

Description Author: K. Boggs
Version: 09 Oct 2008
Concept Author: Western Ecology Group and Alaska Natural Heritage Program

Stakeholders: Canada, West
ClassifResp: West

ALASKA ARCTIC POLYGONAL GROUND WET SEDGE TUNDRA (CES102.203)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Arctic (102)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Ice-Wedge Polygons; Polar [Polar Oceanic]; Graminoid; Eriophorum angustifolium
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2706; ESLF 9418; ESP 1706

CONCEPT

Summary: Ice-wedge polygons and the thaw-lake cycle dominate the Beaufort Coastal Plain ecoregion. The ice-wedge polygons generally occur on level surfaces (0- to 2-degree slopes), and the ice wedges may be 2 m wide at the top. Polygon diameter ranges from several to more than 30 m. In addition to the Beaufort Coastal Plain, ice-wedge polygons are a common feature on level ground within foothills and mountains, on glacial drift, lacustrine and floodplain terrace surficial deposits. This system typically occurs on low-center polygons. The polygon centers have standing water, marsh and wet sedge vegetation, primarily *Carex aquatilis* and *Eriophorum angustifolium*. The polygon perimeters typically support wet sedge vegetation also dominated by *Carex aquatilis* and *Eriophorum angustifolium*. More elevated perimeters support low shrubs and tussocks. Common shrubs include *Betula nana, Salix pulchra, Ledum palustre ssp. decumbens, Vaccinium vitis-idaea, Vaccinium uliginosum,* and *Empetrum nigrum*. *Eriophorum vaginatum* is the primary tussock-former in most sites, but *Carex bigelowii* may dominate some sites. Common mosses include *Sphagnum* spp., *Polytrichum strictum*, and *Hylocomium splendens*.

Related Concepts:

- III.A.3.a - Wet sedge meadow tundra (Viereck et al. 1992) Intersecting
- III.A.3.b - Wet sedge-grass meadow tundra (Viereck et al. 1992) Intersecting
- III.A.3.c - Wet sedge-herb meadow tundra (Viereck et al. 1992) Intersecting
- III.A.3.f - Subarctic lowland sedge wet meadow (Viereck et al. 1992) Intersecting
- III.A.3.g - Subarctic lowland sedge-shrub wet meadow (Viereck et al. 1992) Intersecting
- III.A.3.j - Subarctic lowland sedge bog meadow (Viereck et al. 1992) Intersecting
- III.B.3.b - Subarctic lowland herb wet meadow (Viereck et al. 1992) Intersecting

DESCRIPTION

Dynamics: Ice-wedge polygons are formed by large ice wedges which grow in thermal contraction cracks in permafrost. Low-center polygons indicate that ice wedges are actually growing and that sediments are being actively upturned. High-center polygons indicate that erosion, deposition, or thawing are more prevalent than the up-pushing of the sediments along the sides of the wedge. Ice-wedge polygons are typically part of a spatially coarser thaw-lake cycle.

Most of the land on the Beaufort Coastal Plain (Nowacki et al. (2001) ecoregion 1) is polygonal ground and pond complexes. To be able to model and map polygonal ground systems in this region, first mask out lakes, ponds, floodplains and tidal marshes. Then, use only land with less than a 2-degree slope as being polygonal ground.

DISTRIBUTION

Range: This system is typically found in the lowland regions of arctic Alaska, particularly on the Beaufort Coastal Plain in northern Alaska, and the Kotzebue Sound lowlands of west-central Alaska, but it also occurs in other scattered locations of arctic Alaska where there ice-wedge processes occur.
Divisions: 102:C; 104:C
Nations: CA, US
Subnations: AK
Map Zones: 67:C, 68:C, 69:C, 72:?
TNC Ecoregions: 73:C, 75:C, 79:C

SOURCES

References: Nowacki et al. 2001a, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818256#references
Description Author: K. Boggs
Version: 09 Oct 2008 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKA ARCTIC SEDGE FRESHWATER MARSH (CES102.184)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Arctic (102)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Herbaceous; Polar [Polar Oceanic]
Non-Diagnostic Classifiers: Floodplain; Lake; Pond
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2705; ESLF 9419; ESP 1705

CONCEPT

Summary: Freshwater marshes occur as small patches throughout arctic Alaska, typically on the margins of ponds, lakes and beaded streams. This system is also found on large to small floodplains where various wetlands form in oxbows, wet depressions, low-lying areas, and abandoned channels, including freshwater marshes. Soils are muck or mineral, and water is nutrient-rich. In floodplains, permafrost is absent. This system typically has standing water. It is often dominated by *Carex aquatilis* or *Eriophorum angustifolium*, but other emergent species may occur, including *Comarum palustre, Hippuris vulgaris, Carex utriculata, Menyanthes trifoliata, Lysimachia thyrsiflora*, and *Equisetum fluviatile*.
Classification Comments: This system includes those types known as Freshwater Marsh- *Carex aquatilis* and Floodplain Freshwater Marsh by the Alaska Natural Heritage Program. It is proposed to classify a separate floodplain freshwater marsh, but mapping and modeling of that as its own system is difficult. For now, marshes found in arctic Alaska floodplains are included in either this non-floodplain marsh system or in Alaska Arctic Pendantgrass Freshwater Marsh (CES102.183).
Similar Ecological Systems:
- Alaska Arctic Pendantgrass Freshwater Marsh (CES102.183)
- Aleutian Freshwater Marsh (CES105.235)

Related Concepts:
- III.A.3.b - Wet sedge-grass meadow tundra (Viereck et al. 1992) Intersecting
- III.A.3.c - Wet sedge-herb meadow tundra (Viereck et al. 1992) Intersecting
- III.A.3.f - Subarctic lowland sedge wet meadow (Viereck et al. 1992) Intersecting

DESCRIPTION

Dynamics: This system occurs within a variety of successional processes, including thaw lakes, ice-wedge polygons, and oriented lakes. Seral stages and the rate of succession are unclear. In floodplains, primary succession on the Yukon-Kuskokwim Delta may move rapidly from aquatic bed to marsh to wet sedge and, possibly, wet low-tall shrub. An alternate wetland pathway is mesic sites supporting low or tall willows moving to wet low-tall shrub to wet sedge to tussocks, but this last stage is no longer part of floodplain dynamics. Primary succession on the Beaufort Coastal Plain progresses slowly from gravel bars to tall willow (possibly persisting for 300 years) or alder-willow, then to wet low willow (possibly persisting for 500 years). Paludification may lead to wet sedge (possibly persisting for 1000-2000 years), and permafrost formation may lead to tussock tundra, but this last stage is no longer part of the floodplain dynamics.

DISTRIBUTION

Range: This system occurs throughout arctic Alaska, from the Bristol Bay lowlands in southwestern Alaska to the North Slope on the Arctic Ocean.
Divisions: 102:C; 104:C
Nations: CA, US
Subnations: AK
Map Zones: 67:C, 68:C, 69:C, 72:C, 76:C
TNC Ecoregions: 73:C, 74:C, 75:C, 79:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818234#references
Description Author: K. Boggs
Version: 10 Dec 2008 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKA ARCTIC TIDAL MARSH (CES102.209)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Arctic (102)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Saline Water Chemistry; Estuary; Herbaceous; Tidal / Estuarine; Graminoid
Non-Diagnostic Classifiers: Brackish (Mesohaline); Lagoon; Marsh
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2711; ESLF 9420; ESP 1711

CONCEPT

Summary: This system consists of herbaceous marshes with >10% vascular species cover that are subject to regular tidal inundation. The marshes are salt or brackish. Some are primarily freshwater that are infrequently flooded during storm surges or extreme high tides. Tidal marshes are primarily associated with estuaries or coastal lagoons or other locations protected from wave action. Two different types of tidal marshes are included in this system: tidal sedge marshes and tidal herbaceous (non-sedge) marshes. *Carex ramenskii* or *Carex subspathacea* dominate the tidal sedge marshes. *Carex subspathacea* is more common along the Beaufort Sea. *Carex lyngbyei* may dominate on portions of the Yukon-Kuskokwim Delta and is often found more inland or adjacent to tidal creeks. *Dupontia fisheri* and *Puccinellia* spp. dominate the tidal herbaceous marshes. *Argentina egedii (= Potentilla egedii)* may dominate on Alaska's west coast but not on the Beaufort Coastal Plain.

Tidal marshes often form an ecotone with freshwater non-tidal wetlands, especially on the Yukon-Kuskokwim Delta. On this delta, the first system moving inland is tidal marsh (*Puccinellia* spp. then *Carex ramenskii* or *Carex subspathacea*), then Alaska Arctic Coastal Brackish Meadow (CES102.210) (*Carex rariflora, Calamagrostis deschampsioides*, and *Dendranthema arcticum (= Chrysanthemum arcticum)*), then Alaska Arctic Coastal Sedge-Dwarf-Shrubland (CES102.211) (*Empetrum nigrum, Salix fuscescens, Salix ovalifolia, Carex rariflora, Calamagrostis deschampsioides, Deschampsia caespitosa*), and then raised bogs or permafrost plateaus supporting Alaska Arctic Dwarf-Shrub-Sphagnum Peatland (CES102.201) or Alaska Arctic Permafrost Plateau Dwarf-Shrub Lichen Tundra (CES102.202).

Classification Comments: This system is known as Tidal Marsh by the Alaska Natural Heritage Program. This system is very similar in composition and processes to the Aleutian tidal marsh system; for now they are maintained as two distinct systems, but may be merged in the future.

Similar Ecological Systems:
- Aleutian Tidal Marsh (CES105.279)

Related Concepts:
- III.A.3.h - Halophytic grass wet meadow (Viereck et al. 1992) Intersecting
- III.A.3.i - Halophytic sedge wet meadow (Viereck et al. 1992) Intersecting
- III.B.3.d - Halophytic herb wet meadow (Viereck et al. 1992) Intersecting
- III.D.2.a - Four-leaf marestail (Viereck et al. 1992) Intersecting

DESCRIPTION

Dynamics: This system's disturbance processes and succession have not been described.

DISTRIBUTION

Range: This system occurs along Alaska's arctic coastline, from the Bristol Bay lowlands in southwestern Alaska to the North Slope on the Arctic Ocean.
Divisions: 102:C; 104:C
Nations: US
Subnations: AK
Map Zones: 67:C, 68:C, 72:C, 76:C
TNC Ecoregions: 73:C, 74:C, 75:C, 79:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818274#references
Description Author: K. Boggs
Version: 09 Oct 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKA ARCTIC TUSSOCK TUNDRA (CES102.179)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Arctic (102)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Polar [Polar Oceanic]; Graminoid; Tussock-forming grasses; Eriophorum vaginatum
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2694; ESLF 9421; ESP 1694

CONCEPT

Summary: Tussock tundra is common in valleys and slopes throughout arctic Alaska. These sites are cold, poorly drained, and underlain by mesic, silty mineral soils with a shallow surface organic layer surrounding the tussocks. Permafrost is present. Patch size is small to large. Tussock tundra has >35% cover of sedges in a tussock growth form; the combined cover of dwarf- and low shrubs is <25%, and lichen cover is <25%. *Eriophorum vaginatum* is the primary tussock-former in most stands, but *Carex bigelowii* may dominate some sites. *Calamagrostis canadensis, Arctagrostis latifolia,* and *Chamerion latifolium (= Epilobium latifolium)* may be common. Shrubs include *Betula nana, Ledum palustre ssp. decumbens,* and *Vaccinium* spp. Mosses (*Sphagnum* spp., *Polytrichum strictum*, and *Hylocomium splendens*) may form a nearly continuous mat between tussocks. There are also distinctions between acidic and non-acidic tussock tundra. Acidic sites have more ericaceous shrubs and *Sphagnum* and less *Eriophorum* spp., *Betula nana*, and *Carex bigelowii*. Acidic sites also have more organic matter buildup and the tussocks tend to be larger.
Classification Comments: This system is known as Tussock Tundra by the Alaska Natural Heritage Program.
Related Concepts:
- III.A.2.d - Tussock tundra (Viereck et al. 1992) Broader

DESCRIPTION

Environment: Tussock tundra is common in valleys and slopes throughout arctic Alaska. These sites are cold, poorly drained, and underlain by mesic, silty mineral soils with a shallow surface organic layer surrounding the tussocks (Viereck et al. 1992). Permafrost is present. Patch size is small to large.
Vegetation: Tussock tundra has >35% cover of sedges in a tussock growth form; the combined cover of dwarf- and low shrubs is <25%, and lichen cover is <25%. *Eriophorum vaginatum* is the primary tussock-former in most stands, but *Carex bigelowii* may dominate some sites. *Calamagrostis canadensis, Arctagrostis latifolia,* and *Chamerion latifolium (= Epilobium latifolium)* may be common. Shrubs include *Betula nana, Ledum palustre ssp. decumbens,* and *Vaccinium* spp. Mosses (*Sphagnum* spp., *Polytrichum strictum*, and *Hylocomium splendens*) may form a nearly continuous mat between tussocks. There are also distinctions between acidic and non-acidic tussock tundra. Acidic sites have more ericaceous shrubs and *Sphagnum* and less *Eriophorum* spp., *Betula nana*, and *Carex bigelowii*. Acidic sites also have more organic matter buildup and the tussocks tend to be larger.
Dynamics: According to lake-core records, the fire-return interval is approximately 240 years on the Seward Peninsula and 1000+ years on the Beaufort Coastal Plain (J. Allen pers. comm.). These figures may apply to acidic more than non-acidic tussock tundra. This system is sometimes an early-seral stage following fire in the tussock shrub tundra system. The shrubs often recover to pre-fire cover within 15 years.

DISTRIBUTION

Range: This system occurs throughout arctic Alaska, from the Bristol Bay lowlands in southwestern Alaska to the North Slope on the Arctic Ocean.
Divisions: 102:C; 104:C
Nations: CA, US
Subnations: AK
Map Zones: 67:C, 68:C, 69:C, 72:C, 76:C
TNC Ecoregions: 73:C, 74:C, 75:C, 79:C

SOURCES

References: Allen pers. comm., Viereck et al. 1992, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818205#references
Description Author: K. Boggs
Version: 09 Oct 2008 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKA ARCTIC TUSSOCK-LICHEN TUNDRA (CES102.181)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Arctic (102)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Polar [Polar Oceanic]; Shallow Soil; Silt Soil Texture; Graminoid; Lichen; Tussock-forming grasses; Eriophorum vaginatum
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2695; ESLF 9422; ESP 1695

CONCEPT

Summary: The tussock lichen tundra system is common in valleys and slopes throughout arctic Alaska. These sites are cold, poorly drained, and underlain by mesic, silty mineral soils with a shallow surface organic layer surrounding the tussocks. Permafrost is present. Lichens are more common on the drier tussock tundra sites in western Alaska. Patch size is small to large. Tussock lichen tundra has >35% cover of sedges in a tussock growth form, shrub cover is <25%, and lichen cover is >25%. Dwarf-shrubs may be common. *Eriophorum vaginatum* is the primary tussock-former in most stands, but *Carex bigelowii* may dominate some sites. Lichens may include *Flavocetraria cucullata (= Cetraria cucullata), Cetraria islandica, Cladonia* spp., *Cladina rangiferina*, and *Thamnolia subuliformis*. There are also distinctions between acidic and non-acidic tussock tundra. Acidic sites have more ericaceous shrubs and *Sphagnum* and less *Eriophorum* spp., *Betula nana*, and *Carex bigelowii*. Acidic sites also have more organic matter buildup and the tussocks tend to be larger.
Classification Comments: This system is known as Tussock Lichen Tundra by the Alaska Natural Heritage Program.
Related Concepts:
- III.A.2.d - Tussock tundra (Viereck et al. 1992) Broader

DESCRIPTION

Environment: The tussock lichen tundra system is common in valleys and slopes throughout arctic Alaska. These sites are cold, poorly drained, and underlain by mesic, silty mineral soils with a shallow surface organic layer surrounding the tussocks (Viereck et al. 1992). Permafrost is present. Lichens are more common on the drier tussock tundra sites in western Alaska. Patch size is small to large.
Vegetation: Tussock lichen tundra has >35% cover of sedges in a tussock growth form, shrub cover is <25%, and lichen cover is >25%. Dwarf-shrubs may be common. *Eriophorum vaginatum* is the primary tussock-former in most stands, but *Carex bigelowii* may dominate some sites. Lichens may include *Flavocetraria cucullata (= Cetraria cucullata), Cetraria islandica, Cladonia* spp., *Cladina rangiferina*, and *Thamnolia subuliformis*. There are also distinctions between acidic and non-acidic tussock tundra. Acidic sites have more ericaceous shrubs and *Sphagnum* and less *Eriophorum* spp., *Betula nana*, and *Carex bigelowii*. Acidic sites also have more organic matter buildup and the tussocks tend to be larger.
Dynamics: This system's successional status is unclear. According to lake-core records, the fire-return interval is approximately 240 years on the Seward Peninsula and 1000+ years on the Beaufort Coastal Plain (J. Allen pers. comm.). These figures may apply to acidic more than non-acidic tussock tundra.

DISTRIBUTION

Range: This system occurs throughout arctic Alaska, from the Bristol Bay lowlands in southwestern Alaska to the North Slope on the Arctic Ocean.
Divisions: 102:C; 104:C
Nations: CA, US
Subnations: AK
Map Zones: 67:C, 68:C, 69:C, 72:C, 76:C
TNC Ecoregions: 73:C, 74:C, 75:C, 79:C

SOURCES

References: Allen pers. comm., Viereck et al. 1992, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818212#references
Description Author: K. Boggs
Version: 09 Oct 2008 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKA ARCTIC WET SEDGE MEADOW (CES102.185)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Arctic (102)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Linear, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Saturated Soil; Herbaceous; Polar [Polar Oceanic]; Eriophorum angustifolium
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2698; ESLF 9423; ESP 1698

CONCEPT

Summary: This ecological system occurs on wet sites (typically with 0-10% visible surface water) with >25% cover of sedge species. Sites are flat to sloping in valley bottoms, basins, low-center polygons, water tracks and adjacent to streams. It also includes patterned wetlands such as ribbed fens. These wet sedge meadows are also found on large to small floodplains, which support the various wetlands that form in oxbows, wet depressions, low-lying areas, and abandoned channels, including wet sedge meadows. Soils range from acidic to non-acidic, are saturated during the summer, and have an organic horizon over silt with permafrost, although on floodplains, permafrost is absent. Patch size is small to moderate and may be linear. Species diversity is much higher than in the freshwater marsh systems. Sites are typically dominated by *Carex aquatilis* and *Eriophorum angustifolium* but may also be dominated or codominated by *Carex glareosa, Carex rotundata, Carex rariflora, Carex chordorrhiza, Carex rostrata, Carex saxatilis, Carex utriculata, Eriophorum russeolum,* and *Eriophorum scheuchzeri*. *Dupontia fisheri* may also occur. Dwarf-shrubs such as *Salix fuscescens, Salix pulchra, Andromeda polifolia, Betula nana, Empetrum nigrum, Ledum palustre ssp. decumbens*, and *Vaccinium uliginosum* may be common but make up <25% cover. Moss species include *Drepanocladus* spp. and *Sphagnum* spp.
Classification Comments: This system include those types known as Wet Sedge and Floodplain Wet Sedge by the Alaska Natural Heritage Program. It is proposed to classify a separate floodplain wet sedge meadow, but mapping and modeling of that as its own system is difficult. For now, wet sedge meadows found in arctic Alaska floodplains are included in this sedge meadow system.
Related Concepts:
- III.A.3.a - Wet sedge meadow tundra (Viereck et al. 1992) Intersecting
- III.A.3.b - Wet sedge-grass meadow tundra (Viereck et al. 1992) Intersecting
- III.A.3.c - Wet sedge-herb meadow tundra (Viereck et al. 1992) Intersecting
- III.A.3.f - Subarctic lowland sedge wet meadow (Viereck et al. 1992) Intersecting
- III.A.3.g - Subarctic lowland sedge-shrub wet meadow (Viereck et al. 1992) Intersecting
- III.A.3.j - Subarctic lowland sedge bog meadow (Viereck et al. 1992) Intersecting
- III.B.3.b - Subarctic lowland herb wet meadow (Viereck et al. 1992) Intersecting

DESCRIPTION

Dynamics: This system occurs within a variety of successional processes, including thaw lakes, polygonal ground, ice-wedge polygons, oriented lakes, water tracks and adjacent to streams. Seral stages and the rate of succession in this system are unclear. In floodplains, primary succession on the Yukon-Kuskokwim Delta may move rapidly from aquatic bed to marsh to wet sedge and, possibly, wet low-tall shrub. An alternate wetland pathway is mesic sites supporting low or tall willows moving to wet low-tall shrub to wet sedge to tussocks, but this last stage is no longer part of floodplain dynamics. Primary succession on the Beaufort Coastal Plain progresses slowly from gravel bars to tall willow (possibly persisting for 300 years) or alder-willow, then to wet low willow (possibly persisting for 500 years). Paludification may lead to wet sedge (possibly persisting for 1000-2000 years), and permafrost formation may lead to tussock tundra, but this last stage is no longer part of the floodplain dynamics.

DISTRIBUTION

Range: This system occurs throughout arctic Alaska, from the Bristol Bay lowlands in southwestern Alaska to the North Slope on the Arctic Ocean.
Divisions: 102:C; 104:C
Nations: CA, US
Subnations: AK
Map Zones: 67:C, 68:C, 69:C, 72:C, 76:C
TNC Ecoregions: 73:C, 74:C, 75:C, 79:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818237#references
Description Author: K. Boggs
Version: 10 Dec 2008 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKA ARCTIC WET SEDGE-SPHAGNUM PEATLAND (CES102.200)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Arctic (102)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Saturated Soil; Herbaceous; Polar [Polar Oceanic]; Acidic Soil; Organic Peat (>40 cm); Sphagnum spp.; Eriophorum angustifolium; Eriophorum vaginatum
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2702; ESLF 9424; ESP 1702

CONCEPT

Summary: This system occurs on the Yukon-Kuskokwim Delta and the Kotzebue Sound lowlands ecoregions. It is common in wet depressions and old lake basins. Soils are poorly drained and acidic, typically with a well-developed peat layer. Permafrost may be present. Patch size is small to large. *Sphagnum* cover is >25% (usually continuous), and herbaceous species (primarily sedges) cover is >25%. The dominant sedges are *Eriophorum* spp. and *Carex utriculata*. Other common species include *Betula nana, Comarum palustre (= Potentilla palustris)*, and *Equisetum fluviatile*.
Classification Comments: This system is known as Lowland Wet Sedge Sphagnum by the Alaska Natural Heritage Program.
Related Concepts:
- III.A.3.a - Wet sedge meadow tundra (Viereck et al. 1992) Intersecting
- III.A.3.k - Subarctic lowland sedge-moss bog meadow (Viereck et al. 1992) Intersecting
- III.B.3.c - Subarctic lowland herb bog meadow (Viereck et al. 1992) Intersecting
- III.C.1.a - Wet bryophyte (Viereck et al. 1992) Intersecting

DESCRIPTION

Dynamics: This is an early-seral stage in the thaw-pond cycle. It starts with the collapse of a permafrost plateau resulting in a wet depression often with open water. This is colonized by marsh species or *Sphagnum* spp. or a combination of both. Sedges eventually invade, and this wet sedge-*Sphagnum* system develops. If organic matter buildup or permafrost uplift the surface, then this system may be seral to Alaska Arctic Dwarf-Shrub-Sphagnum Peatland (CES102.201). This system, in turn, may be seral to Alaska Arctic Permafrost Plateau Dwarf-Shrub Lichen Tundra (CES102.202). The seral sequence may not be unidirectional, and the timeframe is unclear, possibly taking hundreds of years.

DISTRIBUTION

Range: This system occurs on the Yukon-Kuskokwim Delta and the Kotzebue Sound lowlands ecoregions of Alaska.
Divisions: 102:C; 104:C
Nations: CA, US
Subnations: AK
Map Zones: 67:C, 68:C, 72:C, 76:C
TNC Ecoregions: 74:C, 75:C, 79:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818249#references
Description Author: K. Boggs
Version: 09 Oct 2008 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKAN PACIFIC MARITIME ALPINE WET MEADOW (CES204.160)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Alpine/AltiAndino; Riparian Mosaic; Toeslope/Valley Bottom; Temperate [Temperate Oceanic]
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2673; ESLF 9425; ESP 1673

CONCEPT

Summary: This small-patch ecological system often occurs as a mosaic of alpine wetlands including headwater fens, marshes, and riparian zones. Common species include *Salix reticulata, Salix stolonifera, Viola* spp., *Lupinus nootkatensis, Mimulus guttatus, Mimulus lewisii, Petasites frigidus var. frigidus, Sanguisorba canadensis,* and *Leptarrhena pyrolifolia*; *Valeriana sitchensis, Castilleja parviflora, Ranunculus* spp., *Caltha* spp., and *Saxifraga* spp. often occur along streambanks. Peatlands and associated wet meadows and marshes often feature *Trichophorum caespitosum, Carex anthoxanthea*, and *Juncus mertensianus*.
Classification Comments: This system is known as Alpine Wet Meadow by the Alaska Natural Heritage Program.
Related Concepts:
- III.A.3.c - Wet sedge-herb meadow tundra (Viereck et al. 1992) Intersecting

DISTRIBUTION

Range: This system occurs from Kodiak Island through southeastern Alaska.
Divisions: 204:C
Nations: US
Subnations: AK
Map Zones: 77:C, 78:C
TNC Ecoregions: 69:C, 70:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817722#references
Description Author: T. Boucher
Version: 10 Dec 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKAN PACIFIC MARITIME COASTAL MEADOW AND SLOUGH-LEVEE (CES204.159)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Lowland; Herbaceous; Temperate [Temperate Hyperoceanic]; Tidal / Estuarine
Non-Diagnostic Classifiers: Levee; Raised beach; Raised estuary; Slough; Forb; Graminoid; Delta
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2665; ESLF 9426; ESP 1665

CONCEPT

Summary: This ecological system includes moist and wet meadows associated with delta deposits, uplifted marshes, or beach deposits. These meadows occur inland of tidal marshes and are also common along sloughs and levees. Meadows are dominated by a wide variety of graminoids and forbs, including *Deschampsia beringensis, Festuca rubra, Argentina egedii (= Potentilla egedii), Lathyrus japonicus var. maritimus, Castilleja* spp., *Heracleum maximum, Parnassia palustris, Lupinus nootkatensis, Achillea millefolium var. borealis (= Achillea borealis), Angelica lucida*, and *Carex mackenziei*. *Leymus mollis* and *Lupinus nootkatensis* are common on levees, and *Carex lyngbyei* often dominates in sloughs and wet depressions.
Classification Comments: This system is known as Coastal Meadow and Slough-Levee by the Alaska Natural Heritage Program.
Related Concepts:
- *Carex mackenziei* (Sparks et al. 1977) Finer
- *Deschampsia beringensis* (Boggs 2000) Finer
- *Potentilla egedii - Festuca rubra* (Sparks et al. 1977) Finer
- III.A.1.e - Hair-grass (Viereck et al. 1992) Intersecting
- III.A.3.h - Halophytic grass wet meadow (Viereck et al. 1992) Intersecting
- III.A.3.i - Halophytic sedge wet meadow (Viereck et al. 1992) Intersecting
- III.B.2.a - Mixed herbs (Viereck et al. 1992) Intersecting
- III.B.3.d - Halophytic herb wet meadow (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: This ecological system includes moist and wet meadows associated with delta deposits, uplifted marshes, or beach deposits. These meadows occur inland of tidal marshes and are also common along sloughs and levees.
Vegetation: Meadows are dominated by a wide variety of graminoids and forbs, including *Deschampsia beringensis, Festuca rubra, Argentina egedii (= Potentilla egedii), Lathyrus japonicus var. maritimus, Castilleja* spp., *Heracleum maximum, Parnassia palustris, Lupinus nootkatensis, Achillea millefolium var. borealis (= Achillea borealis), Angelica lucida*, and *Carex mackenziei*. *Leymus mollis* and *Lupinus nootkatensis* are common on levees, and *Carex lyngbyei* often dominates in sloughs and wet depressions (Sparks et al. 1977, Stone 1993, Boggs 2000).

DISTRIBUTION

Range: This system occurs from the Cook Inlet Basin, on Kodiak Island, and through southeastern Alaska.
Divisions: 204:C
Nations: US
Subnations: AK
Map Zones: 75:C, 76:C, 77:C, 78:C
TNC Ecoregions: 69:C, 70:C, 71:C

SOURCES

References: Boggs 2000, Sparks et al. 1977, Stone 1993, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817719#references
Description Author: T. Boucher
Version: 10 Dec 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKAN PACIFIC MARITIME FEN AND WET MEADOW (CES204.158)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Saturated Soil; Herbaceous; Temperate [Temperate Oceanic]; Carex aquatilis var. dives
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2661; ESLF 9427; ESP 1661

CONCEPT

Summary: This ecological system includes herbaceous wetlands in fens (not including bogs) and non-peatlands. The fen/wet meadow system may be dominated either by sedges, sedges with a variety of forbs, or forbs. The organic layer ranges from thick to thin, and may be composed of sphagnum, sedge, or other organic material and can occur over mineral soil, or may be floating or submerged. Rich fens consistently feature *Carex aquatilis var. dives (= Carex sitchensis)*, although a variety of other sedges and forbs may be present, including *Dodecatheon pulchellum, Parnassia fimbriata, Eriophorum russeolum, Menyanthes trifoliata*, and *Comarum palustre*. Ericaceous shrubs are absent. Bryophytes (when present) include *Calliergon giganteum, Sphagnum squarrosum*, and *Sphagnum riparium*. Mixed sedge and forb meadows include *Carex saxatilis, Carex lyngbyei, Sanguisorba canadensis, Swertia perennis*, and *Platanthera dilatata*. Forb-dominated sites include *Equisetum fluviatile, Comarum palustre (= Potentilla palustris)*, and *Menyanthes trifoliata*.

Classification Comments: This system is known as Fen and Wet Meadow by the Alaska Natural Heritage Program. This type does not include poor fens; these are included with bog types. Species composition in the *Menyanthes* fen type is similar in composition through south-central, southwestern, and interior Alaska (Drury 1956, Tande 1983, Racine and Walters 1991), but processes driving succession vary.

Similar Ecological Systems:
- North Pacific Bog and Fen (CES204.063)
- Temperate Pacific Subalpine-Montane Wet Meadow (CES200.998)

Related Concepts:
- *Carex canescens - Carex exsiccata - Carex phyllomanica - Eriophorum chamissonis* (between beach ridges) (Banner et al. 1986) Finer
- *Carex obnupta - Carex sitchensis - Calamagrostis nutkaensis* (CAN) (Banner et al. 1986) Finer
- *Carex pluriflora - Menyanthes trifoliata* (Banner et al. 1986) Finer
- *Carex sitchensis - Carex obnupta* (CAN) (Banner et al. 1986) Finer
- *Carex sitchensis - Deschampsia caespitosa* (Banner et al. 1986) Finer
- *Carex sitchensis / Equisetum fluviatile* (Shephard 1995) Finer
- *Carex sitchensis / Sphagnum* spp. (Boggs 2000) Finer
- *Carex sitchensis* (Boggs 2000) Finer
- *Carex sitchensis* (Banner et al. 1986) Finer
- *Equisetum variegatum* (Shephard 1995) Finer
- *Menyanthes trifoliata - Equisetum variegatum* (Shephard 1995) Finer
- Alpine Grassland (213) (Shiflet 1994) Broader
- III.A.3.f - Subarctic lowland sedge wet meadow (Viereck et al. 1992) Intersecting
- III.B.3.b - Subarctic lowland herb wet meadow (Viereck et al. 1992) Intersecting
- III.B.3.c - Subarctic lowland herb bog meadow (Viereck et al. 1992) Intersecting
- Montane Meadows (216) (Shiflet 1994) Broader
- Wetlands (217) (Shiflet 1994) Broader

DESCRIPTION

Environment: This ecological system includes herbaceous wetlands in fens (not including bogs) and non-peatlands. The fen/wet meadow system may be dominated either by sedges, sedges with a variety of forbs, or forbs. The organic layer ranges from thick to thin, and may be composed of sphagnum, sedge, or other organic material and can occur over mineral soil, or may be floating or submerged.

Vegetation: Rich fens consistently feature *Carex aquatilis var. dives (= Carex sitchensis)* (McClellan et al. 2003), although a variety of other sedges and forbs may be present, including *Dodecatheon pulchellum, Parnassia fimbriata, Eriophorum russeolum, Menyanthes trifoliata*, and *Comarum palustre*. Ericaceous shrubs are absent. Bryophytes (when present) include *Calliergon giganteum, Sphagnum squarrosum*, and *Sphagnum riparium* (Shephard 1995, Boggs 2000). Mixed sedge and forb meadows include *Carex saxatilis, Carex lyngbyei, Sanguisorba canadensis, Swertia perennis*, and *Platanthera dilatata*. Forb-dominated sites include *Equisetum fluviatile, Comarum palustre (= Potentilla palustris)*, and *Menyanthes trifoliata*.

Component Associations:

- *Carex aquatilis var. dives - Comarum palustre* Herbaceous Vegetation (CEGL003433, G2)
- *Carex aquatilis var. dives* Herbaceous Vegetation (CEGL001826, G4)
- *Menyanthes trifoliata* Herbaceous Vegetation (CEGL003410, G5)

DISTRIBUTION

Range: This system occurs from Kodiak Island through southeastern Alaska.
Divisions: 204:C
Nations: US
Subnations: AK
Map Zones: 77:C, 78:C
TNC Ecoregions: 69:C, 70:C

SOURCES

References: Banner et al. 1986, Boggs 2000, Drury 1956, McClellan et al. 2003, Racine and Walters 1991, Shephard 1995, Shiflet 1994, Tande 1983, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817714#references
Description Author: T. Boucher
Version: 10 Dec 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALEUTIAN FRESHWATER AQUATIC BED (CES105.234)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Lake; Pond; Herbaceous; Boreal [Boreal Oceanic]; Aquatic Herb
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - forbland, Hydromorphic-rooted grassland
National Mapping Codes: EVT 2721; ESLF 9428; ESP 1721

CONCEPT

Summary: Freshwater aquatic beds occur in permanently flooded depressions, shallow ponds, and the littoral zone of lakes where penetration of light is the limiting factor for growth. They are small patch in size. Soils are mineral or muck. This system has standing water with >25% cover of submerged or floating aquatic species. Genera and species include *Subularia, Callitriche, Limosella, Isoetes maritima, Isoetes occidentalis, Potamogeton alpinus, Ranunculus aquatilis, Ranunculus trichophyllus var. trichophyllus, Sparganium hyperboreum*, and *Nuphar polysepala (= Nuphar lutea ssp. polysepala)*.
Classification Comments: This system is known as Freshwater Aquatic Bed by the Alaska Natural Heritage Program. This system should probably be merged with other aquatic bed systems in Alaska; it's unlikely that aquatic beds in the Aleutians are significantly different from those in the boreal or maritime regions.
Similar Ecological Systems:
- Alaska Arctic Freshwater Aquatic Bed (CES102.182)
- North American Boreal Freshwater Aquatic Bed (CES103.125)
- Temperate Pacific Freshwater Aquatic Bed (CES200.876)

Related Concepts:
- *Nuphar polysepalum* (Boggs et al. 2003) Finer
- III.D.1.a - Pondlily (Viereck et al. 1992) Intersecting
- III.D.1.b - Common marestail (Viereck et al. 1992) Intersecting
- III.D.1.c - Aquatic buttercup (Viereck et al. 1992) Intersecting
- III.D.1.d - Burreed (Viereck et al. 1992) Intersecting
- III.D.1.e - Water milfoil (Viereck et al. 1992) Intersecting
- III.D.1.f - Fresh pondweed (Viereck et al. 1992) Intersecting
- III.D.1.g - Water star-wort (Viereck et al. 1992) Intersecting
- III.D.1.h - Cryptogam (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: Freshwater aquatic beds occur in permanently flooded depressions, shallow ponds, and the littoral zone of lakes where penetration of light is the limiting factor for growth. They are small patch in size. Soils are mineral or muck. This system has standing water with >25% cover of submerged or floating aquatic species.
Vegetation: This system has standing water with >25% cover of submerged or floating aquatic species. Genera and species include *Subularia, Callitriche, Limosella, Isoetes maritima, Isoetes occidentalis, Potamogeton alpinus, Ranunculus aquatilis, Ranunculus trichophyllus var. trichophyllus, Sparganium hyperboreum*, and *Nuphar polysepala (= Nuphar lutea ssp. polysepala)*.

DISTRIBUTION

Range: This system occurs on the Alaska Peninsula, Aleutian Islands and Kodiak Island.
Divisions: 102:C; 105:C
Nations: US
Subnations: AK
Map Zones: 76:C
TNC Ecoregions: 70:C, 72:C, 73:C

SOURCES

References: Boggs et al. 2003, Fleming and Spencer 2007, Shacklette et al. 1969, Talbot et al. 2006, Viereck et al. 1992, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818569#references
Description Author: K. Boggs
Version: 16 Oct 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALEUTIAN FRESHWATER MARSH (CES105.235)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Herbaceous; Boreal [Boreal Oceanic]; Graminoid
Non-Diagnostic Classifiers: Lake; Marsh; Pond
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2722; ESLF 9429; ESP 1722

CONCEPT

Summary: Freshwater marshes typically occur with other wetland systems on the margins of ponds and lakes. They are mostly small patch, semipermanently flooded, but some have seasonal flooding. Water is at or above the surface for most of the growing season. Soils are muck or mineral. Freshwater marshes have >10% cover of emergent herbaceous vegetation. Species include *Carex aquatilis*, *Carex utriculata*, *Menyanthes trifoliata*, *Comarum palustre*, *Equisetum fluviatile*, *Equisetum palustre*, and *Hippuris* spp. Species of *Eriophorum* do not commonly occur in this system. Species diversity is often low.
Classification Comments: This system is known as Freshwater Marsh by the Alaska Natural Heritage Program. This system should probably be merged with other freshwater marsh systems in Alaska; it's unlikely that freshwater marshes in the Aleutians are significantly different from those in the boreal or maritime regions.
Similar Ecological Systems:
- Alaska Arctic Pendantgrass Freshwater Marsh (CES102.183)
- Alaska Arctic Sedge Freshwater Marsh (CES102.184)
- Temperate Pacific Freshwater Emergent Marsh (CES200.877)

Related Concepts:
- *Carex aquatilis* (Boggs et al. 2003) Finer
- *Carex utriculata* (Boggs et al. 2003) Finer
- *Equisetum fluviatile* (Boggs et al. 2003) Finer
- *Hippuris tetraphylla* (Boggs et al. 2003) Finer
- III.A.3.d - Fresh sedge marsh (Viereck et al. 1992) Intersecting
- III.A.3.e - Fresh grass marsh (Viereck et al. 1992) Intersecting
- III.B.3.a - Fresh herb marsh (Viereck et al. 1992) Intersecting

DISTRIBUTION

Range: This system occurs on the Alaska Peninsula, Aleutian Islands and Kodiak Island.
Divisions: 102:C; 105:C
Nations: US
Subnations: AK
Map Zones: 76:C
TNC Ecoregions: 70:C, 72:C, 73:C

SOURCES

References: Boggs et al. 2003, Fleming and Spencer 2007, Viereck et al. 1992, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818572#references
Description Author: K. Boggs
Version: 16 Oct 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALEUTIAN NONVASCULAR PEATLAND (CES105.237)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Moss/Lichen (Nonvascular); Boreal [Boreal Oceanic]; Organic Peat (>40 cm)
Non-Diagnostic Classifiers: Seepage-Fed Sloping [Peaty]; Depressional [Lakeshore]; Depressional [Pond]
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Nonvascular, Bryophyte
National Mapping Codes: EVT 2724; ESLF 9430; ESP 1724

CONCEPT

Summary: This ecological system occurs in shallow depressions, seepage channels on gentle slopes, and pond margins. Peat depth is >40 cm and may be over mineral soil, floating or submerged. The sites are wet, and patch size is small. Dominance ranges from mosses and forbs (*Sphagnum* spp. or *Philonotis fontana var. americana* and *Parnassia kotzebuei*) to liverworts (*Scapania* spp., *Nardia* spp., *Marsupella* spp., *Siphula* spp.)
Classification Comments: This system is known as Nonvascular Peatland by the Alaska Natural Heritage Program.
Related Concepts:
- III.C.1.a - Wet bryophyte (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: This ecological system occurs in shallow depressions, seepage channels on gentle slopes, and pond margins. Peat depth is >40 cm and may be over mineral soil, floating or submerged. The sites are wet, and patch size is small.
Vegetation: Dominance ranges from mosses and forbs (*Sphagnum* spp. or *Philonotis fontana var. americana* and *Parnassia kotzebuei*) to liverworts (*Scapania* spp., *Nardia* spp., *Marsupella* spp., *Siphula* spp.)

DISTRIBUTION

Range: This system occurs on the Alaska Peninsula and Aleutian Islands.
Divisions: 102:C; 105:C
Nations: US
Subnations: AK
Map Zones: 76:C
TNC Ecoregions: 72:C, 73:C

SOURCES

References: Shacklette et al. 1969, Talbot et al. 2006, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818578#references
Description Author: K. Boggs
Version: 16 Oct 2008
Stakeholders: West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program
ClassifResp: West

ALEUTIAN TIDAL MARSH (CES105.279)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Saline Water Chemistry; Marsh; Herbaceous; Boreal [Boreal Oceanic]; Tidal / Estuarine; Graminoid
Non-Diagnostic Classifiers: Brackish (Mesohaline); Estuary; Lagoon
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2726; ESLF 9431; ESP 1726

CONCEPT

Summary: This system consists of herbaceous marshes with >10% vascular species cover that are subject to regular tidal inundation. The marshes are typically salt or brackish. Some, however, are primarily freshwater that are infrequently flooded by storm surges or extreme high tides. Tidal marshes are primarily associated with estuaries or coastal lagoons or other locations protected from wave action. Lagoons with outer spits and beaches are well developed and common in the Aleutians. Tidal marshes, however, are not extensive within these lagoons because of constant winds and waves, plus winter sea ice may be extensive and blown to shore, battering the vegetation. It appears that tectonic/isostatic uplift is common, lifting the marshes above the tide. Two existing vegetation types dominate the system: tidal sedge and tidal herbaceous. *Carex lyngbyei, Carex glareosa,* and *Carex mackenziei* dominate the tidal sedge class. Other species include *Hippuris tetraphylla, Hippuris vulgaris, Ruppia cirrhosa, Stellaria humifusa,* and *Zannichellia palustris*. *Puccinellia* spp. or *Plantago maritima* dominate the tidal herbaceous type, often with <25% cover.
Classification Comments: This system is known as Tidal Marsh by the Alaska Natural Heritage Program. This system should probably be merged with other tidal marsh systems in Alaska; it's unlikely that tidal marshes in the Aleutians are significantly different from those in the maritime or southern arctic regions.
Similar Ecological Systems:
- Alaska Arctic Tidal Marsh (CES102.209)

Related Concepts:
- *Carex lyngbyei* (Boggs et al. 2003) Finer
- *Carex mackenziei* (Boggs et al. 2003) Finer
- *Carex ramenskii* (Boggs et al. 2003) Finer
- *Eleocharis palustris* (Boggs et al. 2003) Finer
- *Hippuris tetraphylla* (Boggs et al. 2003) Finer
- *Plantago maritima* (Boggs et al. 2003) Finer
- *Puccinellia andersonii* (Boggs et al. 2003) Finer
- *Puccinellia nutkaensis* (Boggs et al. 2003) Finer
- III.A.3.h - Halophytic grass wet meadow (Viereck et al. 1992) Intersecting
- III.A.3.i - Halophytic sedge wet meadow (Viereck et al. 1992) Intersecting
- III.B.3.d - Halophytic herb wet meadow (Viereck et al. 1992) Intersecting
- III.D.2.a - Four-leaf marestail (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: This system consists of herbaceous marshes with >10% vascular species cover that are subject to regular tidal inundation. The marshes are typically salt or brackish. Some, however, are primarily freshwater that are infrequently flooded by storm surges or extreme high tides. Tidal marshes are primarily associated with estuaries or coastal lagoons or other locations protected from wave action. Lagoons with outer spits and beaches are well developed and common in the Aleutians. Tidal marshes, however, are not extensive within these lagoons because of constant winds and waves, plus winter sea ice may be extensive and blown to shore, battering the vegetation. It appears that tectonic/isostatic uplift is common, lifting the marshes above the tide.
Vegetation: Two existing vegetation types dominate the system: tidal sedge and tidal herbaceous. *Carex lyngbyei, Carex glareosa,* and *Carex mackenziei* dominate the tidal sedge class. Other species include *Hippuris tetraphylla, Hippuris vulgaris, Ruppia cirrhosa, Stellaria humifusa,* and *Zannichellia palustris*. *Puccinellia* spp. or *Plantago maritima* dominate the tidal herbaceous type, often with <25% cover.

DISTRIBUTION

Range: This system occurs on the Alaska Peninsula and Aleutian Islands.
Divisions: 102:C; 105:C
Nations: US
Subnations: AK
Map Zones: 76:C
TNC Ecoregions: 72:C, 73:C

SOURCES

References: Boggs et al. 2003, Fleming and Spencer 2007, Talbot et al. 2006, Viereck et al. 1992, Western Ecology Working Group n.d.

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818594#references

Description Author: K. Boggs

Version: 16 Oct 2008 **Stakeholders:** West

Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALEUTIAN WET MEADOW AND HERBACEOUS PEATLAND (CES105.236)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Saturated Soil; Herbaceous; Boreal [Boreal Oceanic]; Organic Peat (>40 cm); Sphagnum spp.; Empetrum nigrum
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2723; ESLF 9432; ESP 1723

CONCEPT

Summary: This ecological system includes a variety of herbaceous wetlands. Wet meadows occur in shallow depressions, seepage channels on gentle slopes, old beaver ponds, pond margins, along streams, lake borders, wet slopes, valley toeslopes, terraces, late-melting snowbeds, in wet depressions of *Empetrum* heath, bedrock or colluvium. The organic layer ranges from thick (sometimes >40 cm) to relatively thin. It may be composed of sphagnum, sedge, or other organic material and can occur over mineral soil or may be floating. Vegetation has >25% herbaceous species cover and <25% shrub cover. Common genera and species include *Eriophorum russeolum, Eriophorum angustifolium ssp. scabriusculum, Eriophorum scheuchzeri, Anthelia* (liverwort), *Saxifraga hirculus, Geum pentapetalum, Calamagrostis canadensis, Calamagrostis stricta ssp. inexpansa, Carex saxatilis, Carex nigricans, Carex pluriflora, Carex lyngbyei, Carex anthoxanthea, Leptarrhena pyrolifolia, Ranunculus eschscholtzii, Ranunculus flammula, Saxifraga rivularis, Caltha palustris, Claytonia sibirica, Deschampsia beringensis, Comarum palustre, Rubus chamaemorus, Juncus alpinoarticulatus ssp. nodulosus, Juncus triglumis,* and *Drosera* spp. Shrubs include *Salix planifolia, Ledum palustre ssp. decumbens,* and *Empetrum nigrum*. *Sphagnum* may be common.
Classification Comments: This system is known as Wet Meadow by the Alaska Natural Heritage Program.
Related Concepts:
- *Eriophorum angustifolium ssp. scabriusculum* (Boggs et al. 2003) Finer
- *Eriophorum russeolum* (Boggs et al. 2003) Finer
- *Eriophorum scheuchzeri* (Boggs et al. 2003) Finer
- III.A.3.c - Wet sedge-herb meadow tundra (Viereck et al. 1992) Intersecting
- III.A.3.j - Subarctic lowland sedge bog meadow (Viereck et al. 1992) Intersecting
- III.A.3.k - Subarctic lowland sedge-moss bog meadow (Viereck et al. 1992) Intersecting
- III.B.3.c - Subarctic lowland herb bog meadow (Viereck et al. 1992) Intersecting
- Wet-*Calamagrostis canadensis* (Boggs et al. 2003) Finer

DESCRIPTION

Environment: This ecological system includes a variety of herbaceous wetlands. Wet meadows occur in shallow depressions, seepage channels on gentle slopes, old beaver ponds, pond margins, along streams, lake borders, wet slopes, valley toeslopes, terraces, late-melting snowbeds, in wet depressions of *Empetrum* heath, bedrock or colluvium. The organic layer ranges from thick (sometimes >40 cm) to relatively thin.
Vegetation: It may be composed of sphagnum, sedge, or other organic material and can occur over mineral soil or may be floating. Vegetation has >25% herbaceous species cover and <25% shrub cover. Common genera and species include *Eriophorum russeolum, Eriophorum angustifolium ssp. scabriusculum, Eriophorum scheuchzeri, Anthelia* (liverwort), *Saxifraga hirculus, Geum pentapetalum, Calamagrostis canadensis, Calamagrostis stricta ssp. inexpansa, Carex saxatilis, Carex nigricans, Carex pluriflora, Carex lyngbyei, Carex anthoxanthea, Leptarrhena pyrolifolia, Ranunculus eschscholtzii, Ranunculus flammula, Saxifraga rivularis, Caltha palustris, Claytonia sibirica, Deschampsia beringensis, Comarum palustre, Rubus chamaemorus, Juncus alpinoarticulatus ssp. nodulosus, Juncus triglumis,* and *Drosera* spp. Shrubs include *Salix planifolia, Ledum palustre ssp. decumbens,* and *Empetrum nigrum*. *Sphagnum* may be common.

DISTRIBUTION

Range: This system occurs on the Alaska Peninsula, Aleutian Islands and Kodiak Island.
Divisions: 102:C; 105:C
Nations: US
Subnations: AK
Map Zones: 76:C
TNC Ecoregions: 70:C, 72:C, 73:C

SOURCES

References: Boggs et al. 2003, Fleming and Spencer 2007, Shacklette et al. 1969, Talbot et al. 1984, Talbot et al. 2006, Viereck et al. 1992, Western Ecology Working Group n.d.
Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818575#references
Description Author: K. Boggs
Version: 16 Oct 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ATLANTIC COASTAL PLAIN EMBAYED REGION SEAGRASS BED (CES203.243)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Tidal / Estuarine; Aquatic Herb
Non-Diagnostic Classifiers: Herbaceous
National Mapping Codes: ESLF 9295

CONCEPT

Summary: This system of seagrass beds occurs primarily in the embayed regions of North Carolina and southeastern Virginia. The vast series of barriers provides ample area for colonization of hydromorphic herbaceous vegetation in protected sounds and lagoons which are subject to wind tides only. Local habitats range from small guts, shallow tributary creeks, and large marsh pools along freshwater and oligohaline sections of tidal rivers to shallow estuarine bays, tidal creeks, and salt marsh pools. This system lies outside the climatic range for most tropical species, especially *Thalassia testudinum* and *Cymodocea filiformis*. These species are largely replaced by *Zostera marina*. This region is the northern terminus for *Halodule wrightii (= Halodule beaudettei)*, and most typical beds of the region can be characterized as *Zostera - Halodule*.
Classification Comments: Northern Atlantic Coastal Plain Seagrass Bed (CES203.246) is a related system with a range to the north of this type that is generally characterized as *Zostera - Ruppia* (Thayer et al. 1984).
Similar Ecological Systems:
- Atlantic Coastal Plain Embayed Region Tidal Salt and Brackish Marsh (CES203.260)
- Northern Atlantic Coastal Plain Seagrass Bed (CES203.246)

DESCRIPTION

Environment: Water salinity ranges from oligohaline at the mouths of tidal rivers to brackish waters.
Vegetation: According to Fleming et al. (2001), *Ceratophyllum demersum* is the most important and abundant species found along the freshwater margins of this system, where associates include *Utricularia* spp., *Elodea nuttallii*, *Spirodela polyrrhiza*, and *Wolffiella gladiata*. Shallow waters may support sparse to dense surface cover of *Nymphaea odorata* or, rarely, *Nelumbo lutea*. More saline areas support *Ruppia maritima*, *Zostera marina*, *Zannichellia palustris*, and *Stuckenia pectinata*. Aquatic algae are frequent to abundant associates. In portions of the area where *Zostera* and *Halodule* co-occur, each attains maximum biomass at different times of the year (Thayer et al. 1984).
Dynamics: The dynamics of tidal, aquatic communities dominated by vascular plants are complex and poorly understood. The distribution and abundance of vascular plants in these habitats are probably controlled by responses to water chemistry, water clarity and light penetration, the impact of currents and boat wakes, and herbivory by aquatic animals (Fleming et al. 2001).

Component Associations:
- *Halodule wrightii* Herbaceous Vegetation (CEGL004318, G4?)
- *Ruppia maritima* Carolinian Zone Herbaceous Vegetation (CEGL004335, G4G5)
- *Zostera marina* Herbaceous Vegetation (CEGL004336, G4G5)

DISTRIBUTION

Range: This system is found in the embayed regions of North Carolina and southeastern Virginia southward to Cape Fear. South of Cape Fear seagrasses are largely absent until the St. Johns region of Florida (Kenworthy pers. comm.).
Divisions: 203:C
Nations: US
Subnations: NC, VA
Map Zones: 58:C, 60:C
TNC Ecoregions: 57:C

SOURCES

References: Comer et al. 2003, Fleming et al. 2001, Grech et al. 2012, Koch and Orth 2003, Orth et al. 2006, Thayer et al. 1984
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723242#references
Description Author: R. Evans
Version: 06 Feb 2014
Concept Author: R. Evans
Stakeholders: East, Southeast
ClassifResp: Southeast

ATLANTIC COASTAL PLAIN EMBAYED REGION TIDAL FRESHWATER MARSH (CES203.259)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Tidal / Estuarine [Freshwater]; Graminoid
Non-Diagnostic Classifiers: Herbaceous
National Mapping Codes: ESLF 9276

CONCEPT

Summary: Embayed region tidal freshwater marshes are characterized by fresh to oligohaline waters which are driven by irregular wind tides, with minimal lunar tidal influence. They are the predominant marsh system in the drowned creeks and inland estuary shores of the embayed region of northeastern North Carolina and adjacent Virginia. This system typically occurs as complexes of several associations dominated by large graminoids such as *Spartina cynosuroides, Cladium mariscus ssp. jamaicense, Schoenoplectus pungens, Typha angustifolia, Typha latifolia*, and *Juncus roemerianus*, sometimes with species-rich associations of shorter graminoids, forbs, and floating or submerged aquatics. While some association dominants are tolerant of brackish water, they are associated with plants restricted to oligohaline or freshwater. Irregular flooding and fire are both important forces in this system, and rising sea level is a particularly important driver of long-term trends.
Classification Comments: The distinction between this system and other tidal freshwater marsh systems is based on the distinctive dynamics of the irregular wind tidal flooding.

DESCRIPTION

Environment: The embayed region of the Mid-Atlantic Coastal Plain stretches along northeastern North Carolina and adjacent areas of Virginia. Estuaries in drowned river valleys are unusually extensive here. The barrier islands along the coast are unusually continuous and the ocean's tidal range modest. This produces estuaries where irregular wind tides are the dominant hydrological process. The water is oligohaline to fresh over most of the tidal areas, with brackish water near the coast and saltwater only on or near the barrier island inlets. Rainfall may be an important influence in marsh interiors for significant periods of time between high wind tides. Soils appear to be essentially always saturated, with shallow flooding for periods of several days at all times of year. Due to limited sediment transport, marsh soils are primarily organic. Marshes occur in small to large patches or bands along the drowned creeks and rivers. Most give way to tidal swamps inland and upstream, but some occur on islands. Those near the transition to brackish water may grade to wind tide-influenced brackish marshes downstream.
Vegetation: This system consists largely of wetland vegetation dominated by large graminoid herbs that are tolerant of constant saturation but intolerant of too much salt. *Spartina patens, Cladium mariscus ssp. jamaicense, Schoenoplectus pungens, Typha angustifolia*, and *Typha latifolia* dominate large areas. *Juncus roemerianus* is sometimes a dominant, especially in areas that have become fresh in the last 100 years as a result of coastal inlet changes. All of these dominants are accompanied by at least a few other plants intolerant of saltwater. Vegetation dominated by smaller graminoids, wetland forbs, submerged or floating aquatics, shrubs, or open stands of trees may also be present. Individual marshes usually are mosaics or zoned complexes of patches of the component associations.
Dynamics: Hydrology is the most important driving process, with the constant saturation determining the potential vegetation, and the variable flooding and variations in salinity in the fresh to brackish range a primary disturbance. Wind tides flood or expose the marshes at irregular intervals and transport nutrients and organic matter. Storm surges and unusually high tides associated with storms may bring saltier water into these systems, disturbing the less salt-tolerant plants. These disturbances may be an important factor determining the boundary between this system and adjacent tidal swamps, but this is not well documented. Rising sea level is an important driver of longer term vegetation trends, including expansion into adjacent swamp areas. Fire is also an important natural process in all but the smallest and most isolated patches. Frost (pers. comm.) estimates that many marshes burned as often as every three years in presettlement times and were an important source of ignition for adjacent communities. Marshes that have not burned recently have lower species richness, are more strongly dominated by the large graminoids, and are believed to be poorer habitat for waterfowl. Marshes often show evidence of transition to or from tree-dominated communities, in the form of young invading trees and shrubs or standing dead older trees. Lack of fire appears to be allowing sufficient tree invasion to eventually produce a swamp forest in some upstream examples, but the trend in most places is toward development of marshes in former swamp areas.

Component Associations:
- *Carex stricta - Peltandra virginica - Sagittaria (lancifolia ssp. media, latifolia)* Tidal Herbaceous Vegetation (CEGL004314, G2?)
- *Cladium mariscus ssp. jamaicense* Tidal Herbaceous Vegetation (CEGL004178, G4?)
- *Eleocharis fallax - Eleocharis rostellata - Schoenoplectus americanus - Sagittaria lancifolia* Herbaceous Vegetation (CEGL004628, G1G2)
- *Eriocaulon parkeri - Polygonum punctatum* Herbaceous Vegetation (CEGL006352, G2)
- *Halodule wrightii* Herbaceous Vegetation (CEGL004318, G4?)
- *Isoetes riparia* Tidal Herbaceous Vegetation (CEGL006058, GNR)

- *Juncus roemerianus - Pontederia cordata* Herbaceous Vegetation (CEGL004660, G2G3)
- *Morella cerifera - Rosa palustris / Thelypteris palustris var. pubescens* Shrubland (CEGL004656, G4)
- *Nuphar advena* Tidal Herbaceous Vegetation (CEGL004472, G4G5)
- *Sagittaria subulata - Limosella australis* Tidal Herbaceous Vegetation (CEGL004473, G2G4)
- *Schoenoplectus pungens - (Osmunda regalis var. spectabilis)* Herbaceous Vegetation (CEGL004189, G2G3)
- *Spartina alterniflora - Lilaeopsis chinensis* Herbaceous Vegetation (CEGL004193, G3G4)
- *Spartina cynosuroides - Panicum virgatum - Phyla lanceolata* Herbaceous Vegetation (CEGL007741, G2G3)
- *Spartina cynosuroides* Herbaceous Vegetation (CEGL004195, G4)
- *Typha angustifolia - Hibiscus moscheutos* Herbaceous Vegetation (CEGL004201, G4G5)
- *Typha latifolia* Southern Herbaceous Vegetation (CEGL004150, G5)
- *Zizania aquatica* Tidal Herbaceous Vegetation (CEGL004202, G4?)
- *Zizaniopsis miliacea* Tidal Herbaceous Vegetation (CEGL004705, G3G5)

SPATIAL CHARACTERISTICS

Size: Patches range from a few square meters to 1000-2000 acres.

Adjacent Ecological Systems:

- Atlantic Coastal Plain Embayed Region Tidal Salt and Brackish Marsh (CES203.260)
- Southern Atlantic Coastal Plain Tidal Wooded Swamp (CES203.240)

Adjacent Ecological System Comments: Generally grades to Southern Atlantic Coastal Plain Tidal Wooded Swamp (CES203.240) inland and upstream. May grade to Atlantic Coastal Plain Embayed Region Tidal Salt and Brackish Marsh (CES203.260) downstream or seaward. Occasionally borders uplands or other wetlands.

DISTRIBUTION

Range: This system is restricted to the embayed region of North Carolina and Virginia, with the best development in coastal areas along the North Carolina-Virginia border. The transition to areas with more lunar tidal influence is fairly gradual to the south over a space of 50 miles.

Divisions: 203:C

Nations: US

Subnations: NC, VA

Map Zones: 58:C, 60:C

USFS Ecomap Regions: 232I:CC

TNC Ecoregions: 57:C

SOURCES

References: Comer et al. 2003

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723227#references

Description Author: R. Evans, M. Schafale, G. Fleming, mod. C. Nordman

Version: 14 Jan 2014 **Stakeholders:** East, Southeast

Concept Author: R. Evans, M. Schafale, G. Fleming **ClassifResp:** Southeast

ATLANTIC COASTAL PLAIN EMBAYED REGION TIDAL SALT AND BRACKISH MARSH (CES203.260)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Tidal / Estuarine [Haline]; Graminoid
Non-Diagnostic Classifiers: Herbaceous
National Mapping Codes: ESLF 9261

CONCEPT

Summary: This ecological system encompasses the brackish to salt intertidal marshes of the Embayed Region of southeastern Virginia and adjacent North Carolina. It is distinguished by the extensive brackish water and tidal flooding driven by winds which are characteristic of that region. Low in plant diversity, these marshes are found on intertidal flats generally cut off from direct oceanic influence by a series of protective barrier islands. Embedded within the matrix of marshes are smaller hypersaline areas or salt pannes. Vegetation is primarily herbaceous marsh, most of it dominated by *Juncus roemerianus*. Areas near tidal inlets have salt marsh dominated by *Spartina alterniflora*. The marshes are low in plant species richness and are strongly dominated by a single plant species. Also part of the system are more limited communities such as hypersaline flats dominated by *Distichlis spicata* and *Sarcocornia*, as well as salt-tolerant shrublands and a few tree-dominated hammocks that occur on small elevated areas closely associated with the marshes.

Classification Comments: This system is distinguished from the salt marsh systems to the north and south because of the characteristic hydrology of the embayed region and its implications to ecosystem dynamics. However, the species-poor vegetation is not notably different. There is some question whether the few salt marshes on near inlets on the barrier islands in this region should be considered part of this system. They have regular lunar tidal flooding and full strength saltwater, both not characteristic of most of the region. However, lunar tidal flooding is muted compared to other regions. Submerged aquatic vegetation (*Ruppia*, etc.) is covered under Atlantic Coastal Plain Embayed Region Seagrass Bed (CES203.243).

Similar Ecological Systems:
- Atlantic Coastal Plain Embayed Region Seagrass Bed (CES203.243)
- Atlantic Coastal Plain Indian River Lagoon Tidal Marsh (CES203.257)
- Southern Atlantic Coastal Plain Salt and Brackish Tidal Marsh (CES203.270)

Related Concepts:
- Cabbage Palmetto: 74 (Eyre 1980) Finer
- Southern Redcedar: 73 (Eyre 1980) Finer

DESCRIPTION

Environment: Occurs on intertidal flats that are tidally flooded with salt to brackish water in the Embayed Region of the Mid-Atlantic Coastal Plain in North Carolina and Virginia. The Embayed Region is characterized by very extensive sounds cut off from the ocean by long barrier islands with few tidal inlets. A low tidal range in the ocean in this region limits tidal exchange at the inlets. Saltwater is present only in limited areas near the inlets. Brackish water prevails in most of the southern part of the region and some of the seaward side of the northern part of the region, grading to oligohaline and freshwater inland and northward, as well as upstream in tidal creeks. Lunar tidal fluctuation is negligible in most of the Embayed Region, and the irregular flooding of wind tides dominates. Soils are generally organic, but mineral soils are present in the more regularly flooded areas.

Vegetation: Vegetation is primarily herbaceous marsh, most of it dominated by *Juncus roemerianus*. Areas near tidal inlets have salt marsh dominated by *Spartina alterniflora*. The marshes are low in species richness and are strongly dominated by a single species. Also part of the system are more limited communities such as hypersaline flats dominated by *Distichlis spicata* and *Sarcocornia*, salt-tolerant shrublands, and a few hammocks that occur on small elevated areas closely associated with the marshes.

Dynamics: Tidal flooding is an ecological factor that distinguishes this system from others. Because tides are irregular and shifts not as frequent or as strong as in lunar tide-dominated areas, sediment transport and probably productivity are lower in the marshes. Storms may drive increased amounts of salt into the sounds, stressing or killing plants in the brackish marshes. For marshes on the back of barrier islands, overwash in storms may deposit sand in the marsh. Marshes usually recover from this, but if sufficient sand is deposited, a different system may develop on the site. Fire is a natural force in the larger and less isolated patches of marsh, removing dead material, stimulating growth, and increasing species richness slightly but not altering overall composition. Rising sea level will affect this system strongly, drowning some marsh areas, promoting shoreline erosion, and causing salt or brackish marshes to spread into freshwater marsh areas. However, elevated atmospheric CO2 increases the productivity of marsh grasses, which can lead to marsh elevation gain (Langley et al. 2009). The marsh snail (*Littoraria irrorata*) is a native and characteristic part of the marsh ecosystem, and is eaten by blue crabs. The disruption of marsh snail predation by blue crabs can lead to a trophic cascade (Silliman and Bertness 2002, Bertness et al. 2004).

Component Associations:
- *Baccharis halimifolia - Iva frutescens / Panicum virgatum* Shrubland (CEGL003921, G5)

- *Borrichia frutescens / (Spartina patens, Juncus roemerianus)* Shrubland (CEGL003924, G4)
- *Eriocaulon parkeri - Polygonum punctatum* Herbaceous Vegetation (CEGL006352, G2)
- *Juncus roemerianus* Herbaceous Vegetation (CEGL004186, G5)
- *Juniperus virginiana var. silicicola - (Quercus virginiana, Sabal palmetto)* Forest (CEGL007813, G3?)
- *Sagittaria subulata - Limosella australis* Tidal Herbaceous Vegetation (CEGL004473, G2G4)
- *Salicornia (virginica, bigelovii, maritima) - Spartina alterniflora* Herbaceous Vegetation (CEGL004308, G5)
- *Schoenoplectus pungens* Tidal Herbaceous Vegetation (CEGL004188, GNR)
- *Spartina alterniflora / (Ascophyllum nodosum)* Acadian/Virginian Zone Herbaceous Vegetation (CEGL004192, G5)
- *Spartina alterniflora* Carolinian Zone Herbaceous Vegetation (CEGL004191, G5)
- *Spartina patens - Distichlis spicata - (Juncus roemerianus)* Herbaceous Vegetation (CEGL004197, G4G5)

SPATIAL CHARACTERISTICS

Spatial Summary: Large-patch system.
Size: Occurs in small to large patches, with a few ranging up to thousands of acres.
Adjacent Ecological Systems:
- Atlantic Coastal Plain Embayed Region Tidal Freshwater Marsh (CES203.259)

Adjacent Ecological System Comments: Grades to Atlantic Coastal Plain Embayed Region Tidal Freshwater Marsh (CES203.259) upstream and inland. May border various communities on the upland side.

DISTRIBUTION

Range: Endemic to southeastern Virginia and adjacent North Carolina.
Divisions: 203:C
Nations: US
Subnations: NC, VA
Map Zones: 58:C, 60:C
USFS Ecomap Regions: 232I:CC
TNC Ecoregions: 57:C

SOURCES

References: Bertness et al. 2004, Comer et al. 2003, Eyre 1980, FNAI 2010a, Hackney and Cleary 1987, Langley et al. 2009, Silliman and Bertness 2002
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723226#references
Description Author: R. Evans, M. Schafale, G. Fleming
Version: 06 Feb 2014 **Stakeholders:** East, Southeast
Concept Author: R. Evans, M. Schafale, G. Fleming **ClassifResp:** Southeast

ATLANTIC COASTAL PLAIN INDIAN RIVER LAGOON SEAGRASS BED (CES203.256)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Tidal / Estuarine; Aquatic Herb
Non-Diagnostic Classifiers: Herbaceous
National Mapping Codes: ESLF 9254

CONCEPT

Summary: Seagrass beds comprising this ecological system are found on the Atlantic Coast of Florida from approximately the St. Johns River (near the Florida-Georgia border) south to Sebastian Inlet (approximately from 30 degrees 30 minutes N latitude to 28 degrees N latitude). This region is the northernmost range of *Thalassia testudinum* and *Cymodocea filiformis* along the Atlantic Coast (W. Kenworthy pers. comm.). Seagrasses in this region are found in a narrow longitudinal complex of lagoonal embayments, including Mosquito Lagoon, Indian River, and Banana River, where they occupy approximately 2% of the available bottom area (Moore 1992). All of the typical seagrass species are present, including *Cymodocea filiformis, Halodule wrightii (= Halodule beaudettei), Halophila engelmannii, Ruppia maritima*, and *Thalassia testudinum*. Little specific information is available on the extent of each type, but it is believed that several of the individual seagrass species may be found in mixed-species beds. More commonly, they are likely to exhibit the general pattern of individual species zonation typical of other systems where zones are largely related to water depth. Beds along the northern boundary of the system are somewhat less diverse than those associated with the Indian River Lagoon, due largely to the absence of *Halophila engelmannii* (which does not extend northward of the lagoon) (W. Kenworthy pers. comm.).

Similar Ecological Systems:
- East Gulf Coastal Plain Florida Big Bend Seagrass Bed (CES203.244)
- Florida Keys Seagrass Bed (CES411.285)
- Southwest Florida Seagrass Bed (CES203.274)

Related Concepts:
- Seagrass Bed (FNAI 1990) Broader

DESCRIPTION

Environment: This system is largely protected from storm surges by a nearly continuous series of protective barriers which are perched on limestone and consequently wind tides predominate. This region is connected to the Atlantic by 4 small inlets. However, since freshwater inputs are so localized and minimal, water salinity is close to sea strength.
Vegetation: All of the typical seagrass species are present, including *Cymodocea filiformis, Halodule beaudettei, Halophila engelmannii, Ruppia maritima*, and *Thalassia testudinum*. Little specific information is available on the extent of each type, but it is believed that several of the individual seagrass species may be found in mixed-species beds.
Dynamics: Very high levels of light are required by seagrasses. Because of this, increased water turbidity leads to seagrass decline. Eutrophication can lead to algal blooms which increase turbidity; also increased sediment in the water from dredging or erosion can cause increased turbidity. When seagrasses decline, the substrate can erode, which further increases turbidity and slows or prevents recovery of the seagrasses. Seagrasses are a critical part of estuarine and near-shore marine food webs. Seagrass beds provide habitat for many commercially valuable and sensitive fish and other marine species.

Component Associations:
- *Cymodocea filiformis - (Thalassia testudinum)* Herbaceous Vegetation (CEGL004317, G4?)
- *Halodule wrightii* Herbaceous Vegetation (CEGL004318, G4?)
- *Halophila engelmannii* Herbaceous Vegetation (CEGL004688, G3?)
- *Ruppia maritima* Carolinian Zone Herbaceous Vegetation (CEGL004335, G4G5)
- *Thalassia testudinum* Herbaceous Vegetation (CEGL004319, G4?)

DISTRIBUTION

Range: This system occurs in Florida, from the St. Johns River (near the Florida-Georgia border) south to Sebastian Inlet, in a narrow longitudinal complex of lagoonal embayments along the Florida coast, including Mosquito Lagoon, Indian River, and Banana River.
Divisions: 203:C
Nations: US
Subnations: FL
Map Zones: 55:C, 56:C
TNC Ecoregions: 55:C, 56:C

SOURCES

References: Comer et al. 2003, FNAI 1990, Grech et al. 2012, Kenworthy pers. comm., Moore 1992, Yarbro and Carlson 2011

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723230#references
Description Author: R. Evans, mod. M. Pyne
Version: 06 Feb 2014
Concept Author: R. Evans
Stakeholders: Southeast
ClassifResp: Southeast

ATLANTIC COASTAL PLAIN INDIAN RIVER LAGOON TIDAL MARSH (CES203.257)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Tidal / Estuarine; Graminoid
Non-Diagnostic Classifiers: Herbaceous
National Mapping Codes: ESLF 9253

CONCEPT

Summary: This tidally influenced marsh system of the Indian River Lagoon along Florida's Atlantic Coast supports approximately 10% of the salt marshes in Florida. It is endemic to the Atlantic Coast of Florida where it ranges from central Volusia County, southward through Brevard, Indian River, St. Lucie, and northern Martin counties, beginning in the vicinity of Daytona Beach and extending south from there. The bulk of these are "high marshes" wholly above mean high water levels. They are protected from direct exposure to the Atlantic Ocean by perched barrier islands, and consequently receive natural inundation only from wind tides and seasonal sea level changes. A berm or levee generally separates these high marshes from lower fringing marshes of *Spartina alterniflora* (to the north) and *Rhizophora mangle* (to the south). Landward of this berm, salt flats or hypersaline zones often develop with *Salicornia, Distichlis spicata, Borrichia frutescens, Batis maritima,* and *Paspalum vaginatum*. In some areas these species occur in monospecific zones, while in others they co-occur, grading into occasional *Avicennia germinans*. These zones are followed by a typical *Juncus roemerianus* zone, and the most inland fringes may be dominated by *Spartina bakeri*. Marshes of this region have been heavily altered by mosquito control impoundments of the 1950s and 1960s.

Similar Ecological Systems:
- Atlantic Coastal Plain Embayed Region Tidal Salt and Brackish Marsh (CES203.260)
- Southern Atlantic Coastal Plain Salt and Brackish Tidal Marsh (CES203.270)

Related Concepts:
- Tidal Marsh (FNAI 1990) Broader

DESCRIPTION

Environment: Tidal amplitudes in this region range from 0.6-1.5 m. Tides have a minute range in the north contributing to a very narrow intertidal zone, which is sometimes occupied by *Spartina alterniflora*. In the south where tidal range is greater, mangroves occupy the intertidal zone, replacing *Spartina alterniflora*.
Vegetation: *Spartina alterniflora* zone is dominant, with lesser area of *Juncus roemerianus* and *Spartina patens*.
Dynamics: Tidal flooding is the ecological factor that distinguishes this system, but tidal amplitudes along the east coast of Florida are low. Due to evaporation in the Indian River Lagoon, salt flats with *Batis maritima, Salicornia virginica,* and *Salicornia bigelovii* were a common feature (Rey and Connelly 2012). Some of these salt flats were lost to mosquito-control impoundments (Rey and Connelly 2012). Tides bring nutrients, making the regularly flooded marshes fertile. Storms may push saltwater into brackish areas and higher zones, acting as a disturbance to vegetation. For marshes on the back of barrier islands, storm overwash may deposit sand in the marsh. Marshes usually recover from this, but if sufficient sand is deposited, a different system may develop on the site. Fire may be a natural force in some patches that are connected to the mainland. Prescribed fire has been used to manage tidal marshes for wildlife. Rising sea level will affect this system, drowning some marsh areas, promoting shoreline erosion, and causing salt or brackish marshes to spread inland into freshwater marsh areas. However, elevated atmospheric CO2 increases the productivity of marsh grasses, which can lead to marsh elevation gain (Langley et al. 2009). The marsh snail (*Littoraria irrorata*) is a native and characteristic part of the marsh ecosystem, and is eaten by blue crabs. The disruption of marsh snail predation by blue crabs can lead to a trophic cascade (Silliman and Bertness 2002, Bertness et al. 2004).

Component Associations:
- *Cladium mariscus ssp. jamaicense* Tidal Herbaceous Vegetation (CEGL004178, G4?)
- *Distichlis spicata - (Sporobolus virginicus)* Herbaceous Vegetation (CEGL007694, G3G5)
- *Juncus roemerianus* Herbaceous Vegetation (CEGL004186, G5)
- *Sarcocornia pacifica* - (*Batis maritima, Distichlis spicata*) Dwarf-shrubland (CEGL002278, G4)
- *Spartina alterniflora* Carolinian Zone Herbaceous Vegetation (CEGL004191, G5)
- *Spartina bakeri - Kosteletzkya virginica* Herbaceous Vegetation (CEGL004194, G3?)
- *Spartina bakeri* Herbaceous Vegetation (CEGL003992, G3?)

DISTRIBUTION

Range: This system is endemic to the Atlantic Coast of Florida where it ranges from central Volusia County, southward through Brevard, Indian River, St. Lucie, and northern Martin counties. This area begins in the vicinity of Daytona Beach and extends south from there.
Divisions: 203:C

Nations: US
Subnations: FL
Map Zones: 55:C, 56:C
USFS Ecomap Regions: 232G:CC
TNC Ecoregions: 55:C

SOURCES

References: Bertness et al. 2004, Comer et al. 2003, FNAI 1990, Langley et al. 2009, Montague and Wiegert 1990, Rey and Connelly 2012, Silliman and Bertness 2002

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723229#references

Description Author: R. Evans, mod. M. Pyne and C. Nordman
Version: 14 Jan 2014
Concept Author: R. Evans

Stakeholders: Southeast
ClassifResp: Southeast

ATLANTIC COASTAL PLAIN NORTHERN SALT POND MARSH (CES203.892)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Non-Diagnostic Classifiers: Herbaceous
National Mapping Codes: ESLF 9274

CONCEPT

Summary: This system occurs from New Hampshire to New York on ponds behind sandy or cobbly barrier beaches that are breached periodically by storm surges, causing seawater incursion into the pond. Salinity levels, and thus effects on vegetation, are highly variable as a result. A mixture of salt marsh, brackish marsh, and shrublands occur on the periphery of the pond. *Spartina patens, Typha angustifolia, Eleocharis parvula, Eleocharis halophila, Schoenoplectus maritimus (= Scirpus maritimus), Schoenoplectus pungens (= Scirpus pungens),* and *Hibiscus moscheutos* are typical species; *Spartina pectinata* is a major component in marshes of Massachusetts and New York. Salt shrub vegetation characterized by *Iva frutescens* may occur at the upper reaches of flooding, and *Ruppia maritima* or *Zannichellia palustris* may occur in the pond.

DESCRIPTION

Environment: This vegetation occurs on the shores of coastal ponds behind barrier beaches or narrow spits that impede tidal flow. Salinity is extremely variable, influenced by freshwater input from the surrounding uplands, as well as by the periodicity of breaching of the barrier beach by coastal storms.
Dynamics: Coastal salt ponds are generally sheltered from tidal flow for at least part of the year despite their close proximity to the ocean. Their location behind barrier beaches and narrow spits exposes them to seasonal changes in the amount of inflow, intermittent breaching by coastal storms, and highly variable salinity levels ranging from nearly fresh to mesohaline.

Component Associations:
- *Baccharis halimifolia - Iva frutescens / Panicum virgatum* Shrubland (CEGL003921, G5)
- *Cornus amomum - Alnus serrulata* Shrubland (CEGL006414, GNR)
- *Panicum virgatum - Spartina patens - Carex silicea* Herbaceous Vegetation (CEGL006150, GNR)
- *Ruppia maritima* Acadian/Virginian Zone Temperate Herbaceous Vegetation (CEGL006167, GNR)
- *Schoenoplectus pungens - Eleocharis parvula* Herbaceous Vegetation (CEGL006398, GNR)
- *Spartina patens - Agrostis stolonifera* Herbaceous Vegetation (CEGL006365, GNR)
- *Spartina patens - Distichlis spicata - (Juncus gerardii)* Herbaceous Vegetation (CEGL006006, G5)
- *Spartina patens - Schoenoplectus pungens - Solidago sempervirens* Herbaceous Vegetation (CEGL004097, G2G3)
- *Typha angustifolia - Hibiscus moscheutos* Herbaceous Vegetation (CEGL004201, G4G5)

DISTRIBUTION

Range: This system occurs in New Hampshire, Massachusetts, Rhode Island and New York.
Divisions: 203:C
Nations: US
Subnations: MA, NH, NY, RI
Map Zones: 65:C, 66:C
TNC Ecoregions: 62:C

SOURCES

References: Anderson and Edwards 1986, Comer et al. 2003, Crawford and Carey 1985, Culbert and Raleigh 2001, Faber-Langendoen et al. 2011, MNHESP 2010a, MNHESP 2010b, Nichols et al. 2013, NYNHP 2013l, Swain and Kearsley 2011, Thorne-Miller et al. 1983
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722788#references
Description Author: L.A. Sneddon, mod. S.C. Gawler
Version: 14 Jan 2014
Concept Author: L. Sneddon
Stakeholders: East
ClassifResp: East

ATLANTIC COASTAL PLAIN SANDHILL SEEP (CES203.253)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Seepage-Fed Sloping
Non-Diagnostic Classifiers: Herbaceous; Isolated Wetland [Partially Isolated]
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2516; ESLF 3187; ESP 1516

CONCEPT

Summary: This sandhill seep system occurs in small patches on slopes in dissected terrain, where a clay lens or other impermeable layer forces groundwater to the surface as seepage. This type occurs largely in the Fall-line Sandhills region of the Carolinas and Georgia but also rarely in other parts of the Atlantic Coastal Plain. Soils are seasonally to permanently saturated by seepage and range from sandy or clayey to mucky. Vegetation is variable and complex in composition and structure, consisting of a mixture of plants of pine savannas and streamhead pocosins, but contrasting with both in structure and proportions. The tree canopy of *Pinus serotina* and *Pinus palustris* may be open or rarely absent, and patches of dense shrubs, grasses, ferns, and various herbaceous plants may be present. Where burned every one to three years, *Arundinaria gigantea ssp. tecta* may be patch-dominant. Fire is a crucial determinant of structure and composition; it tends to occur in a variable and patchy pattern that is driven by both the fire regime of the surrounding system and the wetness of the seep vegetation.
Classification Comments: This system is distinguished from Central Atlantic Coastal Plain Wet Longleaf Pine Savanna and Flatwoods (CES203.265) by having wetland hydrology driven by seepage rather than seasonal high water table, and by vegetational and landscape differences. Occurs rarely in southeastern Georgia in escarpment areas which have greater topography than is locally typical, and perched water tables which flow to the surface in sloping areas.
Similar Ecological Systems:
- Atlantic Coastal Plain Streamhead Seepage Swamp, Pocosin and Baygall (CES203.252)
- Central Atlantic Coastal Plain Wet Longleaf Pine Savanna and Flatwoods (CES203.265)
- East Gulf Coastal Plain Interior Shrub Bog (CES203.385)
- Piedmont Seepage Wetland (CES202.298)

Related Concepts:
- Longleaf Pine - Slash Pine: 83 (Eyre 1980) Finer
- Longleaf Pine: 70 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs on gentle to steep slopes of dissected areas in interbedded sand and clay, largely in the Fall-line Sandhills region but rarely in other parts of the Atlantic Coastal Plain. Sites are seasonally to permanently saturated with seeping groundwater, forced to the surface by an impermeable layer such as a clay bed. Soils may be sandy, clayey, or in the wettest sites, mucky. The hydrological connection to adjacent Atlantic Coastal Plain Fall-line Sandhills Longleaf Pine Woodland (CES203.254), whose well-drained sandy soils are the source of seepage water, is crucial. Fire is a crucial natural force, and is also dependent on the adjacent systems. At Fort Benning, Georgia, examples of this system occur in wet mineral soils in zones between drier, sandhills longleaf pine communities and saturated streamside forests dominated by *Nyssa biflora*. In the Sandhills region of North Carolina, they may occur in a similar position between sandy uplands and streamhead pocosins, or they may occur as isolated wetlands on slopes surrounded by dry longleaf pine communities.
Vegetation: Vegetation is a potentially diverse mixture of plants of wet savannas and pocosins. Vegetation structure may vary widely, with dense shrubs, dense herbs, or mixtures of shrubs and herbs, and with an open tree canopy or absent tree canopy occurring in complexes or in different patches. *Pinus palustris, Pinus serotina*, or several hardwood species may dominate the canopy. Characteristic Streamhead Pocosin shrubs, such as *Ilex glabra, Lyonia lucida, Clethra alnifolia, Toxicodendron vernix, Ilex coriacea*, and *Zenobia pulverulenta*, may mix with flatwoods shrubs, such as *Gaylussacia frondosa* and *Kalmia carolina*. The herbs are primarily species shared with wet savannas, such as *Aristida stricta, Calamovilfa brevipilis, Ctenium aromaticum, Andropogon glomeratus*, and a variety of showy forbs and insectivorous plants, but often occur in very different proportions. Large wetland ferns, such as *Osmunda cinnamomea, Osmunda regalis*, and *Pteridium aquilinum*, also often dominate.
Dynamics: The ecological dynamics of the Sandhill seep are influenced by the amount and duration of saturation and the frequency and intensity of wildland fire. Fires can burn completely through Sandhill seeps, keeping shrub cover low and promoting graminoids and herbs (Nordman 2012). Fire is the predominant natural dynamic force in this system and is critical in determining its structure and even its identity. Fire regime is dominated by the fire regime of the surrounding system, which naturally burned every few years, but is modified by the wetness and flammability of the seep vegetation. Some fires do not penetrate parts of the seeps, creating variable age and vegetation structure. Areas that seldom burn have dense and tall shrubs, while areas that burn frequently are dominated by herbs, usually with patches of *Arundinaria gigantea ssp. tecta*. With long absence of fire, many seeps become indistinguishable from

Atlantic Coastal Plain Streamhead Seepage Swamp, Pocosin and Baygall (CES203.252). Canopy dynamics are probably driven mainly by fire, with hot fires killing the less fire-tolerant trees and creating a fine mosaic or zoned complex of older trees, younger regeneration, and treeless areas. Shrubs and herbs readily sprout after fires, but relative proportions are controlled by the frequency of fire.

Component Associations:
- *(Pinus palustris, Pinus serotina) / Ctenium aromaticum - Muhlenbergia expansa - Calamovilfa brevipilis* Woodland (CEGL003659, G2)
- *Arundinaria gigantea ssp. tecta* Shrubland (CEGL003843, G1)
- *Clethra alnifolia - Toxicodendron vernix / Aristida stricta - Osmunda cinnamomea - Sarracenia* spp. Shrub Herbaceous Vegetation (CEGL004467, G2?)
- *Gaylussacia frondosa - Clethra alnifolia - Arundinaria gigantea ssp. tecta / Aristida stricta - Pteridium aquilinum var. pseudocaudatum* Herbaceous Vegetation (CEGL004468, G3?)
- *Ilex coriacea - Lyonia lucida - Smilax laurifolia* Shrubland (CEGL004666, G3G4)
- *Pinus palustris - Pinus serotina / Ilex glabra - Lyonia lucida / Ctenium aromaticum* Woodland (CEGL003860, G3)

Spatial Characteristics

Spatial Summary: Small patch, with occurrences ranging from a fraction of an acre to several acres. Patches sometimes occur in complexes in close proximity, but as often are isolated. Some seeps are linear bodies stretching across slopes, some are linear running downslope, and some are small oval bodies.

Adjacent Ecological Systems:
- Atlantic Coastal Plain Fall-line Sandhills Longleaf Pine Woodland (CES203.254)
- Atlantic Coastal Plain Streamhead Seepage Swamp, Pocosin and Baygall (CES203.252)

Adjacent Ecological System Comments: Generally, this system is surrounded by Atlantic Coastal Plain Fall-line Sandhills Longleaf Pine Woodland (CES203.254). It is sometimes interspersed or found grading to Atlantic Coastal Plain Streamhead Seepage Swamp, Pocosin and Baygall (CES203.252) on one side.

Distribution

Range: This system occurs from east-central North Carolina to central Georgia, primarily in the Fall-line Sandhills region but occasionally occurring in the Outer Coastal Plain. For example, this system occurs in limited parts of southeastern Georgia associated with the topography of old escarpments. It occurs primarily in the Atlantic drainage but is rarely represented in the Gulf drainage (such as at Fort Benning, Georgia).

Divisions: 203:C
Nations: US
Subnations: GA, NC, SC
Map Zones: 55:C, 58:C
USFS Ecomap Regions: 232J:CC
TNC Ecoregions: 53:C, 56:C, 57:C

Sources

References: Comer et al. 2003, Elliott, M. pers. comm., Engeman et al. 2007, Eyre 1980, Nelson 1986, Nordman 2012

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723232#references

Description Author: M. Schafale and R. Evans, mod. C. Nordman
Version: 14 Jan 2014
Concept Author: M. Schafale and R. Evans
Stakeholders: Southeast
ClassifResp: Southeast

BOREAL FRESHWATER EMERGENT MARSH (CES103.525)

CLASSIFIERS

Classification Status: Standard

Primary Division: Boreal (103)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Lake; Pond; Herbaceous; Alluvial flat; Boreal [Boreal Subcontinental]; Mineral: W/ A-Horizon >10 cm; Graminoid
National Mapping Codes: ESLF 9445

CONCEPT

Summary: Freshwater marshes are found throughout boreal transition and boreal regions of central Canada, east into Ontario and Quebec. They are characterized by emergent herbaceous vegetation. Freshwater marshes typically occur with other wetland systems, occurring on the margins of ponds, lakes, and riparian systems and on inland deltas where rivers drain into large lakes. They also occur on glacial potholes, along small streams, in channels in glacial outwash and on lakeplains. Inland marshes are mostly small patch, confined to limited areas in suitable floodplain or basin topography. Often the marsh contains a deep to shallow area of freshwater dominated by emergent and submergent species. Stands may be open ponds with floating or rooted aquatics, or deep marsh with bulrush or cattails, and range from fairly small to several acres. They are typically semipermanently flooded, but some marshes have seasonal flooding. Water is at or above the surface for most of the growing season (typically 10 cm above the surface). Soils are muck or mineral, and water is nutrient-rich. These systems are highly productive and have high rates of decomposition. Freshwater marsh vegetation is dominated by emergent vegetation in the genera of *Typha, Schoenoplectus (= Scirpus), Juncus*, and *Eleocharis* with an occasional scattering of tall *Carex* spp. and forbs that can vary from dense to open cover. Trees are generally absent and, if present, are scattered. Floating aquatic herbs may also occur in areas of open water within or adjacent to the marsh. Some of the common species include *Sparganium eurycarpum, Acorus calamus, Carex utriculata, Schoenoplectus acutus, Schoenoplectus tabernaemontani (= Scirpus validus), Typha latifolia, Sagittaria cuneata, Calla palustris, Alisma plantago-aquatica, Menyanthes trifoliata, Comarum palustre (= Potentilla palustris),* and *Scheuchzeria palustris*.
Classification Comments: Exactly where this system transitions to Western North American Boreal Freshwater Emergent Marsh (CES105.123) in Alaska is uncertain, but is likely to be somewhere in Yukon Territory. It is also similar to North-Central Interior Freshwater Marsh (CES202.899) which is found the northern Midwest of the U.S., and ranges into southern Canada.
Similar Ecological Systems:
- North-Central Interior Freshwater Marsh (CES202.899)--of the northern Midwest of the U.S. and southern Canada.

DESCRIPTION

Environment: Freshwater marshes are found throughout boreal transition and boreal regions of central Canada. They are characterized by emergent herbaceous vegetation. Freshwater marshes typically occur with other wetland systems. They occur on the margins of ponds, lakes, and riparian systems and on inland deltas where rivers drain into large lakes. Inland marshes are mostly small patch, confined to limited areas in suitable floodplain or basin topography. They are typically semipermanently flooded, but some marshes have seasonal flooding. Water is at or above the surface for most of the growing season (typically 10 cm above the surface). Soils are muck or mineral, and water is nutrient-rich and may experience periodic drawdowns. These systems are highly productive and have high rates of decomposition (National Wetlands Working Group 1997).
Vegetation: Freshwater marsh vegetation is dominated by emergent vegetation such as *Sparganium eurycarpum, Acorus calamus, Carex utriculata, Schoenoplectus acutus, Schoenoplectus tabernaemontani (= Scirpus validus), Typha latifolia, Sagittaria cuneata, Calla palustris, Alisma plantago-aquatica, Menyanthes trifoliata, Comarum palustre (= Potentilla palustris),* and *Scheuchzeria palustris*.
Dynamics: This system requires a source of freshwater. Seasonal flooding is characteristic of inland deltas. Marsh zonation is related to water depth and duration of flooding. A typical sequence progresses from open water to emergent deep marsh to shallow marsh to wet meadow or fen. Floating marsh mats may be seral to fens.

Component Associations:
- *Eleocharis palustris* Herbaceous Vegetation (CEGL001833, G5)
- *Equisetum fluviatile* Boreal Herbaceous Vegetation (CEGL005292, GNR)
- *Schoenoplectus pungens* Herbaceous Vegetation (CEGL001587, G3G4)
- *Schoenoplectus tabernaemontani* Temperate Herbaceous Vegetation (CEGL002623, G5)
- *Typha (latifolia, angustifolia)* Western Herbaceous Vegetation (CEGL002010, G5)

DISTRIBUTION

Range: This system is found from lowlands through valley bottoms in the boreal and boreal transition regions of central Canada.
Divisions: 103:C
Nations: CA
Subnations: AB, MB, ON, QC?, SK, YT

TNC Ecoregions: 66:P, 135:P, 139:P, 140:C, 141:C

SOURCES

References: Gracz et al. 2005, Jorgenson 1999, Lawrence et al. 2005, National Wetlands Working Group 1997, Smith et al. 2007, Stone et al. 2007, Viereck et al. 1992, Western Ecology Working Group n.d., Willoughby 2007, Willoughby et al. 2006

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.837976#references

Description Author: M.S. Reid

Version: 31 Mar 2010 **Stakeholders:** Canada, West

Concept Author: M.S. Reid **ClassifResp:** West

CENTRAL FLORIDA HERBACEOUS PONDSHORE (CES203.890)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Herbaceous; Depressional; Graminoid
Non-Diagnostic Classifiers: Isolated Wetland [Partially Isolated]
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2514; ESLF 9275; ESP 1514

CONCEPT

Summary: This system includes a variety of seasonal depression ponds in central Florida, especially along the Lake Wales Ridge. Examples are rounded or irregularly shaped, shallow depressions from tens to hundreds of meters in diameter. Extensive variation is present based on the variety of soils and hydroperiods. Most examples have vegetation in zones, and nearly all are ringed by *Serenoa repens*. Characteristic or dominant species associated with the interior of the ponds include *Panicum hemitomon, Panicum abscissum, Hypericum edisonianum*, and *Andropogon brachystachyus*.
Classification Comments: Compare to East Gulf Coastal Plain Depression Pondshore (CES203.558), found to the north.
Similar Ecological Systems:
- East Gulf Coastal Plain Depression Pond (CES203.558)

DESCRIPTION

Environment: Most examples are known from the Lake Wales Ridge area of central Florida. These are shallow depressions from tens to hundreds of meters in diameter, found on a variety of different soils with different hydroperiods (Abrahamson et al. 1984).
Vegetation: Most depression ponds accommodated in this system display distinct vegetational zonation. At least four vegetational zones can be readily distinguished (Abrahamson et al. 1984); the community types need to be further reconciled into associations.
Dynamics: Variation in the duration and depth of flooding is part of the natural dynamics of the ponds in central Florida. The herbaceous pondshore or rim can burn with fires that burn the surrounding uplands or flatwoods. These fires help maintain the diversity of plants which can occur along the herbaceous pondshore or rim which circles the pond.

Component Associations:
- *Amphicarpum muehlenbergianum - (Panicum hemitomon)* Herbaceous Vegetation (CEGL008588, G2G3)
- *Andropogon (capillipes, glaucopsis) - Rhynchospora fascicularis var. fascicularis - Rhexia mariana* Herbaceous Vegetation (CEGL004460, G2?)
- *Dichanthelium wrightianum - Dichanthelium erectifolium* Herbaceous Vegetation (CEGL004105, G2G3)
- *Hypericum brachyphyllum* Dwarf-shrubland (CEGL003955, G3?)
- *Panicum hemitomon - Pluchea (camphorata, rosea) - Ludwigia* spp. Herbaceous Vegetation (CEGL007792, G3)
- *Panicum hemitomon - Pontederia cordata* Herbaceous Vegetation (CEGL004461, G3G4)
- *Rhynchospora (careyana, inundata)* Seasonally Flooded Herbaceous Vegetation (CEGL004132, G3?)
- *Woodwardia virginica / Sphagnum cuspidatum* Herbaceous Vegetation (CEGL004475, G2?)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Central Florida Pine Flatwoods (CES203.382)
- Central Florida Wet Prairie and Herbaceous Seep (CES203.491)
- Florida Dry Prairie (CES203.380)

Adjacent Ecological System Comments: May grade into Central Florida Wet Prairie and Herbaceous Seep (CES203.491). Surrounding matrix vegetation can include Central Florida Pine Flatwoods (CES203.382) and Florida Dry Prairie (CES203.380).

DISTRIBUTION

Range: Endemic to central Florida.
Divisions: 203:C
Nations: US
Subnations: FL
Map Zones: 55:C, 56:C
USFS Ecomap Regions: 232K:CC
TNC Ecoregions: 55:C

SOURCES

References: Abrahamson et al. 1984, Comer et al. 2003
Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722789#references
Description Author: R. Evans, mod. C. Nordman
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: R. Evans **ClassifResp:** Southeast

CENTRAL FLORIDA WET PRAIRIE AND HERBACEOUS SEEP (CES203.491)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Seepage-Fed Sloping; Graminoid
Non-Diagnostic Classifiers: Herbaceous
National Mapping Codes: ESLF 9279

CONCEPT

Summary: This system includes herbaceous seepage wetlands and nearly treeless plains over poorly drained soils in central Florida. Although examples of this system are similar to other wetland ecological systems, these are characterized by the presence of subtropical plant species not occurring in herbaceous-dominated wetlands farther north, especially *Panicum abscissum*. At least some examples have dense cover of grasses and low shrubs, with fairly high species diversity. Examples may be most common along the southern part of the Lake Wales Ridge area.
Classification Comments: East Gulf Coastal Plain Savanna and Wet Prairie (CES203.192) is a closely related system found farther north.
Similar Ecological Systems:
- East Gulf Coastal Plain Savanna and Wet Prairie (CES203.192)

Related Concepts:
- Wet Prairie (FNAI 1990) Intersecting

DESCRIPTION

Environment: Associated with saturated soils caused by seepage or high water tables; some examples may be saturated for 50-100 days/year. Seepage-influenced examples tend to occur in areas of greater topographic relief than wet prairies.
Vegetation: Usually dominated by *Panicum abscissum*.
Dynamics: Frequent fires were an important natural process in this system, with an estimated frequency of 1-4 years (FNAI 1990, FNAI 2010a).

Component Associations:
- *Andropogon (capillipes, glaucopsis) - Rhynchospora fascicularis var. fascicularis - Rhexia mariana* Herbaceous Vegetation (CEGL004460, G2?)
- *Panicum abscissum* Herbaceous Vegetation (CEGL004113, G2G3)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Central Florida Herbaceous Pondshore (CES203.890)
- Central Florida Pine Flatwoods (CES203.382)
- Florida Dry Prairie (CES203.380)
- Florida Longleaf Pine Sandhill (CES203.284)

Adjacent Ecological System Comments: May grade downslope into Central Florida Herbaceous Pondshore (CES203.890). Surrounding matrix vegetation can include Central Florida Pine Flatwoods (CES203.382) and Florida Dry Prairie (CES203.380).

DISTRIBUTION

Range: Endemic to central Florida, mainly found in the southern Lake Wales Ridge.
Divisions: 203:C
Nations: US
Subnations: FL
Map Zones: 55:P, 56:C
TNC Ecoregions: 55:C

SOURCES

References: Comer et al. 2003, FNAI 1990, FNAI 2010a
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723095#references
Description Author: R. Evans and C. Nordman
Version: 14 Jan 2014
Concept Author: R. Evans and C. Nordman
Stakeholders: Southeast
ClassifResp: Southeast

CENTRAL TEXAS COAST RIVER TERRACE SANDYLAND GRASSLAND (CES203.712)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Herbaceous; Terrace; West Gulf Coastal Plain; Deep Soil; Sand Soil Texture; Graminoid
National Mapping Codes: ESLF 9441

CONCEPT

Summary: This grassland system occurs on deep sands of alluvial origin in the Coastal Prairie region of Texas from Austin to Refugio counties. Formed by stream deposition, these areas occur on fluvial terraces adjacent to rivers and streams. Vegetative composition is typically dominated by graminoids, including *Schizachyrium scoparium, Sorghastrum nutans, Paspalum plicatulum*, and *Andropogon gerardii*. Other grass species that may be present to dominant include *Paspalum setaceum, Trachypogon spicatus, Paspalum monostachyum, Elionurus tripsacoides, Cenchrus spinifex, Eragrostis secundiflora, Aristida* spp., and *Triplasis purpurea*.
Similar Ecological Systems:
- Central Texas Coastal Prairie Riparian (CES203.714)
- Central Texas Coastal Prairie River Floodplain (CES203.713)
- Texas-Louisiana Coastal Prairie (CES203.550)

Related Concepts:
- Central Texas Coast River Terrace Sandyland Grassland (7907) (Elliott 2011) Equivalent

DESCRIPTION

Environment: This system occurs on Quaternary alluvium comprised of deep sand terraces (typically >1 m [3 feet] in depth) along rivers and streams. These terraces and benches are higher than the adjacent level and ridge-and-swale topography of river floodplains. The ecological site type is characterized as Sand Hill on soils such as Sarita-Falfurrias fine sands, but other coarse, deep sand sites on river terraces are also occupied by this system.
Vegetation: These sites are typically dominated by graminoids, including species such as *Schizachyrium scoparium, Sorghastrum nutans, Paspalum plicatulum*, and *Andropogon gerardii*. Other grass species that may be present to dominant include *Paspalum setaceum, Trachypogon spicatus, Paspalum monostachyum, Elionurus tripsacoides, Cenchrus spinifex, Eragrostis secundiflora, Aristida* spp., and *Triplasis purpurea*. Characteristic forbs of the system include *Aphanostephus skirrhobasis, Heterotheca subaxillaris, Cnidoscolus texanus, Stillingia sylvatica, Gaillardia aestivalis, Croton argyranthemus, Acalypha radians, Croton parksii, Croton capitatus, Phyllanthus abnormis, Physalis cinerascens, Helianthus argophyllus, Verbesina encelioides, Eriogonum multiflorum, Froelichia floridana, Croptilon divaricatum, Diodia teres, Polanisia erosa*, and *Chamaecrista fasciculata*. *Prosopis glandulosa* is a common woody invader on these sites, but other woody species such as *Zanthoxylum fagara, Celtis pallida (= Celtis ehrenbergiana)*, and the uncommon *Prunus texana* may also be present.

Component Associations:
- *Schizachyrium scoparium - Triplasis purpurea - Eriogonum multiflorum - Liatris elegans var. carizzana* Herbaceous Vegetation (CEGL008483, G1)

DISTRIBUTION

Range: This system occurs on terraces of deep sand along rivers and streams of the Coastal Prairie region from Austin to Refugio counties in Texas.
Divisions: 203:C
Nations: US
Subnations: TX
Map Zones: 34:C
USFS Ecomap Regions: 255C:CC, 255D:CC, 315E:PP
TNC Ecoregions: 30:P, 31:C, 32:C

SOURCES

References: Elliott 2011, Southeastern Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.859574#references
Description Author: L. Elliott, mod. J. Teague
Version: 25 Feb 2011
Stakeholders: Southeast
Concept Author: L. Elliott, D. Diamond, A. Treuer-kuehn, D. German, J. Teague
ClassifResp: Southeast

COLORADO PLATEAU HANGING GARDEN (CES304.764)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Saturated Soil; Montane [Montane]; Montane [Lower Montane]; Cliff (Substrate); Sedimentary Rock; Temperate [Temperate Xeric]; Seepage-Fed Sloping; Forb; Fern; Graminoid; Cliff (Landform)
Non-Diagnostic Classifiers: Herbaceous; Isolated Wetland [Strictly Isolated]
National Mapping Codes: ESLF 9285

CONCEPT

Summary: Hanging gardens in the Colorado Plateau region are surrounded by arid environments and associated with canyons of the Colorado River and its tributaries. These highly localized environments occur in canyons with perennial water sources (springs) forming pocketed and often isolated wetlands and draping vegetation across wet cliff faces or associated ledges and colluvium. Four main garden types exist: alcove, terrace, windowblind and channel types. Each is determined by the nature of the geological formation and the presence or absence of joint systems. They tend to occur at all exposures of the canyon walls, but they are always shaded for much to most of each day. Temperature and humidity are relatively stable compared to the surrounding environment. Hanging gardens are dominated by herbaceous plants, and a number of these are endemic to this region. Common species include *Adiantum capillus-veneris, Carex curatorum, Mimulus eastwoodiae, Mimulus guttatus, Primula specuicola, Cirsium rydbergii*, and several species of *Aquilegia*.

DESCRIPTION

Environment: Several major sandstone and limestone aquifers exist on the Colorado Plateau, supporting thousands of springs. These springs exist in a matrix of arid and semi-arid upland plant communities, and are often strongly isolated from one another. Hanging gardens are a special type of spring associated with sedimentary rocks in strongly dissected landscapes with relatively narrow and deep bedrock canyons. These systems are defined by the presence and dominance (using canopy cover) of certain herbaceous plant species, although shrub- and tree-dominated vegetation can be associated with them. These gardens support numerous wetland plant species, including a suite of about 25 Colorado Plateau endemics. The local climate is hot and arid and supports annual precipitation from 12 to 36 cm (5-14 inches), and mean annual temperatures are high and summer temperatures greater than 100 degrees F are common.

Certain formations on the Colorado Plateau, especially eolian-derived coarse-grained sandstones, act as aquifers, with water moving through the porous matrix, often along joints. Within these aquifers there are lenses of impermeable fine-grained lake and fluvial sediments that often constrain the flow of water, and they can be underlain by older geological formations that act as major aquicludes (barriers to groundwater movement). When water reaches these impermeable layers, it flows laterally until reaching a cliff face, where it emerges as a series of seeplines, often perched well above the canyon floors. In some cases, primarily in Zion Canyon, the impermeable layers are vertically inclined (windowblind alcoves). The wet walls, ledges and associated detritus slopes are colonized by a wide variety of primarily herbaceous wetland species, and the flora is quite distinct from other spring-supported communities (Spence 2008). Some of the largest and most complex hanging gardens are found along the Virgin and Colorado rivers associated with tributary theater-headed valley networks where groundwater sapping creates large shaded alcoves at cliff bases (Laity and Malin 1985). These alcoves are best developed in the Jurassic-age Navajo Sandstone aquifer associated with the underlying Kayenta Sandstone aquiclude, but also occur in other important aquifers such as the Cedar Mesa and Entrada formations.

Although hanging gardens can occur in a variety of aspects and geological settings, the largest and most characteristic are associated with deep-shaded alcoves where climactic conditions are more stable than in the surrounding uplands. During the growing season temperatures can be as much as 10-15 degrees C cooler than in more exposed areas, with higher relative humidity and significant shading from the sun. Some of these alcoves see little if any direct solar radiation, even in June.

Water quality generally varies from neutral to mildly basic (pH 7-8), with relatively low values of specific conductance, but can be extremely high in limestone aquifers such as the Redwall and Muav formations in the Grand Canyon. However, water chemistry appears to be less important in controlling plant species presence than elevation (climate) is, as many species are found in both sandstone- and limestone-supported gardens (Spence 2008). Upper limits for hanging gardens is typically around 1800-1900 m, above which characteristic garden species are replaced by more cold-adapted montane floras.
Vegetation: The species diversity of hanging garden ranges from 1-2 species to over 50 species in the largest alcoves. Larger gardens are extremely diverse, much more so than most upland communities. The huge garden at the head of Rose Canyon, probably the largest one in the world, supports 50+ phreatophytes plus at least another 30-40 upland species in an area <1 ha in size. The diversity of vegetation is much greater in the gardens on the Colorado Plateau versus those of the Utah High Plateaus. The vegetation may overlap with the nearby riparian vegetation, but there are a series of species that are unique to hanging gardens (Welsh 1989), including boreal-temperate relicts, Colorado Plateau endemics, southwestern hot desert riparian species, and tallgrass prairie species. Several species of algae are restricted to these hanging gardens. The classic alcove type of hanging garden in the Canyonlands of

southeastern Utah and in the central Colorado Plateau around Lake Powell consists of an overhanging back wall, a vaulted face wall, a detrital slope, and a plunge basin. The back and face walls support clinging plants of *Adiantum capillus-veneris, Mimulus eastwoodiae* (*Mimulus cardinalis* in Grand Canyon and Zion), *Muhlenbergia thurberi, Petrophyton caespitosum, Primula specuicola,* and several other species. The wet, sandy to rocky detritus supports *Aquilegia formosa (= Aquilegia fosteri), Aquilegia micrantha, Calamagrostis scopulorum, Carex aurea, Cirsium rydbergii, Dichanthelium acuminatum (= Panicum acuminatum), Epipactis gigantea,* and *Zigadenus vaginatus*. A fringing margin of *Celtis laevigata var. reticulata (= Celtis reticulata), Cercis canadensis var. texensis (= Cercis occidentalis), Frangula betulifolia,* and *Quercus gambelii* often occurs outward from the footslope where the plants tend to conceal the alcove base, or on adjacent slopes. Sometimes the rare and local *Ostrya knowltonii* occurs in these woodlands. The outer and drier edges support grasses typical of the prairies and plains of the western U.S., such as *Andropogon glomeratus, Panicum virgatum,* and *Sorghastrum nutans*. In the Utah High Plateaus gardens, the dominants are usually *Sullivantia hapemanii var. purpusii* and *Aquilegia barnebyi* with *Mimulus guttatus* common. Hanging garden vegetation varies from canyon to canyon as well as among separate alcoves within a canyon. The vegetation of hanging gardens generally has some common species that are found at most of them, e.g., *Maianthemum stellatum, Adiantum capillus-veneris, Adiantum pedatum,* and *Mimulus* spp., but numerous endemics occur of which some may be represented by just one or two sites. The following species are endemic to hanging gardens of the Colorado Plateau region: *Aquilegia micrantha, Carex curatorum, Cirsium rydbergii, Erigeron kachinensis* (one occurrence outside of hanging gardens in the Abajo Mountains), *Erigeron sionis, Erigeron zothecinus, Platanthera zothecina (= Habenaria zothecina), Mimulus eastwoodiae, Perityle specuicola,* and *Primula specuicola*.

Dynamics: The most critical controlling feature of most hanging gardens is that they generally do not experience riparian-like flooding, unlike other spring types, such as rheocrenes (springs that discharge into a defined channel). The lack of flooding scour allows the development of highly unusual flood-sensitive herbaceous communities. Common disturbances in gardens include rock spalling, slumps, ungulate grazing, seasonal drought, and ice shear on wet backwalls and ledges in winter.

Key processes determining the species composition and vegetation cover include geomorphic disturbances, drought and ice shear. Groundwater sapping cause rock spalling (flaking, splitting, breakage) which can form and enlarge alcoves, and can creates gaps in the garden vegetation, as do occasional slumps on colluvial slopes. In cold winters ice sheets form on terraces and backwalls, which often collapse and shear off vegetation. Seasonal drought can also reduce canopy cover and species performance. In some channel gardens flooding can also be important, but where regular flooding occurs garden vegetation is very limited and species poor. Some gardens are visited by native ungulates, but disturbance by grazing and trampling are generally relatively minimal.

Component Associations:
- *Aquilegia micrantha - Calamagrostis scopulorum* Herbaceous Vegetation (CEGL002592, GNR)
- *Aquilegia micrantha - Mimulus eastwoodiae* Herbaceous Vegetation (CEGL002729, G2G3)
- *Aquilegia micrantha* Herbaceous Vegetation (CEGL002762, GNR)
- *Calamagrostis scopulorum* Hanging Garden Herbaceous Vegetation (CEGL002751, GNR)

DISTRIBUTION

Range: This system occurs on the Colorado Plateau.
Divisions: 304:C
Nations: US
Subnations: AZ, CO, NM, UT
Map Zones: 15:P, 16:C, 17:C, 23:C, 24:C, 25:?, 27:P, 28:C
USFS Ecomap Regions: 313A:CC, 313B:CC, 322A:CC, 341A:C?, 341B:CC, 341F:C?, M331D:C?, M331E:CP, M331G:CC, M341B:CC
TNC Ecoregions: 19:C

SOURCES

References: CNHP 2010b, Comer et al. 2003, Karl et al. 2009, Keammerer and Keammerer 1978, Laity and Malin 1985, Malanson 1980, Malanson 1982, Malanson and Kay 1980, Romme et al. 1993, Spence 2008, Tuhy et al. 2002, Welsh 1989, Welsh and Toft 1981
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722908#references
Description Author: NatureServe Western Ecology Team, R. Rondeau, mod. G. Kittel
Version: 14 Jan 2014 **Stakeholders:** West
Concept Author: NatureServe Western Ecology Team; R. Rondeau **ClassifResp:** West

COLUMBIA PLATEAU VERNAL POOL (CES304.057)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Impermeable Layer; 1-29-day hydroperiod; Vernal Pool Mosaic; Depressional [Vernal Pool]
Non-Diagnostic Classifiers: Short (50-100 yrs) Persistence; Herbaceous; Mediterranean [Mediterranean Xeric-Oceanic]; Temperate [Temperate Oceanic]; Isolated Wetland [Strictly Isolated]; Consolidated
National Mapping Codes: ESLF 9231

CONCEPT

Summary: This system includes shallow ephemeral waterbodies found in very small (3 m2 to 1 acre) to large depressions (1500 m2 to a square mile, average size of vernal pools is 1600 m2, while average size on non-alkaline playa lakes is 5-10 acres) throughout the exposed volcanic scablands of the Columbia Plateau in Washington, Oregon, and northern Nevada. Most of these pools and lakes are located on massive basalt flows exposed by Pleistocene floods; southward they also occur on andesite or rhyodacite caprock. Inundation is highly irregular, sometimes not occurring for several years. Depressions usually (but not always) fill with water during winter and spring. They are generally dry again within 9 months, though in exceptional times they can remain inundated for two years in a row. Water is from rainfall and snowmelt in relatively small closed basins, on average probably no more than 5-15 times the area of the ponds themselves. Because these pools and playas are perched above the general surrounding landscape, they are not generally subject to runoff from major stream systems. They typically have silty clay soils, sometimes with sandy margins. Pools are often found within a mounded or biscuit-swale topography with *Artemisia* shrub-steppe or rarely *Pinus ponderosa* savanna. In the northern Columbia Plateau, characteristic species are predominantly annual and diverse. Floristically akin to California vernal pool flora (one-third), however, many of the most abundant species are not reported in Californian pools. The Columbia Plateau vernal pools have many floristic similarities to their California counterparts. In one study. Crowe et al. (2004) found that thirty-four percent of the native taxa and 65% of the genera also occurred in a comprehensive listing of California vernal pool (Keeler-Wolf et al. 1998).Characteristic species of these vernal pools include *Callitriche marginata, Camissonia tanacetifolia, Cuscuta californica var. breviflora (= Cuscuta occidentalis), Elatine californica, Elatine chilensis, Elatine rubella, Juncus uncialis, Myosurus minimus (= Myosurus clavicaulis), Plagiobothrys* spp., *Polygonum polygaloides ssp. confertiflorum, Polygonum polygaloides ssp. polygaloides, Psilocarphus brevissimus, Psilocarphus elatior, Psilocarphus oregonus,* and *Trifolium cyathiferum*. *Artemisia ludoviciana ssp. ludoviciana* can occur on better developed soils. In northern Nevada, most of the species by biomass are perennials and include *Polygonum, Rumex, Juncus balticus, Eleocharis, Carex douglasii, Muhlenbergia richardsonis,* and *Polyctenium* species, in addition to *Camissonia tanacetifolia* and *Psilocarphus brevissimus*. Endemic plant species *Navarretia leucocephala ssp. diffusa* and *Polyctenium williamsiae* may occur.
Classification Comments: This includes Bjork (1997) vernal pool annual-dominated, vernal pool perennial-dominated and rain pools.

DESCRIPTION

Environment: This system includes shallow ephemeral waterbodies found in very small (3 m2 to 1 acre) to large depressions (1500 m2 to a square mile, average size of vernal pools is 1600 m2, while average size on non-alkaline playa lakes is 5-10 acres) throughout the exposed volcanic scablands of the Columbia Plateau in Washington, Oregon, and northern Nevada. Most of these pools and lakes are located on massive basalt flows exposed by Pleistocene floods; southward they also occur on andesite or rhyodacite caprock. Inundation is highly irregular, sometimes not occurring for several years. Depressions usually (but not always) fill with water during winter and spring. They are generally dry again within 9 months, though in exceptional times they can remain inundated for two years in a row. Water is from rainfall and snowmelt in relatively small closed basins, on average probably no more than 5-15 times the area of the ponds themselves. Because these pools and playas are perched above the general surrounding landscape, they are not generally subject to runoff from major stream systems. They typically have silty clay soils, sometimes with sandy margins. Pools are often found within a mounded or biscuit-swale topography with Artemisia shrub-steppe or rarely Pinus ponderosa savanna. Winters are colder (coldest average median temperature month in the high 20 degrees F) than California vernal pools and are climatically defined by wet winters (November through January, sporadically so southward) and severe summer drought (July-September), although May or June can be wet. The northernmost vernal pools are adapted to cold spring and long summer days (18 hours).
Vegetation: In the northern Columbia Plateau, characteristic species are predominantly annual and diverse. Floristically akin to California vernal pool flora (one-third), however, many of the most abundant species are not reported in Californian pools. Characteristic species include *Callitriche marginata, Camissonia tanacetifolia, Elatine* spp., *Epilobium densiflorum (= Boisduvalia densiflora), Eryngium vaseyi, Juncus uncialis, Myosurus X clavicaulis, Plagiobothrys* spp., *Polygonum polygaloides ssp. confertiflorum, Polygonum polygaloides ssp. polygaloides, Psilocarphus brevissimus, Psilocarphus elatior, Psilocarphus oregonus,* and *Trifolium cyathiferum*. *Artemisia ludoviciana ssp. ludoviciana* can occur on better developed soils. In northern Nevada, most of the species by biomass are perennials and include *Polygonum, Rumex, Juncus balticus, Eleocharis, Carex douglasii, Muhlenbergia richardsonis,* and *Polyctenium* species, in addition to *Camissonia tanacetifolia* and *Psilocarphus brevissimus*. Endemic plant species

Navarretia leucocephala ssp. diffusa (Bjork 2002) and *Polyctenium williamsiae* may occur.
Dynamics: Vernal pools are precipitation-filled seasonal wetlands inundated during the growing season, allowing for plant growth, followed by a brief water-logged terrestrial stage and culminating in complete drying of surface and subsurface soils. Inundation during the growing season eliminates establishment of upland species in the pool basins, and the dry period prevents the establishment of many typical wetland taxa (Keeley and Zedler 1998). Pool filling is a combination of direct precipitation and lateral flow among pools within a complex of pools and subsurface flow from uplands which buffers pool volume, keeping them filled into the dry season (Hanes and Stromberg 1998). Soils are relatively shallow (10-30 cm) underlain by basalt bedrock that prevents drainage (Crowe et al. 1994, Bjork and Dunwiddie 2004). What is unique about vernal pools is the seasonality of the wetting period followed by the desiccation period, which generally is supported by a Mediterranean climate (Crowe et al. 1994, Keeley and Zedler 1998), resulting in the development of diverse and highly endemic vegetation (Barbour et al. 2003, 2005, Solomeshch et al. 2007). Natural fire regimes for vernal pools are generally unknown, but are assumed to be similar to their surrounding upland grassland fire regimes (Wills 2006). Fire can have a positive effect on vernal pool vegetation as it can results in robust response by native grasses and can reduce non-native invasive woody and non-native herbaceous species (Pollak and Kan 1998).

SPATIAL CHARACTERISTICS

Size: Depressions (3-4608 square meters to a square mile; average 1600 sq.m to 10 acres), mean depth 0.47 to 1.5 m.
Adjacent Ecological Systems:
- Columbia Plateau Scabland Shrubland (CES304.770)
- Inter-Mountain Basins Big Sagebrush Steppe (CES304.778)

Adjacent Ecological System Comments: Primarily Columbia Plateau Scabland Shrubland (CES304.770) or Inter-Mountain Basins Big Sagebrush Steppe (CES304.778) (three-tip sagebrush) rarely into ponderosa pine savanna or pinyon-juniper.

DISTRIBUTION

Range: This system is restricted to the northern Columbia Plateau ecoregion commonly called the Columbia Basin and perhaps the Okanagan Valley in British Columbia, and to the western Great Basin.
Divisions: 304:C
Nations: CA? , US
Subnations: BC?, NV, OR, WA, WY?
Map Zones: 7:C, 8:C, 9:P, 18:C
USFS Ecomap Regions: 331A:PP, 342B:CC, 342C:CC, 342D:C?, 342H:C?, 342I:CC, M242C:CC, M333A:??
TNC Ecoregions: 6:C, 68:P

SOURCES

References: Barbour 1998, Barbour et al. 2003, Barbour et al. 2005, Bjork 1997, Bjork 2002, Bjork and Dunwiddie 2004, Brown 1999, Comer et al. 2003, Crowe et al. 1994, Dalton et al. 2013, Dlugolecki 2010, Hanes and Stromberg 1998, Keeley and Zedler 1998, Pollak and Kan 1998, Rocchio pers. comm., Solomeshch et al. 2007, Wills 2006
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722654#references
Description Author: R. Crawford, mod. J. Morefield and G. Kittel
Version: 10 Jan 2014 **Stakeholders:** Canada, West
Concept Author: R. Crawford **ClassifResp:** West

EAST GULF COASTAL PLAIN DEPRESSION POND (CES203.558)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Non-Diagnostic Classifiers: Herbaceous; Depressional; Isolated Wetland [Partially Isolated]
National Mapping Codes: ESLF 9403

CONCEPT

Summary: This small-patch herbaceous or shrub dominated wetland ecological system occupies upland depressions (ponds and pondshores) in the East Gulf Coastal Plain. Included here are shallow ponds of various geomorphic origins in a variety of substrates (e.g., limesinks, Grady Ponds, Citronelle Ponds, flatwoods depression marshes) which are not separately distinguished as ecological systems. This ecological system only includes herbaceous or shrub ponds and pondshores in more-or-less isolated upland settings, not those in riparian or floodplain environments. They may serve as the origin of a stream system in a general way, releasing water gradually into the stream drainage system during periods of very wet weather. These tend to occupy basins that were formed by subsidence of surface sediments caused by solution in underlying limestone or as swales in eolian sand deposits. In some examples, a distinct zonation of vegetation is present, in others the zones are not distinct or the differing associations are present in a complex mosaic. Most seasonal depression ponds are composed of mosaics of several plant associations. The vegetation includes various zones which become exposed as water levels decline, as well as emergent (rising out of the water) or submergent/floating plants. Some typical species are *Dichanthelium wrightianum, Dichanthelium erectifolium, Eleocharis equisetoides, Eleocharis microcarpa, Juncus effusus, Juncus repens, Leersia* spp., *Ludwigia* spp., *Rhynchospora corniculata, Rhynchospora inundata, Panicum hemitomon, Panicum verrucosum, Proserpinaca* spp., *Pluchea* spp., *Saccharum* spp., *Rhexia* spp., and *Sabatia angularis*. Coastal dune lakes and related wetlands of barrier islands are covered by another system, Southeastern Coastal Plain Interdunal Wetland (CES203.258).
Classification Comments: In Mississippi, this system is apparently confined to the "Pamlico Plain" (this is meant to refer to the Outer Coastal Plain) where it is very rare and small scale in occurrence (R. Wieland pers. comm.). It is unknown how distinct these depressions are from so-called "Grady Ponds" (e.g., Cottonmouth Savanna site). This system is closely related to Southern Atlantic Coastal Plain Depression Pondshore (CES203.262) of the Atlantic Coastal Plain. This system also has karstic origins in common with Southern Coastal Plain Sinkhole (CES203.495) but occupies comparatively much shallower depressions and lacks exposed limestone. Compare to Central Florida Herbaceous Pondshore (CES203.890) to the south.
Similar Ecological Systems:
- Atlantic Coastal Plain Clay-Based Carolina Bay Wetland (CES203.245)
- Central Florida Herbaceous Pondshore (CES203.890)
- East Gulf Coastal Plain Sandhill Lakeshore Depression (CES203.292)
- Southern Atlantic Coastal Plain Depression Pond (CES203.262)
- Southern Coastal Plain Sinkhole (CES203.495)

Related Concepts:
- Baldcypress: 101 (Eyre 1980) Intersecting
- Black Willow: 95 (Eyre 1980) Finer
- Depression Marsh (FNAI 1990) Broader
- Flatwoods/Prairie/Marsh Lake (FNAI 1990) Intersecting
- Limesink (in part) (Wharton 1978) Intersecting
- Pondcypress: 100 (Eyre 1980) Finer
- Water Tupelo - Swamp Tupelo: 103 (Eyre 1980) Finer

DESCRIPTION

Environment: Examples of this ecological system occur in relatively shallow depressions or basins that were formed by subsidence of surface sediments caused by solution in underlying limestone or were formed as swales in eolian sand deposits. However, sinkholes with steep, vertical, exposed limestone walls are accommodated by another ecological system, as are sandhill ponds that develop on extreme sandy sites in the East Gulf Coastal Plain of Florida and adjacent Alabama. Hydroperiod can vary substantially from year to year, and vegetation can similarly vary significantly in aspect and dominants. Highly variable hydroperiods help maintain herbaceous vegetation, and prevent the succession to forest.
Vegetation: Most seasonal depression ponds are usually composed of mosaics of several plant associations. The vegetation includes various zones which become exposed as water levels decline. These are occupied sequentially by various graminoids and/or forbs, as well as emergent (rising out of the water) and submergent/floating plants. Some typical dominant species in component associations include *Aristida palustris, Dichanthelium wrightianum, Dichanthelium erectifolium, Eleocharis elongata, Eleocharis equisetoides, Eleocharis microcarpa, Fuirena scirpoidea, Juncus repens, Rhynchospora chapmanii, Rhynchospora corniculata, Rhynchospora harperi, Rhynchospora inundata, Rhynchospora filifolia, Rhynchospora tracyi, Proserpinaca* spp., *Juncus abortivus, Juncus effusus, Panicum hemitomon, Pluchea* spp., *Ludwigia* spp., *Saccharum* spp., *Panicum verrucosum, Rhexia* spp., and *Sabatia angularis*. In

addition, associations dominated by *Polygonum* spp., *Leersia* spp., and *Typha* spp. may be present but are not characteristic. Other characteristic species include *Rhexia cubensis, Panicum rigidulum, Panicum verrucosum, Carex striata, Lachnanthes caroliana, Bartonia verna, Lachnocaulon minus*, and *Centella erecta*. Woody plants which may be present (particularly on margins) include *Cephalanthus occidentalis, Hibiscus* spp., *Hypericum chapmanii, Hypericum fasciculatum, Hypericum reductum, Ilex myrtifolia*, and *Nyssa ursina*. Some stands with trees contain *Fraxinus pennsylvanica, Populus heterophylla, Ulmus americana*, and *Quercus texana*. Vegetation may exhibit distinct zonation in response to variation in duration of flooding. Communities can range from floating aquatic types (in the centers of the deepest basins) to emergent herbaceous zones (in semipermanent water drawdown zones) to sparse, yet diverse, small graminoid and forb herbaceous vegetation to bald-cypress woodland edges. Some examples may have emergent trees throughout their extent.

Dynamics: The seasonal fluctuation in the water levels in these ponds controls both the overall vegetation composition as well as the composition of the zones of the vegetation, which may be quite distinct from one another. Hydroperiod can vary substantially from year to year, and vegetation can similarly vary significantly in aspect and dominants. Highly variable hydroperiods help maintain herbaceous vegetation and prevent the succession to forest. Fire is an important natural disturbance, and the outer, drier portions of the depressions burn most frequently. Fires may sweep through the interior of many examples during dry periods. Today, prescribed fire is important for the management of the pineland landscapes which include these herbaceous or shrub wetland ecological systems.

Component Associations:

- *Alnus serrulata* Saturated Southern Interior Shrubland (CEGL007059, G3)
- *Alnus serrulata* Southeastern Seasonally Flooded Shrubland (CEGL008474, G4)
- *Cephalanthus occidentalis / Hibiscus moscheutos ssp. moscheutos* Depression Pond Shrubland (CEGL004742, G3?)
- *Crataegus aestivalis* Forest (CEGL004639, G2G3)
- *Crataegus rufula* Forest (CEGL007783, G2G3)
- *Cyrilla racemiflora - Lyonia lucida* Shrubland (CEGL003844, G3?)
- *Dichanthelium wrightianum - Dichanthelium erectifolium* Herbaceous Vegetation (CEGL004105, G2G3)
- *Eleocharis (elongata, equisetoides) - Rhynchospora tracyi* Semipermanently Flooded Herbaceous Vegetation (CEGL004960, G3?)
- *Eleocharis microcarpa - Juncus repens - Rhynchospora corniculata - (Mecardonia acuminata, Proserpinaca* spp.) Herbaceous Vegetation (CEGL004748, G2G3)
- *Fuirena scirpoidea - Rhynchospora tracyi* Herbaceous Vegetation (CEGL004123, G3G4)
- *Hypericum chapmanii - Ilex myrtifolia - (Nyssa ursina)* Shrubland (CEGL003867, G1)
- *Hypericum fasciculatum / Rhynchospora (chapmanii, harperi)* Shrubland (CEGL003869, G2G3)
- *Juncus effusus* Seasonally Flooded Herbaceous Vegetation (CEGL004112, G5)
- *Nyssa biflora / Itea virginica - Cephalanthus occidentalis* Depression Forest (CEGL007434, G3G4)
- *Panicum hemitomon - Eleocharis equisetoides - Rhynchospora inundata* Herbaceous Vegetation (CEGL004127, G3)
- *Panicum hemitomon - Pluchea (camphorata, rosea) - Ludwigia* spp. Herbaceous Vegetation (CEGL007792, G3)
- *Panicum virgatum - Andropogon (capillipes, glaucopsis) - Aristida palustris* Herbaceous Vegetation (CEGL004100, G2?)
- *Polygonum (hydropiperoides, punctatum) - Leersia* spp. Herbaceous Vegetation (CEGL004290, G4?)
- *Polygonum amphibium - (Polygonum hydropiperoides)* Seasonally Flooded Herbaceous Vegetation (CEGL004699, G4G5)
- *Polygonum densiflorum - (Saccharum giganteum)* Herbaceous Vegetation (CEGL004966, G4G5)
- *Rhynchospora filifolia - Juncus abortivus* Herbaceous Vegetation (CEGL004131, G2?)
- *Saccharum* spp. - *Panicum verrucosum* - (*Rhexia* spp., *Sabatia* spp.) Herbaceous Vegetation (CEGL004752, G2G3)
- *Salix nigra / (Cephalanthus occidentalis)* Forest (CEGL004773, G4G5)
- *Sparganium americanum - Saccharum giganteum* Herbaceous Vegetation (CEGL004769, G3)
- *Taxodium ascendens / Ilex myrtifolia* Depression Forest (CEGL007418, G3?)
- *Taxodium distichum* East Gulf Coastal Plain Pondshore Woodland (CEGL004046, G3)
- *Typha latifolia* Southern Herbaceous Vegetation (CEGL004150, G5)

SPATIAL CHARACTERISTICS

Spatial Summary: Small patch

DISTRIBUTION

Range: This ecological system is found in the East Gulf Coastal Plain, including the Gulf Coast Flatwoods (i.e., EPA Level IV Ecoregion 75a (EPA 2004)), as well as more inland portions (EPA Level III Ecoregion 65). In particular, there are clusters of large ponds in parts of the Southern Pine Plains and Hills (EPA 65f), the Dougherty Plain (EPA 65g), and Tallahassee Hills/Valdosta Limesink (EPA 65o), and the Okefenokee Plain (EPA 75e).
Divisions: 203:C
Nations: US
Subnations: AL, FL, GA, LA?, MS
Map Zones: 45:P, 46:C, 55:C, 99:C
TNC Ecoregions: 42:P, 43:C, 53:C

SOURCES

References: EPA 2004, Eyre 1980, FNAI 1990, Kirkman et al. 2012, Peet and Allard 1993, Southeastern Ecology Working Group n.d., Wharton 1978, Wieland pers. comm.
Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723046#references
Description Author: M. Pyne, mod. C. Nordman
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: M. Pyne **ClassifResp:** Southeast

EAST GULF COASTAL PLAIN FLORIDA BIG BEND SEAGRASS BED (CES203.244)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Tidal / Estuarine; Aquatic Herb
Non-Diagnostic Classifiers: Herbaceous
National Mapping Codes: ESLF 9412

CONCEPT

Summary: This seagrass bed system overlies the drowned karst of the Florida Big Bend region extending along the west coast from approximately St. Marks National Wildlife Refuge to Tarpon Springs, Florida (Anclote Key). This area is one of the few known places in the world with a zero energy coast line (Murali 1982). This phenomenon allows for the development of seagrass beds without protective ocean barriers. Six different species of seagrasses comprise these beds which range from near-shore shoals (exposed at low tide) to relatively deep waters as far as 112 km offshore. The deepest extent of this system is constrained, at least in part, by water clarity as seagrasses require light penetration for photosynthesis. For this reason, these beds are found in deeper waters along the southern boundary of the system, deeper waters where the water is increasingly clear due apparently to reduced input of highly organic river runoff which is concentrated in the north (Zieman and Zieman 1989). Species composition and density are variable. The densest beds are found in shallow waters well removed from river mouths. Although several of the individual seagrass species may be found in mixed species beds, there is a general pattern of species zonation evident, largely related to water depth. Periodically exposed shoals tend to support monospecific stands of *Halodule*. *Thalassia* grows only in shallower subtidal areas, and *Cymodocea* is concentrated in deeper subtidal areas. Pure stands of *Halophila* are abundant in deepest areas often removed from beds of the other species, while *Ruppia* is confined to river mouths.

Similar Ecological Systems:
- Atlantic Coastal Plain Indian River Lagoon Seagrass Bed (CES203.256)
- Florida Keys Seagrass Bed (CES411.285)
- Northern Gulf of Mexico Seagrass Bed (CES203.263)
- Southwest Florida Seagrass Bed (CES203.274)

Related Concepts:
- Seagrass Bed (FNAI 1990) Broader

DESCRIPTION

Environment: This system is found along a zero energy coast line of Florida where the average wave breaker heights are 3-4 cm or less, and there is almost no significant littoral transport of sand. Factors contributing to this phenomenon are the wide gently sloping shelf, the divergence of approaching wave trains into the large expanding coastal concavity, the location of the coast in an upwind direction, small sediment supply, and wave dampening effects of submerged beaches. These are important factors which allow the development of this system without normal ocean barriers (Murali 1982).

Vegetation: Seagrasses are monocots which carry out their entire life cycle completely submerged in the marine environment. Species composition and density are variable. The densest beds are found in shallow waters well removed from river mouths. Although several of the individual seagrass species may be found in mixed-species beds, there is a general pattern of species zonation evident, largely related to water depth. Periodically exposed shoals tend to support monospecific stands of *Halodule*. *Thalassia* grows only in shallower subtidal areas, and *Cymodocea* is concentrated in deeper subtidal areas. Pure stands of *Halophila* are abundant in deepest areas often removed from beds of the other species, while *Ruppia* is confined to river mouths. Succession dynamics also helps determine composition. *Halodule beaudettei (= Halodule wrightii)* is the local pioneering species which colonizes areas from seed or vegetative reproduction. *Cymodocea* often appears next and may mix with *Halodule*. *Thalassia* occupies beds as succession advances.

Dynamics: Unlike most other seagrass systems, these beds are not protected from large storm surges. Hurricanes may cause localized disruptions and bottom scouring which may dislodge plants. The rate of recolonization depends upon the severity of the disturbance and the species involved. Colonization of seagrasses often follows a generalized successional sequence. Non-vegetated areas may first be colonized by rhizophytic macroalgae which have some sediment-binding capacity. Possibly more importantly they contribute sedimentary particles as they die and decompose (Zieman and Zieman 1989). *Halodule wrightii (= Halodule beaudettei)* is the local pioneering species which colonizes areas from seed or vegetative reproduction. *Cymodocea* often appears next and may mix with *Halodule*. *Thalassia* occupies beds as succession advances. This pattern marks a progressive increase of biomass in the system with increased leaf areas, increased sediment-trapping capacity, and increased microbial cycling. Seagrasses in this region experience large temperature fluctuations and exhibit more cold tolerance than those in more southerly areas. Cold temperatures during the winter cause leaf die-off to within several centimeters of the sediment surface.

Component Associations:
- *Cymodocea filiformis - (Thalassia testudinum)* Herbaceous Vegetation (CEGL004317, G4?)
- *Halodule wrightii* Herbaceous Vegetation (CEGL004318, G4?)

- *Halophila engelmannii* Herbaceous Vegetation (CEGL004688, G3?)
- *Ruppia maritima* Louisianian Zone Herbaceous Vegetation (CEGL004450, G4G5)
- *Thalassia testudinum* Herbaceous Vegetation (CEGL004319, G4?)
- *Vallisneria americana* Estuarine Bayou Herbaceous Vegetation (CEGL004634, G3G5)

DISTRIBUTION

Range: This system is restricted to the Florida Big Bend region extending along the west coast from approximately St. Marks to Tarpon Springs.
Divisions: 203:C
Nations: US
Subnations: FL
Map Zones: 55:C, 56:C
TNC Ecoregions: 53:C

SOURCES

References: Comer et al. 2003, FNAI 1990, Grech et al. 2012, Murali 1982, Orth et al. 2006, Yarbro and Carlson 2011, Zieman and Zieman 1989
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723241#references
Description Author: R. Evans, mod. M. Pyne
Version: 06 Feb 2014 **Stakeholders:** Southeast
Concept Author: R. Evans **ClassifResp:** Southeast

EAST GULF COASTAL PLAIN SANDHILL LAKESHORE DEPRESSION (CES203.292)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Depressional [Vernal Pool]; Graminoid
Non-Diagnostic Classifiers: Herbaceous; Isolated Wetland [Partially Isolated]
National Mapping Codes: ESLF 9223

CONCEPT

Summary: This small-patch wetland system occupies upland depressions on deep sandy soils in the southern portions of the East Gulf Coastal Plain of Florida. These depressions are apparently of karstic origin but exhibit no evidence of calcareous conditions or evidence of limestone. Limestone is buried 50 or more feet below the surface under coarse sandy soils that cover the margins and, in some cases, the entire surface extent of these depressions (A. Johnson pers. comm.). The resulting appearance of these pondshores is that of large, inland white sand beach (at least in dry years). In the drier margins they even support some plant species found on coastal beaches of the region, such as *Lupinus westianus*, *Hypericum reductum*, and *Chrysoma pauciflosculosa*. The aspect of the vegetation ranges from shrublands to herbaceous-dominated with local variability. Several narrowly endemic plant species may be present such as *Hypericum lissophloeus*, *Rhexia salicifolia*, and *Xyris longisepala*. Examples may be periodically flooded to depths of as much as 1.5 m deep, but they dry down regularly. Some are fairly large, steep-sided depressions with as much as a 30-m elevation change from rim (sandhill) to center, while others form much more gradual depressions. Fire may be an important natural force in some examples.
Classification Comments: This system has karstic origins in common with Southern Coastal Plain Sinkhole (CES203.495) but lacks exposed limestone and steep vertical, limestone walls. Other upland depressions of the East Gulf Coastal Plain (that may or may not have karstic origins) on less extreme sandy soils are accommodated by East Gulf Coastal Plain Depression Pondshore (CES203.558).

This system was originally covered by the former East Gulf Coastal Plain Southern Depression Pondshore (CES203.504) but was split out and recognized as distinct in February 2004.

Similar Ecological Systems:
- East Gulf Coastal Plain Depression Pond (CES203.558)
- Southern Coastal Plain Sinkhole (CES203.495)

Related Concepts:
- Sandhill Upland Lake (FNAI 1990) Undetermined

DESCRIPTION

Environment: Examples occur in the southern Dougherty Plain of the Florida panhandle (65g of EPA 2004), only in Bay and Washington counties. This is high rolling sandhill territory (not flatwoods) with very steep-sided ponds in many cases (A. Johnson pers. comm. 2009). Some are fairly large, steep-sided depressions with as much as a 30-m elevation change from rim (sandhill) to center, while others form much more gradual depressions. The limestone beneath them is more deeply dissected than elsewhere in Florida, but it is solidly blanketed with deep sand, so it does not reach the surface at all, and the soils are all acidic. Fire may be an important natural force in some examples.
Vegetation: *Hypericum lissophloeus, Rhexia salicifolia*, and *Xyris longisepala* are some of the more unusual species associated with this system (A. Johnson pers. comm.).
Dynamics: These depressions are generally permanent waterbodies, although water levels may fluctuate substantially, sometimes becoming completely dry during extreme droughts (FNAI 2010a). They are typically lentic waterbodies without significant surface inflows or outflows. Instead, water may be largely derived from lateral groundwater seepage through the surrounding well-drained uplands and/or from artesian sources via connections with the underlying limestone aquifer (FNAI 2010a). Sandhill upland lakes are frequently extremely important breeding areas for terrestrial amphibians, including the threatened Carolina gopher frog (*Lithobates capito*), as well as many unusual or endemic insects (FNAI 2010a). They are also important watering holes for many mammals and birds inhabiting the surrounding xeric communities (FNAI 2010a). Wading birds and ducks may also use these lakes as feeding areas (FNAI 2010a).

Component Associations:
- *Hypericum lissophloeus* Shrubland (CEGL003870, G1)
- *Hypericum reductum / Syngonanthus flavidulus - Rhexia salicifolia - (Xyris longisepala)* Dwarf-shrubland (CEGL004998, G1G2)

DISTRIBUTION

Range: This system is restricted to the Florida panhandle (apparently confined to a single site) (A. Johnson pers. comm. 2009).
Divisions: 203:C
Nations: US
Subnations: FL

Map Zones: 99:C
TNC Ecoregions: 53:C

SOURCES

References: EPA 2004, FNAI 1990, FNAI 2010a, Johnson, A. pers. comm., Southeastern Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.731768#references
Description Author: R.E. Evans and A. Johnson, mod. C. Nordman
Version: 14 Jan 2014
Concept Author: R.E. Evans and A. Johnson
Stakeholders: Southeast
ClassifResp: Southeast

EAST GULF COASTAL PLAIN SAVANNA AND WET PRAIRIE (CES203.192)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Extensive Wet Flat; Very Short Disturbance Interval; Graminoid
Non-Diagnostic Classifiers: Herbaceous
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2485; ESLF 9206; ESP 1485

CONCEPT

Summary: This ecological system of western Florida and adjacent Alabama and Mississippi has been called "lush grassland," "grass-sedge savannah," wet prairie, or wet savanna. As implied by these names, this system consists of primarily herbaceous vegetation with relatively thick cover of grasses and sedge species. Examples occupy low, flat plains on poorly drained soils, often saturated for 50-100 days per year. Frequent fires, including growing-season burns, are essential for maintenance of this system. Some examples have a sparse tree component of *Pinus elliottii* or *Pinus palustris* and scattered shrubs, such as *Morella caroliniensis*.
Classification Comments: Related vegetation of central Florida is covered by another ecological system.
Similar Ecological Systems:
- Central Florida Wet Prairie and Herbaceous Seep (CES203.491)

Related Concepts:
- Pondcypress: 100 (Eyre 1980) Finer
- Wet Prairie (FNAI 2010a) Broader
- Wet Prairie (FNAI 1990) Broader

DESCRIPTION

Environment: This system occupies low, flat plains on poorly drained Ultisols. Sites are saturated for 50-100 days per year (FNAI 1990). Other soil orders may include Ultisols, Spodosols, Inceptisols, and Entisols (Collins et al. 2001); some of these soils have an argillic horizon which impedes drainage and contributes to high water tables. On Eglin Air Force Base, this system is found on the Rutledge series (Kindell et al. 1997).
Vegetation: Collins et al. (2001) documented less than 10 trees per acre (*Pinus elliottii* and *Pinus palustris*) in examples of this system on the Apalachicola National Forest. *Magnolia virginiana, Acer rubrum,* and *Morella cerifera* are often present in sometimes locally dense patches, especially when managed with infrequent fires (FNAI 1990, Collins et al. 2001). *Aristida beyrichiana, Ctenium aromaticum, Rhexia alifanus, Rhynchospora* spp., and *Eriocaulon* spp. are typical species. This ecological system may be considered a "lush grassland" (Kindell et al. 1997), "grass-sedge savannah" (Clewell 1981), wet prairie (FNAI 1990), or wet savanna (Collins et al. 2001).
Dynamics: Wet prairies are seasonally inundated or saturated for 50 to 100 days a year (FNAI 1990). Fire-return intervals have been estimated to be 2-3 years (FNAI 2010a). Wet prairies can be large areas which would have been naturally prone to frequent fire. Today prescribed fire is needed to maintain high-quality examples of wet prairies. Without frequent fire, shrubs and trees can dominate the site, and this leads to a decline in the herbaceous plant diversity.

Component Associations:
- *Aristida beyrichiana - Rhynchospora oligantha - Carphephorus pseudoliatris - Sarracenia (alata, flava, leucophylla)* Herbaceous Vegetation (CEGL004154, G2)
- *Aristida beyrichiana - Rhynchospora* spp. *- Pleea tenuifolia - Sarracenia (psittacina, flava)* Herbaceous Vegetation (CEGL004153, G2)
- *Aristida beyrichiana - Rhynchospora* spp. *- Verbesina chapmanii* Herbaceous Vegetation (CEGL004152, G2)
- *Hypericum fasciculatum / Rhynchospora (chapmanii, harperi)* Shrubland (CEGL003869, G2G3)
- *Nyssa ursina / Aristida beyrichiana - Rhynchospora (chapmanii, corniculata)* Herbaceous Vegetation (CEGL008595, G1G2)
- *Scleria baldwinii - Rhynchospora cephalantha - Polygala cymosa - Fuirena scirpoidea* Herbaceous Vegetation (CEGL007717, G2?)
- *Taxodium ascendens / Hypericum chapmanii / Rhynchospora harperi* Dwarf Woodland (CEGL007725, G1)

DISTRIBUTION

Range: Western Florida and adjacent Alabama and Mississippi.
Divisions: 203:C
Nations: US
Subnations: AL, FL, MS
Map Zones: 55:C, 99:C
USFS Ecomap Regions: 232B:CC, 232D:CC, 232K:CC, 232L:CC

TNC Ecoregions: 53:C

SOURCES

References: Clewell 1981, Collins et al. 2001, Comer et al. 2003, Eyre 1980, FNAI 1990, FNAI 2010a, Hubricht 1985, Kindell et al. 1997, Norquist 1984

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723248#references

Description Author: R. Evans and C. Nordman

Version: 14 Jan 2014 **Stakeholders:** Southeast

Concept Author: R. Evans and C. Nordman **ClassifResp:** Southeast

EASTERN GREAT PLAINS WET MEADOW, PRAIRIE AND MARSH (CES205.687)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Eastern Great Plains (205)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Non-Diagnostic Classifiers: Shoreline; Herbaceous; Depressional; Isolated Wetland [Partially Isolated]; Depression
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2488; ESLF 9213; ESP 1488

CONCEPT

Summary: This system is found along creeks and streams from Nebraska and Iowa to Illinois, and from Minnesota to Texas. It is also found in depressions and along lake borders, especially in the northern extension of its range into Minnesota. It is often adjacent to a floodplain system but is devoid of trees and riparian vegetation. It is also distinguished from upland prairie systems by having more hydrology, especially associated with silty, dense clay soils that are often hydric, classified as Vertic Haplaquolls. The landform is usually floodplain or poorly drained, relatively level land. The vegetation is dominated by *Spartina pectinata, Tripsacum dactyloides*, numerous large sedges, such as *Carex frankii* and *Carex hyalinolepis*, and in wetter areas, *Eleocharis* spp. Other emergent marsh species such as *Typha* spp. can be associated with this system. Forbs can include *Helianthus grosseserratus*, *Vernonia fasciculata*, and *Physostegia virginiana*. Some parts of this system may be saline and have species such as *Distichlis spicata* and *Schoenoplectus maritimus*. Fire has been the primary influence in keeping these wet areas free of trees. Other dynamic processes include grazing and flooding (often in late spring). Many areas have been converted to agricultural, but this usually requires some sort of drainage.

Related Concepts:
- Eastern Great Plains Wet-Meadow, Prairie and Marsh (Rolfsmeier and Steinauer 2010) Equivalent

DESCRIPTION

Environment: This system is found primarily on silty and/or dense clay, hydric soils, usually classified as Vertic Haplaquolls. It is found within poorly drained, relatively level areas.
Vegetation: *Spartina pectinata, Tripsacum dactyloides*, and numerous large sedges, such as *Carex frankii* and *Carex hyalinolepis*, dominate this system. In wetter areas, *Eleocharis* spp. and *Typha* spp. may be significant. Forbs such as *Helianthus grosseserratus*, *Vernonia fasciculata*, and *Physostegia virginiana* also may be common. Shrub species can be present, especially in the northern range of this system; however, they are usually insignificant compared to the prairie and meadow species.
Dynamics: Fire and grazing can affect this system. Fire could spread from adjacent upland prairie, especially in the fall when water levels tended to be low and vegetation was driest. The wet prairie/wet meadow zone burned most frequently, but in the fall, dense, dry tall emergent vegetation in shallow or deep marshes could carry fire, as well. These fires could remove standing dead vegetation, allowing more light to reach the ground and returning nutrients to the soil, but they did not result in a conversion to a different system. In the eastern portion of this system's range, fire was more important in keeping woody species from invading. Native ungulates grazed the margins of potholes and used them as water sources. Muskrats live in larger, wetter potholes and, when populations get high, can have significant effects on the vegetation by eating *Typha* spp. and substantially reducing its cover. Flooding or saturation of sites for part of the growing season is required for the dominant species to survive over time. Grazing during the late summer or other dry periods can result in significant reduction in herbaceous cover but, in general, grazing is of lower importance than fire and flooding in maintaining this system.

Component Associations:
- *Calamagrostis canadensis - Carex* spp. Laurentian & Northeast Wet Meadow (CEGL005448, G4G5)
- *Calamagrostis canadensis* North-Central Wet Meadow (CEGL005449, G4G5)
- *Calamagrostis stricta - Carex sartwellii - Carex praegracilis - Plantago eriopoda* Saline Herbaceous Vegetation (CEGL002255, G2G3)
- *Carex aquatilis - Carex* spp. Herbaceous Vegetation (CEGL002262, G4?)
- *Carex atherodes* Herbaceous Vegetation (CEGL002220, G3G5)
- *Carex lacustris* Herbaceous Vegetation (CEGL002256, G4G5)
- *Carex pellita - Calamagrostis stricta* Herbaceous Vegetation (CEGL002254, G3G5)
- *Carex stricta - Carex* spp. Herbaceous Vegetation (CEGL002258, G4?)
- *Carex utriculata - Carex lacustris - (Carex vesicaria, Carex stricta)* Herbaceous Vegetation (CEGL002257, G4G5)
- *Ceratophyllum demersum - Stuckenia pectinata* Herbaceous Vegetation (CEGL004528, G4G5)
- *Cornus sericea - Salix (bebbiana, discolor, petiolaris) / Calamagrostis stricta* Shrubland (CEGL002187, G3G4)
- *Cornus sericea - Salix* spp. - (*Rosa palustris*) Shrubland (CEGL002186, G5)
- *Distichlis spicata - Schoenoplectus maritimus - Salicornia rubra* Herbaceous Vegetation (CEGL002043, G1G2)
- *Impatiens pallida - Cystopteris bulbifera - Adoxa moschatellina - (Chrysosplenium iowense, Aconitum noveboracense)* Algific Talus Herb Vegetation (CEGL002387, G2)

- *Nuphar advena - Nymphaea odorata* Herbaceous Vegetation (CEGL002386, G4G5)
- *Polygonum amphibium - (Polygonum hydropiperoides)* Seasonally Flooded Herbaceous Vegetation (CEGL004699, G4G5)
- *Polygonum* spp. - Mixed Forbs Herbaceous Vegetation (CEGL002430, G4G5)
- *Potamogeton nodosus* Herbaceous Vegetation (CEGL004529, GNR)
- *Potamogeton* spp. - *Ceratophyllum* spp. Midwest Herbaceous Vegetation (CEGL002282, G5)
- *Sagittaria cuneata - Sagittaria longiloba* Herbaceous Vegetation (CEGL004525, GNR)
- *Sagittaria latifolia - Leersia oryzoides* Herbaceous Vegetation (CEGL005240, GNR)
- *Schoenoplectus acutus - (Schoenoplectus fluviatilis)* Freshwater Herbaceous Vegetation (CEGL002225, G4G5)
- *Schoenoplectus fluviatilis - Schoenoplectus* spp. Herbaceous Vegetation (CEGL002221, G3G4)
- *Schoenoplectus maritimus - Atriplex patula - Eleocharis parvula* Herbaceous Vegetation (CEGL005111, G1)
- *Schoenoplectus tabernaemontani - Typha* spp. - (*Sparganium* spp., *Juncus* spp.) Herbaceous Vegetation (CEGL002026, G4G5)
- *Spartina pectinata - Calamagrostis stricta - Carex* spp. Herbaceous Vegetation (CEGL002027, G3?)
- *Spartina pectinata - Carex* spp. - *Calamagrostis canadensis - Lythrum alatum - (Oxypolis rigidior)* Herbaceous Vegetation (CEGL002224, G3?)
- *Spartina pectinata - Carex* spp. - *Calamagrostis canadensis* Sand Herbaceous Vegetation (CEGL005178, G3?)
- *Spartina pectinata - Eleocharis* spp. - *Carex* spp. Herbaceous Vegetation (CEGL002223, G2G4)
- *Spiraea tomentosa - Salix humilis / Andropogon gerardii - Panicum virgatum* Shrubland (CEGL005069, G1Q)
- *Typha (angustifolia, domingensis, latifolia) - Schoenoplectus americanus* Herbaceous Vegetation (CEGL002032, G3G4)
- *Typha latifolia - Thalia dealbata* Herbaceous Vegetation (CEGL004526, GNR)
- *Typha* spp. - *Schoenoplectus acutus* - Mixed Herbs Midwest Herbaceous Vegetation (CEGL002229, G4?)
- *Typha* spp. Midwest Herbaceous Vegetation (CEGL002233, G5)

DISTRIBUTION

Range: This system is found throughout the northeastern Great Plains ranging from eastern Kansas to western Illinois and north into Minnesota.
Divisions: 205:C
Nations: US
Subnations: IA, IL, KS, MN, MO, ND, NE, OK, SD, TX?
Map Zones: 31:P, 38:C, 39:C, 40:C, 41:P, 42:C, 43:C, 49:C, 50:C, 51:P, 52:P
USFS Ecomap Regions: 251A:CC, 251B:CC, 251E:CC, 251F:CC, 251G:CC, 251H:CC, 255A:PP, 332B:CP, 332C:CC, 332D:CC, 332E:CC, 332F:C?
TNC Ecoregions: 35:C, 36:C, 45:P, 46:P

SOURCES

References: Comer et al. 2003, Lauver et al. 1999, Rolfsmeier and Steinauer 2010, Steinauer and Rolfsmeier 2000
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722972#references
Description Author: S. Menard and K. Kindscher
Version: 10 Jan 2014 **Stakeholders:** Canada, Midwest, Southeast
Concept Author: S. Menard and K. Kindscher **ClassifResp:** Midwest

EDWARDS PLATEAU UPLAND DEPRESSION (CES303.654)

CLASSIFIERS

Classification Status: Standard

Primary Division: Western Great Plains (303)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Depressional; Depression
National Mapping Codes: ESLF 9239

CONCEPT

Summary: This system includes shallow wetlands formed over limestone on the Edwards Plateau of Texas. Variable in size and duration of inundation, these wetlands are typically found on level uplands. Dominant vegetation includes both graminoids and forbs tolerant of wet periods but not necessarily wetland-dependent. Dominant species may include *Pleuraphis mutica, Buchloe dactyloides, Sedum pulchellum, Sedum nuttallianum, Sporobolus vaginiflorus, Chaetopappa bellidifolia, Paronychia* spp., and the alga *Nostoc commune*. Some larger occurrences of this wetland system are found in Crocket, Reagan, Schleicher, Irion and Sterling counties in the northwest Edwards Plateau (the Eldorado Plateau). Formation of these occurrences is apparently from solution of the underlying limestone.

Classification Comments: The solution ponds of the Eldorado Plateau are superficially similar to the playa lakes of the Llano Estacado, but the underlying geology of the Edwards Plateau (Cretaceous limestone) occurrences is different from the Llano Estacado (Pliocene and late Tertiary) conglomerates and caliche of the Ogallala Formation and is mantled by a thick layer of wind-deposited Pleistocene sands and silty sands. Further field investigation is needed to better develop the association-level information for this system.

Related Concepts:
- Edwards Plateau: Playa (1507) [CES303.654.9] (Elliott 2011) Equivalent

DESCRIPTION

Environment: This system occurs in shallow depressions over massive Cretaceous limestones, such as the Edwards Formation in the Edwards Plateau of Texas. These are internally draining depressions of karstic origin on level plateau surfaces. Soils are loams and clay loams, often mapped as Lakebed ecoclass (Elliott 2011). This system includes shallow wetlands formed over limestone on the Edwards Plateau of Texas. Variable in size and duration of inundation, these wetlands are typically found on level uplands. Formation of these occurrences is apparently from solution of the underlying limestone.

Vegetation: Dominant vegetation includes both graminoids and forbs tolerant of wet periods but not necessarily wetland-dependent. Dominant species may include *Pleuraphis mutica, Buchloe dactyloides, Tridens albescens, Sedum pulchellum, Sedum nuttallianum, Sporobolus vaginiflorus, Chaetopappa bellidifolia, Ambrosia psilostachya, Paronychia* spp., and the alga *Nostoc commune*. *Panicum obtusum, Bothriochloa barbinodis, Pascopyrum smithii, Bouteloua gracilis, Chenopodium album, Helianthus ciliaris*, and *Solanum elaeagnifolium* may also be present (Elliott 2011).

Component Associations:
- *Pleuraphis mutica - Buchloe dactyloides* Herbaceous Vegetation (CEGL002272, G4?)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Edwards Plateau Cliff (CES303.653)
- Edwards Plateau Dry-Mesic Slope Forest and Woodland (CES303.656)
- Edwards Plateau Floodplain Terrace (CES303.651)
- Edwards Plateau Limestone Savanna and Woodland (CES303.660)
- Edwards Plateau Limestone Shrubland (CES303.041)
- Edwards Plateau Mesic Canyon (CES303.038)
- Edwards Plateau Riparian (CES303.652)

DISTRIBUTION

Range: This system is found throughout the Edwards Plateau of Texas. Some larger occurrences of this wetland system are found in Crockett, Reagan, Schleicher, Irion and Sterling counties in the northwest Edwards Plateau (the Eldorado Plateau). In TPWD Phase 1, they are found primarily in Runnels, Concho, and Sutton counties (Elliott 2011).
Divisions: 303:C
Nations: US
Subnations: TX
Map Zones: 35:C
TNC Ecoregions: 29:C

SOURCES

References: Elliott 2011, Southeastern Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.791378#references
Description Author: J. Teague, mod. L. Elliott
Version: 24 Feb 2011 **Stakeholders:** Midwest, Southeast, West
Concept Author: J. Teague **ClassifResp:** Southeast

FLORIDA BIG BEND FRESH AND OLIGOHALINE TIDAL MARSH (CES203.507)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Tidal / Estuarine [Freshwater]; Graminoid
Non-Diagnostic Classifiers: Herbaceous
National Mapping Codes: ESLF 9290

CONCEPT

Summary: This ecological system includes tidal freshwater and oligohaline marshes of the northern Gulf of Mexico along the Florida Big Bend area (roughly from Wakulla County to the Pasco/Hernando county line on Florida's west coast). The tidal range in this region is higher than in the western Panhandle, and wave energy is low; lunar, wind and seasonal tides make flooding irregular. In comparison to the matrix-forming salt and brackish marshes of the same region, this system is confined to small patches that are generally restricted to areas near the mouths of rivers where freshwater is abundant. This system is dominated by herbaceous graminoids tolerant of tidal flooding, but not tolerant of saltwater and with only a limited tolerance of true brackish conditions.
Related Concepts:
- Tidal Marsh (FNAI 1990) Broader

DESCRIPTION

Environment: The flooding regime is tidal (irregular) but influenced by the freshwater flows of rivers. This system occurs where there is adequate river flow and discharge to maintain fresh to oligohaline conditions, while still within tidal range. These marshes occur near the mouths and upstream, well inside the mouths of tidal creeks and rivers.
Vegetation: This system is dominated by herbaceous graminoids tolerant of tidal flooding, but not tolerant of saltwater and with only a limited tolerance of true brackish conditions. It does not include the abundant salt marshes of *Spartina alterniflora* and *Juncus roemerianus* (brackish).
Dynamics: The tidal range in this region is higher than in the western Panhandle, and wave energy is low; lunar, wind and seasonal tides make flooding irregular (Montague and Wiegert 1990). In times of drought and low freshwater flows, brackish water will reach upstream further, into areas which would normally be freshwater. This can be a disturbance which alters community structure, decreasing populations or fecundity of those species intolerant of brackish water.

Component Associations:
- *Eleocharis rostellata - Rhynchospora colorata - Rhynchospora microcarpa* Herbaceous Vegetation (CEGL004951, G2?Q)
- *Sagittaria lancifolia - Glottidium vesicarium - Solidago sempervirens - Lythrum lineare* Herbaceous Vegetation (CEGL008447, G3G4)
- *Schoenoplectus californicus* Tidal Herbaceous Vegetation (CEGL003985, G4G5)
- *Typha domingensis* Tidal Herbaceous Vegetation (CEGL008456, GNR)
- *Zizaniopsis miliacea* Tidal Herbaceous Vegetation (CEGL004705, G3G5)

DISTRIBUTION

Range: Endemic to Florida from Wakulla County (Apalachicola Bay) to Pasco/Hernando county line, north of Tampa Bay.
Divisions: 203:C
Nations: US
Subnations: FL
Map Zones: 55:C, 99:C
USFS Ecomap Regions: 232D:CC, 232L:CC
TNC Ecoregions: 53:C

SOURCES

References: Comer et al. 2003, FNAI 1990, FNAI 2010a, Montague and Wiegert 1990
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723081#references
Description Author: R. Evans and C. Nordman, mod. M. Pyne
Version: 06 Feb 2014
Concept Author: R. Evans and C. Nordman
Stakeholders: Southeast
ClassifResp: Southeast

FLORIDA BIG BEND SALT AND BRACKISH TIDAL MARSH (CES203.508)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Tidal / Estuarine; Graminoid
Non-Diagnostic Classifiers: Herbaceous
National Mapping Codes: ESLF 9289

CONCEPT

Summary: This ecological system represents salt and brackish marshes of the northern Gulf of Mexico along the Florida Big Bend (roughly from Wakulla County [Apalachicola Bay] to the Pasco/Hernando county line [more or less to Tampa Bay] on Florida's west coast). The tidal range here is higher than in the western Panhandle, and wave energy is low; lunar, wind and seasonal tides make flooding irregular. The bulk of these marshes are comprised of monospecific stands of *Juncus roemerianus* that often exhibit tall- and short-growth zones. Patches of *Spartina alterniflora* are less common, and may be confined to the edges of creeks or in other pockets of low elevation. Small patches of *Distichlis spicata* may also be present near berms or levees.
Related Concepts:
- Tidal Marsh (FNAI 1990) Broader

DESCRIPTION

Environment: Irregularly tidal; wind, lunar, and seasonal influences are important.
Vegetation: This system consists of salt marshes characterized by *Spartina alterniflora, Juncus roemerianus,* and *Distichlis spicata* and brackish marshes dominated by *Juncus roemerianus*. The bulk of these marshes are comprised of monospecific stands of *Juncus roemerianus* that often exhibit tall- and short-growth zones. Patches of *Spartina alterniflora* are less common, and may be confined to the edges of creeks or in other pockets of low elevation. Small patches of *Distichlis spicata* may also be present near berms or levees (Montague and Wiegert 1990). The brackish marshes are in areas slightly higher than the salt marshes, where flooding is greater.
Dynamics: The tidal range here is higher than in the western Panhandle, and wave energy is low; lunar, wind and seasonal tides make flooding irregular (Montague and Wiegert 1990).

Component Associations:
- *Batis maritima - Sarcocornia pacifica* Dwarf-shrubland (CEGL003956, G5)
- *Juncus roemerianus* Herbaceous Vegetation (CEGL004186, G5)
- *Spartina alterniflora - Juncus roemerianus - Distichlis spicata* Louisianian Zone Salt Tidal Herbaceous Vegetation (CEGL004190, G5)

DISTRIBUTION

Range: This system is endemic to Florida from Wakulla County (Apalachicola Bay) to the Pasco/Hernando county line, north of Tampa Bay. (To the west of Apalachicola Bay, where the tides are diurnal instead of semi-diurnal, Mississippi Sound Salt and Brackish Tidal Marsh (CES203.303) replaces this system.)
Divisions: 203:C
Nations: US
Subnations: FL
Map Zones: 55:C, 99:C
USFS Ecomap Regions: 232D:CC, 232L:CC
TNC Ecoregions: 53:C, 55:C

SOURCES

References: Bertness et al. 2004, Comer et al. 2003, FNAI 1990, FNAI 2010a, Hackney and Cleary 1987, Montague and Wiegert 1990
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723080#references
Description Author: R. Evans and C. Nordman, mod. M. Pyne
Version: 06 Feb 2014
Concept Author: R. Evans and C. Nordman
Stakeholders: Southeast
ClassifResp: Southeast

FLORIDA KEYS SEAGRASS BED (CES411.285)

CLASSIFIERS

Classification Status: Standard

Primary Division: Caribbean (411)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Tidal / Estuarine; Aquatic Herb
Non-Diagnostic Classifiers: Herbaceous
National Mapping Codes: ESLF 9270

CONCEPT

Summary: This system encompasses seagrass beds of Florida Bay and the Florida Keys. *Thalassia testudinum, Cymodocea filiformis (= Syringodium filiforme),* and *Halodule beaudettei* are the primary potential species. All three species may co-occur in mixed beds, or stands may be heavily dominated by *Thalassia testudinum* only. Some stands may be further characterized by high density and abundance of calcareous green algae.

Similar Ecological Systems:
- Atlantic Coastal Plain Indian River Lagoon Seagrass Bed (CES203.256)
- East Gulf Coastal Plain Florida Big Bend Seagrass Bed (CES203.244)
- Southwest Florida Seagrass Bed (CES203.274)

Related Concepts:
- Seagrass Bed (FNAI 1990) Broader

DESCRIPTION

Environment: The Florida Bay region is characterized by a peculiar depositional environment (Tanner 1960) with low wave energy, shallow waters, and prevalence of calcareous material. The extensive seagrass beds may form marine peats.
Vegetation: *Thalassia testudinum, Cymodocea filiformis,* and *Halodule* are the primary potential species. All three species may co-occur in mixed beds, while other areas may be heavily dominated by *Thalassia testudinum* only, such as Bob Allen Key and Duck Key (http://serc.fiu.edu/seagrass/!CDreport/DataHome.htm). Some stands may be further characterized by high density and abundance of calcareous green algae.

Component Associations:
- *Thalassia testudinum - Cymodocea filiformis* Herbaceous Vegetation (CEGL008384, GNR)
- *Thalassia testudinum* Herbaceous Vegetation (CEGL004319, G4?)

DISTRIBUTION

Range: Endemic to south Florida.
Divisions: 411:C
Nations: US
Subnations: FL
Map Zones: 56:C
TNC Ecoregions: 54:C

SOURCES

References: Comer et al. 2003, Tanner 1960
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723203#references
Description Author: R. Evans
Version: 27 Sep 2005
Concept Author: R. Evans
Stakeholders: Southeast
ClassifResp: Southeast

FLORIDA RIVER FLOODPLAIN MARSH (CES203.055)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Graminoid
Non-Diagnostic Classifiers: Herbaceous
National Mapping Codes: ESLF 9246

CONCEPT

Summary: This system occupies generally narrow, but widely fluctuating, zones of herbaceous vegetation along rivers of northeastern, central and southern Florida. *Cladium mariscus ssp. jamaicense* or *Panicum hemitomon* and *Polygonum punctatum* were apparently the historical dominant plant species, but a variety of other species may also be present. Plant species composition (including dominants) may vary seasonally or annually depending on inundation and fire history.
Classification Comments: Placing all component associations is difficult due to a number of factors; the current list (8-03) is incomplete.
Similar Ecological Systems:
- Floridian Highlands Freshwater Marsh (CES203.077)--is found on lakes and former lakes (i.e., Paynes Prairie) not on rivers.
- South Florida Slough, Gator Hole and Willow Head (CES411.485)

Related Concepts:
- Floodplain Marsh (FNAI 1990) Broader
- Floodplain Marsh (FNAI 2010a) Broader

DESCRIPTION

Environment: This system occupies non-tidal, generally narrow, but widely fluctuating, zones of freshwater herbaceous marsh vegetation along rivers of northeastern, central and southern Florida. These include the Myakka, St. Johns, Kissimmee, and perhaps Caloosahatchee rivers.
Vegetation: A relatively diverse assemblage of vegetation is present, ranging from open-water communities to emergent and graminoid marshes and scattered shrublands. See floristic list provided by Huffman and Judd (1998). In the absence of fire, portions of stands will become dominated by *Salix caroliniana*. If fire continues to be absent, these areas may succeed to *Acer rubrum* until a replacement fire or mechanical activity restores the marsh.
Dynamics: This system is subject to river flooding. In the absence of fire, portions of stands will become dominated by *Salix caroliniana*. If fire continues to be absent, these areas may succeed to *Acer rubrum* until a replacement fire or mechanical activity restores the marsh.

Component Associations:
- *Cephalanthus occidentalis / Limnobium spongia - Salvinia minima* Shrubland (CEGL004457, G3?)
- *Cladium mariscus ssp. jamaicense* Herbaceous Vegetation (CEGL003940, GNR)
- *Nelumbo lutea - Pontederia cordata - Schoenoplectus tabernaemontani* Herbaceous Vegetation (CEGL004470, G2G3)
- *Osmunda regalis var. spectabilis - Peltandra virginica - Sagittaria lancifolia* Herbaceous Vegetation (CEGL004471, G2?)
- *Panicum hemitomon - Pontederia cordata* Herbaceous Vegetation (CEGL004461, G3G4)
- *Salix caroliniana / Decodon verticillatus / Typha latifolia* Forest (CEGL004423, G2G3)
- *Salix caroliniana* Temporarily Flooded Coastal Plain Shrubland (CEGL007052, G4?)
- *Typha latifolia - Pontederia cordata* Herbaceous Vegetation (CEGL004462, G3?)

DISTRIBUTION

Range: This system is endemic to rivers of northeastern, central and southern Florida.
Divisions: 203:C; 411:C
Nations: US
Subnations: FL
Map Zones: 55:C, 56:C
USFS Ecomap Regions: 232D:CC, 232G:CC, 232K:CC
TNC Ecoregions: 54:C, 55:C

SOURCES

References: Comer et al. 2003, FNAI 1990, FNAI 2010a, Hubricht 1985, Huffman and Judd 1998, Kushlan 1990, Patton and Judd 1986
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722655#references
Description Author: R. Evans, mod. C.W. Nordman and M. Pyne

Version: 05 Jul 2006
Concept Author: R. Evans

Stakeholders: Southeast
ClassifResp: Southeast

FLORIDIAN HIGHLANDS FRESHWATER MARSH (CES203.077)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Depressional [Sinkhole]; Graminoid
Non-Diagnostic Classifiers: Herbaceous; Isolated Wetland [Partially Isolated]
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2489; ESLF 9214; ESP 1489

CONCEPT

Summary: This system represents non-tidal marsh vegetation in the peninsula of Florida and in the Tallahassee area. These highland marshes occupy different types of depressions such as former lake basins, shallow peat-filled valleys, and zones around existing natural lakes. The marshes and the basins they occur within are unstable over time due to subsurface subsidence and drainage pattern changes. In some examples, surface waterflow is generally lacking due to the presence of limestone near the surface, but water levels have fluctuated greatly over time. Soils range from mucky surfaces to sandy loams or sands, but slowly permeable subsoils contribute to the presence of standing water for much of the year. The vegetation mosaic includes a range of mostly herbaceous plant communities that may be referred to as marshes, meadows, and prairies, collectively comprising a relatively diverse number of associations. Permanent water bodies support a range of submerged and floating aquatic species. Areas with approximately a meter of standing water tend to support dense stands of emergent herbaceous perennials, often in monospecific stands; species include *Typha latifolia, Pontederia cordata, Nelumbo lutea*, and others. Where there is less water (usually present only during wet season), more graminoid vegetation is present, with species such as *Panicum hemitomon, Leersia hexandra*, and other species. With historic water level fluctuations, the vegetation mosaic has also changed, sometimes quite rapidly.
Classification Comments: This system was originally intended to cover Paynes Prairie only, but the concept was greatly expanded to include other non-tidal marsh vegetation of Florida, including that around natural lakes, as well as the large Kissimmee and St. Johns River marshes. The Kissimmee and St. Johns River marshes also occur within floodplains but are influenced by somewhat different processes than typical highland marshes. These were formerly considered part of Florida River Floodplain Marsh (CES203.055).
Similar Ecological Systems:
- Florida River Floodplain Marsh (CES203.055)
- South Florida Slough, Gator Hole and Willow Head (CES411.485)

Related Concepts:
- Basin Marsh (FNAI 2010a) Broader
- Basin Marsh (FNAI 1990) Broader

DESCRIPTION

Environment: These highland marshes occupy different types of depressions such as former lake basins, shallow peat-filled valleys, and zones around existing natural lakes (Kushlan 1990). The marshes and the basins they occur within are unstable over time due to subsurface subsidence and drainage pattern changes. Soils range from mucky surfaces to sandy loams or sands, but slowly permeable subsoils contribute to the presence of standing water for much of the year.
Vegetation: A relatively diverse assemblage of vegetation is present, ranging from open water communities to emergent and graminoid marshes, and scattered shrublands. Placing all component associations is difficult due to a number of factors; the current list (12-02) is incomplete. In the absence of fire, portions of stands will become dominated by *Salix caroliniana.* If fire continues to be absent, these areas may succeed to *Acer rubrum* until a replacement fire or mechanical activity restores the marsh.
Dynamics: In some examples, surface waterflow is generally lacking due to the presence of limestone near the surface, but water levels have fluctuated greatly over time (Patton and Judd 1986). In the absence of fire, portions of stands will become dominated by *Salix caroliniana*. If fire continues to be absent, these areas may succeed to *Acer rubrum* until a replacement fire or mechanical activity restores the marsh. Paynes Prairie is a large permanently protected example of highland marsh. Water-control structures allow the manipulation of water levels in Paynes Prairie to achieve ecosystem management goals (Kushlan 1990).

Component Associations:
- *Andropogon (capillipes, glaucopsis) - Rhynchospora fascicularis var. fascicularis - Rhexia mariana* Herbaceous Vegetation (CEGL004460, G2?)
- *Cephalanthus occidentalis / Limnobium spongia - Salvinia minima* Shrubland (CEGL004457, G3?)
- *Cladium mariscus ssp. jamaicense* Herbaceous Vegetation (CEGL003940, GNR)
- *Nelumbo lutea - Pontederia cordata - Schoenoplectus tabernaemontani* Herbaceous Vegetation (CEGL004470, G2G3)
- *Osmunda regalis var. spectabilis - Peltandra virginica - Sagittaria lancifolia* Herbaceous Vegetation (CEGL004471, G2?)
- *Panicum hemitomon - Pontederia cordata* Herbaceous Vegetation (CEGL004461, G3G4)
- *Pontederia cordata* Seasonally Flooded Herbaceous Vegetation (CEGL004474, G3?)
- *Salix caroliniana / Decodon verticillatus / Typha latifolia* Forest (CEGL004423, G2G3)

- *Salix caroliniana* Temporarily Flooded Coastal Plain Shrubland (CEGL007052, G4?)
- *Spartina bakeri - Muhlenbergia filipes - Andropogon glomeratus - Rhynchospora colorata* Herbaceous Vegetation (CEGL004511, G3?)
- *Typha latifolia - Pontederia cordata* Herbaceous Vegetation (CEGL004462, G3?)

DISTRIBUTION

Range: This system is found in the Florida Peninsula and in the Tallahassee Hills/Valdosta Limesink area, possibly ranging into adjacent Georgia.
Divisions: 203:C
Nations: US
Subnations: FL, GA?
Map Zones: 55:C, 56:C
USFS Ecomap Regions: 232B:CC, 232D:CC, 232G:CC, 232J:CC, 232K:CC
TNC Ecoregions: 53:C, 55:C

SOURCES

References: Comer et al. 2003, FNAI 2010a, Kushlan 1990, Patton and Judd 1986
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723252#references
Description Author: R. Evans, mod. C.W. Nordman and M. Pyne
Version: 06 Feb 2014 **Stakeholders:** Southeast
Concept Author: R. Evans **ClassifResp:** Southeast

GREAT LAKES FRESHWATER ESTUARY AND DELTA (CES202.033)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Herbaceous; Riverine / Alluvial; Tidal / Estuarine
Non-Diagnostic Classifiers: >180-day hydroperiod; Lowland [Lowland]; Temperate [Temperate Continental]
National Mapping Codes: ESLF 9268

CONCEPT

Summary: This system is found throughout the southern Great Lakes Basin in the United States and Canada. It can include many associated wetlands occurring along portions of tributary rivers and streams that are directly affected by Great Lakes water regimes. It also forms much of the St. Clair River delta. Species distributions and community patterns are determined by multiple abiotic factors, including the type of aquatic system (major river channels, smaller tributary rivers, major deltas, or estuarine), Great Lakes water-level fluctuations, surficial bedrock, glacial landform, climate, and land use. Although wetland species are generally widely distributed, those of more temperate prairie regions are found in the southern parts of the basin. Vegetation types found across this diverse set of abiotic factors can be placed into a number of zones, though not all are present at a given site. The first four zones are typically inundated directly by lake waters: (a) submergent marsh; (b) emergent marsh; (c) shore fen; and (d) shoreline or strand. The next set of zones are inland from the water's edge and include: (e) herbaceous and shrubby wet meadows and (f) shrub or wooded swamps.

This system can be divided into a number of geographical variants, based on the various community types found across the range of the system: (1) Lake Michigan Lacustrine Estuary; (2) Lake Erie-St. Clair Lakeplain Marsh; (3) Lake Ontario Lagoon Marsh; and (4) St Lawrence River Estuary.

Similar Ecological Systems:

- Northern Great Lakes Coastal Marsh (CES201.722)

DESCRIPTION

Environment: Species distributions and community patterns are determined by multiple abiotic factors. Great Lakes water-level fluctuations, surficial bedrock, glacial landform, climate, and land use. Great Lakes water level fluctuate over at least three temporal time scales: first, short-term fluctuations caused by winds or barometric pressures; second, seasonal fluctuations reflecting the annual hydrologic cycle in the basin; and third, interannual fluctuations in lake level as a result of variable precipitation and evaporation within the drainage basin. Interannual fluctuations can be as much as 1.3-2.5 m, with apparently little or no periodicity. These fluctuations, which also alter turbidity, nutrient availability, ice scour zones, etc., cause locational shifts in vegetation zones, but also in the composition of these zones, as species have individual tolerance limits.

The major bedrock distinction in the Great Lakes Basin is between igneous and metamorphic bedrock of the Precambrian period and younger (Paleozoic) sedimentary bedrock. The igneous and metamorphic bedrock form the rugged north shore of Lake Superior and Georgian Bay, and line much of the St. Lawrence River; they are locally present on the south shore of western Lake Superior. They lack the shallow protected waters and fine-textured substrates that support broad coastal wetlands. Where such bedrock is at or near the surface, it forms soils that are nutrient-poor and acidic. The rest of the basin is dominated by softer, sedimentary bedrock, which, with its broad, horizontal depositions, favors broad zones of shallow waters. The sedimentary rocks are typically more alkaline (calcareous), forming soils that are nutrient- and moisture-rich loams and clays. Bedrock patterns are overlaid by glacial landforms that, in combination with recent long-shore transport processes, create the prevalent physiographic features of the shorelines. In the lakes themselves, sand lakeplains, clay lakeplains, and moraines are shaped by currents, and the long-shore transportation of sediments has created sand-spit embayments and swales, dune-swale complexes, and tombolos. Channels and rivers contain channel-side wetlands, embayments, and deltas, and estuaries form as either open or barred river mouths. It is this diversity of landforms that has given rise to a diverse set of vegetation types.

Finally, regional patterns of climate affect the basin. The strong latitudinal gradient from southern Lake Erie to northern Lake Superior creates marked differences in length of growing season and solar radiation. Although wetland species are generally widely distributed, those of more temperate and prairie regions are found in the southern parts.

Vegetation: Vegetation types found across this diverse set of abiotic factors vary in any number of ways, but they can be placed into a number of zones, though not all are present at a given site. The first four zones are typically inundated directly by lake waters: (a) submergent marsh - containing submergent and/or floating vegetation; (b) emergent marsh - characterized by shallow water or semipermanently flooded soils, and typically dominated by bulrushes, cattails, and other emergent species, but also containing submergent and/or floating vegetation; (c) shore fen - saturated vegetation mats characterized by groundwater influence from shoreline habitats but affected by lake level fluctuations, and dominated by herbaceous or shrubby species; and (d) shoreline or strand - a narrow zone at or just above the water level where seasonal water-level fluctuations and waves cause erosion, and which is dominated by annual or pioneer herbaceous species. The next set of zones are inland from the water's edge and include: (e) herbaceous and shrubby wet meadows - characterized by saturated or seasonally flooded soils, and typically dominated by sedges, grasses, and

other herbs, but occasionally dominated by shrubs; and (f) shrub or wooded swamps - characterized by seasonal flooding and dominated by woody species. Species assemblages in these zones change depending on the interaction of factors across the Great Lakes Basin.

Component Associations:
- *Calamagrostis canadensis - Carex viridula - Cladium mariscoides - Lobelia kalmii* Herbaceous Vegetation (CEGL005115, G1G2)
- *Carex* spp. - *(Carex pellita, Carex vulpinoidea)* Herbaceous Vegetation (CEGL005272, GNR)
- *Nelumbo lutea* Herbaceous Vegetation (CEGL004323, G4?)
- *Nuphar advena - Nymphaea odorata* Herbaceous Vegetation (CEGL002386, G4G5)
- *Potamogeton zosteriformis - Ceratophyllum demersum - Elodea canadensis* Southern Great Lakes Shore Herbaceous Vegetation (CEGL005152, G3G4)
- *Typha* spp. - *Schoenoplectus tabernaemontani* - Mixed Herbs Southern Great Lakes Shore Herbaceous Vegetation (CEGL005112, G3G4)

DISTRIBUTION

Range: Throughout the southern Great Lakes Basin in the United States and Canada.
Divisions: 201:?; 202:C
Nations: CA, US
Subnations: MI, NY, OH, ON, PA
Map Zones: 41:P, 49:C, 50:C, 51:C, 52:C, 62:C, 63:C, 64:C
USFS Ecomap Regions: 212Ha:CCC, 212Hf:CCC, 212Hj:CCC, 212Hl:CCC, 212Lb:CCP, 212Ra:CCC, 212Rc:CCC, 212Rd:CCC, 212Re:CCC, 212Sc:CCC, 212Sn:CCC, 212Sq:CCC, 212Te:CCC, 212Y:CC, 222Ja:CCC, 222Ua:CCC, 222Ud:CCC, 222Ue:CCC
TNC Ecoregions: 48:C

SOURCES

References: Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722674#references
Description Author: D. Albert, L. Minc
Version: 26 Mar 2003 **Stakeholders:** Canada, East, Midwest
Concept Author: D. Albert, L. Minc **ClassifResp:** Midwest

GULF COAST CHENIER PLAIN FRESH AND OLIGOHALINE TIDAL MARSH (CES203.467)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Tidal / Estuarine [Freshwater]; Aquatic Herb; Graminoid
Non-Diagnostic Classifiers: Herbaceous
National Mapping Codes: ESLF 9237

CONCEPT

Summary: This system includes large expanses of tidal marshes, strongly influenced by freshwater, along the Chenier Plain of Louisiana and Texas. Fresh to oligohaline marsh is the most common marsh type of the Chenier Plain because of the unique geomorphology of the area. The Chenier Plain is characterized by a prograding coastline replenished by sediments carried to the Gulf of Mexico by the Atchafalaya and other rivers. It is void of barrier islands, and shoreline sediments are reworked by waves into beach ridges. This process has been continuing since the last glacial retreat, and as the coastline progrades, older beach ridges are left as interior ridges surrounded by marsh. Historically, there were very few natural connections between the marshes and the ocean, resulting in a predominance of fresh to oligohaline salinity. This is a highly threatened system in coastal Louisiana.
Classification Comments: This system also includes some flotant marshes formerly recognized as a distinct ecological group.
Similar Ecological Systems:
- Mississippi Delta Fresh and Oligohaline Tidal Marsh (CES203.470)
- Texas Coast Fresh and Oligohaline Tidal Marsh (CES203.472)

Related Concepts:
- Chenier Plain: Fresh and Intermediate Tidal Marsh (5807) [CES203.541.7] (Elliott 2011) Finer
- Chenier Plain: Fresh and Intermediate Tidal Shrub Wetland (5806) [CES203.541.6] (Elliott 2011) Finer

DESCRIPTION

Environment: This system occupies coastal sites with mucky soils and salinities generally less than 4 ppt. Soils are recent alluvial deposits. It occurs along bay margins and outlets of coastal rivers where freshwater inflow is sufficient to drive marsh composition. Sites may be interspersed with areas of open water. Soils are saturated, very deep, mineral soils, often with high organic content, at least at the surface. Ecoclasses (from Ecological Site Descriptions) include various fresh and intermediate marsh types (Elliott 2011). Coastal Louisiana contains about "37% of the estuarine herbaceous marshes in the conterminous U.S." (Glick et al. 2013).
Vegetation: Dominant plant species are graminoids, including *Panicum hemitomon, Paspalum vaginatum, Zizaniopsis miliacea, Typha latifolia, Spartina patens, Schoenoplectus* spp., and *Phragmites australis*. Other wetland species such as *Sagittaria* spp., *Ludwigia* spp., and *Vigna luteola* may also be present. Some occurrences may have some woody cover with species such as *Iva frutescens* or *Baccharis halimifolia* (Elliott 2011).
Dynamics: Historically, the deltaic processes of the Mississippi River helped to build and maintain this system. Sediments brought to the coast by the Mississippi River and its distributaries were carried west along the coast by longshore currents. The shifting over time of the location of the Mississippi River deltas resulted in variations in sediment availability which, along with other coastal processes, caused an alternating prograding and retreating chenier plain coastline. Sediments were reworked into beach ridges that trapped freshwater flowing coastward off the mainland resulting in a chenier plain of beach ridges (cheniers) alternating with large expanses of fresh to oligohaline marshes. Today, sediments from the Atchafalaya River are again forming mudflats in the chenier plain but not to the extent that was associated with Mississippi River deltaic processes (Gosselink et al. 1998). One of the few areas of coastal accretion in Louisiana is located in the eastern Chenier Plain, a process fed by sediments from the Atchafalaya. Given the predominance of coastal loss and subsidence in Louisiana, the accretion of the eastern Chenier Plain is unusual (Gosselink et al. 1998, Draut et al. 2005). In addition to local rainfall, freshwater entering the chenier plain marshes comes from rivers and streams, and is dependent on functioning hydrological processes in those systems. This marsh system is dependent upon freshwater input, sediment input and organic matter build-up. Species richness is typically higher in oligohaline marshes than in brackish marshes. In addition to these natural barriers limiting waterflow, many human-made impoundments exist in the Chenier Plain. These impoundments tend to support fresh marsh because water loss through evapotranspiration is less than local rainfall (Gosselink et al. 1979).

Component Associations:
- *Panicum hemitomon* Semipermanently Flooded Herbaceous Vegetation (CEGL004665, G3G4)
- *Paspalum vaginatum - Spartina patens* Oligohaline Herbaceous Vegetation (CEGL007885, G2?)
- *Phragmites australis - (Sagittaria platyphylla, Vigna luteola)* Tidal Herbaceous Vegetation (CEGL007891, G4?)
- *Sagittaria lancifolia - Typha* spp. - *Ludwigia* spp. Herbaceous Vegetation (CEGL007894, G3G4)
- *Schoenoplectus americanus - (Spartina patens) - Typha* spp. Herbaceous Vegetation (CEGL008476, G3?)
- *Schoenoplectus californicus* Tidal Herbaceous Vegetation (CEGL003985, G4G5)
- *Spartina patens - Typha* spp. Chenier Plain Oligohaline Herbaceous Vegetation (CEGL007887, G3?)
- *Zizaniopsis miliacea - Panicum hemitomon* Herbaceous Vegetation (CEGL007895, G3G4)

SPATIAL CHARACTERISTICS

Spatial Summary: Typically in large patches but may also occur in small patches.

DISTRIBUTION

Range: This system extends from Vermillion Bay, Louisiana, through Jefferson County, Texas. It does not extend into Galveston Bay. Approximately 3000 square km of marshes were present in the Chenier Plain of Louisiana in 1997 and the majority of these were fresh to oligohaline marshes (Visser et al. 2000).
Divisions: 203:C
Nations: US
Subnations: LA, TX
Map Zones: 37:C, 98:C
USFS Ecomap Regions: 232E:CC, 255D:CC
TNC Ecoregions: 31:C

SOURCES

References: Bernier 2013, Comer et al. 2003, Couvillion and Beck 2013, Couvillion et al. 2011, Draut et al. 2005, Elliott 2011, Glick et al. 2013, Gosselink et al. 1979, Gosselink et al. 1998, Howard and Mendelssohn 1999, LDWF 2005, Neubauer 2013, Smith 1993, Visser et al. 2000, Williams 2013, Willis and Hester 2004
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723119#references
Description Author: J. Teague and R. Evans, mod. M. Pyne and L. Elliott
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: J. Teague and R. Evans **ClassifResp:** Southeast

GULF COAST CHENIER PLAIN SALT AND BRACKISH TIDAL MARSH (CES203.468)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Saltwater (Polyhaline); Brackish (Mesohaline); Tidal / Estuarine [Haline]; Graminoid
Non-Diagnostic Classifiers: Herbaceous
National Mapping Codes: ESLF 9240

CONCEPT

Summary: This system includes brackish to salt intertidal marshes in the Chenier Plain of Louisiana and Texas. This area was characterized historically by a prograding coastline replenished by sediments carried to the Gulf of Mexico by the Mississippi, Atchafalaya and other rivers. It is void of barrier islands. Shoreline sediments are deposited by longshore currents and reworked by waves into alternating beach ridges and mudflats depending on the amount of sediment input. This process started after the last glacial retreat and, as the coastline prograded over time, older beach ridges were left as interior ridges surrounded by marsh. Historically, natural connections between the marshes and the ocean were limited by these beach ridges, resulting in an abundance of fresh to oligohaline (intermediate) marsh, not as much brackish marsh, and even less salt marsh. In more recent times, with the increase of dredged canals connecting the marsh system to the gulf, an increase in salinity has occurred, to the detriment of plants adapted to freshwater environments. Significant fresh marsh loss has occurred in this area. Increases in salinity levels may be caused by saltwater intrusion and/or freshwater diversion. Both water level and salinity influence species composition. Salt marshes (about 16 ppt) receive regular daily tides and are typically dominated by *Spartina alterniflora*. Brackish marshes (about 8 ppt), under slightly less tidal influence and moderately influenced by freshwater, are typically dominated by *Spartina patens*, and degraded by saltwater intrusion. Brackish occurrences may be found along tidal creeks, smaller ponds and at the upper reaches of daily tides or in areas more influenced by wind tides. Inclusions of *Juncus roemerianus* and other brackish species are found in small to large patches. Through the control of the Mississippi River, historic chenier processes have been lost. Historically a progradational shoreline, today the Chenier Plain shoreline is dominated by erosion. However, coastal processes of progradation are still present in limited areas fed by sediments from the Atchafalaya River.

Similar Ecological Systems:
- Mississippi Delta Salt and Brackish Tidal Marsh (CES203.471)
- Texas Coast Salt and Brackish Tidal Marsh (CES203.473)

Related Concepts:
- Chenier Plain: Salt and Brackish High Tidal Marsh (5717) [CES203.468.17] (Elliott 2011) Finer
- Chenier Plain: Salt and Brackish High Tidal Shrub Wetland (5716) [CES203.468.16] (Elliott 2011) Finer
- Chenier Plain: Salt and Brackish Low Shrub Tidal Wetland (5706) [CES203.468.6] (Elliott 2011) Finer
- Chenier Plain: Salt and Brackish Low Tidal Marsh (5707) [CES203.468.7] (Elliott 2011) Finer

DESCRIPTION

Environment: Salt marshes on the Gulf Coast receive regular daily microtides. Brackish marshes, under slightly less tidal influence and moderately influenced by freshwater, are degraded by saltwater intrusion. This ecological system is found flanking large bays, along tidal creeks, between saltwater and fresh to oligohaline marshes, and in areas more influenced by wind tides. Examples are found on recent alluvial deposits of coastlines, bay margins, bay inlets, along dredged canals, creeks, and river inlets where tidal influence is adequate to maintain mesohaline to polyhaline conditions. Soils are fine-textured, sometimes with high organic content at the surface. Ecoclasses (from Ecological Site Descriptions) include brackish and salt marsh types in Texas (Elliott 2011). Though progradation has been reduced from the loss of sediment as a result of the control of the Mississippi River, the Chenier Plain is prograding in some places, most notably west of the mouth of the Atchafalaya River. Historically a progradational shoreline, the Chenier Plain shoreline is now dominated by erosion.

Vegetation: This typically herbaceous-dominated system has a species composition that varies depending on the salinity of the environment and the depth of frequent tidal flooding. Marshes that are frequently flooded by tides (low marshes) tend to be strongly dominated by *Spartina alterniflora*. Occasionally these sites may have significant cover of *Avicennia germinans*, though freezes tend to reduce the cover of mangrove. Some patches of *Juncus roemerianus* may be interspersed. Higher marshes of saline to brackish sites tend to be somewhat more diverse, with *Spartina patens* a common dominant. *Spartina alterniflora* may be present but is typically not strongly dominant. Other species that may be present or sometimes dominant include *Spartina spartinae, Distichlis spicata, Batis maritima, Salicornia* spp., *Schoenoplectus robustus, Schoenoplectus americanus, Paspalum vaginatum, Sporobolus virginicus*, and *Borrichia frutescens*. *Iva frutescens* and *Baccharis halimifolia* are commonly encountered woody species (Elliott 2011).

Dynamics: Historic natural processes of the Chenier Plain were tied to the deltaic processes of the Mississippi River and the natural hydrological processes of other rivers along the western coast of Louisiana and eastern coast of Texas. These natural processes have all been altered, but processes of freshwater and sediment input still persist even though in an altered state. Sediment input is critical to marsh persistence and becomes even more important under accelerated sea-level rise scenarios. Marsh vegetation plays an equally

important role in maintaining marsh elevation (Baustian et al. 2012). The Chenier Plain of Louisiana has unusually high relative sea-level rise (Draut et al. 2005). This is a microtidal environment. Salt and brackish marshes are important habitats for many animal species.

Component Associations:
- *Borrichia frutescens / (Spartina patens, Juncus roemerianus)* Shrubland (CEGL003924, G4)
- *Iva frutescens ssp. frutescens - Baccharis halimifolia / Spartina spartinae* Shrubland (CEGL004616, G4?)
- *Juncus roemerianus* Herbaceous Vegetation (CEGL004186, G5)
- *Sarcocornia pacifica* - (*Batis maritima, Distichlis spicata*) Dwarf-shrubland (CEGL002278, G4)
- *Spartina alterniflora - Distichlis spicata - Spartina patens* Mesohaline Tidal Herbaceous Vegetation (CEGL002230, G4?)
- *Spartina alterniflora - Juncus roemerianus - Distichlis spicata* Louisianian Zone Salt Tidal Herbaceous Vegetation (CEGL004190, G5)
- *Spartina patens - Schoenoplectus (americanus, pungens) - (Distichlis spicata)* Herbaceous Vegetation (CEGL004755, G4?)
- *Spartina spartinae - Sporobolus virginicus* Tidal Herbaceous Vegetation (CEGL004199, G4G5)
- *Typha domingensis* Tidal Herbaceous Vegetation (CEGL008456, GNR)

DISTRIBUTION

Range: This system extends from Vermillion Bay, Louisiana, to East Bay, Texas. Salt marsh is limited to areas fringing saltwater shorelines. Brackish marshes are found landward of the salt marshes (typically between fresh to oligohaline marshes and salt marshes) and are more prominent around coastal lakes.
Divisions: 203:C
Nations: US
Subnations: LA, TX
Map Zones: 37:C
USFS Ecomap Regions: 232E:CC, 255D:CC
TNC Ecoregions: 31:C

SOURCES

References: Baustian et al. 2012, Comer et al. 2003, Couvillion et al. 2011, Draut et al. 2005, Elliott 2011, Glick et al. 2013, Gosselink et al. 1979, LDWF 2005, Neubauer 2013, Osland et al. 2013, Smith 1993, USGS 2013b, Visser et al. 2000, Williams 2013
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723118#references
Description Author: J. Teague and R. Evans, mod. M. Pyne and L. Elliott
Version: 14 Jan 2014
Concept Author: J. Teague and R. Evans
Stakeholders: Southeast
ClassifResp: Southeast

HAWAI'I ANCHIALINE POOL (CES412.420)

CLASSIFIERS

Classification Status: Standard

Primary Division: Northern Polynesia (412)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Brackish (Mesohaline); Shrubland (Shrub-dominated); Shoreline; Sinkhole; Grassland, Savanna, Steppe (graminoid-dominated); Lava; Depressional
Non-Diagnostic Classifiers: Lowland [Lowland]; Herbaceous; Basalt; Tropical/Subtropical [Tropical Pluvial]; Tropical/Subtropical [Tropical Pluviseasonal]; Tropical/Subtropical [Tropical Xeric]; Tidal / Estuarine [Freshwater]; Tidal / Estuarine [Haline]; Salt Spray; Coast
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2801; ESLF 9438; ESP 1801

CONCEPT

Summary: This ecological system is composed of rare, land-locked, often brackish pools with indirect subterranean connections to the ocean. They occur on the coasts of Hawai'i, Maui, Moloka'i, O'ahu, and Kaho'olawe with most of the pools occurring on the Big Island. The pools are found on relatively recent lava flows or on uplifted corral beds (limestone). Fresh surface water and groundwater mix with seawater to create different salinity levels with and among pools. Water levels in pools may fluctuate with tidal changes, although delayed depending on the hydraulic conductivity of the substrates. Vegetation is limited and includes a variety of algae (green, blue-green, red) and emergent vegetation including *Carex* spp., *Sesuvium portulacastrum*, and *Thespesia populnea*. The fauna is most distinctive and includes many endemic and native crustaceans (shrimps (*Halocaridina rubra*), prawns, amphipods, and isopods), small fish, and invertebrates such as the orange-black damselfly (*Megalagrion xanthomelas*), which is a rare, anchialine pool endemic.

DESCRIPTION

Environment: This ecological system is composed of rare, land-locked, often brackish pools with indirect subterranean connections to the ocean. They occur on the coasts of Hawai'i, Maui, Moloka'i, O'ahu, and Kaho'olawe with most of the pools occurring on the Big Island. Climate is variable depending on which coast the pools occur and ranges from arid to moderately wet (Zones 1-6) of the 7 Moisture Zones developed for the Hawaiian Islands by Price et al. (2007). The pools are found on relatively recent lava flows or on uplifted corral beds (limestone). Fresh surface water and groundwater mix with seawater to create different salinity levels with and among pools. Water levels in pools may fluctuate with tidal changes, although delayed depending on the hydraulic conductivity of the substrates.
Vegetation: The vegetation of this ecological system is very limited and includes a variety of algae (green, blue-green, red) and emergent vegetation including *Carex* spp., *Sesuvium portulacastrum*, and *Thespesia populnea*. The fauna is most distinctive and includes many endemic and native crustaceans (shrimps (*Halocaridina rubra*), prawns, amphipods, and isopods), small fish, and invertebrates such as the orange-black damselfly (*Megalagrion xanthomelas*), which is a rare, anchialine pool endemic.

DISTRIBUTION

Range: This ecological system occurs in the Hawai'ian Islands on the coasts of Hawai'i, Maui, Moloka'i, O'ahu, and Kaho'olawe.
Divisions: 412:C
Nations: US
Subnations: HI
Map Zones: 79:C
USFS Ecomap Regions: M423:C
TNC Ecoregions: 65:C

SOURCES

References: Gagne and Cuddihy 1990, Gon et al. 2006, Mueller-Dombois and Fosberg 1998, Price et al. 2007, Stone and Pratt 1994b, USGS and NPS 2005, Wagner et al. 1999, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.821176#references
Description Author: K.A. Schulz
Version: 05 Mar 2009
Concept Author: Western Ecology Working Group
Stakeholders: West
ClassifResp: West

HAWAI'I BOG (CES412.216)

CLASSIFIERS

Classification Status: Standard

Primary Division: Northern Polynesia (412)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Impermeable Layer; Saturated Soil; Peat and mud; Tropical/Subtropical [Tropical Pluvial]; Depressional; Isolated Wetland [Strictly Isolated]; Organic Peat (>40 cm); Muck; Bog
Non-Diagnostic Classifiers: Montane; Lowland; Herbaceous; Seepage-Fed Sloping; Extensive Wet Flat
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2806; ESLF 9286; ESP 1806

CONCEPT

Summary: Hawai'i Bog occurs primarily between 1067 and 1670 m (3500-5500 feet) elevation as isolated small patches on flat or gently sloping topography in high rainfall areas in cloud forests and other wet forests on all of the high islands. This bog system also occurs in the subalpine zone at 2270 m (7446 feet) elevation on Maui, and as a low-elevation bog at 646 m (2120 feet) on Kaua'i. Soils remain saturated on a shallow to deep layer of peat (0.01-5 m), underlain by an impervious basal clay layer that impedes drainage. A few sloping bogs occur on steeper terrain were precipitation is extremely high, such as in North Bog in the Wai'ale'ale summit region of Kaua'i, where soils remain saturated despite adequate drainage. Two bogs are believed to have formed in former small lakes, one along the Wailuku River, Hawai'i (Treeless bog), the other the subalpine bog on East Maui (Flat Top bog). The low-elevation bog on Kaua'i occurs on shallow, poorly drained acidic peat. Bogs are characterized by an uneven hummocky matrix of sedges and grasses (*Oreobolus furcatus, Carex* spp., *Rhynchospora* spp., *Dichanthelium* spp.) and stunted woody plants including *Metrosideros* spp. (ohi'a), *Coprosma ochracea* (pilo), and (*Dubautia* spp. (na'ena'e). Dwarfed or stunted woody plants can occur as scattered individuals, in clumps, or as a continuous layer. Associated ferns and herbs include *Dicranopteris linearis, Sadleria* spp., *Polypodium* spp., *Hymenophyllum* spp., *Elaphoglossum* spp., *Athyrium* spp., *Schizaea robusta, Selaginella deflexa, Plantago* spp., *Astelia* spp., *Viola* spp., *Machaerina* spp., *Lysimachia* spp., and on Kaua'i, the boreal catchfly *Drosera anglica*.

DESCRIPTION

Environment: Clay formation in Hawaiian bogs is typically a result of basaltic weathering under cool, wet conditions that permits an accumulation of humus. Climate is generally very wet (Zones 7) of the 7 Moisture Zones developed for the Hawaiian Islands by Price et al. (2007). Annual precipitation typically is over 4500 mm. On flat and gently sloping terrain, the clay formation impedes drainage resulting in perched water on top of the clay. In addition, it has now been established that eolian clay mineral deposits accumulated on broad summits and ridges within high rainfall and cloud areas over a 200,000- to 500,000-year time span have also contributed to the formation of clay substrates that support Hawaiian bogs.
Vegetation: Bogs are characterized by an uneven hummocky matrix of sedges and grasses (*Oreobolus furcatus, Carex* spp., *Rhynchospora* spp., *Dichanthelium* spp.) and stunted woody plants including *Metrosideros* spp., *Coprosma ochracea*, and *Dubautia* spp. Dwarfed or stunted woody plants can occur as scattered individuals, in clumps, or as a continuous layer. Associated ferns and herbs include *Sadleria* spp., *Polypodium* spp., *Hymenophyllum* spp., *Elaphoglossum* spp., *Athyrium* spp., *Schizaea robusta, Selaginella deflexa, Plantago* spp., *Astelia* spp., *Viola* spp., *Machaerina* spp., *Lysimachia* spp., and on Kaua'i, the boreal catchfly *Drosera anglica*.
Dynamics: All bogs are threatened by feral pig rooting followed by invasion of exotic sedges (*Cyperus* spp.) and colonization by grasses (*Andropogon virginicus, Schizachyrium condensatum*). Fencing at a few bogs has been shown to arrest damage, by keeping pigs away.

Component Associations:
- *Metrosideros polymorpha / Rhynchospora* spp. / *Dicranopteris linearis* Mixed Lowland Bog Dwarf-shrubland (CEGL008080, G1)
- *Metrosideros polymorpha* Mixed Montane Bog Dwarf-shrubland (CEGL008081, G2)

DISTRIBUTION

Range: This system is found near mountain summits on Kaua'i, O'ahu, Moloka'i, and West Maui (Selling 1948, Carlquist 1980), on high-rainfall windward slopes of East Maui, and on windward slopes of the Kohala Mountains, Mauna Kea, and Mauna Loa on Hawai'i Island.
Divisions: 412:C
Nations: US
Subnations: HI
Map Zones: 79:C
USFS Ecomap Regions: M423:C
TNC Ecoregions: 65:C

SOURCES

References: Gagne and Cuddihy 1990, Mueller-Dombois and Fosberg 1998, Price et al. 2007, Wagner et al. 1999, Western Ecology

Working Group n.d., Ziegler 2002

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.770632#references

Description Author: M. Castillo, mod. D. Johnson

Version: 05 Mar 2009

Concept Author: M. Castillo and G. Kittel

Stakeholders: West

ClassifResp: West

HAWAI'I FRESHWATER AQUATIC BED (CES412.225)

CLASSIFIERS

Classification Status: Standard

Primary Division: Northern Polynesia (412)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Pond; Depressional [Pond]; Aquatic Herb
Non-Diagnostic Classifiers: Montane; Lowland; Herbaceous; Tropical/Subtropical
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - forbland, Hydromorphic-rooted grassland
National Mapping Codes: EVT 2803; ESLF 9245; ESP 1803

CONCEPT

Summary: This freshwater aquatic bed system is permanently flooded and characterized by submerged, partially submerged or floating vegetation lacking structural support. This system is found in reservoirs, ponds, pools, slow-moving streams, irrigation ditches, canals, and open bodies of water surrounded by freshwater marshes. Mean water depths of these habitats are too great for rooted emergent plants. Habitats may be subject to water level fluctuations greater than 1 m (3 feet) and to regular or intermittent exposure at extreme low tides. Vegetation consists entirely of floating and submerged aquatics. Many of the dominant species may remain dormant/dry part of the year and complete their reproductive cycle during the wet part of the year. *Potamogeton foliosus* and *Potamogeton nodosus* are characteristic of this system.

DESCRIPTION

Dynamics: Aquatic bed plants serve as important food sources for waterfowl and are bird-dispersed. This system is threatened by alien and naturalized species, including *Ceratophyllum demersum, Eichhornia crassipes, Hydrocotyle verticillata, Lemna perpusilla, Ludwigia palustris, Monochoria vaginalis, Myriophyllum aquaticum, Pistia stratiotes*, and *Spirodela polyrrhiza*.

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Hawai'i Floodplain Forest (CES412.221)
- Hawai'i Riparian Forest and Shrubland (CES412.220)

DISTRIBUTION

Range: This system occurs in coastal areas to 1220 m (4000 feet) elevation on Kaua'i, O'ahu, Maui, and Hawai'i.
Divisions: 412:C
Nations: US
Subnations: HI
Map Zones: 79:C
USFS Ecomap Regions: M423:C
TNC Ecoregions: 65:C

SOURCES

References: Gagne and Cuddihy 1990, Mueller-Dombois and Fosberg 1998, Stemmermann 1983, Wagner et al. 1999, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.770659#references
Description Author: M. Castillo
Version: 20 Apr 2005
Concept Author: M. Castillo and G. Kittel
Stakeholders: West
ClassifResp: West

HAWAI'I FRESHWATER MARSH (CES412.222)

CLASSIFIERS

Classification Status: Standard

Primary Division: Northern Polynesia (412)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Marsh; Tropical/Subtropical; Seepage-Fed Sloping; Depressional [Pond]; Riverine / Alluvial; Tidal / Estuarine
Non-Diagnostic Classifiers: Floodplain; Lowland [Lowland]; Herbaceous; Riverine / Alluvial [Brownwater]; Tidal / Estuarine [Oligohaline]; Basin
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2804; ESLF 9299; ESP 1804

CONCEPT

Summary: Freshwater marshes occur on the northwestern Hawaiian Islands and throughout the main islands as a mostly small-patch system confined to limited areas in floodplain or basin topography. This system occupies estuaries, surrounds open bodies of water, occurs in former ponds, and sometimes along streams and springs. Water levels in freshwater marshes fluctuate seasonally, but they usually retain standing water most of the year. Soils range from silty clays to deep gley mucks to loams and sand over less permeable subsoils. Vegetation is dominated by emergent herbaceous bulrushes, sedges and grasses, including *Schoenoplectus maritimus (= Bolboschoenus maritimus), Cyperus* spp., *Schoenoplectus* spp., and *Urochloa mutica (= Brachiaria mutica)*. Forbs include *Bacopa monnieri* and *Ludwigia octovalvis*. Introduced species include *Typha latifolia* and the subshrub *Pluchea indica*. In a few locations known to formerly support bodies of water on Hawai'i (Waimanu Valley) and O'ahu (Kawai Nui marsh and at Ka'au Crater), marsh vegetation is dominated by *Cladium mariscus ssp. jamaicense (= Cladium jamaicense)*. This system interfaces with saline tidal marsh in windward estuaries, where species from both freshwater and saltwater marshes coexist. This system serves as important habitat for endemic and migratory waterbirds.
Classification Comments: This system does not include bogs where sphagnum moss develop as the substrate. This type may be historic. Known stands are largely converted to introduced wetland. Invasive species are a serious threat to all wetlands in Hawai'i.

DESCRIPTION

Environment: Freshwater marshes occur as a mostly small-patch system confined to limited areas in floodplain or basin topography. This system occupies estuaries, surrounds open bodies of water, occurs in former ponds, and sometimes along streams and springs. Water levels in freshwater marshes fluctuate seasonally, but they usually retain standing water most of the year. Climate is variable depending on where the stand occurs, ranging from arid to very wet (Zones 1-7) of the 7 Moisture Zones developed for the Hawaiian Islands by Price et al. (2007). Soils range from silty clays to deep gley mucks to loams and sand over less permeable subsoils.
Vegetation: Vegetation is dominated by emergent herbaceous bulrushes, sedges and grasses, including *Schoenoplectus maritimus (= Bolboschoenus maritimus), Cyperus* spp., *Schoenoplectus* spp., and *Urochloa mutica (= Brachiaria mutica)*. Forbs include *Bacopa monnieri* and *Ludwigia octovalvis*. Introduced species include *Typha latifolia* and the subshrub *Pluchea indica*. In a few locations known to formerly support bodies of water on Hawai'i (Waimanu Valley) and O'ahu (Kawai Nui marsh and at Ka'au Crater), marsh vegetation is dominated by *Cladium mariscus ssp. jamaicense (= Cladium jamaicense)*.
Dynamics: Nearly all occurrences have been cultivated in the past. Agricultural and alien-species pressures continue to degrade this system and diminish its ability to provide suitable habitat for wildlife.

Component Associations:
- *Bolboschoenus* spp. - *Schoenoplectus* spp. - *Cyperus laevigatus* Coastal Wet Herbaceous Vegetation (CEGL008093, G4)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Northern Polynesia Tidal Salt Marsh (CES412.224)

Adjacent Ecological System Comments: This system interfaces with saline tidal marsh in windward estuaries, where species from both freshwater and saltwater marshes coexist.

DISTRIBUTION

Range: This system occurs from sea level up to 500 m (1640 feet) elevation on Laysan, Kaua'i, O'ahu, Moloka'i, LÃ¢na'i, Maui, and Hawai'i.
Divisions: 412:C
Nations: US
Subnations: HI
Map Zones: 79:C
USFS Ecomap Regions: M423:C
TNC Ecoregions: 65:C

SOURCES

References: Gagne and Cuddihy 1990, Mueller-Dombois and Fosberg 1998, Price et al. 2007, Stemmermann 1983, Wagner et al. 1999, Western Ecology Working Group n.d.

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.770650#references

Description Author: M. Castillo, mod. K.A. Schulz

Version: 05 Mar 2009 **Stakeholders:** West

Concept Author: M. Castillo and G. Kittel **ClassifResp:** West

INTER-MOUNTAIN BASINS ALKALINE CLOSED DEPRESSION (CES304.998)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Non-Diagnostic Classifiers: Saline Water Chemistry; Herbaceous; Depressional [Mineral]; Isolated Wetland [Partially Isolated]; Depression
National Mapping Codes: ESLF 9297

CONCEPT

Summary: This ecological system occurs on in playas that are seasonally to semipermanently flooded, usually retaining water into the growing season and drying completely only in drought years. Many are associated with hot and cold springs, located in basins with internal drainage. Soils are alkaline to saline clays with hardpans. Seasonal drying exposes mudflats colonized by both annual and perennial wetland vegetation. Salt encrustations can occur on the surface in some examples of this system, and the soils are severely affected and have poor structure. Species that typify this system are salt-tolerant and halophytic species such as *Distichlis spicata, Puccinellia lemmonii, Poa secunda, Muhlenbergia* spp., *Leymus triticoides (= Elymus triticoides), Schoenoplectus maritimus, Schoenoplectus americanus, Triglochin maritima,* and *Salicornia* spp. During exceptionally wet years, an increase in precipitation can dilute the salt concentration in the soils of some examples of this system which may allow for less salt-tolerant species to occur. Communities found within this system may also occur in floodplains (i.e., more open depressions), but probably should not be considered a separate system unless they transition to areas outside the immediate floodplain. Types often occur along the margins of perennial lakes, in alkaline closed basins, with extremely low-gradient shorelines. This system is very similar to Western Great Plains Closed Depression Wetland (CES303.666).

Similar Ecological Systems:
- Western Great Plains Closed Depression Wetland (CES303.666)

Related Concepts:
- Other Sagebrush Types (408) (Shiflet 1994) Intersecting. *Artemisia cana ssp. bolanderi* shrublands are included in this ecological system.

DESCRIPTION

Environment: This system occurs in cooler context than the playas found further south in the southern Great Basin and Mojave/Sonoran deserts. This ecological system occurs on sites that are seasonally to semipermanently flooded, usually retaining water into the growing season and drying completely only in drought years. Many are associated with hot and cold springs, located in basins with internal drainage. Soils are alkaline to saline clays with hardpans. Seasonal drying exposes mudflats colonized by annual wetland vegetation. The soils are severely affected by salts and have poor structure. This system is distinct from the freshwater depression systems by its brackish nature caused by strongly saline soils. Salt encrustations could occur near the surface in some examples of this system.

Vegetation: Species that typify this system are salt-tolerant and halophytic species such as *Distichlis spicata, Puccinellia lemmonii, Poa secunda, Muhlenbergia* spp., *Leymus triticoides (= Elymus triticoides), Schoenoplectus maritimus, Schoenoplectus americanus, Triglochin maritima,* and *Salicornia* spp. It also supports many Federally-listed plant species.

Dynamics: This ecological system is primarily driven by hydrological processes. It occurs on sites that are seasonally to semipermanently flooded, usually retaining water into the growing season, drying completely only in drought years. Increases in precipitation and/or runoff can dilute the salt concentration and allow for less salt-tolerant species to occur.

Component Associations:
- *Artemisia tridentata ssp. tridentata / Leymus cinereus* Shrubland (CEGL001016, G2)
- *Distichlis spicata* Herbaceous Vegetation (CEGL001770, G5)
- *Eleocharis palustris - Distichlis spicata* Herbaceous Vegetation (CEGL001834, G2G4)
- *Eleocharis palustris - Juncus balticus* Herbaceous Vegetation (CEGL001835, G2G4)
- *Leymus triticoides - Poa secunda* Herbaceous Vegetation (CEGL001572, G2)
- *Leymus triticoides* Herbaceous Vegetation (CEGL001571, G4?)
- *Poa secunda - Muhlenbergia richardsonis* Herbaceous Vegetation (CEGL002755, GNR)
- *Puccinellia lemmonii - Poa secunda* Seasonally Flooded Herbaceous Vegetation (CEGL001658, G1)
- *Schoenoplectus americanus - Eleocharis palustris* Herbaceous Vegetation (CEGL001585, G4)

DISTRIBUTION

Range: This system can occur throughout the Columbia Plateau and the northern Great Basin but is most common in eastern Oregon and northern Nevada. It occurs in the Wyoming basins (central Wyoming) where it is surrounded by sage steppe systems.
Divisions: 304:C
Nations: US

Subnations: CA, ID, NV, OR, UT, WA?, WY
Map Zones: 7:P, 8:P, 9:C, 12:C, 13:?, 16:?, 17:P, 18:C, 22:C, 23:P, 24:?
USFS Ecomap Regions: 341A:??, 341D:??, 341E:??, 341G:??, 342B:CC, 342C:CC, 342D:CC, 342H:CC, 342I:CC, 342J:CC, M261G:PP, M341A:??, M341D:??
TNC Ecoregions: 6:C

SOURCES

References: CNHP 2010b, Cooper and Severn 1992, Dlugolecki 2010, Haukos and Smith 1994, Johnson et al. 2011, Reuter et al. 2013, Shiflet 1994, TNC 2013, Western Ecology Working Group n.d., WNHP 2011
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.731763#references
Description Author: J. Kagan and P. Comer, mod. K.A. Schulz
Version: 14 Jan 2014 **Stakeholders:** West
Concept Author: J. Kagan **ClassifResp:** West

INTER-MOUNTAIN BASINS INTERDUNAL SWALE WETLAND (CES304.059)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Dune (Landform); Dune field; Dune (Substrate); Temperate [Temperate Xeric]; Depressional; Isolated Wetland [Partially Isolated]; Sand Soil Texture; W-Landscape/High Intensity; Graminoid
Non-Diagnostic Classifiers: Dune (undifferentiated); Lowland [Lowland]; Shrubland (Shrub-dominated); Herbaceous; Temperate [Temperate Continental]; Aridic
National Mapping Codes: ESLF 9235

CONCEPT

Summary: This ecological system occurs within dune fields in the Intermountain western U.S. as small (usually less than 0.1 ha) interdunal wetlands that occur in wind deflation areas, where sands are scoured down to the water table. Small ponds may be associated. The water table may be perched over an impermeable layer of caliche or clay or, in the case of the Great Sand Dunes of Colorado, a geologic dike that creates a closed basin that traps water. These wetland areas are typically dominated by common emergent herbaceous vegetation such as species of *Eleocharis, Juncus*, and *Schoenoplectus*. Dune field ecological processes distinguish these emergent wetlands from similar non-dune wetlands.
Classification Comments: This system was originally included within Inter-Mountain Basins Active and Stabilized Dune (CES304.775). These small-scale wetlands were pulled out into their own system because they are isolated wetlands and support completely different biota than the surrounding dry dunes. Many dune fields in the Great Basin are associated with playas and playa lakes such as Washoe Lake, Great Salt Lake, and Mono Lake. At Great Sand Dunes National Monument, Colorado, isolated interdunal swale wetlands occur where winds scour sand to expose wet sand at the water table, largely on the west side (windward) of the main dune field. The same groundwater source also feeds springs that form intermittent creeks that are not part of this interdunal swale system.

DESCRIPTION

Environment: Occurs in wet interdunal swales.
Vegetation: A variety of emergent herbaceous vegetation may occur including, *Juncus balticus, Schoenoplectus pungens, Typha* spp., *Cyperus* spp., *Eleocharis* spp., and *Salix exigua*.
Dynamics: The dunes are shaped by the wind and continue to change. The size and exact location of the wet swales may change as the sand dunes shift, due to active dune migration. Dune "blowouts" and subsequent stabilization through succession are characteristic processes of the active dunes which surround the interdunal swales.

Component Associations:
- *Carex nebrascensis* Herbaceous Vegetation (CEGL001813, G4)
- *Carex utriculata* Herbaceous Vegetation (CEGL001562, G5)
- *Juncus balticus* Herbaceous Vegetation (CEGL001838, G5)
- *Salicornia rubra* Herbaceous Vegetation (CEGL001999, G2G3)
- *Schoenoplectus acutus* Herbaceous Vegetation (CEGL001840, G5)
- *Schoenoplectus americanus - Carex* spp. Herbaceous Vegetation (CEGL004144, GNR)
- *Schoenoplectus americanus - Eleocharis palustris* Herbaceous Vegetation (CEGL001585, G4)
- *Schoenoplectus americanus - Eleocharis* spp. Herbaceous Vegetation (CEGL001586, GNR)
- *Schoenoplectus americanus* Western Herbaceous Vegetation (CEGL001841, G3Q)
- *Schoenoplectus maritimus* Herbaceous Vegetation (CEGL001843, G4)
- *Schoenoplectus pungens* Herbaceous Vegetation (CEGL001587, G3G4)
- *Typha (latifolia, angustifolia)* Western Herbaceous Vegetation (CEGL002010, G5)
- *Typha domingensis* Western Herbaceous Vegetation (CEGL001845, G5?)

SPATIAL CHARACTERISTICS

Spatial Summary: Small patch.
Adjacent Ecological Systems:
- Inter-Mountain Basins Active and Stabilized Dune (CES304.775)

Adjacent Ecological System Comments: This wetland system occurs in wet swales within Inter-Mountain Basins Active and Stabilized Dune (CES304.775).

DISTRIBUTION

Range: The system occurs in some dune fields across the Intermountain western U.S., including the Great Sand Dunes in southern Colorado and the Pink Coral Dunes in Utah. Interdunal wetlands may also occur in dune fields in northeastern Arizona and the Great Basin, as well as in southwestern Wyoming in the Killpecker Dunes and Ferris Dunes, and southern Idaho.

Divisions: 304:C; 306:C
Nations: US
Subnations: AZ?, CO, ID, NV, UT, WY
Map Zones: 7:P, 8:P, 9:P, 12:P, 16:?, 17:P, 18:?, 22:C, 23:?, 24:?, 28:C
USFS Ecomap Regions: 313A:PP, 321A:CC, 331J:CC, 342B:PP, 342C:PP, 342D:PP, 342H:P?, M332E:PP
TNC Ecoregions: 6:?, 10:?, 11:?, 19:?, 20:C

SOURCES

References: Bowers 1982, Bowers 1984, Bowers 1986, Brand and Sanderson 2002, Cooper and Severn 1992, Hammond 1998, Pineada et al. 1999, Pineda 2000, Rondeau 2001, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.777819#references
Description Author: K.A. Schulz
Version: 12 May 2005
Concept Author: Hammond (1998)
Stakeholders: West
ClassifResp: West

INTERIOR LOW PLATEAU SEEPAGE FEN (CES202.346)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Seepage-Fed Sloping
Non-Diagnostic Classifiers: Shrubland (Shrub-dominated)
National Mapping Codes: ESLF 9409

CONCEPT

Summary: This system accommodates small-scale, herbaceous-dominated seepage areas found in limited areas of the Interior Low Plateau of Tennessee, Kentucky and possibly Ohio. It is most frequent in the Western Highland Rim of Tennessee (Lewis, Cheatham, and Williamson counties). There are also rare occurrences of this system in the Eastern Highland Rim of Tennessee and related limited areas of Kentucky and possibly Ohio (D. Minney pers. comm. 2006). These features have been generally known as "seepage fens" and are fed by mineral-rich groundwater. Examples are associated with stream drainages but are generally not affected by stream-related hydrology. Soils contain a thin organic layer over limestone gravel, over a less permeable layer of more solid rock. The vegetation is dominated by herbaceous plants. Characteristic species include *Carex atlantica, Carex lurida, Carex leptalea ssp. harperi, Parnassia grandifolia, Juncus brachycephalus, Rudbeckia fulgida var. umbrosa, Cardamine bulbosa, Impatiens capensis, Juncus coriaceus, Juncus effusus, Lobelia puberula, Lobelia cardinalis, Oxypolis rigidior, Phlox glaberrima, Rhynchospora capitellata, Scirpus atrovirens, Scirpus cyperinus, Solidago patula var. patula,* and *Thelypteris palustris var. pubescens*. Woody species include *Alnus serrulata, Salix humilis, Salix caroliniana, Cornus amomum,* and *Acer rubrum,* which may invade the herbaceous seep. *Xyris tennesseensis* is endemic to this system and occurs in 50% or more of its occurrences.
Classification Comments: This system is a small-patch system, originally described from a small region. Its range has been expanded to include a greater geographic scope.
Similar Ecological Systems:
- North-Central Appalachian Seepage Fen (CES202.607)
- Ozark-Ouachita Fen (CES202.052)
- Southern Ridge and Valley Seepage Fen (CES202.458)

Related Concepts:
- *Carex lurida (hystericina?) - Carex leptalea - Rhynchospora capillacea* Alkaline Seep (Minney 2000) Undetermined
- Calcareous Seep (Evans 1991) Finer

DESCRIPTION

Environment: These features are fed by mineral-rich groundwater. Stands occur on the sideslopes of hills in narrow valleys, bases of bluffs, rock ledges, and terraces of streams and rivers, where the soil or substrate is saturated by calcareous groundwater seepage. Examples are associated with stream drainages but are generally not affected by stream-related hydrology. The parent material is a mixture of gravel and dolomite with fragments of deeply weathered bedrock present or colluvium over bedrock. Soils contain a thin organic layer over limestone gravel, over a less permeable layer of more solid rock.
Vegetation: The vegetation is dominated by herbaceous plants. Characteristic species include *Carex atlantica, Carex lurida, Carex leptalea ssp. harperi, Parnassia grandifolia, Juncus brachycephalus, Rudbeckia fulgida var. umbrosa, Cardamine bulbosa, Impatiens capensis, Juncus coriaceus, Juncus effusus, Lobelia puberula, Lobelia cardinalis, Oxypolis rigidior, Phlox glaberrima, Rhynchospora capitellata, Scirpus atrovirens, Scirpus cyperinus, Solidago patula var. patula,* and *Thelypteris palustris var. pubescens*. Woody species include *Alnus serrulata, Salix humilis, Salix caroliniana, Cornus amomum,* and *Acer rubrum*. Some stands in southern Ohio may lack *Parnassia* (D. Minney pers. comm. 2006).

Component Associations:
- *Alnus serrulata* Saturated Southern Interior Shrubland (CEGL007059, G3)
- *Carex lurida - Carex leptalea - Parnassia grandifolia - Juncus brachycephalus - (Xyris tennesseensis)* Herbaceous Vegetation (CEGL004161, G1)

DISTRIBUTION

Range: This system is found in limited areas of the Interior Low Plateau of Tennessee, Kentucky and possibly Ohio, including primarily the Western Highland Rim region of Tennessee (Ecoregion 71f of Griffith et al. (1998), EPA (2004); Subsection 222Eg of Keys et al. (1995)).
Divisions: 202:C
Nations: US
Subnations: KY, OH?, TN
Map Zones: 47:C, 48:C, 53:C
TNC Ecoregions: 44:C

SOURCES

References: Comer et al. 2003, EPA 2004, Griffith et al. 1998, Keys et al. 1995, Minney pers. comm.

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723164#references

Description Author: M. Pyne

Version: 17 Apr 2006

Concept Author: M. Pyne

Stakeholders: Midwest, Southeast

ClassifResp: Southeast

LAURENTIAN-ACADIAN FRESHWATER MARSH (CES201.594)

CLASSIFIERS

Classification Status: Standard

Primary Division: Laurentian-Acadian (201)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Shallow (<15 cm) Water; >180-day hydroperiod; Depressional [Lakeshore]; Riverine / Alluvial; Graminoid
Non-Diagnostic Classifiers: Circumneutral Water; Acidic Water; Moderate (100-500 yrs) Persistence; Herbaceous; Extensive Wet Flat; Depressional [Pond]; Muck; Aquatic Herb
National Mapping Codes: ESLF 9405

CONCEPT

Summary: These freshwater emergent and/or submergent marshes are dominated by herbaceous vegetation. They are common throughout the northeastern United States and adjacent Canadian provinces. Freshwater marshes occur in closed or open basins that are generally flat and shallow. They are associated with lakes, ponds, slow-moving streams, and/or impoundments or ditches. The herbaceous vegetation does not persist through the winter. Scattered shrubs are often present and usually total less than 25% cover. Trees are generally absent and, if present, are scattered. The substrate is typically muck over mineral soil. Examples of vegetation in the Delaware Estuary freshwater marsh communities include *Typha latifolia, Typha angustifolia, Phragmites australis, Schoenoplectus americanus, Thelypteris palustris, Impatiens capensis, Carex* spp., *Vallisneria americana, Potamogeton perfoliatus, Nuphar advena (= Nuphar lutea ssp. advena),* and *Nymphaea odorata*.

Similar Ecological Systems:
- Laurentian-Acadian Wet Meadow-Shrub Swamp (CES201.582)
- North-Central Interior Freshwater Marsh (CES202.899)

Related Concepts:
- Bulrush Bed (Gawler and Cutko 2010) Finer
- Cattail Marsh (Gawler and Cutko 2010) Finer
- Circumneutral-Alkaline Water Macrophyte Suite (Gawler and Cutko 2010) Finer
- Pickerelweed - Macrophyte Aquatic Bed (Gawler and Cutko 2010) Finer
- Pipewort - Water Lobelia Aquatic Bed (Gawler and Cutko 2010) Finer
- Water-lily - Macrophyte Aquatic Bed (Gawler and Cutko 2010) Finer

Component Associations:
- *Elodea canadensis - Potamogeton* spp. Eastern Herbaceous Vegetation (CEGL006431, GNR)
- *Equisetum fluviatile - (Eleocharis palustris)* Herbaceous Vegetation (CEGL005258, G4)
- *Eriocaulon aquaticum - Lobelia dortmanna* Herbaceous Vegetation (CEGL006346, GNR)
- *Juncus militaris - Eriocaulon aquaticum* Herbaceous Vegetation (CEGL006345, GNR)
- *Nuphar advena - Nymphaea odorata* Herbaceous Vegetation (CEGL002386, G4G5)
- *Nymphaea odorata - Nuphar (microphylla, variegata)* Herbaceous Vegetation (CEGL002562, G5)
- *Nymphaea tetragona - Nuphar (microphylla, variegata)* Herbaceous Vegetation (CEGL002563, G4G5)
- *Pontederia cordata - Peltandra virginica - Sagittaria latifolia* Herbaceous Vegetation (CEGL006191, G5)
- *Potamogeton* spp. - *Ceratophyllum* spp. Midwest Herbaceous Vegetation (CEGL002282, G5)
- *Schoenoplectus (tabernaemontani, acutus)* Eastern Herbaceous Vegetation (CEGL006275, GNR)
- *Schoenoplectus acutus - (Schoenoplectus fluviatilis)* Freshwater Herbaceous Vegetation (CEGL002225, G4G5)
- *Schoenoplectus acutus - Carex lasiocarpa* Herbaceous Vegetation (CEGL006358, G1G2)
- *Schoenoplectus fluviatilis - Schoenoplectus* spp. Herbaceous Vegetation (CEGL002221, G3G4)
- *Schoenoplectus fluviatilis* Herbaceous Vegetation (CEGL006366, GNR)
- *Schoenoplectus tabernaemontani - Typha* spp. - (*Sparganium* spp., *Juncus* spp.) Herbaceous Vegetation (CEGL002026, G4G5)
- *Scirpus cyperinus* Seasonally Flooded Herbaceous Vegetation (CEGL006349, GNR)
- *Typha (angustifolia, latifolia) - (Schoenoplectus* spp.) Eastern Herbaceous Vegetation (CEGL006153, G5)
- *Typha* spp. - *Schoenoplectus acutus* - Mixed Herbs Midwest Herbaceous Vegetation (CEGL002229, G4?)
- *Vallisneria americana - Potamogeton perfoliatus* Herbaceous Vegetation (CEGL006196, G5)
- *Zizania (aquatica, palustris)* Herbaceous Vegetation (CEGL002382, G3G4)

DISTRIBUTION

Range: This system occurs in New England and northern New York west across the upper Great Lakes to Minnesota, and adjacent Canada, southward to Pennsylvania, New Jersey, and Ohio; mostly north of the glacial boundary.
Divisions: 201:C; 202:C
Nations: CA, US
Subnations: CT, IL?, IN?, MA, ME, MI, MN, NB, NH, NJ, NY, OH?, ON, PA, QC, RI, VT, WI
Map Zones: 41:C, 49:?, 50:C, 51:C, 52:?, 60:C, 61:C, 62:P, 63:C, 64:C, 65:C, 66:C

USFS Ecomap Regions: 212Ha:CCC, 212Hb:CCC, 212Hc:CCC, 212Hd:CCC, 212He:CCC, 212Hf:CCC, 212Hg:CCC, 212Hh:CCC, 212Hi:CCC, 212Hj:CCC, 212Hk:CCC, 212Hl:CCC, 212Hm:CCC, 212Ra:CCC, 212Rb:CCC, 212Rc:CCC, 212Rd:CCC, 212Re:CCC
TNC Ecoregions: 47:C, 48:C, 49:C, 59:C, 60:C, 61:C, 63:C, 64:C

SOURCES

References: Comer and Albert 1997, Eastern Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.731557#references
Description Author: E. Largay
Version: 22 Dec 2005 **Stakeholders:** Canada, East, Midwest
Concept Author: S.C. Gawler, D. Faber-Langendoen **ClassifResp:** East

LAURENTIAN-ACADIAN WET MEADOW-SHRUB SWAMP (CES201.582)

CLASSIFIERS

Classification Status: Standard

Primary Division: Laurentian-Acadian (201)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Shallow (<15 cm) Water; Depressional [Lakeshore]; Riverine / Alluvial; Broad-Leaved Shrub; Graminoid
Non-Diagnostic Classifiers: Circumneutral Water; Acidic Water; Moderate (100-500 yrs) Persistence; Herbaceous; Extensive Wet Flat; Depressional [Pond]; Muck
National Mapping Codes: ESLF 9406

CONCEPT

Summary: This system encompasses shrub swamps and wet meadows on mineral soils of the Northeast and upper Midwest. They are often associated with lakes and ponds, but are also found along streams, where the water level does not fluctuate greatly. They are commonly flooded for part of the growing season but often do not have standing water throughout the season. The size of occurrences ranges from small pockets to extensive acreages. The system can have a patchwork of shrub and graminoid dominance; typical species include *Salix* spp., *Cornus amomum*, *Alnus incana*, *Spiraea alba*, *Calamagrostis canadensis*, tall *Carex* spp., and *Juncus effusus*. Trees are generally absent and, if present, are scattered.
Classification Comments: Compared to North-Central Interior Wet Meadow-Shrub Swamp (CES202.701), this system is more often dominated by *Alnus* spp. rather than the *Cornus* spp. dominance of the latter.
Similar Ecological Systems:
- Laurentian-Acadian Freshwater Marsh (CES201.594)
- North-Central Interior Wet Meadow-Shrub Swamp (CES202.701)

Related Concepts:
- Alder Floodplain (Gawler and Cutko 2010) Finer
- Alder Shrub Thicket (Gawler and Cutko 2010) Finer
- Bluejoint Meadow (Gawler and Cutko 2010) Finer
- Mixed Graminoid - Shrub Marsh (Gawler and Cutko 2010) Finer
- Sweetgale Mixed Shrub Fen (Gawler and Cutko 2010) Finer
- Tussock Sedge Meadow (Gawler and Cutko 2010) Finer

Component Associations:
- *Alnus incana* Swamp Shrubland (CEGL002381, G5)
- *Alnus serrulata* Swamp Shrubland (CEGL005082, G4G5)
- *Calamagrostis canadensis - Carex* spp. Laurentian & Northeast Wet Meadow (CEGL005448, G4G5)
- *Calamagrostis canadensis - Scirpus* spp. - *Dulichium arundinaceum* Herbaceous Vegetation (CEGL006519, GNR)
- *Carex lacustris* Herbaceous Vegetation (CEGL002256, G4G5)
- *Carex stricta - Carex* spp. Herbaceous Vegetation (CEGL002258, G4?)
- *Carex stricta - Carex vesicaria* Herbaceous Vegetation (CEGL006412, G4G5)
- *Carex tetanica - Carex prairea - Eleocharis erythropoda - Lysimachia quadriflora* Herbaceous Vegetation (CEGL006170, G1Q)
- *Carex utriculata - Carex lacustris - (Carex vesicaria, Carex stricta)* Herbaceous Vegetation (CEGL002257, G4G5)
- *Cephalanthus occidentalis / Carex* spp. Northern Shrubland (CEGL002190, G4)
- *Cornus sericea - Salix* spp. - (*Rosa palustris*) Shrubland (CEGL002186, G5)
- *Equisetum fluviatile - (Eleocharis palustris)* Herbaceous Vegetation (CEGL005258, G4)
- *Juncus effusus* Seasonally Flooded Herbaceous Vegetation (CEGL004112, G5)
- *Myrica gale - Spiraea alba - Chamaedaphne calyculata* Shrubland (CEGL006512, GNR)
- *Scirpus cyperinus* Seasonally Flooded Herbaceous Vegetation (CEGL006349, GNR)
- *Typha latifolia - Caltha palustris* Herbaceous Vegetation (CEGL006245, G1)

DISTRIBUTION

Range: New England and northern New York west across the upper Great Lakes to Minnesota, and adjacent Canada, southward to Pennsylvania and Ohio; mostly north of the glacial boundary.
Divisions: 201:C
Nations: CA, US
Subnations: CT, IL?, IN?, MA, ME, MI, MN, NB, NH, NY, OH?, ON, PA, QC, RI, VT, WI
Map Zones: 41:C, 49:?, 50:C, 51:C, 52:?, 60:C, 61:C, 62:P, 63:C, 64:C, 65:C, 66:C
USFS Ecomap Regions: 212Ha:CCC, 212Hb:CCC, 212Hc:CCC, 212Hd:CCC, 212He:CCC, 212Hf:CCC, 212Hg:CCC, 212Hh:CCC, 212Hi:CCC, 212Hj:CCC, 212Hk:CCC, 212Hl:CCC, 212Hm:CCC, 212J:CC, 212K:CC, 212L:CC, 212M:CC, 212N:CC, 212Q:CC, 212Ra:CCC, 212Rb:CCC, 212Rc:CCC, 212Rd:CCC, 212Re:CCC, 212S:CC, 212T:CC, 212X:CC, 212Y:CC, 212Z:CC, 222K:CC, 222M:CC, 222R:CC, 222Ue:CCC

TNC Ecoregions: 47:C, 48:C, 49:C, 59:C, 60:C, 61:C, 63:C, 64:C

SOURCES

References: Comer and Albert 1997, Eastern Ecology Working Group n.d.

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.731538#references

Description Author: S.C. Gawler, D. Faber-Langendoen, mod. E. Largay

Version: 11 Apr 2007 **Stakeholders:** Canada, East, Midwest

Concept Author: S.C. Gawler, D. Faber-Langendoen **ClassifResp:** East

MEDITERRANEAN CALIFORNIA COASTAL INTERDUNAL WETLAND (CES206.951)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Shallow (<15 cm) Water; Sand Subsoil Texture; Coastal Dune Mosaic; Herbaceous; Mediterranean [Mediterranean Xeric-Oceanic]; Depressional [Pond]; Mineral: W/ A-Horizon <10 cm; Graminoid
Non-Diagnostic Classifiers: Dune field; Saturated Soil; Very Short Flooding Interval; 1-29-day hydroperiod; Short (50-100 yrs) Persistence; Lowland [Lowland]; Slough; Swale; Isolated Wetland [Partially Isolated]; Barrier flat; Forb; Aquatic Herb
National Mapping Codes: ESLF 9262

CONCEPT

Summary: Coastal interdunal wetlands are common components of larger active and stabilized coastal dune fields, ranging from Coos Bay, Oregon, south to San Luis Obispo County, California. They can be referred to as "slack dune ponds" when associated with larger and deeper water or "coastal dune swales" when water is shallow, and typically occur behind active foredunes, especially where the base of the dunes are at or near groundwater levels. They may result from active dune movement, sometimes when dunes interrupt surface waterflow, or where extensive dune "blowouts" remove sand down to the water table. Seasonal rise in the water table from winter rains are one source of pond formation and wet swale formation. Water tends to be fresh but may grade to brackish as ponds dry up. This ecosystem is defined as herbaceous, emergent vegetation. Common plant species include *Argentina anserina (= Potentilla anserina), Hydrocotyle umbellata, Eleocharis palustris, Eleocharis acicularis, Euthamia occidentalis, Juncus* spp., *Carex obnupta*, and *Sparganium* spp.
Related Concepts:
- Wetlands (217) (Shiflet 1994) Broader

DESCRIPTION

Environment: Interdunal ponds occur where water is shallow, and typically occur behind active foredunes, especially where the base of the dunes are at or near groundwater levels. They may result from active dune movement, sometimes when dunes interrupt surface waterflow, or where extensive dune "blowouts" remove sand down to the water table. Lakes within dune sheets occur in deflated areas where the water table is intercepted, typically shallow and subject to seasonal changes in water levels (Christy et al. 1998).
Dynamics: Dune sands have poor moisture-holding capacity. They are underlain by groundwater aquifers that maintain a high water table (Christy et al. 1998). Winter precipitation elevates the water table and inundates some deflation plains to a depth of 1 m (3 feet). The seasonal rises in water table also cause interdunal swale ponds to form (Christy et al. 1998). Some ponds dry up seasonally, others are permanent features of the dune sheet. But all ponds have seasonal fluctuations in the water depth and consequently pond size (Christy et al. 1998, Pickart and Barbour 2007). These coastal freshwater marshes are unique in that they are also subject to salt spray, and therefore have more salt-tolerant species than freshwater marshes not associated with coastal sand dunes (Christy et al. 1998, Pickart 2006, Pickart and Barbour 2007).

DISTRIBUTION

Range: This system is found in Coos Bay, Oregon, south to San Luis Obispo County, California. In California dune swales are present at Tomales Bay, Point Reyes, Bodega Bay and Tolowa Dunes (Pickart and Barbour 2007).
Divisions: 206:C
Nations: US
Subnations: CA, OR
Map Zones: 2:P, 3:C, 4:C
USFS Ecomap Regions: 261B:CC, 263A:CC
TNC Ecoregions: 1:P, 14:C, 15:C, 16:P

SOURCES

References: Barbour and Major 1988, Christy et al. 1998, CNRA 2009, Comer et al. 2003, Faber-Langendoen et al. 2008b, Holland and Keil 1995, Pickart 2006, Pickart and Barbour 2007, PRBO Conservation Science 2011, Sawyer and Keeler-Wolf 1995, Shiflet 1994, WNHP 2011
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722730#references
Description Author: P. Comer and T. Keeler-Wolf, mod. G. Kittel
Version: 14 Jan 2014 **Stakeholders:** West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

MEDITERRANEAN CALIFORNIA EELGRASS BED (CES206.999)

CLASSIFIERS

Classification Status: Standard

Primary Division: Mediterranean California (206)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Saline Water Chemistry; Mediterranean [Mediterranean Pluviseasonal-Oceanic]; Mediterranean [Mediterranean Xeric-Oceanic]; Mediterranean [Mediterranean Desertic-Oceanic]; Aquatic Herb; Marine Algae
Non-Diagnostic Classifiers: >180-day hydroperiod; Short (50-100 yrs) Persistence; Lowland [Lowland]; Herbaceous
National Mapping Codes: ESLF 9266

CONCEPT

Summary: Intertidal zones are found with clear water in bays, inlets and lagoons, typically dominated by macrophytic algae and marine aquatic angiosperms along the temperate Pacific Coast. Subtidal portions are never exposed, while intertidal areas support species that can tolerate exposure to the air. Common substrates include marine silts, but may also include exposed bedrock and cobble, where many algal species become attached with holdfasts. Intertidal systems are dominated by *Zostera marina (= Zostera pacifica), Phyllospadix scouleri, Fucus distichus, Postelsia palmiformis*, and a host of green and brown algae. Adjacent subtidal zones, where rocky substrates are common, support undersea kelp "forest."

DISTRIBUTION

Range: This system is found along the temperate Pacific Coast.
Divisions: 206:C
Nations: MX, US
Subnations: CA, MXBC(MX)
Map Zones: 2:P, 3:C, 4:C
USFS Ecomap Regions: 261B:CC, 263A:CC
TNC Ecoregions: 14:C, 15:C, 16:C

SOURCES

References: Barbour and Major 1988, Comer et al. 2003, Holland and Keil 1995
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722706#references
Description Author: P. Comer, mod. T. Keeler-Wolf
Version: 07 Oct 2005
Concept Author: P. Comer
Stakeholders: Latin America, West
ClassifResp: West

MEDITERRANEAN CALIFORNIA SERPENTINE FEN (CES206.953)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Ultramafic; Bog and Fen Mosaic; Moss/Lichen (Nonvascular); Mediterranean [Mediterranean Pluviseasonal-Oceanic]; Seepage-Fed Sloping; Organic Peat (>40 cm); Bryophyte; Darlingtonia californica
Non-Diagnostic Classifiers: Acidic Water; Montane; Lowland; Shrubland (Shrub-dominated); Herbaceous; Forb; Graminoid
National Mapping Codes: ESLF 9255

CONCEPT

Summary: This ecological system is found uncommonly throughout coastal lowlands and high mountains of the Klamath Mountains and surrounding landscapes where serpentine soils are common in cool and moist environments. This system includes unique assemblages of wetlands species restricted to serpentine and ultramafic substrates. These sites remain moist or wet throughout the year and may have substantial *Sphagnum* accumulation. Some may be bogs in the sense of nutrients and moisture primarily coming from rainfall, or more commonly they are seeps or fens maintained by groundwater discharge. Soils are acidic and often derived from ultramafic parent materials. The acidic (6.5-6.7 pH) and nutrient-poor substrates produce severe nitrogen deficiency which favors insectivorous plants. Characteristic plant species include *Darlingtonia californica*, *Drosera rotundifolia*, *Eleocharis quinqueflora*, *Eriophorum crinigerum*, *Carex californica*, and *Deschampsia caespitosa*. Around the edges of these fens *Chamaecyparis lawsoniana* can occur and form part of the fen. Burning is essential to maintain healthy stands. *Darlingtonia* fens are important habitat for rare species that respond positively to burning. Burning at least eliminates some of the tree invaders (*Pinus jeffreyi*, *Pseudotsuga menziesii*, *Chamaecyparis lawsoniana*) and maintains a high water table, essential for the fen-dependent plants.

DESCRIPTION

Environment: This system comprises wetlands located on serpentine soils, where a layer of sphagnum moss overlays serpentine soils and parent material. Soils are acidic and often derived from ultramafic parent materials. The acidic (6.5-6.7 pH) and nutrient-poor substrates produce severe nitrogen deficiency.
Dynamics: Consistently high water table and spring flows to maintain wet soils, water quantity and quality are very important, and stable groundwater, surface water, or precipitation inputs are crucial for continual integrity of these organic soils.

Component Associations:
- *Chamaecyparis lawsoniana / Rhododendron occidentale / Carex* spp. Temporarily Flooded Forest (CEGL000047, G2)

DISTRIBUTION

Range: This system is found uncommonly throughout coastal lowlands and high mountains of the Klamath Mountains of California and Oregon and surrounding landscapes where serpentine soils are common in cool and moist environments.
Divisions: 206:C
Nations: US
Subnations: CA, OR
Map Zones: 2:C, 3:C, 7:P
USFS Ecomap Regions: M261A:CC, M261B:CP, M261D:CP
TNC Ecoregions: 5:C, 14:P

SOURCES

References: Barbour and Major 1988, Comer et al. 2003, Cooper and Wolf 2005, Cooper and Wolf 2006, Cooper and Wolf 2006b, Cooper and Wolf 2006c, Holland and Keil 1995, Littell et al. 2009, PRBO Conservation Science 2011, Sawyer and Keeler-Wolf 1995, Sikes et al. 2010, Sikes et al. 2011, Sikes et al. 2012, Sikes et al. 2013, WNHP 2011
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722728#references
Description Author: P. Comer and T. Keeler-Wolf, mod. G. Kittel
Version: 14 Jan 2014 **Stakeholders:** West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

MEDITERRANEAN CALIFORNIA SUBALPINE-MONTANE FEN (CES206.952)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Circumneutral Water; Extreme (Mineral) Rich and Iron-Rich; Bog and Fen Mosaic; Temperate [Temperate Oceanic]; Seepage-Fed Sloping; Muck
Non-Diagnostic Classifiers: Saturated Soil; Long (>500 yrs) Persistence; Montane [Upper Montane]; Montane [Montane]; Herbaceous; Moss/Lichen (Nonvascular); Organic Peat (>40 cm); Forb; Graminoid; Bryophyte
National Mapping Codes: ESLF 9248

CONCEPT

Summary: This system is found in montane to subalpine elevations confined to specific environments defined by groundwater discharge, soil chemistry, and peat accumulation. This system includes extreme rich fens which are quite rare. Fens form at low points in the landscape or near slopes where groundwater intercepts the soil surface. Groundwater inflows maintain a fairly constant water level year-round, with water at or near the surface most of the time. Constant high water levels lead to accumulation of organic material. In addition to peat accumulation and perennially saturated soils, the extreme rich fens have distinct soil and water chemistry, with high levels of one or more minerals such as calcium and/or magnesium. They usually occur as a mosaic of several plant associations dominated by species of *Carex*, *Betula*, *Kobresia*, or *Schoenoplectus*. The surrounding landscape may be ringed with other wetland systems, e.g., riparian shrublands, or a variety of upland systems from grasslands to forests.
Related Concepts:
- Wetlands (217) (Shiflet 1994) Broader

DISTRIBUTION

Range: These fens are found in montane to subalpine elevations of California mountains, in the Sierra Nevada, northwestern California coastal mountains, and possibly the Klamath - Siskiyou mountains.
Divisions: 206:C
Nations: US
Subnations: CA, NV, OR
Map Zones: 2:P, 3:C, 4:?, 6:C, 7:C, 12:P
USFS Ecomap Regions: 341D:PP, M261A:C?, M261B:C?, M261D:C?, M261E:CC
TNC Ecoregions: 5:P, 12:P, 14:P

SOURCES

References: Barbour and Major 1988, Comer et al. 2003, Hickman 1993, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722729#references
Description Author: P. Comer, T. Keeler-Wolf
Version: 14 Dec 2004 **Stakeholders:** West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

MISSISSIPPI DELTA FRESH AND OLIGOHALINE TIDAL MARSH (CES203.470)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Tidal / Estuarine [Freshwater]; Graminoid
Non-Diagnostic Classifiers: Herbaceous
National Mapping Codes: ESLF 9241

CONCEPT

Summary: This system includes tidal marshes strongly influenced by freshwater producing a fresh to oligohaline chemistry. These areas can occupy small to large patches of the Mississippi Delta. A unique type of floating fresh marsh (flotant) is also included in this system. This system has a heterogeneous physiognomy including shrublands, grasslands, and aquatic herbs. Significant fresh marsh loss has occurred in the deltaic plain of the Mississippi River. These losses are related to natural and anthropogenic causes. Subsidence and loss of wetlands are a natural part of the deltaic process, but they have been exacerbated by the reduction in sediment load and freshwater input into coastal areas caused by the impoundment and channelization of streams and rivers. In addition dredged channels in the marsh facilitate saltwater intrusion, and spoil banks prevent marshes from draining. Increases in salinity cause shifts in composition to species more tolerant of salinity, ultimately resulting in loss of species diversity and open saline waters.

Similar Ecological Systems:
- Gulf Coast Chenier Plain Fresh and Oligohaline Tidal Marsh (CES203.467)

DESCRIPTION

Environment: This system occurs in the Mississippi River deltaic plain where freshwater inflow is greatest - near the mouths of distributary channels for the Mississippi River and near the mainland where freshwater flow from upland runoff and smaller creeks and rivers enters the marshes.

Vegetation: Species found in examples of this system include *Colocasia esculenta, Eleocharis baldwinii, Eleocharis rostellata, Hydrocotyle ranunculoides, Hydrocotyle umbellata, Ludwigia* spp., *Morella cerifera, Panicum hemitomon, Paspalum vaginatum, Phragmites australis, Sagittaria lancifolia, Sagittaria latifolia, Sagittaria platyphylla, Schoenoplectus californicus, Spartina patens, Vigna luteola, Typha domingensis*, and *Zizaniopsis miliacea*.

Dynamics: Historically, the deltaic processes of the Mississippi River helped to build and maintain this system. Today, in addition to the large fresh to oligohaline marshes that hug the mainland, two active deltas, the Atchafalaya and the Mississippi Balize deltas, support fresh to oligohaline marshes areas. However, these areas of sediment accumulation and accretion are an anomaly compared to the predominance of coastal loss and subsidence in the Mississippi River deltaic plain (Gosselink et al. 1998, Draut et al. 2005). The natural sediment load and freshwater entering the deltaic marshes are dependent on functioning hydrological processes in the Mississippi River. This marsh system is dependent upon freshwater input, sediment input and organic matter build-up. Species richness is typically higher in oligohaline marshes than in brackish marshes. Much of this system is characterized by floating mats of vegetation (Visser et al. 1998). Some studies suggest that marshes may convert to floating mats as a result of rapid subsidence.

Component Associations:
- *Eleocharis baldwinii - Hydrocotyle (ranunculoides, umbellata)* Herbaceous Vegetation (CEGL007893, G3G4Q)
- *Eleocharis rostellata - Sagittaria lancifolia* Oligohaline Herbaceous Vegetation (CEGL007886, G3G4)
- *Morella cerifera - Panicum hemitomon* Flotant Marsh Herbaceous Vegetation (CEGL007834, G2G3)
- *Panicum hemitomon* Semipermanently Flooded Herbaceous Vegetation (CEGL004665, G3G4)
- *Paspalum vaginatum - Spartina patens* Oligohaline Herbaceous Vegetation (CEGL007885, G2?)
- *Phragmites australis - (Sagittaria platyphylla, Vigna luteola)* Tidal Herbaceous Vegetation (CEGL007891, G4?)
- *Sagittaria lancifolia - Typha* spp. - *Ludwigia* spp. Herbaceous Vegetation (CEGL007894, G3G4)
- *Sagittaria lancifolia* Mississippi River Deltaic Plain Herbaceous Vegetation (CEGL007889, G3G4)
- *Sagittaria latifolia - Sagittaria platyphylla - (Colocasia esculenta)* Deltaic Herbaceous Vegetation (CEGL007890, G3G4)
- *Schoenoplectus californicus* Tidal Herbaceous Vegetation (CEGL003985, G4G5)
- *Spartina patens - Vigna luteola* Mississippi River Deltaic Plain Herbaceous Vegetation (CEGL007888, G3G4)
- *Typha domingensis* Tidal Herbaceous Vegetation (CEGL008456, GNR)
- *Zizaniopsis miliacea - Panicum hemitomon* Herbaceous Vegetation (CEGL007895, G3G4)
- *Zizaniopsis miliacea* Tidal Herbaceous Vegetation (CEGL004705, G3G5)

DISTRIBUTION

Range: This system occurs in the Mississippi River deltaic plain. Marshes in the Mississippi River deltaic plain encompass 22% of the marshes in the conterminous U.S. and about half of these are fresh to oligohaline marshes (Gosselink 1984, Visser et al. 1998).
Divisions: 203:C
Nations: US

Subnations: LA
Map Zones: 98:C
USFS Ecomap Regions: 232E:CC
TNC Ecoregions: 31:C

SOURCES

References: Bernier 2013, Comer et al. 2003, Couvillion and Beck 2013, Couvillion et al. 2011, Deegan et al. 1984, Draut et al. 2005, Glick et al. 2013, Gosselink 1984, Gosselink et al. 1998, Howard and Mendelssohn 1999, LDWF 2005, Neubauer 2013, Smith 1993, Visser et al. 1998, Williams 2013, Willis and Hester 2004

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723116#references

Description Author: J. Teague and R. Evans, mod. M. Pyne
Version: 14 Jan 2014
Concept Author: J. Teague and R. Evans
Stakeholders: Southeast
ClassifResp: Southeast

MISSISSIPPI DELTA SALT AND BRACKISH TIDAL MARSH (CES203.471)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Saltwater (Polyhaline); Brackish (Mesohaline); Tidal / Estuarine [Haline]; Graminoid
Non-Diagnostic Classifiers: Herbaceous
National Mapping Codes: ESLF 9242

CONCEPT

Summary: This system includes brackish to saline intertidal marshes in the Mississippi Delta area of Louisiana. Both water level and salinity influence species composition. The salt marsh component of this system receives regular daily tides; these areas are typically dominated by large to extensive expanses of *Spartina alterniflora*. Brackish marshes, under slightly less tidal influence and moderate freshwater influence, are typically dominated or codominated by *Spartina patens* and may cover larger expanses than salt marshes in this system. Inclusions of *Juncus roemerianus* and other brackish species are found in small to large patches. Significant brackish marsh loss has occurred in the deltaic plain of the Mississippi River. These losses are related to natural and anthropogenic causes. Subsidence and loss of wetlands are a natural part of the deltaic process, but they have been exacerbated by the reduction in sediment load into coastal areas caused by the impoundment and channelization of the Mississippi River. In addition dredged channels in the marsh facilitate saltwater intrusion, and spoil banks prevent marshes from draining. Increases in salinity cause shifts in composition to species more tolerant of salinity, ultimately resulting in loss of species diversity and potentially open saline waters when marsh accretion is outpaced by a rising sea level.

Similar Ecological Systems:
- Gulf Coast Chenier Plain Salt and Brackish Tidal Marsh (CES203.468)

DESCRIPTION

Environment: This system occurs in the Mississippi River deltaic plain. Salt marshes in this system receive regular daily microtides. Brackish marshes, under slightly less tidal influence and moderately influenced by freshwater, are degraded by saltwater intrusion. This ecological system is found flanking large bays, along tidal creeks, between saline waters and fresh to oligohaline marshes, and in areas more influenced by wind tides. Examples are found on recent alluvial deposits of coastlines, bay margins, bay inlets, along dredged canals, creeks, and river inlets where tidal influence is adequate to maintain high salinities. Soils are fine-textured, sometimes with high organic content at the surface. Historically, these marshes have been protected from the Gulf of Mexico by a series of barrier islands associated with different delta lobes. With the alteration of the Mississippi River deltaic processes, these islands are undergoing increasing deterioration with potential negative effects on the marshes they protect.

Dynamics: Historically, the deltaic processes of the Mississippi River helped to build and maintain this system. However, today there is a predominance of coastal loss and subsidence in the Mississippi River deltaic plain (Gosselink et al. 1998, Draut et al. 2005). The natural sediment load and freshwater entering the deltaic marshes are dependent on functioning hydrological processes in the Mississippi River. This marsh system is dependent upon freshwater input, sediment input and organic matter build-up. Historically, these marshes have been protected from the Gulf of Mexico by a series of barrier islands associated with different delta lobes. With the alteration of the Mississippi River deltaic processes, these islands are undergoing increasing deterioration with potential negative effects on the marshes they protect. Sediment input is critical to marsh persistence and becomes even more important under accelerated sea-level rise scenarios. Salt and brackish marshes are important habitats for many animal species.

Component Associations:
- *Avicennia germinans / Spartina alterniflora* Shrubland (CEGL003801, G2?)
- *Juncus roemerianus* Herbaceous Vegetation (CEGL004186, G5)
- *Sarcocornia pacifica* - (*Batis maritima, Distichlis spicata*) Dwarf-shrubland (CEGL002278, G4)
- *Spartina alterniflora - Distichlis spicata - Spartina patens* Mesohaline Tidal Herbaceous Vegetation (CEGL002230, G4?)
- *Spartina alterniflora - Juncus roemerianus - Distichlis spicata* Louisianian Zone Salt Tidal Herbaceous Vegetation (CEGL004190, G5)
- *Spartina patens - Schoenoplectus (americanus, pungens) - (Distichlis spicata)* Herbaceous Vegetation (CEGL004755, G4?)

DISTRIBUTION

Range: This system is confined to the deltaic plain of Louisiana. Marshes in the Mississippi River deltaic plain encompass approximately 20% of the marshes in the conterminous U.S. and about half of these are salt and brackish marshes (Gosselink 1984, Field et al. 1991, Visser et al. 1998, Hester et al. 2005).
Divisions: 203:C
Nations: US
Subnations: LA
Map Zones: 36:C, 98:C

USFS Ecomap Regions: 232E:CC
TNC Ecoregions: 31:C

SOURCES

References: Comer et al. 2003, Couvillion et al. 2011, Deegan et al. 1984, Draut et al. 2005, Field et al. 1991, Glick et al. 2013, Gosselink 1984, Gosselink et al. 1998, Hester et al. 2005, LDWF 2005, Neubauer 2013, Osland et al. 2013, Smith 1993, USGS 2013b, Visser et al. 1998, Williams 2013

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723115#references

Description Author: J. Teague and R. Evans

Version: 14 Jan 2014 **Stakeholders:** Southeast

Concept Author: J. Teague and R. Evans **ClassifResp:** Southeast

MISSISSIPPI SOUND FRESH AND OLIGOHALINE TIDAL MARSH (CES203.067)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Tidal / Estuarine [Freshwater]; Graminoid
Non-Diagnostic Classifiers: Herbaceous
National Mapping Codes: ESLF 9271

CONCEPT

Summary: This system includes fresh and oligohaline tidal marshes of the northern Gulf of Mexico region of northwestern Florida, southern Alabama, and southeastern Mississippi. These marshes are typically associated with mud-bottomed bays behind barrier islands. Wind-dominated tides and low tidal amplitudes (<1 meter) characterize this region. Diverse freshwater marshes dominate this system. Some typical and dominant graminoids include *Eleocharis rostellata, Rhynchospora colorata, Rhynchospora microcarpa, Schoenoplectus californicus*, and *Zizaniopsis miliacea*. Stands of *Typha domingensis* may also be present in some stands. More information is needed.

Similar Ecological Systems:
- North-Central Gulf of Mexico Salt and Brackish Tidal Marsh (CES203.303)

Related Concepts:
- Floodplain Marsh - Tidal Freshwater Marsh (FNAI 2010a) Broader
- Tidal Freshwater Marsh (Wieland 2000b) Equivalent

DESCRIPTION

Environment: This marsh system occurs in a region characterized by diurnal tides, with waves usually less than 0.5 m in amplitude. Inundation is irregular and depends upon wind speed and direction and the flow of water from nearby rivers; generally more flooding occurs in the summer than winter (Hackney and de la Cruz 1982). The climate is mixed, with subtropical conditions prevailing during years with mild winters and temperate conditions when strong arctic cold fronts extend to the gulf.

Vegetation: Diverse freshwater marshes dominate this system. Some typical and dominant graminoids include *Eleocharis rostellata, Rhynchospora colorata, Rhynchospora microcarpa, Schoenoplectus californicus*, and *Zizaniopsis miliacea*. Some other herbs include *Sagittaria lancifolia, Glottidium vesicarium, Solidago sempervirens*, and *Lythrum lineare*. *Typha domingensis* may also be present in some stands.

Component Associations:
- *Eleocharis rostellata - Rhynchospora colorata - Rhynchospora microcarpa* Herbaceous Vegetation (CEGL004951, G2?Q)
- *Panicum virgatum - (Cladium mariscus ssp. jamaicense, Juncus roemerianus)* Herbaceous Vegetation (CEGL004962, G3?)
- *Sagittaria lancifolia - Glottidium vesicarium - Solidago sempervirens - Lythrum lineare* Herbaceous Vegetation (CEGL008447, G3G4)
- *Schoenoplectus californicus* Tidal Herbaceous Vegetation (CEGL003985, G4G5)
- *Typha domingensis* Tidal Herbaceous Vegetation (CEGL008456, GNR)
- *Zizania aquatica* Gulf Coast Herbaceous Vegetation (CEGL003887, G4?)
- *Zizaniopsis miliacea* Tidal Herbaceous Vegetation (CEGL004705, G3G5)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- North-Central Gulf of Mexico Salt and Brackish Tidal Marsh (CES203.303)

DISTRIBUTION

Range: This system is found along the northern Gulf of Mexico in northwestern Florida, southern Alabama, and southeastern Mississippi, from Bourne Lake on the west to Cape San Blas on the east. The eastern extent of this system coincides with the range of diurnal tides in the northern Gulf of Mexico. East of Apalachicola Bay, the tides are semi-diurnal (Stout 1984), and Florida Big Bend Fresh and Oligohaline Tidal Marsh (CES203.507) replaces this system. To the west, Mississippi Delta Fresh and Oligohaline Tidal Marsh (CES203.470) replaces this system in the Mississippi Delta.

Divisions: 203:C
Nations: US
Subnations: AL, FL, MS
Map Zones: 99:C
USFS Ecomap Regions: 232L:CC
TNC Ecoregions: 53:C

SOURCES

References: FNAI 2010a, Hackney and de la Cruz 1982, Kushlan 1990, Southeastern Ecology Working Group n.d., Stout 1984, Wieland 2000b

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.790953#references

Description Author: M. Pyne

Version: 17 Jan 2006

Concept Author: M. Pyne

Stakeholders: Southeast

ClassifResp: Southeast

MODOC BASALT FLOW VERNAL POOL (CES204.996)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Impermeable Layer; 1-29-day hydroperiod; Vernal Pool Mosaic; Depressional
Non-Diagnostic Classifiers: Short (50-100 yrs) Persistence; Montane [Montane]; Montane [Lower Montane]; Herbaceous; Mediterranean [Mediterranean Xeric-Oceanic]; Temperate [Temperate Oceanic]; Isolated Wetland [Strictly Isolated]; Consolidated
National Mapping Codes: ESLF 9264

CONCEPT

Summary: This system includes shallow ephemeral waterbodies found in very small depressions (typically no larger than 50 square meters) throughout the Lassen, Klamath, and upper Pit river drainages, as well as the Devils Garden area of northern California, and along the eastern flanks of the Columbia River Gorge along the Oregon-Washington border. These vernal pools are located on top of massive basalt flows where soils are very thin over solid bedrock. Where soils are better developed, they trend towards Vertisols (freeze-thaw characteristics). Characteristic species include *Blennosperma nanum, Epilobium densiflorum (= Boisduvalia densiflora), Callitriche marginata, Cicendia quadrangularis, Eryngium vaseyi, Psilocarphus brevissimus*, and *Sedella pumila (= Parvisedum pumilum). Artemisia cana ssp. bolanderi* can occur on better developed soils. Endemic plant species *Eryngium mathiasiae*, as well as several species of *Mimulus* and *Pogogyne*, may occur.
Related Concepts:
- Wetlands (217) (Shiflet 1994) Broader

DESCRIPTION

Environment: These vernal pools are located on top of massive basalt flows where soils are very thin over solid bedrock. Where soils are better developed, they trend towards Vertisols (with freeze-thaw characteristics).
Dynamics: Vernal pools are precipitation-filled seasonal wetlands inundated during the growing season, allowing for plant growth, followed by a brief water-logged terrestrial stage and culminating in complete drying of surface and subsurface soils. Inundation during the growing season eliminates establishment of upland species in the pool basins and the dry period prevents the establishment of many typical wetland taxa (Keeley and Zedler 1998). Pool filling is a combination of direct precipitation (Solomeshch et al. 2007). Soils are shallow over basalt that prevents drainage. What is unique about vernal pools is the seasonality of the wetting period followed by the desiccation period, which generally is supported by a Mediterranean climate (Keeley and Zedler 1998). Natural fire regimes for vernal pools are generally unknown, but are assumed to be similar to their surrounding upland grassland fire regimes (Wills 2006). Fire can have a positive effect on vernal pool vegetation as it can results in robust response by native grasses and can reduce non-native invasive woody and non-native herbaceous species (Pollak and Kan 1998).

DISTRIBUTION

Range: Throughout the Lassen, Klamath, and upper Pit river drainages, as well as the Devils Garden area of northern California, and along the eastern flanks of the Columbia River Gorge along the Oregon-Washington border.
Divisions: 204:C; 206:C
Nations: US
Subnations: CA, OR, WA
Map Zones: 1:?, 2:?, 6:?, 7:C, 8:?, 9:?, 12:?
USFS Ecomap Regions: 342B:PP, M242C:??, M261D:CP, M261G:CC
TNC Ecoregions: 4:C, 5:P

SOURCES

References: Barbour 1998, Barbour and Major 1988, Barbour et al. 2003, Barbour et al. 2005, Bjork 1997, Bjork and Dunwiddie 2004, Brown 1999, Comer et al. 2003, Dalton et al. 2013, Dlugolecki 2010, Holland and Keil 1995, Keeley and Zedler 1998, Pollak and Kan 1998, PRBO Conservation Science 2011, Rocchio pers. comm., Sawyer and Keeler-Wolf 1995, Shiflet 1994, Solomeshch et al. 2007, Wills 2006
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722709#references
Description Author: P. Comer and T. Keeler-Wolf, mod. G. Kittel
Version: 14 Jan 2014 **Stakeholders:** West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

NORTH AMERICAN ARID WEST EMERGENT MARSH (CES300.729)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Western Great Plains (303)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Deep (>15 cm) Water; Saturated Soil; Herbaceous; Depressional [Lakeshore]; Depressional [Pond]; Mineral: W/ A-Horizon >10 cm; Aquatic Herb; Graminoid
Non-Diagnostic Classifiers: Clay Subsoil Texture; Floodplain; Montane [Montane]; Montane [Lower Montane]; Lowland [Foothill]; Lowland [Lowland]; Marsh; Oxbow; Pond; Backwater; Temperate [Temperate Continental]; Forb; Alga; Drainage bottom (undifferentiated)
National Mapping Codes: ESLF 9222

CONCEPT

Summary: This widespread ecological system occurs throughout much of the arid and semi-arid regions of western North America, typically surrounded by savanna, shrub-steppe, steppe, or desert vegetation. Natural marshes may occur in depressions in the landscape (ponds, kettle ponds), as fringes around lakes, and along slow-flowing streams and rivers (such riparian marshes are also referred to as sloughs). Marshes are frequently or continually inundated, with water depths up to 2 m. Water levels may be stable, or may fluctuate 1 m or more over the course of the growing season. Water chemistry may include some alkaline or semi-alkaline situations, but the alkalinity is highly variable even within the same complex of wetlands. Marshes have distinctive soils that are typically mineral, but can also accumulate organic material. Soils have characteristics that result from long periods of anaerobic conditions in the soils (e.g., gleyed soils, high organic content, redoximorphic features). The vegetation is characterized by herbaceous plants that are adapted to saturated soil conditions. Common emergent and floating vegetation includes species of *Scirpus* and/or *Schoenoplectus, Typha, Juncus, Potamogeton, Polygonum, Nuphar*, and *Phalaris*. This system may also include areas of relatively deep water with floating-leaved plants (*Lemna, Potamogeton*, and *Brasenia*) and submerged and floating plants (*Myriophyllum, Ceratophyllum*, and *Elodea*).
Classification Comments: This ecological system occurs in the arid and semi-arid regions of western North America, where semipermanently flooded habitats are found as small patches in the matrix of a relatively dry landscape. Except for stands in the semi-arid portions of the western Great Plains, emergent marsh found in the Great Plains should be classified into one of the Western Great Plains depressional wetland systems.
Similar Ecological Systems:
- Western Great Plains Closed Depression Wetland (CES303.666)
- Western Great Plains Open Freshwater Depression Wetland (CES303.675)
- Western Great Plains Saline Depression Wetland (CES303.669)

Related Concepts:
- Wooded Potholes and Basins (Jahrsdoerfer and Leslie 1988) Finer

DESCRIPTION

Environment: Natural marshes may occur in depressions in the landscape (ponds, kettle ponds), as fringes around lakes, and along slow-flowing streams and rivers (such riparian marshes are also referred to as sloughs). Marshes are frequently or continually inundated, with water depths up to 2 m. Water chemistry may include some alkaline or semi-alkaline situations, but the alkalinity is highly variable even within the same complex of wetlands. Marshes have distinctive soils that are typically mineral, but can also accumulate organic material. Soils have characteristics that result from long periods of anaerobic conditions in the soils (e.g., gleyed soils, high organic content, redoximorphic features).
Dynamics: Water levels may be stable, or may fluctuate 1 m or more over the course of the growing season. Some marshes draw down completely on an annual or semi-annual cycle, or longer 5-20 year cycle. During the "dry" period, different plant species may become established, encouraging seedlings and discouraging others, in fact, allowing for natural changes in water levels leads to higher diversity of structure and composition of the marsh ecosystems (Mitsch and Gosselink 2000). Fire also has profound effects on marsh vegetation (Kirby et al. 1988). Literature on the specifics of natural fire frequency and effects in western U.S. non-tidal wetlands is very limited (Kirby et al. 1988, Clark and Wilson 2001).

Component Associations:
- *Calamagrostis canadensis* Western Herbaceous Vegetation (CEGL001559, G4)
- *Carex nebrascensis* Herbaceous Vegetation (CEGL001813, G4)
- *Carex praegracilis* Herbaceous Vegetation (CEGL002660, G3G4)
- *Carex utriculata* Herbaceous Vegetation (CEGL001562, G5)
- *Carex vesicaria* Herbaceous Vegetation (CEGL002661, G4Q)
- *Distichlis spicata - (Scirpus nevadensis)* Herbaceous Vegetation (CEGL001773, G4)
- *Eleocharis palustris - Carex praegracilis - Berula erecta* Herbaceous Vegetation (CEGL002634, G2)
- *Eleocharis palustris* Herbaceous Vegetation (CEGL001833, G5)

- *Equisetum X ferrissii* Herbaceous Vegetation (CEGL005394, GNR)
- *Glyceria borealis* Herbaceous Vegetation (CEGL001569, G4)
- *Juncus balticus* Herbaceous Vegetation (CEGL001838, G5)
- *Lemna* spp. Western North American Aquatic Vegetation (CEGL005450, G5)
- *Myriophyllum sibiricum* Herbaceous Vegetation (CEGL002000, GUQ)
- *Nuphar polysepala* Herbaceous Vegetation (CEGL002001, G5)
- *Phalaris arundinacea* Western Herbaceous Vegetation (CEGL001474, G5)
- *Phragmites australis* Western North America Temperate Semi-natural Herbaceous Vegetation (CEGL001475, G5)
- *Potamogeton diversifolius* Herbaceous Vegetation (CEGL002007, G1?)
- *Potamogeton foliosus* Herbaceous Vegetation (CEGL002742, G3?)
- *Potamogeton natans* Herbaceous Vegetation (CEGL002925, G5?)
- *Ranunculus aquatilis - Callitriche palustris* Herbaceous Vegetation (CEGL001984, GU)
- *Ruppia (cirrhosa, maritima)* Permanently Flooded Herbaceous Vegetation (CEGL003119, G1G3)
- *Salicornia rubra* Herbaceous Vegetation (CEGL001999, G2G3)
- *Schoenoplectus acutus - Typha latifolia - (Schoenoplectus tabernaemontani)* Sandhills Herbaceous Vegetation (CEGL002030, G4)
- *Schoenoplectus acutus* Herbaceous Vegetation (CEGL001840, G5)
- *Schoenoplectus americanus - Carex* spp. Herbaceous Vegetation (CEGL004144, GNR)
- *Schoenoplectus americanus - Eleocharis palustris* Herbaceous Vegetation (CEGL001585, G4)
- *Schoenoplectus americanus - Eleocharis* spp. Herbaceous Vegetation (CEGL001586, GNR)
- *Schoenoplectus americanus - Flaveria chlorifolia - (Helianthus paradoxus)* Herbaceous Vegetation (CEGL004592, G1)
- *Schoenoplectus americanus* Western Herbaceous Vegetation (CEGL001841, G3Q)
- *Schoenoplectus maritimus* Herbaceous Vegetation (CEGL001843, G4)
- *Schoenoplectus pungens* Herbaceous Vegetation (CEGL001587, G3G4)
- *Schoenoplectus tabernaemontani* Temperate Herbaceous Vegetation (CEGL002623, G5)
- *Sparganium angustifolium* Herbaceous Vegetation (CEGL001990, G4)
- *Sparganium eurycarpum* Herbaceous Vegetation (CEGL003323, G4)
- *Spartina gracilis* Herbaceous Vegetation (CEGL001588, GU)
- *Spartina pectinata* Western Herbaceous Vegetation (CEGL001476, G3?)
- *Stuckenia filiformis* Herbaceous Vegetation (CEGL002008, GU)
- *Triglochin maritima* Herbaceous Vegetation (CEGL001995, GU)
- *Typha (latifolia, angustifolia)* Western Herbaceous Vegetation (CEGL002010, G5)
- *Typha domingensis* Western Herbaceous Vegetation (CEGL001845, G5?)

DISTRIBUTION

Range: This system occurs throughout much of the arid and semi-arid regions of western North America, extending east peripherally into the semi-arid portions of the western Great Plains.
Divisions: 301:C; 302:C; 303:C; 304:C; 305:C; 306:C
Nations: CA, MX, US
Subnations: AB, AZ, BC, CA, CO, ID, MT, MXBC(MX), MXCH(MX), MXSO(MX), NM, NV, OR, TX, UT, WA, WY
Map Zones: 1:C, 2:C, 5:C, 6:P, 7:C, 8:C, 9:C, 10:C, 12:C, 13:C, 14:C, 15:C, 16:C, 17:C, 18:C, 19:C, 20:P, 21:C, 22:C, 23:P, 24:P, 25:C, 26:C, 27:C, 28:C, 29:P, 31:?, 33:C, 34:C, 35:P, 36:P
USFS Ecomap Regions: 313A:CC, 313B:CC, 313C:C?, 313D:CC, 315A:CC, 315B:CC, 315H:CP, 321A:CC, 322A:CC, 322B:CC, 322C:CP, 331A:CP, 331B:CC, 331C:CC, 331D:CC, 331E:CC, 331F:CC, 331G:CC, 331H:CC, 331I:CC, 331J:CC, 331K:CC, 331L:CC, 331M:CC, 331N:CC, 341A:CC, 341B:CC, 341C:CC, 341D:CC, 341E:CC, 341F:CC, 341G:CC, 342A:CC, 342B:CC, 342C:CC, 342D:CC, 342E:CC, 342F:CC, 342G:CC, 342H:CP, 342I:CC, 342J:CC, M261E:CP, M261G:CC, M313A:CC, M313B:CC, M331A:CC, M331B:C?, M331D:CC, M331E:CC, M331F:CP, M331G:CC, M331H:CC, M331I:CC, M331J:C?, M332A:CP, M332B:C?, M332D:CC, M332E:CC, M332F:CC, M332G:C?, M333A:CP, M333C:CC, M341A:CC, M341B:CP, M341D:CC
TNC Ecoregions: 6:C, 7:C, 8:C, 9:C, 11:C, 17:C, 18:C, 19:C, 20:C, 21:C, 23:C, 24:C, 26:?, 27:C, 28:C, 29:?, 30:C, 68:C

SOURCES

References: Brown 1982a, Clark and Wilson 2001, Comer et al. 2003, Comer et al. 2013a, Cooper 1986b, Dick-Peddie 1993, Faber-Langendoen et al. 1997, Hansen et al. 1995, Jahrsdoerfer and Leslie 1988, Johnson, J. pers. comm., Kirby et al. 1988, Kittel et al. 1994, Kittel et al. 2012, Melack et al. 1997, Mitsch and Gosselink 2000, Neely et al. 2001, Padgett et al. 1989, PRBO Conservation Science 2011, Rondeau 2001, Szaro 1989, Ungar 1965, Ungar 1972, WNHP 2011
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722943#references
Description Author: NatureServe Western Ecology Team, mod. G. Kittel
Version: 14 Jan 2014 **Stakeholders:** Canada, Latin America, Midwest, Southeast, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

NORTH AMERICAN BOREAL FRESHWATER AQUATIC BED (CES103.125)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Boreal (103)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Aquatic Herb
Non-Diagnostic Classifiers: Lake; Pond; Herbaceous; Boreal [Boreal Subcontinental]
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - forbland, Hydromorphic-rooted grassland
National Mapping Codes: EVT 2627; ESLF 9433; ESP 1627

CONCEPT

Summary: Freshwater aquatic beds are found at all elevations below timberline throughout boreal Alaska, the montane boreal of western Canada, and the boreal plains into eastern Canada. This system is small patch in size and confined to lakes, ponds, and slow-moving portions of rivers and streams. In large bodies of water, it is usually restricted to the littoral region where penetration of light is the limiting factor for growth. Bodies of water may be deep or shallow. A variety of rooted or floating-aquatic herbaceous species may dominate, including *Nuphar polysepala (= Nuphar lutea ssp. polysepala)*, *Nuphar variegata*, *Nymphaea tetragona*, *Potamogeton* spp., *Lemna minor*, *Lemna trisulca*, *Spirodela polyrrhiza*, *Sparganium* spp., *Ranunculus* spp., *Myriophyllum* spp., *Hippuris vulgaris*, *Brasenia schreberi*, and *Callitriche* spp.
Classification Comments: This system is known as Boreal Freshwater Aquatic Bed by the Alaska Natural Heritage Program. All aquatic beds throughout the boreal region of North America are combined into this one ecological system. Floristics, environmental settings and successional trajectories are the same across this huge area, so there is no reason to keep boreal Alaska as a separate system from boreal Canada. In addition, freshwater aquatic beds found in the arctic might be included in this, but that remains to be worked out.
Similar Ecological Systems:
- Alaska Arctic Freshwater Aquatic Bed (CES102.182)
- Aleutian Freshwater Aquatic Bed (CES105.234)
- Western North American Boreal Freshwater Emergent Marsh (CES105.123)

Related Concepts:
- III.D.1.a - Pondlily (Viereck et al. 1992) Intersecting
- III.D.1.b - Common marestail (Viereck et al. 1992) Intersecting
- III.D.1.c - Aquatic buttercup (Viereck et al. 1992) Intersecting
- III.D.1.d - Burreed (Viereck et al. 1992) Intersecting
- III.D.1.e - Water milfoil (Viereck et al. 1992) Intersecting
- III.D.1.f - Fresh pondweed (Viereck et al. 1992) Intersecting
- III.D.1.h - Cryptogam (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: Freshwater aquatic beds occur in permanently flooded depressions, shallow ponds, and the littoral zone of lakes. Soils are mineral or muck (National Wetlands Working Group 1997).
Vegetation: A variety of rooted or floating aquatic herbaceous species may dominate, including *Nuphar polysepala (= Nuphar lutea ssp. polysepala)*, *Potamogeton* spp., *Lemna minor*, *Sparganium* spp., and *Ranunculus* spp. Other common species include *Myriophyllum* spp., *Hippuris vulgaris*, *Isoetes tenella (= Isoetes muricata)*, and *Callitriche* spp. (Ritchie et al. 1981, Hogan and Tande 1983, Tande 1983, Talbot et al. 1984, Rosenburg 1986, Jorgenson et al. 1999, 2001a, 2001b, 2003, Gracz et al. 2005). Deep ponds (>3 m) often feature *Nuphar polysepala*, while species such as *Hippuris vulgaris* and *Sparganium* spp. often grow in shallower water (5-50 cm). Several of the shallow-water species are facultative aquatics and can survive in wet muck soils during periods of low water (Viereck et al. 1992).
Dynamics: Freshwater aquatic beds are early-successional wetlands and will likely be replaced by marshes, wet meadows, fens, or floating bog mats (Viereck et al. 1992). Aquatic beds form in shallow water in ponds and lake margins including kettles, oxbow lakes, and thaw ponds (Racine et al. 1998, Jorgenson et al. 2001a, 2001b, 2003).

Component Associations:
- *Hippuris vulgaris* Herbaceous Vegetation (CEGL003315, G5)
- *Stuckenia pectinata - Myriophyllum (sibiricum, spicatum)* Herbaceous Vegetation (CEGL002003, G3G4)

DISTRIBUTION

Range: This system is found in lowlands of the boreal plains of central Canada, the montane boreal regions of western Canada, and west into boreal Alaska.
Divisions: 103:C; 105:C; 205:C; 207:C
Nations: CA, US

Subnations: AB, AK, BC, MB, NT?, ON, QC?, SK, YT
Map Zones: 68:?, 69:C, 70:C, 71:C, 72:?, 73:C, 74:C, 75:C
TNC Ecoregions: 71:C, 72:C, 74:C, 75:C, 76:C, 77:C, 78:C, 134:C, 135:C, 139:C, 141:C, 144:C

SOURCES

References: Gracz et al. 2005, Hogan and Tande 1983, Jorgenson et al. 1999, Jorgenson et al. 2001a, Jorgenson et al. 2001b, Jorgenson et al. 2003, Klein et al. 2005, National Wetlands Working Group 1997, Racine et al. 1998, Ritchie et al. 1981, Rosenberg 1986, Smith et al. 2007, Talbot et al. 1984, Tande 1983, Viereck et al. 1992, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817433#references
Description Author: T. Boucher, mod. M.S. Reid
Version: 31 Mar 2010 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

NORTH AMERICAN WARM DESERT CIENEGA (CES302.747)

CLASSIFIERS

Conf.: 3 - Weak **Classification Status:** Standard
Primary Division: North American Warm Desert (302)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Alkaline Water; Lowland [Lowland]; Seep; Seepage-Fed Sloping [Mineral]
Non-Diagnostic Classifiers: Herbaceous; Tropical/Subtropical [Tropical Xeric]; Temperate [Temperate Xeric]; Aquatic Herb; Graminoid
National Mapping Codes: ESLF 9284

CONCEPT

Summary: This ecological system occurs at low elevations (<2000 m) across the warm deserts of western North America. "CiÃ©negas" are freshwater spring-fed wetlands, characterized by non-fluctuating shallow surface water; the term ciÃ©nega was applied to riparian marshlands by Spanish explorers. CiÃ©negas are characterized by permanently saturated, highly organic, reducing soils and a relatively simple flora dominated by low-statured herbaceous hydrophytes (water-loving plants), with only occasional patches of trees. Evaporation often creates saline conditions especially on the margins as evidenced by salt-tolerant species such as *Distichlis spicata* and *Sporobolus airoides*. Typically, low-elevation examples are too warm to accumulate a deep organic layer. The type of vegetation depends on depth of water. In shallow margins, emergent plants typical of riparian vegetation are present including species of *Carex*, *Juncus*, and *Schoenoplectus*. In adjacent deeper waters, emergent marsh can be characteristic. The hydrology is controlled by permanently saturated hydrosols, with reducing conditions limiting the type of plant life that may grow there. The dense vegetation can slow surface waterflow, reducing the erosive power of flood waters and increase sedimentation within the ciÃ©nega. Soils can have many meters of organic deposition. Plant life is limited to low shallow-rooted semi-aquatic sedges such as *Eleocharis* spp., Juncus spp., *Carex* spp., a few grasses, and more rarely, *Typha* spp. Forbs include *Hydrocotyle verticillata* and *Ludwigia repens (= Ludwigia natans)*, which can be rooted in patches of gravel below organic root zone in pool bottoms. Few trees and shrubs may be present but may include *Salix gooddingii*, *Populus fremontii*, *Fraxinus velutina*, and *Cephalanthus occidentalis*.

DESCRIPTION

Environment: This spring-fed marsh ecosystem occurs at mid to low elevations (<2000 m [6562 feet]) across the warm deserts of western North America. "CiÃ©negas" are freshwater spring-fed wetlands, characterized by non-fluctuating shallow surface water (PAG 2001, Stromberg et al. 2009). CiÃ©negas are characterized by permanently saturated, highly organic, reducing soils (Hendrickson and Minckley 1984, Stromberg et al. 2009, Stevens et al. 2012).

Vegetation: CiÃ©negas are characterized by permanently saturated, highly organic, reducing soils and a relatively simple flora dominated by low-statured herbaceous hydrophytes (water-loving plants), with only occasional patches of trees (Hendrickson and Minckley 1984, Stromberg et al. 2009, Stevens et al. 2012). Evaporation often creates saline conditions especially on the margins as evidenced by salt-tolerant species such as *Distichlis spicata* and *Sporobolus airoides*. Typically, low-elevation examples are too warm to accumulate a deep organic layer. The type of vegetation depends on depth of water. In shallow margins, emergent plants typical of riparian vegetation are present including species of *Carex*, *Juncus*, and *Schoenoplectus*. In adjacent deeper waters, emergent marsh can be characteristic. The hydrology is controlled by permanently saturated hydrosols, with reducing conditions limiting the type of plant life that may grow there. The dense vegetation can slow surface waterflow, reducing the erosive power of flood waters and increase sedimentation within the ciÃ©nega. Soils can have many meters of organic deposition (Stromberg et al. 1996). Plant life is limited to low shallow-rooted semi-aquatic sedges such as *Eleocharis* spp., Juncus spp., *Carex* spp., a few grasses, and more rarely, *Typha* spp. (Stromberg et al. 2009, Stevens et al. 2012). Forbs include *Hydrocotyle verticillata* and *Ludwigia repens (= Ludwigia natans)*, which can be rooted in patches of gravel below organic root zone in pool bottoms (Stromberg et al. 2009, Stevens et al. 2012). Few trees and shrubs may be present but may include *Salix gooddingii*, *Populus fremontii*, *Fraxinus velutina*,and *Cephalanthus occidentalis* (Stromberg et al. 2009, Stevens et al. 2012).

Dynamics: CiÃ©negas described here are isolated spring-fed wetlands found at the outer edge of floodplains and valley floors. Therefore, they have very stable surface hydrologic dynamics. As such they are entirely dependent on groundwater flow to their source spring, and are sensitive to changes in groundwater levels (Hendrickson and Minckley 1984, Stromberg et al. 1996, 1997, 2009, Bagstad et al. 2005, Noonan 2013). Overland surface flow from intense monsoon rains in the summer may deliver sediments into the ciÃ©nega, depending on the amount of vegetation and exposed soils on hillslopes above. Winter storms are less intense and are more likely to result in soil moisture absorption, groundwater recharge, and less surface runoff. Groundwater level stability is key to maintaining ciÃ©negas (Hendrickson and Minckley 1984, Stromberg et al. 1996, 1997, 2009, Bagstad et al. 2005, Noonan 2013)

Component Associations:
- *Eleocharis palustris - Carex praegracilis - Berula erecta* Herbaceous Vegetation (CEGL002634, G2)
- *Schoenoplectus americanus - Eleocharis* spp. Herbaceous Vegetation (CEGL001586, GNR)
- *Schoenoplectus americanus - Flaveria chlorifolia - (Helianthus paradoxus)* Herbaceous Vegetation (CEGL004592, G1)

DISTRIBUTION

Range: Occurs at low elevations (<1000 m) across the warm deserts of western North America, including the Mojave, Sonoran, and Chihuahuan.
Divisions: 302:C
Nations: MX, US
Subnations: AZ, CA, MXCH(MX), MXSO(MX), NM, NV, TX
Map Zones: 4:?, 13:C, 14:C, 15:C, 17:?, 25:C, 26:C, 27:?
USFS Ecomap Regions: 313C:CC, 321A:CC, 322A:CC, 322B:CC, 322C:CC, M313A:CC, M313B:CC
TNC Ecoregions: 17:C, 22:C, 23:C, 24:C

SOURCES

References: Abell et al. 2000, ACCAG 2006, AFRTF 2010, Anning et al. 2009, Archer and Predick 2008, Bagstad et al. 2005, Berkman and Rabeni 1987, Brown 1982a, Calamusso 2005, Christensen et al. 2007, CNRA 2009, Comer and Hak 2009, Comer et al. 2003, Comer et al. 2013b, Debinski and Holt 2000, Dominguez et al. 2009, EPA 2005, Faber-Langendoen et al. 2006b, Faber-Langendoen et al. 2008b, Heinz Center 2011, Hendrickson and Minckley 1984, Hirschboeck 2009, IPCC 2007c, McKinney and Anning 2009, Mol and Ouboter 2004, Noonan 2013, PAG 2001, Patten 1998, Poff et al. 2010, Price et al. 2005, Rinne 1995, Shafroth et al. 2010, Solomon et al. 2009, Stevens and Meretsky 2008, Stevens et al. 2012, Stromberg 1998, Stromberg and Tellman 2009, Stromberg et al. 1996, Stromberg et al. 1997, Stromberg et al. 2009, Theobald et al. 2010, Unnasch et al. 2009, USCCSP and the Subcommittee on Global Change Research 2009, Webb and Leake 2006, Weltzin et al. 2003, WNHP 2011
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722925#references
Description Author: NatureServe Western Ecology Team, mod. G. Kittel
Version: 14 Jan 2014 **Stakeholders:** Latin America, Southeast, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

NORTH AMERICAN WARM DESERT INTERDUNAL SWALE WETLAND (CES302.039)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: North American Warm Desert (302)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Dune (Landform); Dune field; Dune (Substrate); Temperate [Temperate Xeric]; Isolated Wetland [Partially Isolated]; Sand Soil Texture; W-Landscape/High Intensity; Graminoid
Non-Diagnostic Classifiers: Dune (undifferentiated); Lowland [Lowland]; Shrubland (Shrub-dominated); Herbaceous; Tropical/Subtropical [Tropical Xeric]; Depressional; Aridic
National Mapping Codes: ESLF 9238

CONCEPT

Summary: This interdunal wetland ecological system occurs in dune fields in the Chihuahuan Desert and likely in the Sonoran and Mojave deserts. This isolated or partially isolated wetland system is an occasional component of the more extensive active and stabilized desert dune system. Stands are typically small (usually less than 0.1 ha) interdunal swales that occur in wind deflation areas, where sands are scoured down to the water table. Water table may be perched over an impermeable layer of caliche or clay layer. These wetland areas are typically dominated by common emergent herbaceous vegetation, such as species of *Eleocharis, Juncus*, and *Schoenoplectus*, but may include endemic plants or animals. Occasionally wetlands are dominated by trees and shrubs, such as *Populus fremontii* and *Baccharis salicifolia*, which survive both being buried as dunes advance and having their root system exposed when deflation of the dune occurs. The specific dune field ecological processes distinguish these wetlands from non-dune emergent wetlands with similar species composition.
Classification Comments: Additional interdunal wetland surveys and classification work are needed at dune systems in the Chihuahuan Desert at Cuatro Cienegas, Guadalupe Mountains, and Samalayuca dunes as well as dune systems in the Sonoran or Mojave deserts, such as Algondones, Death Valley, Ereka, Gran Desierto, Kelso, Mohawk, and Salton Sea dunes, to clarify the extent of this small-patch ecological system. It may be necessary to restrict the system to the Chihuahuan Desert if that is the extent. Gypsum dunes have species unique to that substrate and may need to be treated differently.

DESCRIPTION

Environment: This interdunal wetland ecological system occurs in some dune fields in the Chihuahuan and likely the Sonoran and Mojave deserts. This isolated or partially isolated wetland system is an occasional component of the more extensive active and stabilized desert dune system. Stands are typically small (usually less than 0.1 ha) interdunal swales that occur in wind deflation areas, where sands are scoured down to the water table. Water table may be perched over an impermeable layer of caliche or clay. Dune sands may be quartz or gypsum. Gypsum dunes have species unique to that substrate and may need to be treated differently. The specific dune field ecological processes distinguish these wetlands from similar emergent wetlands. In west Texas, these wetlands occur in interdunal swales in Monahan and Kermit quartz sand dunes. These dunes occur northeast of the Pecos River where the prevailing southwest winds have blown the sands to the east where they are trapped by the escarpment of the High Plains (Southern Shortgrass Prairie Ecoregion). The ponds are on a perched water table underlain by impermeable caliche layers. The interdunal ponds are dynamic and change location as active dunes migrate. The White Sands dunes of the Tularosa Basin in southern New Mexico are a gypsum interdunal/dune system that is moving/semi-stable; during the rainy season, many of the interdunes become ephemeral lakes with wetland indicators.
Vegetation: These wetland areas are typically dominated by common emergent herbaceous vegetation, such as species of *Eleocharis, Juncus*, and *Schoenoplectus*, but may include endemic plants or animals, especially on gypsum dunes. Occasionally wetlands are dominated by trees and shrubs, such as *Populus fremontii*, *Baccharis salicifolia*, or *Salix* spp., which must survive both being buried as dunes advance and having their root system exposed when deflation of the dune occurs. On occasion, dunes move over a site, leaving only the tops of cottonwood trees as remnants of the buried community (Muldavin et al. 1994b). The specific dune field ecological processes distinguish these wetlands from non-dune emergent wetlands with similar species composition.

In west Texas, stands in the Monahan and Kermit sandsheets wet interdunal swales, ponds and fringing wetlands are vegetated by herbaceous graminoids (generally >10% plant cover) between active dunes in sandsheets derived from quartz sands. Common vegetation is characterized by herbaceous graminoids and *Salix* spp. These interdunal valleys over impermeable substrata (as with the Monahans Sandsheet) may contain seasonal swales or ephemeral ponds supporting *Achnatherum hymenoides* and other grasses, *Schoenoplectus tabernaemontani, Juncus* spp., *Cyperus* spp., *Baccharis* spp., *Prosopis glandulosa, Salix interior, Pluchea odorata (= Pluchea purpurascens), Xanthium strumarium*, and other weeds (TPWD 1989d). The fringing wetland plants of the more permanent ponds include *Salix* spp., *Scirpus* and/or *Schoenoplectus* spp., *Typha* spp., *Cyperus* spp., *Juncus* spp., *Eleocharis* spp., and others. *Cyperus onerosus* is a rare plant, endemic to this region, also associated with these unusual wetlands (El-Hage and Moulton 1998).
Dynamics: This system is created by iteration of two key processes: hydrological processes and eolian processes. Wind scours out deflation areas between dunes and exposes the water table creating an interdunal wetland. These wetlands exist because a perched water table is underlain by impermeable layers such as a caliche layer. These wetlands receive groundwater flow from the surrounding dune system where precipitation quickly infiltrates and percolates down to the impermeable layer. These interdunal wetlands are

dynamic and change location as active dunes are shaped by the wind (10-100 year timeframe). The size and exact location of the wet swales may change as the sand dunes shift, due to active dune migration. Dune "blowouts" and subsequent stabilization through succession are characteristic processes of the active dunes which surround this system. Drought and mechanical disturbance such as ORVs are linked to periods of active dune migration, whereas periods of above average precipitation are linked to dune stabilization.

Component Associations:
- *Baccharis salicifolia - Baccharis neglecta / Eustoma exaltatum* Shrubland (CEGL004590, G2?)
- *Eleocharis palustris - Carex praegracilis - Berula erecta* Herbaceous Vegetation (CEGL002634, G2)
- *Salix exigua / Baccharis salicifolia - Baccharis neglecta / Schoenoplectus* spp. Woodland (CEGL004587, G2?)
- *Schoenoplectus americanus - Eleocharis* spp. Herbaceous Vegetation (CEGL001586, GNR)
- *Schoenoplectus americanus - Flaveria chlorifolia - (Helianthus paradoxus)* Herbaceous Vegetation (CEGL004592, G1)

SPATIAL CHARACTERISTICS

Spatial Summary: Small patch.
Adjacent Ecological Systems:
- North American Warm Desert Active and Stabilized Dune (CES302.744)

Adjacent Ecological System Comments: This wetland system occurs in wet swales in North American Warm Desert Active and Stabilized Dune (CES302.744).

DISTRIBUTION

Range: This interdunal wetland ecological system occurs in some dune fields in the Chihuahuan Desert and likely occurs in dune fields of the Sonoran and Mojave deserts, but more research in needed to learn the exact extent.
Divisions: 302:C
Nations: US
Subnations: NM, TX
Map Zones: 13:C, 14:C, 15:?, 25:C, 26:C, 27:?
USFS Ecomap Regions: 321A:CC, 322A:??, 322B:??, 322C:??
TNC Ecoregions: 24:C

SOURCES

References: Bezanson 2000, Bowers 1982, Bowers 1984, Bowers 1986, Brown 1982a, Carr 1991, Carr 2004, Muldavin et al. 1994b, Muldavin et al. 2000a, Muldavin et al. 2000b, Southeastern Ecology Working Group n.d., TNC 2013, TPWD 1989d, WNHP 2011
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.771414#references
Description Author: C.W. Nordman and K.A. Schulz
Version: 14 Jan 2014 **Stakeholders:** Southeast, West
Concept Author: El-Hage and Moulton (1998) **ClassifResp:** Southeast

NORTH PACIFIC COASTAL INTERDUNAL WETLAND (CES204.062)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Shallow (<15 cm) Water; Sand Subsoil Texture; Coastal Dune Mosaic; Herbaceous; Depressional [Pond]; Isolated Wetland [Partially Isolated]; Mineral: W/ A-Horizon <10 cm; Graminoid
National Mapping Codes: ESLF 9229

CONCEPT

Summary: Coastal interdunal wetlands are common components of larger active and stabilized coastal barrier islands, spits, and coastal dunes, ranging from southern Oregon through the Aleutian Islands. Distinct landform and vegetation patterns are common to these dune systems. Landforms on the ocean side include low-gradient beaches, sparse to unvegetated dunes, slacks dominated by low herbaceous vegetation, and back dunes dominated by tall herbaceous, shrub, or forested communities. Foredunes in Oregon and Washington are usually densely covered by *Ammophila arenaria* that was introduced for dune stabilization projects and has spread throughout the region. This has largely replaced native *Leymus mollis* that is a less effective sand-binder. *Ammophila* is much less abundant behind the foredunes, and dunes in these areas range from unvegetated and actively moving to completely stabilized with mostly native vegetation.

In Alaska, slacks between dunes are colonized by *Equisetum variegatum* and other herbaceous species. The sites are elevated by the deposition of wind-blown sand, tectonic uplift and isostatic rebound. This further removes the sites from tidal water and allows shrubs, such as *Salix commutata, Salix sitchensis*, and *Myrica gale* to invade. Organic mats also develop. Some slacks may develop into forested sites or peatlands, whereas other slacks may not persist to late succession because of dune encroachment. Depending on moisture and salinity gradients, dune slacks in Oregon and Washington are colonized by *Carex obnupta, Argentina egedii, Juncus lesueurii, Juncus nevadensis, Salix hookeriana*, and various other emergent species. The higher portions of dunes are dry and nutritionally poor because of leaching, moving the moisture and nutrients into the dune bases and slacks.
Classification Comments: Oregon and Washington interdunal wetlands had previously been included in other freshwater wetland ecosystems. The truly interdunal wetlands are included here. While interdunal wetlands undoubtedly occur in Alaska, recent systems classification work did not split them out into a separate system. In the future, it may be appropriate to include interdunal wetlands in Alaska in this system. Currently included in Alaskan Pacific Maritime Coastal Dune, Beach and Beach Meadow (CES204.166) in that state.

DESCRIPTION

Environment: In Oregon and Washington, habitat ranges from small interdunal depressions to extensive deflation plains behind stabilized foredunes. Winter precipitation elevates the water table and inundates some communities to a depth of 1 m (3 feet). The seasonal rise in water table also causes vernal pools to form in forested sites on old deflation plains. These pools are teeming with invertebrates and are temporary sources of food and breeding grounds for amphibians and waterfowl. Some wetlands are perched on an iron-cemented duripan, and groundwater may be charged with iron. pH ranges from 5.0-6.3 (6.9), with low conductivity.

Component Associations:
- *Carex exsiccata* Herbaceous Vegetation (CEGL003312, G2G3)
- *Carex lyngbyei - Argentina egedii* Herbaceous Vegetation (CEGL003289, G4)
- *Carex obnupta - Argentina egedii ssp. egedii* Herbaceous Vegetation (CEGL001820, G4)
- *Carex obnupta* Herbaceous Vegetation (CEGL003313, G4)
- *Juncus falcatus - Trifolium wormskioldii* Herbaceous Vegetation (CEGL001570, G4)
- *Picea sitchensis / Carex obnupta - Lysichiton americanus* Forest (CEGL000400, G2G3)
- *Pinus contorta var. contorta / Carex obnupta* Forest (CEGL000142, G2)
- *Pinus contorta var. contorta / Gaultheria shallon - Rhododendron macrophyllum - Vaccinium ovatum* Forest (CEGL000152, G1)
- *Salix hookeriana - (Malus fusca) / Carex obnupta - Lysichiton americanus* Shrubland (CEGL003432, G3)
- *Salix hookeriana - Morella californica* Shrubland (CEGL001138, G4)
- *Schoenoplectus acutus* Herbaceous Vegetation (CEGL001840, G5)

SPATIAL CHARACTERISTICS

Size: In Oregon and Washington, size ranges from 0.25 to 50 acres or more.
Adjacent Ecological Systems:
- North Pacific Maritime Coastal Sand Dune and Strand (CES200.881)

DISTRIBUTION

Range: This system ranges from southern Oregon into British Columbia. In Alaska, they are treated as part of the dune and beach system.

Divisions: 204:C
Nations: US
Subnations: AK?, OR, WA
USFS Ecomap Regions: 242A:??, M242A:CC
TNC Ecoregions: 1:C, 69:?, 70:?

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.784004#references
Description Author: K. Boggs, G. Kittel, and J. Christy
Version: 08 Dec 2008 **Stakeholders:** West
Concept Author: K. Boggs, G. Kittel, and J. Christy **ClassifResp:** West

NORTH PACIFIC HARDPAN VERNAL POOL (CES204.859)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Herbaceous; Depressional [Vernal Pool]
Non-Diagnostic Classifiers: Lowland [Lowland]; Temperate [Temperate Oceanic]; Isolated Wetland [Strictly Isolated]
National Mapping Codes: ESLF 9225

CONCEPT

Summary: This system includes shallow ephemeral waterbodies found in depressions (up to several hectares in size) among grasslands and open woodlands throughout intermountain valleys of California, Oregon and the Gulf and San Juan islands of Washington and British Columbia. Northern hardpan vernal pools include an indurated clay or cemented (Si or Fe) hardpan that retains water inputs throughout some portion of the spring, but typically the depression dries down entirely into early summer months. In the Sand Juan and Gulf islands, they are created in small depressions in bedrock. This system typically occurs with a hummocky micro-relief. They tend to be acidic wetlands with characteristic plant species including *Downingia elegans, Isoetes orcuttii, Pilularia americana, Triteleia hyacinthina, Eleocharis* spp., *Eryngium petiolatum, Plagiobothrys figuratus, Plagiobothrys scouleri, Grindelia nana, Veronica peregrina, Deschampsia danthonioides*, and *Callitriche* spp. Due to draw-down characteristics, vernal pools typically form concentric rings of similar vegetation. Given their relative isolation in upland-dominated landscapes, many endemic and Federally-listed plant species are common in California vernal pools.
Classification Comments: This system includes both duripan/hardpan and bedrock types, which are segregated in the California systems. Decided to lump them for this system because both occur intermixed in the geographic area defined.

DESCRIPTION

Environment: Northern hardpan vernal pools include an indurated clay or cemented (Si or Fe) hardpan that retains water inputs throughout some portion of the spring, but typically the depression dries down entirely into early summer months. In the Sand Juan and Gulf islands, they are created in small depressions in bedrock. This system typically occurs with a hummocky micro-relief.
Dynamics: Vernal pools are precipitation-filled seasonal wetlands inundated during the growing season, allowing for plant growth, followed by a brief water-logged terrestrial stage and culminating in complete drying of surface and subsurface soils. Inundation during the growing season eliminates establishment of upland species in the pool basins and the dry period prevents the establishment of many typical wetland taxa (Keeley and Zedler 1998). Pool filling is a combination of direct precipitation (Solomeshch et al. 2007). Soils are shallow over basalt bedrock that prevents drainage. What is unique about vernal pools is the seasonality of the wetting period followed by the desiccation period, which generally is supported by a Mediterranean climate (Keeley and Zedler 1998). Natural fire regimes for vernal pools are generally unknown, but are assumed to be similar to their surrounding upland grassland fire regimes (Wills 2006). Fire can have a positive effect on vernal pool vegetation as it can results in robust response by native grasses and can reduce non-native invasive woody and non-native herbaceous species (Pollak and Kan 1998).

Component Associations:
- *Eryngium petiolatum - Grindelia nana* Herbaceous Vegetation (CEGL003345, G1G2)
- *Eryngium petiolatum - Lasthenia glaberrima* Herbaceous Vegetation (CEGL003458, G1G2)
- *Plagiobothrys figuratus* Vernal Pool Herbaceous Vegetation (CEGL003346, G1G2)
- *Plagiobothrys scouleri - Plantago bigelovii* Herbaceous Vegetation (CEGL003459, G2)

DISTRIBUTION

Range: Found in depressions among grasslands and open woodlands throughout intermountain valleys of California, Oregon and the Gulf and San Juan islands of Washington.
Divisions: 204:C
Nations: CA, US
Subnations: BC, CA, OR, WA
Map Zones: 1:C, 2:C, 7:C
USFS Ecomap Regions: 242A:CC, 242B:CP, M242A:PP, M242B:PP, M242C:PP
TNC Ecoregions: 2:C

SOURCES

References: Barbour 1998, Barbour et al. 2003, Barbour et al. 2005, Brown 1999, Calderaro 2011, Chappell and Christy 2004, Comer et al. 2003, Dalton et al. 2013, Hanes and Stromberg 1998, Holland 1998, Holland 2009, Holland and Keil 1995, Keeley and Zedler 1998, Marty 2005, Pollak and Kan 1998, PRBO Conservation Science 2011, Robins and Vollmar 2002, Rocchio pers. comm., Solomeshch et al. 2007, Wills 2006
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722816#references

Description Author: C. Chappell, mod. G. Kittel
Version: 14 Jan 2014
Concept Author: C. Chappell

Stakeholders: Canada, West
ClassifResp: West

NORTH PACIFIC INTERIOR SUBALPINE FEN (CES207.395)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Warm Continental (207)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Fen
National Mapping Codes: ESLF 9446

CONCEPT

Summary: This ecological system encompasses peatlands with 30 to >300 cm depth of peat. These fens occur at high, subalpine elevations (>1200 m) or where cold-air drainage pools. Fens are found on a wide variety of landscape positions but most commonly on palustrine basins. They occupy wetter zones in large peatland complexes but also form extensive pure "meadows." By and large, these fens are dominated by herbaceous species such as *Carex, Eleocharis, Eriophorum angustifolium, Trichophorum* spp., and others.
Classification Comments: This ecological system was developed for the purpose of capturing the coarse filter of terrestrial biodiversity in the interior of British Columbia Ecoregional Assessment, conducted by The Nature Conservancy of Canada, with NatureServe's assistance. This system was designed to be equivalent to those developed for neighboring ecoregions: Canadian Rocky Mountains (7), Okanagan (68), Alaska Coastal Forest and Mountains (69), and the North Cascades (3).
Related Concepts:

- Barclay's willow - Water sedge - Glow moss (BWBSdk2/Wf04) (Banner et al. 1993) Intersecting
- Barclay's willow - Water sedge - Glow moss (ESSFmc/Wf04) (Banner et al. 1993) Intersecting
- Barclay's willow - Water sedge - Glow moss (ESSFmw/Wf04) (Steen and Coupe 1997) Intersecting
- Barclay's willow - Water sedge - Glow moss (ESSFwc2/Wf04) (Lloyd et al. 1990) Intersecting
- Barclay's willow - Water sedge - Glow moss (ESSFwc3/Wf04) (Steen and Coupe 1997) Intersecting
- Barclay's willow - Water sedge - Glow moss (ESSFwc3/Wf04) (DeLong et al. 1994) Intersecting
- Barclay's willow - Water sedge - Glow moss (ESSFwv/Wf04) (Banner et al. 1993) Intersecting
- Barclay's willow - Water sedge - Glow moss (ESSFxc/Wf04) (Steen and Coupe 1997) Intersecting
- Barclay's willow - Water sedge - Glow moss (MSxk/Wf04) (Steen and Coupe 1997) Intersecting
- Barclay's willow - Water sedge - Glow moss (SBSvk/Wf04) (DeLong 2003) Intersecting
- Barclay's willow - Water sedge - Glow moss (SBSwk1/Wf04) (DeLong 2003) Intersecting
- Barclay's willow - Water sedge - Glow moss (SBSwk1/Wf04) (Steen and Coupe 1997) Intersecting
- Few-flowered spike-rush - Hook-moss (ESSFmc/Wf09) (Banner et al. 1993) Intersecting
- Few-flowered spike-rush - Hook-moss (ESSFxc/Wf09) (Steen and Coupe 1997) Intersecting
- Few-flowered spike-rush - Hook-moss (ESSFxv1/Wf09) (Steen and Coupe 1997) Intersecting
- Few-flowered spike-rush - Hook-moss (MSxv/Wf09) (Steen and Coupe 1997) Intersecting
- Few-flowered spike-rush - Hook-moss (SBPSxc/Wf09) (Steen and Coupe 1997) Intersecting
- Few-flowered spike-rush - Hook-moss (SBSmc2/Wf09) (Banner et al. 1993) Intersecting
- Few-flowered spike-rush - Hook-moss (SBSmc2/Wf09) (DeLong et al. 1993) Intersecting
- Hudson Bay clubrush - Red hook-moss (SBSmc2/Wf10) (DeLong et al. 1993) Intersecting
- Hudson Bay clubrush - Red hook-moss (SBSmc2/Wf10) (Banner et al. 1993) Intersecting
- Hudson Bay clubrush - Red hook-moss (SBSmk2/Wf10) (MacKinnon et al. 1990) Intersecting
- Lt - Water sedge - Fen Moss (SBSwk2/07) (MacKinnon et al. 1990) Intersecting
- Narrow-leaved cotton-grass - Marsh-marigold (ESSFmc/Wf12) (Banner et al. 1993) Intersecting
- Narrow-leaved cotton-grass - Marsh-marigold (ESSFmw/Wf12) (Steen and Coupe 1997) Intersecting
- Narrow-leaved cotton-grass - Marsh-marigold (ESSFxc/Wf12) (Steen and Coupe 1997) Intersecting
- Narrow-leaved cotton-grass - Marsh-marigold (MSxk/Wf12) (Steen and Coupe 1997) Intersecting
- Narrow-leaved cotton-grass - Shore sedge (ESSFmc/Wf13) (Banner et al. 1993) Intersecting
- Narrow-leaved cotton-grass - Shore sedge (ESSFmw/Wf13) (Steen and Coupe 1997) Intersecting
- Narrow-leaved cotton-grass - Shore sedge (ESSFwc2/Wf13) (Lloyd et al. 1990) Intersecting
- Narrow-leaved cotton-grass - Shore sedge (ESSFxc/Wf13) (Steen and Coupe 1997) Intersecting
- Narrow-leaved cotton-grass - Shore sedge (SBSwk2/Wf13) (MacKinnon et al. 1990) Intersecting
- Non-forested fen/marsh (BWBSdk1/32) (MacKinnon et al. 1990) Intersecting
- Non-forested fen/marsh (BWBSdk1/32) (Banner et al. 1993) Intersecting
- Non-forested fen/marsh (BWBSdk2/32) (Banner et al. 1993) Intersecting
- Non-forested fen/marsh (CWHvh2/33) (Banner et al. 1993) Intersecting
- Non-forested fen/marsh (CWHvm1/32) (Banner et al. 1993) Intersecting
- Non-forested fen/marsh (CWHvm2/32) (Banner et al. 1993) Intersecting
- Non-forested fen/marsh (CWHwm/32) (Banner et al. 1993) Intersecting
- Non-forested fen/marsh (CWHws1/32) (Banner et al. 1993) Intersecting

- Non-forested fen/marsh (CWHws2/32) (Banner et al. 1993) Intersecting
- Non-forested fen/marsh (ICHmc1/31) (Meidinger et al. 1988) Intersecting
- Non-forested fen/marsh (ICHmc1/31) (Banner et al. 1993) Intersecting
- Non-forested fen/marsh (ICHmc2/32) (Banner et al. 1993) Intersecting
- Non-forested fen/marsh (ICHvc/31) (Banner et al. 1993) Intersecting
- Non-forested fen/marsh (ICHwc/32) (Banner et al. 1993) Intersecting
- Non-forested fen/marsh (SBPSmc/32) (Banner et al. 1993) Intersecting
- Non-forested fen/marsh (SBPSmc/32) (Steen and Coupe 1997) Intersecting
- Non-forested fen/marsh (SBSdk/32) (Steen and Coupe 1997) Intersecting
- Non-forested fen/marsh (SBSdk/32) (Banner et al. 1993) Intersecting
- Non-forested fen/marsh (SBSmc2/31) (Banner et al. 1993) Intersecting
- Non-forested slope/blanket bog (CWHvh2/32) (Banner et al. 1993) Intersecting
- Non-forested topogenous bog (CWHvh2/31) (Banner et al. 1993) Intersecting
- Non-forested wetland (ESSFmc/31) (Banner et al. 1993) Intersecting
- Non-forested wetland (ESSFwv/31) (Banner et al. 1993) Intersecting
- Non-forested wetland (MHmm1/31) (Banner et al. 1993) Intersecting
- Non-forested wetland (MHmm2/31) (Banner et al. 1993) Intersecting
- Non-forested wetland (MHwh1/31) (Banner et al. 1993) Intersecting
- Sedge - Sphagnum (ESSFwc2/10) (Lloyd et al. 1990) Intersecting
- Shore sedge - Buckbean - Hook-moss (ESSFwc3/Wf08) (Steen and Coupe 1997) Intersecting
- Shore sedge - Buckbean - Hook-moss (ESSFwc3/Wf08) (DeLong et al. 1994) Intersecting
- Shore sedge - Buckbean - Hook-moss (ESSFxc/Wf08) (Steen and Coupe 1997) Intersecting
- Shore sedge - Buckbean - Hook-moss (ESSFxv1/Wf08) (Steen and Coupe 1997) Intersecting
- Shore sedge - Buckbean - Hook-moss (MSxk/Wf08) (Steen and Coupe 1997) Intersecting
- Shore sedge - Buckbean - Hook-moss (MSxv/Wf08) (Steen and Coupe 1997) Intersecting
- Shore sedge - Buckbean - Hook-moss (SBPSdc/Wf08) (Steen and Coupe 1997) Intersecting
- Shore sedge - Buckbean - Hook-moss (SBPSdc/Wf08) (MacKenzie and Moran 2004) Intersecting
- Shore sedge - Buckbean - Hook-moss (SBSdk/Wf08) (Banner et al. 1993) Intersecting
- Shore sedge - Buckbean - Hook-moss (SBSdk/Wf08) (DeLong et al. 1993) Intersecting
- Shore sedge - Buckbean - Hook-moss (SBSdk/Wf08) (Steen and Coupe 1997) Intersecting
- Shore sedge - Buckbean - Hook-moss (SBSmc2/Wf08) (Banner et al. 1993) Intersecting
- Shore sedge - Buckbean - Hook-moss (SBSmc2/Wf08) (DeLong et al. 1993) Intersecting
- Shore sedge - Buckbean - Hook-moss (SBSmk2/Wf08) (MacKinnon et al. 1990) Intersecting
- Shore sedge - Buckbean - Hook-moss (SBSwk1/Wf08) (Steen and Coupe 1997) Intersecting
- Shore sedge - Buckbean - Hook-moss (SBSwk1/Wf08) (DeLong 2003) Intersecting
- Tea-leaved willow - Water sedge - Glow moss (ESSFxc/Wf14) (Steen and Coupe 1997) Intersecting
- Tea-leaved willow - Water sedge - Glow moss (MSxv/Wf14) (Steen and Coupe 1997) Intersecting
- Tufted clubrush - Star moss (BWBSdk1/Wf11) (MacKinnon et al. 1990) Intersecting
- Tufted clubrush - Star moss (BWBSdk1/Wf11) (Banner et al. 1993) Intersecting
- Tufted clubrush - Star moss (ESSFwc2/Wf11) (Lloyd et al. 1990) Intersecting
- Tufted clubrush - Star moss (ESSFwc3/Wf11) (DeLong et al. 1994) Intersecting
- Tufted clubrush - Star moss (ESSFwc3/Wf11) (Steen and Coupe 1997) Intersecting
- Tufted clubrush - Star moss (ESSFwk1/Wf11) (DeLong 2003) Intersecting
- Tufted clubrush - Star moss (ESSFxc/Wf11) (Steen and Coupe 1997) Intersecting
- Tufted clubrush - Star moss (ICHmc2/Wf11) (Banner et al. 1993) Intersecting
- Tufted clubrush - Star moss (ICHmw3/Wf11) (Steen and Coupe 1997) Intersecting
- Tufted clubrush - Star moss (SBSdk/Wf11) (DeLong et al. 1993) Intersecting
- Tufted clubrush - Star moss (SBSdk/Wf11) (Banner et al. 1993) Intersecting
- Tufted clubrush - Star moss (SBSdk/Wf11) (Steen and Coupe 1997) Intersecting
- Tufted clubrush - Star moss (SBSwk1/Wf11) (DeLong 2003) Intersecting
- Tufted clubrush - Star moss (SBSwk1/Wf11) (Steen and Coupe 1997) Intersecting
- Water sedge - Peat-moss (ESSFmc/Wf03) (Banner et al. 1993) Intersecting
- Water sedge - Peat-moss (ESSFmw/Wf03) (Steen and Coupe 1997) Intersecting
- Water sedge - Peat-moss (ESSFwc3/Wf03) (Steen and Coupe 1997) Intersecting
- Water sedge - Peat-moss (ESSFwc3/Wf03) (DeLong et al. 1994) Intersecting
- Water sedge - Peat-moss (ESSFwv/Wf03) (Banner et al. 1993) Intersecting
- Water sedge - Peat-moss (ESSFxc/Wf03) (Steen and Coupe 1997) Intersecting
- Water sedge - Peat-moss (ESSFxv2/Wf03) (Steen and Coupe 1997) Intersecting
- Water sedge - Peat-moss (SBSwk1/Wf03) (Steen and Coupe 1997) Intersecting
- Water sedge - Peat-moss (SBSwk1/Wf03) (DeLong 2003) Intersecting

DISTRIBUTION

Range: This ecological system occurs entirely within central interior British Columbia.

Divisions: 207:C
Nations: CA
Subnations: BC
TNC Ecoregions: 144:C

SOURCES

References: Banner et al. 1993, DeLong 2003, DeLong et al. 1993, DeLong et al. 1994, Lloyd et al. 1990, MacKenzie and Moran 2004, MacKinnon et al. 1990, Meidinger et al. 1988, Steen and Coupe 1997, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.820996#references
Description Author: G. Kittel
Version: 26 Jan 2009
Concept Author: G. Kittel
Stakeholders: Canada, West
ClassifResp: West

NORTH PACIFIC INTERTIDAL FRESHWATER WETLAND (CES204.875)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Non-Diagnostic Classifiers: Herbaceous
National Mapping Codes: ESLF 9220

CONCEPT

Summary: This ecological system occurs throughout the coastal margin and intertidal zone of the Pacific Northwest Coast of Oregon, Washington and north into British Columbia. It may occur in Alaska, but has not been described from there. Intertidal freshwater wetlands occur as narrow strips to more extensive patches along tidally influenced portions of rivers. There has been little vegetation data collection of this type in this region; a few studies indicate dominant species include *Picea sitchensis, Alnus rubra, Cornus sericea, Myriophyllum hippuroides, Typha angustifolia, Athyrium filix-femina,* and *Carex lyngbyei*. This system is driven by daily tidal flooding of freshwater and associated soil saturation. Vegetation structure and composition are varied and depend on substrate characteristics and the tidal flooding regime of particular sites. Where small areas of mudflat occur in tidally influenced freshwater areas, they are included in this intertidal freshwater wetland and not in Temperate Pacific Freshwater Mudflat (CES200.878).
Classification Comments: It's unclear if this system occurs in Alaska; it was not identified in recent systems classification work.

Component Associations:
- *Alnus rubra / Rubus spectabilis / Carex obnupta - Lysichiton americanus* Forest (CEGL003389, G3G4)
- *Carex lyngbyei* Herbaceous Vegetation (CEGL003369, G4)
- *Cornus sericea - Salix (hookeriana, sitchensis)* Shrubland (CEGL003292, G3)
- *Picea sitchensis / Carex obnupta - Lysichiton americanus* Forest (CEGL000400, G2G3)
- *Picea sitchensis / Cornus sericea / Lysichiton americanus* Forest (CEGL000055, G2)
- *Populus balsamifera ssp. trichocarpa - Acer macrophyllum / Equisetum hyemale* Forest (CEGL003406, G3)
- *Populus balsamifera ssp. trichocarpa / Cornus sericea / Impatiens capensis* Forest (CEGL003408, G1)

DISTRIBUTION

Range: This system occurs throughout the coastal margin and intertidal zone of the Pacific Northwest coast of Oregon, Washington and north into British Columbia. It may occur in Alaska but has not been described from there.
Divisions: 204:C
Nations: CA, US
Subnations: BC, OR, WA
Map Zones: 1:C, 2:C
USFS Ecomap Regions: 242A:CC, M242A:CC
TNC Ecoregions: 1:C, 69:C

SOURCES

References: Boggs 2000, Boggs 2002, Comer et al. 2003, Kunze 1994, Viereck et al. 1992
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722800#references
Description Author: C. Chappell, G. Kittel, mod. M.S. Reid
Version: 08 Dec 2008
Stakeholders: Canada, West
Concept Author: C. Chappell, G. Kittel
ClassifResp: West

NORTH PACIFIC MARITIME EELGRASS BED (CES200.882)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Herbaceous; Temperate [Temperate Oceanic]; Aquatic Herb
Non-Diagnostic Classifiers: Lowland [Lowland]
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2670; ESLF 9230; ESP 1670

CONCEPT

Summary: Eelgrass beds are found throughout the coastal areas of the North Pacific Coast, from southern Oregon (Coos Bay) north into the Gulf of Alaska, Cook Inlet, and Bristol Bay coasts. Intertidal zones are found with clear water in bays, inlets and lagoons, typically dominated by macrophytic algae and marine aquatic angiosperms along the temperate Pacific Coast. Subtidal portions are never exposed while intertidal areas support species that can tolerate exposure to the air. Common substrates include marine silts, but may also include exposed bedrock and cobble, where many algal species become attached with holdfasts. Subtidal/lower intertidal in clear water. Substrate is usually marine silts, but may be cobble. Beds are dominated by *Zostera marina*.
Related Concepts:
- III.D.3.a - Eelgrass (Viereck et al. 1992) Equivalent

DISTRIBUTION

Range: This system is found throughout the coastal areas of the North Pacific Coast, from southern Oregon (Coos Bay) north into the Gulf of Alaska, Cook Inlet, and Bristol Bay coasts.
Divisions: 204:C
Nations: CA, US
Subnations: AK, BC, OR, WA
Map Zones: 1:C, 2:C, 75:C, 76:C, 77:C, 78:C
USFS Ecomap Regions: 242A:CC, M242A:CC
TNC Ecoregions: 1:C, 2:C, 69:C, 70:C, 71:C, 74:C

SOURCES

References: Boggs 2002, Comer et al. 2003, Holland and Keil 1995, Viereck et al. 1992
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722793#references
Description Author: P. Comer, G. Kittel, K. Boggs
Version: 06 Mar 2003 **Stakeholders:** Canada, West
Concept Author: P. Comer, G. Kittel, K. Boggs **ClassifResp:** West

NORTH PACIFIC SUB-BOREAL LOWER MONTANE FEN (CES207.396)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Warm Continental (207)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Fen
National Mapping Codes: ESLF 9447

CONCEPT

Summary: This ecological system encompasses peatlands with 30 to >300 cm depth of peat. These fens occur at lower elevations (<1400 m) and are dominated by lower-elevation Carices such as *Carex aquatilis, Carex lasiocarpa*, and *Carex limosa*. Scatted shrubs may be present such as *Betula glandulosa* and *Salix barclayi*. These fens occur throughout the central and sub-boreal interior of British Columbia, at middle elevations but below 1400 m. Most sites are hummocked or ribbed with elevated sites and permanent shallow-water hollows. These fens cover much of the acidity-alkalinity gradient with little change in the vascular flora but with a marked difference in bryophyte compositions.

Classification Comments: This ecological system was developed for the purpose of capturing the coarse filter of terrestrial biodiversity in the interior of British Columbia Ecoregional Assessment, conducted by The Nature Conservancy of Canada, with NatureServe's assistance. This system was designed to be equivalent to those developed for neighboring ecoregions: Canadian Rocky Mountains (7), Okanagan (68), Alaska Coastal Forest and Mountains (69), and the North Cascades (3).

Related Concepts:

- Labrador tea - Sedge - Sphagnum (ICHwk4/09) (Steen and Coupe 1997) Intersecting
- Scrub birch - Buckbean - Shore sedge (IDFdk3/Wf07) (Steen and Coupe 1997) Intersecting
- Scrub birch - Buckbean - Shore sedge (SBPSdc/Wf07) (MacKenzie and Moran 2004) Intersecting
- Scrub birch - Buckbean - Shore sedge (SBPSdc/Wf07) (Steen and Coupe 1997) Intersecting
- Scrub birch - Buckbean - Shore sedge (SBSdk/Wf07) (DeLong et al. 1993) Intersecting
- Scrub birch - Buckbean - Shore sedge (SBSdk/Wf07) (Banner et al. 1993) Intersecting
- Scrub birch - Buckbean - Shore sedge (SBSdk/Wf07) (Steen and Coupe 1997) Intersecting
- Scrub birch - Buckbean - Shore sedge (SBSmc2/Wf07) (DeLong et al. 1993) Intersecting
- Scrub birch - Buckbean - Shore sedge (SBSmc2/Wf07) (Banner et al. 1993) Intersecting
- Scrub birch - Buckbean - Shore sedge (SBSvk/Wf07) (DeLong 2003) Intersecting
- Scrub birch - Buckbean - Shore sedge (SBSwk1/Wf07) (DeLong 2003) Intersecting
- Scrub birch - Buckbean - Shore sedge (SBSwk1/Wf07) (Steen and Coupe 1997) Intersecting
- Scrub birch - Buckbean - Shore sedge (SBSwk2/Wf07) (MacKinnon et al. 1990) Intersecting
- Scrub birch - Buckbean - Shore sedge (SBSwk3/Wf07) (Banner et al. 1993) Intersecting
- Scrub birch - Buckbean - Shore sedge (SBSwk3/Wf07) (MacKinnon et al. 1990) Intersecting
- Scrub birch - Water sedge (BWBSdk1/Wf02) (MacKinnon et al. 1990) Intersecting
- Scrub birch - Water sedge (BWBSdk1/Wf02) (Banner et al. 1993) Intersecting
- Scrub birch - Water sedge (BWBSmw1/Wf02) (DeLong et al. 1990) Intersecting
- Scrub birch - Water sedge (BWBSmw2/Wf02) (DeLong et al. 1990) Intersecting
- Scrub birch - Water sedge (ESSFmv2/Wf02) (DeLong et al. 1994) Intersecting
- Scrub birch - Water sedge (ESSFwc3/Wf02) (DeLong et al. 1994) Intersecting
- Scrub birch - Water sedge (ESSFwc3/Wf02) (Steen and Coupe 1997) Intersecting
- Scrub birch - Water sedge (ESSFwk2/Wf02) (DeLong et al. 1994) Intersecting
- Scrub birch - Water sedge (ESSFxc/Wf02) (Steen and Coupe 1997) Intersecting
- Scrub birch - Water sedge (ESSFxv2/Wf02) (Steen and Coupe 1997) Intersecting
- Scrub birch - Water sedge (ICHmc2/Wf02) (Banner et al. 1993) Intersecting
- Scrub birch - Water sedge (ICHvk2/Wf02) (DeLong 2003) Intersecting
- Scrub birch - Water sedge (ICHwk2/Wf02) (Steen and Coupe 1997) Intersecting
- Scrub birch - Water sedge (ICHwk3/Wf02) (Meidinger et al. 1988) Intersecting
- Scrub birch - Water sedge (ICHwk4/Wf02) (Steen and Coupe 1997) Intersecting
- Scrub birch - Water sedge (IDFdk3/Wf02) (Steen and Coupe 1997) Intersecting
- Scrub birch - Water sedge (IDFdk4/Wf02) (Steen and Coupe 1997) Intersecting
- Scrub birch - Water sedge (SBPSdc/Wf02) (Steen and Coupe 1997) Intersecting
- Scrub birch - Water sedge (SBPSdc/Wf02) (MacKenzie and Moran 2004) Intersecting
- Scrub birch - Water sedge (SBPSmc/Wf02) (Steen and Coupe 1997) Intersecting
- Scrub birch - Water sedge (SBPSmc/Wf02) (DeLong et al. 1993) Intersecting
- Scrub birch - Water sedge (SBPSmc/Wf02) (Banner et al. 1993) Intersecting
- Scrub birch - Water sedge (SBPSmk/Wf02) (Steen and Coupe 1997) Intersecting

- Scrub birch - Water sedge (SBPSxc/Wf02) (Steen and Coupe 1997) Intersecting
- Scrub birch - Water sedge (SBSdk/Wf02) (Banner et al. 1993) Intersecting
- Scrub birch - Water sedge (SBSdk/Wf02) (DeLong et al. 1993) Intersecting
- Scrub birch - Water sedge (SBSdk/Wf02) (Steen and Coupe 1997) Intersecting
- Scrub birch - Water sedge (SBSdw1/Wf02) (Steen and Coupe 1997) Intersecting
- Scrub birch - Water sedge (SBSmc2/Wf02) (DeLong et al. 1993) Intersecting
- Scrub birch - Water sedge (SBSmc2/Wf02) (Banner et al. 1993) Intersecting
- Scrub birch - Water sedge (SBSmm/Wf02) (Steen and Coupe 1997) Intersecting
- Scrub birch - Water sedge (SBSvk/Wf02) (DeLong 2003) Intersecting
- Scrub birch - Water sedge (SBSwk1/Wf02) (Steen and Coupe 1997) Intersecting
- Scrub birch - Water sedge (SBSwk1/Wf02) (DeLong 2003) Intersecting
- Scrub birch - Water sedge (SBSwk2/Wf02) (MacKinnon et al. 1990) Intersecting
- Sedge - Sphagnum (ICHwk1/09) (Lloyd et al. 1990) Intersecting
- Slender sedge - Buckbean (CWHws1/Wf06) (Banner et al. 1993) Intersecting
- Slender sedge - Buckbean (ICHwk1/Wf06) (Lloyd et al. 1990) Intersecting
- Slender sedge - Buckbean (SBSdk/Wf06) (Banner et al. 1993) Intersecting
- Slender sedge - Buckbean (SBSdk/Wf06) (Steen and Coupe 1997) Intersecting
- Slender sedge - Buckbean (SBSdk/Wf06) (DeLong et al. 1993) Intersecting
- Slender sedge - Common hook-moss (BWBSdk1/Wf05) (MacKinnon et al. 1990) Intersecting
- Slender sedge - Common hook-moss (BWBSdk1/Wf05) (Banner et al. 1993) Intersecting
- Slender sedge - Common hook-moss (ICHdk/Wf05) (Steen and Coupe 1997) Intersecting
- Slender sedge - Common hook-moss (ICHmc1/Wf05) (Meidinger et al. 1988) Intersecting
- Slender sedge - Common hook-moss (ICHmc1/Wf05) (Banner et al. 1993) Intersecting
- Slender sedge - Common hook-moss (ICHmc2/Wf05) (Banner et al. 1993) Intersecting
- Slender sedge - Common hook-moss (ICHmw3/Wf05) (Steen and Coupe 1997) Intersecting
- Slender sedge - Common hook-moss (ICHwk1/Wf05) (Lloyd et al. 1990) Intersecting
- Slender sedge - Common hook-moss (ICHwk2/Wf05) (Steen and Coupe 1997) Intersecting
- Slender sedge - Common hook-moss (IDFdk3/Wf05) (Steen and Coupe 1997) Intersecting
- Slender sedge - Common hook-moss (IDFdk4/Wf05) (Steen and Coupe 1997) Intersecting
- Slender sedge - Common hook-moss (SBPSdc/Wf05) (Steen and Coupe 1997) Intersecting
- Slender sedge - Common hook-moss (SBPSdc/Wf05) (MacKenzie and Moran 2004) Intersecting
- Slender sedge - Common hook-moss (SBPSmk/Wf05) (Steen and Coupe 1997) Intersecting
- Slender sedge - Common hook-moss (SBPSxc/Wf05) (Steen and Coupe 1997) Intersecting
- Slender sedge - Common hook-moss (SBSdk/Wf05) (Banner et al. 1993) Intersecting
- Slender sedge - Common hook-moss (SBSdk/Wf05) (Steen and Coupe 1997) Intersecting
- Slender sedge - Common hook-moss (SBSdk/Wf05) (DeLong et al. 1993) Intersecting
- Slender sedge - Common hook-moss (SBSmc2/Wf05) (Banner et al. 1993) Intersecting
- Slender sedge - Common hook-moss (SBSmc2/Wf05) (DeLong et al. 1993) Intersecting
- Slender sedge - Common hook-moss (SBSmk1/Wf05) (DeLong et al. 1993) Intersecting
- Slender sedge - Common hook-moss (SBSwk1/Wf05) (DeLong 2003) Intersecting
- Slender sedge - Common hook-moss (SBSwk1/Wf05) (Steen and Coupe 1997) Intersecting
- Water sedge - Beaked sedge (BWBSdk2/Wf01) (Banner et al. 1993) Intersecting
- Water sedge - Beaked sedge (ESSFmc/Wf01) (Banner et al. 1993) Intersecting
- Water sedge - Beaked sedge (ESSFmw/Wf01) (Steen and Coupe 1997) Intersecting
- Water sedge - Beaked sedge (ESSFwk1/Wf01) (DeLong 2003) Intersecting
- Water sedge - Beaked sedge (ESSFxc/Wf01) (Steen and Coupe 1997) Intersecting
- Water sedge - Beaked sedge (ESSFxv1/Wf01) (Steen and Coupe 1997) Intersecting
- Water sedge - Beaked sedge (ESSFxv2/Wf01) (Steen and Coupe 1997) Intersecting
- Water sedge - Beaked sedge (ICHvc/Wf01) (Banner et al. 1993) Intersecting
- Water sedge - Beaked sedge (ICHwc/Wf01) (Banner et al. 1993) Intersecting
- Water sedge - Beaked sedge (IDFdk3/Wf01) (Steen and Coupe 1997) Intersecting
- Water sedge - Beaked sedge (IDFdk4/Wf01) (Steen and Coupe 1997) Intersecting
- Water sedge - Beaked sedge (MHmm2/Wf01) (Banner et al. 1993) Intersecting
- Water sedge - Beaked sedge (MHmm2/Wf01) (Steen and Coupe 1997) Intersecting
- Water sedge - Beaked sedge (MSxk/Wf01) (Steen and Coupe 1997) Intersecting
- Water sedge - Beaked sedge (MSxv/Wf01) (Steen and Coupe 1997) Intersecting

DISTRIBUTION

Range: This ecological system occurs entirely within central interior British Columbia.
Divisions: 207:C
Nations: CA
Subnations: BC
TNC Ecoregions: 144:C

SOURCES

References: Banner et al. 1993, DeLong 2003, DeLong et al. 1990, DeLong et al. 1993, DeLong et al. 1994, Lloyd et al. 1990, MacKenzie and Moran 2004, MacKinnon et al. 1990, Meidinger et al. 1988, Steen and Coupe 1997, Western Ecology Working Group n.d.

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.820999#references

Description Author: G. Kittel

Version: 26 Jan 2009 **Stakeholders:** Canada, West

Concept Author: G. Kittel **ClassifResp:** West

NORTH-CENTRAL AND NORTHEASTERN SEEP (CES202.456)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland

CONCEPT

Summary: This ecological system contains primarily herbaceous seep vegetation of the north-central and northeastern United States from Maryland and Pennsylvania north to Maine, Vermont, Wisconsin, and into adjacent Canada. Vegetation of this group is primarily dominated by tall and short forbs, as well as by graminoids and *Sphagnum* mosses in some associations. These are seepage-fed wetlands of temperate northeastern North America found on gentle slopes. Examples are linear, non-peaty, non-sphagnous, often rocky, groundwater slope wetlands that are embedded in an upland forest setting. Some smaller examples may be nearly or fully shaded by overhanging trees rooted in the adjacent forest, but others are open. Stands of this group are dominated by a wetland flora, but with a lack of species characteristic of floodplains or acidic peatlands. Trees may be present on the edges of stands, or often overhanging, but are not characteristic. Shrub species are typically sparse and most typically mesophytic, rather than obligate wetland species. They may form dense zones around the edge but are not characteristic. The herb layer is generally well-developed, and is usually dominated either by characteristic forbs such as *Impatiens capensis, Impatiens pallida, Symplocarpus foetidus, Chelone* spp., and *Rudbeckia laciniata*, or with presence of *Carex* spp. and other graminoids, e.g., *Glyceria striata* and *Eriophorum virginicum*. In addition, *Sphagnum* spp. may occur in a minority of examples, but it is more characteristic of vegetation in the other groups within this macrogroup.
Classification Comments: The memberships of the clearly related Southern Appalachian Seepage Wetland (CES202.317) and this system have been resolved along (more-or-less) clear biogeographic lines. CES202.317 is "Central and Southern Appalachian" in its affinity and membership, and the range of this system is "North-Central and Northeastern." Clay Seeps Sparse Vegetation (CEGL005163) is an outlier both in geography and environmental setting, but does not appear to fit well in any other existing systems. This is a small-patch system and, as with other forested seeps, could be treated as a component of the larger upland forest system within which it is embedded.
Similar Ecological Systems:
- Southern Appalachian Seepage Wetland (CES202.317)

DESCRIPTION

Environment: This vegetation occurs in small patches where seepage creates permanent or seasonal saturated soil conditions. Wetness may vary substantially over short distances in response to amounts of seepage, flow, and pooling by topography or the presence of an impermeable substrate. Stands of the group occur over a wide elevational range, from low and moderate elevations northward nearly to the highest peaks of the Southern Appalachians. Landforms are usually concave slopes but may be convex slopes or even (rarely) ridgetop gaps. This vegetation is almost never found on flat valley bottoms, though it may be found on the edge of them. Soils are usually saturated mineral soils, rather than peats or mucks, and may be residual or colluvial, and deep or shallow.

Climate: A cool temperate climate, where cool temperatures and high rainfall make more water available, making seepage flow more reliable. *Soil/substrate/hydrology:* This vegetation occurs in small patches where seepage creates permanent or seasonal saturated soil conditions. Soils are usually saturated mineral soils, rather than peats or mucks. Soil wetness may limit recruitment of most tree and shrub seedlings to drier microsites, making canopy gaps persist longer than in adjacent forests and creating and sustaining the openings where this vegetation is found. Wetness may vary substantially over short distances in response to amounts of seepage, flow, and pooling by topography or impermeable substrate.
Vegetation: Stands of this system are typically dominated by tall and short wetland forbs or by graminoids, and normally with a lack of species characteristic of floodplains and acidic peatlands. Trees may be present on the edges of stands, often overhanging, but are not characteristic. Shrub species are typically sparse and most typically mesophytic, rather than obligate wetland species. They may form dense zones around the edge but are not characteristic. The herb layer is generally well-developed, and is usually dominated either by characteristic forbs such as *Impatiens capensis, Impatiens pallida, Chelone* spp., *Symplocarpus foetidus*, and *Rudbeckia laciniata*, or with presence of *Carex* spp. and other graminoids such as *Glyceria striata* and *Eriophorum virginicum*.
Dynamics: The presence of seepage is the primary environmental characteristic of stands of this system. Long-term droughts that would affect seepage flow are presumed to have an effect, but this has not been documented. Soil wetness may limit recruitment of most tree and shrub seedlings to drier microsites, making canopy gaps persist longer than in adjacent forests and creating and sustaining the openings where this vegetation is found. Fire may penetrate from adjacent forests, but only in the driest conditions are they likely to be intense enough to have much effect within. Seeps are fairly permanent features of the landscape, but may potentially be created, destroyed, or changed in extent because of changes in groundwater flow, stream entrenchment or headward erosion, mass movement on slopes, or long-term climatic cycles. Examples are often left undisturbed when surrounding forests are logged. Effects of logging on water infiltration or surface flow may have significant indirect effects.

Component Associations:
- *Carex echinata - Solidago uliginosa / Sphagnum* spp. Herbaceous Vegetation (CEGL008534, G2?)
- *Carex scabrata - Viola cucullata / Plagiomnium ciliare* Herbaceous Vegetation (CEGL006597, G3)

- *Chrysosplenium americanum* Herbaceous Vegetation (CEGL006193, G3G5)
- Clay Seeps Sparse Vegetation (CEGL005163, GNR)
- *Dulichium arundinaceum - Carex folliculata - Juncus* spp. Herbaceous Vegetation (CEGL006552, GNR)
- *Eriophorum virginicum - (Carex folliculata) / Sphagnum* spp. - *Polytrichum* spp. Herbaceous Vegetation (CEGL006570, G3)
- *Prunus virginiana - Acer spicatum - Ribes triste / Angelica atropurpurea - Heracleum maximum* Shrubland (CEGL006583, G3)
- *Symplocarpus foetidus - Impatiens capensis* Herbaceous Vegetation (CEGL006567, GNR)
- *Symplocarpus foetidus* - Mixed Forbs Wet Meadow (CEGL002385, G4?)
- *Vernonia noveboracensis - Thelypteris palustris - Symplocarpus foetidus* Herbaceous Vegetation (CEGL006448, G1)

DISTRIBUTION

Range: This vegetation ranges throughout the north-central and northeastern United States from Maryland and Pennsylvania north to Maine, Vermont, Wisconsin, and into adjacent Canada.
Nations: CA, US
Subnations: CT, DC, DE, IA, IL, MA, MD, ME, MI, MN, NB?, NH, NJ, NY, OH, PA, QC?, RI, VA, VT, WI, WV
TNC Ecoregions: 50:C, 51:C, 59:C, 60:C, 61:C, 62:C

SOURCES

References: Eastern Ecology Working Group n.d., Faber-Langendoen et al. 2013a, Southeastern Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.893945#references
Description Author: M. Pyne and D. Faber-Langendoen
Version: 11 Jul 2013 **Stakeholders:** Canada, East, Midwest, Southeast
Concept Author: D. Faber-Langendoen **ClassifResp:** East

NORTH-CENTRAL APPALACHIAN SEEPAGE FEN (CES202.607)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Herbaceous; Seepage-Fed Sloping
Non-Diagnostic Classifiers: Circumneutral Water; 1-29-day hydroperiod; Short (50-100 yrs) Persistence; Lowland; Shrubland (Shrub-dominated); Temperate; Isolated Wetland [Partially Isolated]
National Mapping Codes: ESLF 9232

CONCEPT

Summary: This system is found in scattered locations in the Central Appalachians and eastern Great Lakes regions. Mostly non-forested, these open fens develop on shallow to deep peat over a sloping substrate, where seepage waters provide nutrients. Conditions are often circumneutral to alkaline. Sedges are the major dominants. *Packera aurea, Symplocarpus foetidus*, and *Lobelia kalmii* are among the characteristic forbs. Some of these areas are kept open by grazing, and succession to shrublands may occur in the absence of disturbance.

Similar Ecological Systems:
- Interior Low Plateau Seepage Fen (CES202.346)--of unglaciated Kentucky, Ohio, and Tennessee.
- Southern Appalachian Seepage Wetland (CES202.317)
- Southern Ridge and Valley Seepage Fen (CES202.458)

Component Associations:
- *Alnus serrulata - Lindera benzoin / Osmunda regalis var. spectabilis - Carex tetanica* Shrubland (CEGL008408, G1?)
- *Betula pumila - Toxicodendron vernix - Dasiphora fruticosa ssp. floribunda* Shrubland (CEGL006360, G2G3)
- *Carex canescens - Eriophorum virginicum / Sphagnum* spp. Herbaceous Vegetation (CEGL006549, GNR)
- *Carex prairea - Carex stricta - Pycnanthemum virginianum* Herbaceous Vegetation (CEGL006551, G1G3)
- *Cornus amomum - Salix candida / Dasiphora fruticosa ssp. floribunda / Carex stricta* Shrubland (CEGL006359, G3?)
- *Cornus racemosa / Carex (sterilis, aquatilis, lacustris)* Shrub Herbaceous Vegetation (CEGL006123, G2G3)
- *Dasiphora fruticosa ssp. floribunda / Carex (sterilis, hystericina, flava)* Shrub Herbaceous Vegetation (CEGL006326, G2)
- *Dasiphora fruticosa ssp. floribunda / Carex interior - Carex flava - Sarracenia purpurea* Shrub Herbaceous Vegetation (CEGL005140, G3)
- *Deschampsia caespitosa - Claytonia virginica var. hammondiae* Herbaceous Vegetation (CEGL006101, G1)
- *Juniperus virginiana / Betula pumila / Carex sterilis - Oligoneuron rigidum* Shrub Herbaceous Vegetation (CEGL006367, G1)
- *Juniperus virginiana / Dasiphora fruticosa ssp. floribunda / Carex flava - Carex tetanica* Shrub Herbaceous Vegetation (CEGL006357, G1G2)
- *Morella pensylvanica - Dasiphora fruticosa ssp. floribunda / Carex sterilis - Carex flava* Shrub Herbaceous Vegetation (CEGL006103, G2)
- *Symplocarpus foetidus* - Mixed Forbs Wet Meadow (CEGL002385, G4?)

DISTRIBUTION

Range: This system is found in scattered locations from central New England and New York west to Lake Erie and south to West Virginia and western Virginia (Central Appalachians ecoregion).
Divisions: 202:C
Nations: US
Subnations: CT, MA, MD, NJ, NY, PA, VA, VT, WV
Map Zones: 53:C, 61:C, 62:C, 63:P, 64:C, 65:C
USFS Ecomap Regions: 221A:CC, 221Ba:CCC, 221E:CC, M221A:CC
TNC Ecoregions: 45:P, 48:P, 49:C, 59:C, 60:C, 61:C

SOURCES

References: Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723002#references
Description Author: S.C. Gawler
Version: 09 Jan 2003 **Stakeholders:** East, Midwest, Southeast
Concept Author: S.C. Gawler **ClassifResp:** East

NORTH-CENTRAL GULF OF MEXICO SALT AND BRACKISH TIDAL MARSH (CES203.303)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Saltwater (Polyhaline); Brackish (Mesohaline); Tidal / Estuarine [Haline]; Graminoid
Non-Diagnostic Classifiers: Herbaceous
National Mapping Codes: ESLF 9263

CONCEPT

Summary: This ecological system includes salt and brackish tidal marshes of the north-central Gulf of Mexico, ranging from the Pearl River to northwestern Florida. These marshes are typically found bordering protected bays, sounds, lagoons and other low-energy shorelines. Wind-dominated tides and low tidal amplitudes (less than 1 m) characterize this region. This system includes predominately brackish marshes and supports what is probably the largest zone of *Juncus roemerianus* in the Atlantic and Gulf coastal plains outside of the North Carolina/Virginia Embayed Region estuarine marshes.

Similar Ecological Systems:
- Mississippi Sound Fresh and Oligohaline Tidal Marsh (CES203.067)

Related Concepts:
- Live Oak: 89 (Eyre 1980) Finer

DESCRIPTION

Environment: This marsh system occurs along low-energy shorelines in a region characterized by diurnal tides usually less than 0.5 m in amplitude. Inundation is irregular and depends upon wind speed and direction, and the flow of water from nearby rivers; generally more flooding occurs in the summer than winter (Hackney and de la Cruz 1982). The climate is mixed, with subtropical conditions prevailing during years with mild winters and temperate conditions when strong arctic cold fronts extend to the Gulf of Mexico.

Vegetation: Brackish needlerush marshes dominate this system. Communities distinguished by tall and short *Juncus roemerianus* may both be present. A *Spartina* zone occurs in narrow bands only; small-scale hypersaline tidal flats are frequently present. Other herbaceous species that may be found in stands include *Cladium mariscus ssp. jamaicense*, *Distichlis spicata*, *Panicum virgatum*, *Schoenoplectus americanus*, *Schoenoplectus pungens*, *Spartina alterniflora*, *Spartina patens*, *Spartina spartinae*, and *Sporobolus virginicus*. Examples of this system may also support inclusions of shrublands containing *Ilex vomitoria* and stunted *Quercus virginiana*.

Dynamics: Important processes and interactions in this system include the natural hydrological processes of rivers bringing freshwater and sediments to the coast, diurnal tides, and protection from high-energy wave actions (Morton et al. 2004). These natural processes have generally all been altered to some degree, but processes of freshwater and sediment input still persist even though in an altered state. Sediment input is critical to marsh persistence and becomes even more important under accelerated sea-level rise scenarios. Marsh vegetation plays an equally important role in maintaining marsh elevation (Baustian et al. 2012). Salt and brackish marshes are important habitats for many animal species.

Component Associations:
- *Cladium mariscus ssp. jamaicense* Tidal Herbaceous Vegetation (CEGL004178, G4?)
- *Ilex vomitoria - Quercus (geminata, virginiana) - Morella cerifera - Serenoa repens* Shrubland (CEGL003813, G2G3)
- *Juncus roemerianus* Herbaceous Vegetation (CEGL004186, G5)
- *Panicum virgatum - (Cladium mariscus ssp. jamaicense, Juncus roemerianus)* Herbaceous Vegetation (CEGL004962, G3?)
- *Spartina alterniflora - Juncus roemerianus - Distichlis spicata* Louisianian Zone Salt Tidal Herbaceous Vegetation (CEGL004190, G5)
- *Spartina patens - Schoenoplectus (americanus, pungens) - (Distichlis spicata)* Herbaceous Vegetation (CEGL004755, G4?)
- *Spartina spartinae - Sporobolus virginicus* Tidal Herbaceous Vegetation (CEGL004199, G4G5)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Mississippi Sound Fresh and Oligohaline Tidal Marsh (CES203.067)

DISTRIBUTION

Range: This system is found along the northern Gulf of Mexico in northwestern Florida, southern Alabama, and southern Mississippi. The eastern extent of this system coincides with the range of diurnal tides in the northeastern Gulf of Mexico. (East of Apalachicola Bay, where the tides are semi-diurnal (Stout 1984), Florida Big Bend Salt and Brackish Tidal Marsh (CES203.508) replaces this system.) To the west, Mississippi Delta Salt and Brackish Tidal Marsh (CES203.471) replaces this system in the Mississippi Delta.

Divisions: 203:C

Nations: US
Subnations: AL, FL, MS
Map Zones: 46:C, 99:C
USFS Ecomap Regions: 232L:CC
TNC Ecoregions: 53:C

SOURCES

References: Baustian et al. 2012, Comer et al. 2003, Eyre 1980, Hackney and de la Cruz 1982, Morton et al. 2004, Stout 1984
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723188#references
Description Author: R. Evans, mod. M. Pyne and J. Teague
Version: 14 Jan 2014
Concept Author: R. Evans
Stakeholders: Southeast
ClassifResp: Southeast

NORTH-CENTRAL INTERIOR FRESHWATER MARSH (CES202.899)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Shallow (<15 cm) Water; >180-day hydroperiod; Depressional [Lakeshore]; Graminoid
Non-Diagnostic Classifiers: Circumneutral Water; Acidic Water; Moderate (100-500 yrs) Persistence; Herbaceous; Depressional [Pond]; Isolated Wetland [Partially Isolated]; Muck; Aquatic Herb
National Mapping Codes: ESLF 9294

CONCEPT

Summary: This system is found throughout the northern Midwest ranging into southern Canada. It is typically found on glacial potholes, along small streams, ponds, channels in glacial outwash and on lakeplains. This system contains a deep to shallow area of freshwater marsh dominated by emergent and submergent species. Stands may be open ponds with floating or rooted aquatics, or deep marsh with bulrush or cattails, and range from fairly small to several acres. It contains hydric soils flooded by water ranging from several centimeters to over 1 meter for most of the growing season. Emergent marsh species such as *Typha* spp. and *Schoenoplectus* spp. dominate this system with an occasional scattering of tall *Carex* spp. and forbs that can vary from dense to open cover. Trees are generally absent and, if present, are scattered. Submergent wetlands include a variety of macrophytes.
Classification Comments: Some of the specific communities will also be found in the floodplain system and should not be considered a separate system in that case [see North-Central Interior Floodplain (CES202.694)]. Many of these marshes also may have a border of shrubby wet-meadow species similar to North-Central Interior Wet Meadow-Shrub Swamp (CES202.701), but only those areas with a relatively narrow border (<5-10 m) should included with this system.
Similar Ecological Systems:
- Boreal Freshwater Emergent Marsh (CES103.525)
- Laurentian-Acadian Freshwater Marsh (CES201.594)
- Laurentian-Acadian Shrub-Herbaceous Wetland Systems (CES201.642)

DESCRIPTION

Environment: This system is typically found on glacial potholes, along small streams, ponds, channels in glacial outwash, and on lakeplains. This system contains a deep to shallow area of freshwater marsh dominated by emergent and submergent species. It contains hydric soils flooded by water ranging from several centimeters to over 1 meter for most of the growing season.
Vegetation: This system contains a deep to shallow area of freshwater marsh dominated by emergent and submergent species. Stands may be open ponds with floating or rooted aquatics, or deep marsh with bulrush or cattails, and range from fairly small to several acres. Emergent marsh species such as *Typha* spp. and *Schoenoplectus* spp. dominate this system with an occasional scattering of tall *Carex* spp. and forbs that can vary from dense to open cover. Trees are generally absent and, if present, are scattered. Submergent wetlands include a variety of macrophytes.

Component Associations:
- *Nelumbo lutea* Herbaceous Vegetation (CEGL004323, G4?)
- *Nuphar advena - Nymphaea odorata* Herbaceous Vegetation (CEGL002386, G4G5)
- *Polygonum* spp. - Mixed Forbs Herbaceous Vegetation (CEGL002430, G4G5)
- *Potamogeton* spp. - *Ceratophyllum* spp. Midwest Herbaceous Vegetation (CEGL002282, G5)
- *Schoenoplectus acutus - (Schoenoplectus fluviatilis)* Freshwater Herbaceous Vegetation (CEGL002225, G4G5)
- *Schoenoplectus fluviatilis - Schoenoplectus* spp. Herbaceous Vegetation (CEGL002221, G3G4)
- *Typha* spp. - *Schoenoplectus acutus* - Mixed Herbs Midwest Herbaceous Vegetation (CEGL002229, G4?)
- *Typha* spp. Midwest Herbaceous Vegetation (CEGL002233, G5)
- *Zizania (aquatica, palustris)* Herbaceous Vegetation (CEGL002382, G3G4)

DISTRIBUTION

Range: This system is found in the northern Midwest and southern Canada.
Divisions: 201:C; 202:C
Nations: CA? , US
Subnations: IA, IL, IN, MI, MN, MO, ND, OH, ON?, SD, WI
Map Zones: 39:C, 40:C, 41:P, 42:C, 43:C, 44:P, 49:C, 50:C, 51:C, 52:C, 62:P
USFS Ecomap Regions: 222Ja:CCC, 222Jb:CCC, 222Jc:CCC, 222Je:CCC, 222Jg:CCC, 222Jh:CCC, 222Ji:CCC, 222Ua:CCC, 222Ud:CCC, 222Ue:CCC
TNC Ecoregions: 35:C, 36:C, 45:C, 46:C, 47:C, 48:C, 49:?

SOURCES

References: Comer and Albert 1997, Midwestern Ecology Working Group n.d.

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.732597#references
Description Author: Midwest Ecology Group
Version: 18 Jul 2006 **Stakeholders:** Canada, Midwest, Southeast
Concept Author: S. Menard **ClassifResp:** Midwest

NORTHERN ATLANTIC COASTAL PLAIN BRACKISH TIDAL MARSH (CES203.894)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Brackish (Mesohaline); Herbaceous; Tidal / Estuarine [Haline]; Graminoid
National Mapping Codes: ESLF 9272

CONCEPT

Summary: This system ranges from Massachusetts south to the Chesapeake drainage and is comprised of brackish marshes occurring on the portion of large tidal rivers and their tributaries where saltwater is mixed with freshwater. Vegetation typically exhibits zonation, with associations distributed by flooding frequency. Typical species include *Spartina alterniflora, Typha angustifolia, Agrostis stolonifera, Spartina cynosuroides*, and *Schoenoplectus americanus*.
Classification Comments: In contrast to Northern Atlantic Coastal Plain Tidal Salt Marsh (CES203.519), which this type grades into, brackish marshes are distinguished by being confined within a tidal river and by reduced cover of *Spartina patens* and increased cover of associated brackish marsh species such as *Schoenoplectus americanus, Typha angustifolia, Amaranthus cannabinus*, and *Polygonum* spp. Flats with low forbs will be dominated by plants such as *Sagittaria subulata* and *Limosella australis* rather than by the halophytes (*Salicornia* and *Sarcocornia* spp., for example) seen in salt marsh flats.
Similar Ecological Systems:
- Acadian Estuary Marsh (CES201.579)

DESCRIPTION

Environment: This vegetation develops on tidal reaches of large rivers where freshwater from inland alluvial inputs mixes with marine saltwater incursion. Salinity levels are variable but generally range from 0.5 to 18 ppt. These marshes most commonly form on freely drained river levees. The substrate is moderately consolidated peat (Barrett 1989).
Dynamics: Tidal flooding by mesohaline waters; alluvial deposition of sediments forms levees where this vegetation develops.

Component Associations:
- *Amaranthus cannabinus* Tidal Herbaceous Vegetation (CEGL006080, G3G5)
- *Sagittaria subulata - Limosella australis* Tidal Herbaceous Vegetation (CEGL004473, G2G4)
- *Schoenoplectus americanus - Spartina patens* Herbaceous Vegetation (CEGL006612, GNR)
- *Schoenoplectus pungens* Tidal Herbaceous Vegetation (CEGL004188, GNR)
- *Schoenoplectus robustus - Spartina alterniflora* Herbaceous Vegetation (CEGL006416, GNR)
- *Spartina alterniflora - Lilaeopsis chinensis* Herbaceous Vegetation (CEGL004193, G3G4)
- *Spartina alterniflora - Polygonum punctatum - Amaranthus cannabinus* Herbaceous Vegetation (CEGL006418, GNR)
- *Spartina cynosuroides* Herbaceous Vegetation (CEGL004195, G4)
- *Spartina patens - Agrostis stolonifera* Herbaceous Vegetation (CEGL006365, GNR)
- *Typha angustifolia - Hibiscus moscheutos* Herbaceous Vegetation (CEGL004201, G4G5)

DISTRIBUTION

Range: This system ranges from Massachusetts south to the Chesapeake drainage and the James River, Virginia.
Divisions: 203:C
Nations: US
Subnations: CT, DE, MA, MD, NJ, NY, RI, VA
Map Zones: 60:C, 65:C
TNC Ecoregions: 62:C

SOURCES

References: Angradi et al. 2001, Barrett 1989, Comer et al. 2003, Faber-Langendoen et al. 2011, Glick et al. 2008, Harshberger 1909, NYNHP 2013h
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722786#references
Description Author: L. Sneddon
Version: 10 Jan 2014 **Stakeholders:** East, Southeast
Concept Author: L. Sneddon **ClassifResp:** East

NORTHERN ATLANTIC COASTAL PLAIN FRESH AND OLIGOHALINE TIDAL MARSH (CES203.516)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Tidal / Estuarine; Graminoid
Non-Diagnostic Classifiers: Herbaceous
National Mapping Codes: ESLF 9293

CONCEPT

Summary: This system includes freshwater tidal vegetation occurring on the upper reaches of large rivers influenced by tidal flooding, but beyond the reach of the salt or brackish waters. The system is well-developed on the Chesapeake and Delaware Bay drainages, including the rivers of southern New Jersey, then extends northeast and includes inland portions of the Hudson, Connecticut, Merrimack, Kennebec, and Penobscot rivers and their tributaries. The vegetation includes tall marshes dominated by tall grasses such as *Zizania aquatica*, marshes of lower stature dominated by forbs such as *Amaranthus cannabinus, Hibiscus moscheutos* and others, and vegetation characterized by short-statured and rosette-forming forbs such as *Eriocaulon parkeri* and *Isoetes riparia*. Associations are distributed by proximity to tidal waters and thus duration and force of flooding. Sediments of more protected and isolated vegetation is comprised of finer-grained materials that are poorly drained, or of well-consolidated peat deposits. Vegetation exposed to greater flooding force and scouring action is supported by mineral substrates such as sand and gravel.

Similar Ecological Systems:
- Acadian Estuary Marsh (CES201.579)

Related Concepts:
- Freshwater Tidal Marsh (Gawler and Cutko 2010) Finer

DESCRIPTION

Environment: This system forms on the upper reaches of large rivers regularly inundated by tidal flooding but beyond the effects of saline waters.

Dynamics: This system is characterized by a mosaic of patches controlled by a combination of substrate particle size, amount of organic matter deposition, and the degree of stress (persistent natural processes) versus disturbance (episodic and disruptive processes) (Barrett 1994). Tidal amplitude in the Delaware Estuary supporting this system is approximately 2m.

Component Associations:
- *Acorus calamus* Tidal Herbaceous Vegetation (CEGL006833, GNR)
- *Alnus (incana ssp. rugosa, serrulata) - Cornus amomum* Shrubland (CEGL006337, GNR)
- *Alnus maritima ssp. maritima / Acorus calamus* Shrubland (CEGL006841, GNR)
- *Alnus serrulata - Salix nigra / Pilea (fontana, pumila)* Tidal Shrubland (CEGL006843, GNR)
- *Amaranthus cannabinus* Tidal Herbaceous Vegetation (CEGL006080, G3G5)
- *Amorpha fruticosa* Tidal Shrubland (CEGL006844, GNR)
- *Carex hyalinolepis* Tidal Herbaceous Vegetation (CEGL006177, GNR)
- *Decodon verticillatus* Semipermanently Flooded Shrubland (CEGL005089, GNR)
- *Eriocaulon parkeri - Polygonum punctatum* Herbaceous Vegetation (CEGL006352, G2)
- *Hibiscus moscheutos - Polygonum punctatum - Peltandra virginica* Tidal Herbaceous Vegetation (CEGL006181, GNR)
- *Impatiens capensis - Peltandra virginica - Polygonum arifolium - Schoenoplectus fluviatilis - Typha angustifolia* Tidal Herbaceous Vegetation (CEGL006325, GNR)
- *Isoetes riparia* Tidal Herbaceous Vegetation (CEGL006058, GNR)
- *Iva frutescens / Spartina cynosuroides* Tidal Shrubland (CEGL006847, GNR)
- *Justicia americana - Peltandra virginica* Herbaceous Vegetation (CEGL006579, GNR)
- *Morella cerifera - Baccharis halimifolia / Eleocharis fallax* Shrubland (CEGL006846, GNR)
- *Nelumbo lutea* Tidal Herbaceous Vegetation (CEGL006913, GNR)
- *Nuphar advena* Tidal Herbaceous Vegetation (CEGL004472, G4G5)
- *Nuphar sagittifolia* Tidal Herbaceous Vegetation (CEGL006094, G1G2)
- *Peltandra virginica - Pontederia cordata* Tidal Herbaceous Vegetation (CEGL004706, G3G4)
- *Peltandra virginica - Schoenoplectus (pungens, tabernaemontani)* Tidal Herbaceous Vegetation (CEGL006578, GNR)
- *Schoenoplectus pungens* Tidal Herbaceous Vegetation (CEGL004188, GNR)
- *Zizania aquatica* Tidal Herbaceous Vegetation (CEGL004202, G4?)

DISTRIBUTION

Range: This system is best developed on the Chesapeake and Delaware Bay drainages, including the rivers of southern New Jersey, but extends northeast and includes inland portions of the Hudson, Connecticut, Merrimack, Kennebec, and Penobscot rivers and their

tributaries.
Divisions: 203:C
Nations: US
Subnations: CT, DE, MA, MD, ME, NJ, NY, PA, VA
Map Zones: 60:C, 65:C, 66:C
USFS Ecomap Regions: 211D:CC, 221A:CC, 221B:CC, 232A:CC, 232B:CC
TNC Ecoregions: 58:C, 62:C, 63:C

SOURCES

References: Barrett 1994, Comer et al. 2003, Faber-Langendoen et al. 2011, NYNHP 2013d, Rhoads and Block 2011c, Zimmerman et al. 2012
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723075#references
Description Author: R. Evans and L.A. Sneddon, mod. S.C. Gawler
Version: 14 Jan 2014 **Stakeholders:** East, Southeast
Concept Author: R. Evans and L. Sneddon **ClassifResp:** East

NORTHERN ATLANTIC COASTAL PLAIN POND (CES203.518)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Non-Diagnostic Classifiers: Herbaceous; Depressional; Isolated Wetland [Partially Isolated]
National Mapping Codes: ESLF 9283

CONCEPT

Summary: This system includes vegetation of groundwater-flooded depressions characterized by a flora generally characteristic of the northeastern and mid-Atlantic Coastal Plain, with peripheral occurrences to southern Maine and southern Vermont. Also included in this system are ponds supporting coastal plain flora in southern Canada, and in scattered locations in the Great Lakes region. Ponds may contain permanent water, such as the deep glacial kettleholes of Cape Cod and Long Island, New York, or may be shallow basins where groundwater drops below the surface late in the growing season. This system occurs on porous deposits such as outwash plains of the glaciated region, and on sandy and silty sediments of the mid-Atlantic and Great Lakes region. Vegetation within this system varies from nearly forested to entirely herbaceous, largely dependent on the depth and duration of seasonal inundation. Overall the floristics are characterized by species that are well-adapted to long periods of submersion or inundation. The vegetation of steeper-sided basins (generally those containing permanent water) are characterized by strong zonation, with a border of tall shrubs, such as *Vaccinium corymbosum*, and several essentially concentric bands or zones dominated by different associations, depending on geography. Characteristic species in Massachusetts and Long Island include *Carex striata, Cyperus dentatus, Drosera filiformis, Euthamia caroliniana (= Euthamia tenuifolia), Fimbristylis autumnalis, Gratiola aurea, Juncus militaris, Juncus pelocarpus, Panicum verrucosum, Rhexia virginica, Rhynchospora capillacea, Rhynchospora macrostachya, Sabatia kennedyana, Scleria reticularis, Xyris difformis*, and many others. In very steep-sided ponds, zonation is compressed or nonexistent.

Ponds of the New Jersey Pine Barrens share many of these species, with others including *Juncus repens, Muhlenbergia torreyi, Rhynchospora cephalantha, Rhynchospora chalarocephala, Rhynchospora oligantha*, and many others. In shallow basins, such strong zonation is generally lacking but still remains evident in some cases. On Cape Cod, Long Island, and New Jersey, this system most often occurs within the pitch pine barrens. From Cape May and south, the system occurs within an upland matrix of mixed hardwood forests and generally supports a seasonally flooded swamp forest characterized by *Liquidambar styraciflua, Acer rubrum*, wetland oaks such as *Quercus palustris* and *Quercus phellos*, and in Virginia and scattered locations on the Inner Coastal Plain of Maryland *Nyssa biflora*. Shrub zones are characterized by *Cephalanthus occidentalis*, *Diospyros virginiana*, and *Leucothoe racemosa*. The vegetation includes many of the species from New England, New York and New Jersey and also *Boltonia asteroides*, *Carex joorii, Coelorachis rugosa, Dichanthelium spretum, Eleocharis quadrangulata, Fimbristylis perpusilla, Juncus repens, Rhynchospora corniculata, Saccharum baldwinii*, *Saccharum giganteum, Torreyochloa pallida*, and others. This system provides important habitat for the state-rare chicken turtle (*Deirochelys reticularia*) and three state-listed amphibians: Mabee's salamander (*Ambystoma mabeei*), tiger salamander (*Ambystoma tigrinum*), and barking tree frog (*Hyla gratiosa*). In addition, the globally rare plants *Fimbristylis perpusilla* and *Litsea aestivalis* are confined to these habitats in Virginia.
Classification Comments: In some cases, these are locally known as "Delmarva bays."
Similar Ecological Systems:
- Atlantic Coastal Plain Clay-Based Carolina Bay Wetland (CES203.245)
- Northern Atlantic Coastal Plain Pitch Pine Lowland (CES203.374)
- Southern Atlantic Coastal Plain Depression Pond (CES203.262)

Related Concepts:
- Three-way Sedge - Goldenrod Outwash Plain Pondshore (Gawler and Cutko 2010) Finer

DESCRIPTION

Environment: This system formed in shallow depressions on sand plains of the glaciated Northeast and mid-Atlantic Coastal Plain. Many examples are likely to be underlain with clay soil lens or dense organic material that limit drainage seasonally. In the Chesapeake Bay region, these wetlands are seasonally flooded and are believed to be sinkhole features that formed through dissolution of underlying carbonate-rich, shell marl deposits. The marl deposits are too deep to influence soil or water chemistry of the depressions, which are strongly acidic in most examples (Fleming et al. 2013).
Dynamics: The primary driver of this system is annual fluctuation of water levels, causing winter and spring flooding that prevent incursion of woody species, and late-season exposure when seed-banking annuals and perennial forbs and grasses emerge (Schneider 1994, NYNHP 2013g). Dry-season fires in adjacent uplands may spread into ponds and may be another factor limiting the invasion of woody species, although fire frequencies throughout the region have been much reduced in recent decades. Use of ponds as reservoirs for cranberry bogs causes contamination by returning water carrying nutrients and pesticides.

Component Associations:
- *Calamagrostis canadensis - Dichanthelium meridionale* - (Mixed Shrub) Herbaceous Vegetation (CEGL006243, GNR)
- *Carex striata var. brevis* Herbaceous Vegetation (CEGL004120, G3G4)

- *Cephalanthus occidentalis / Polygonum hydropiperoides - Panicum verrucosum* Shrubland (CEGL006242, G3?)
- *Cladium mariscoides - Coelorachis rugosa* Herbaceous Vegetation (CEGL006332, G1)
- *Cladium mariscoides - Eleocharis equisetoides* Herbaceous Vegetation (CEGL006016, GNR)
- *Decodon verticillatus / Triadenum virginicum* Shrubland (CEGL006087, GNR)
- *Decodon verticillatus* Semipermanently Flooded Shrubland (CEGL005089, GNR)
- *Dulichium arundinaceum - Juncus canadensis - Juncus pelocarpus* Herbaceous Vegetation (CEGL006415, GNR)
- *Eleocharis (obtusa, flavescens) - Eriocaulon aquaticum* Herbaceous Vegetation (CEGL006261, G3G5)
- *Eleocharis flavescens - Xyris difformis* Herbaceous Vegetation (CEGL006400, GNR)
- *Eragrostis hypnoides - Ludwigia sphaerocarpa - Polygonum hydropiperoides* Herbaceous Vegetation (CEGL006608, GNR)
- *Eriocaulon aquaticum - Lobelia dortmanna* Herbaceous Vegetation (CEGL006346, GNR)
- *Juncus militaris - Eriocaulon aquaticum* Herbaceous Vegetation (CEGL006345, GNR)
- *Juncus repens - Boltonia asteroides* Herbaceous Vegetation (CEGL006610, GNR)
- *Leersia hexandra - (Panicum verrucosum, Scleria reticularis)* Herbaceous Vegetation (CEGL004047, G2G3)
- *Liquidambar styraciflua - Acer rubrum - Nyssa biflora / Carex joorii* Forest (CEGL006223, G1G2)
- *Liquidambar styraciflua - Acer rubrum - Quercus phellos / Leucothoe racemosa* Forest (CEGL006110, G3)
- *Lysimachia terrestris - Dulichium arundinaceum - Rhexia virginica* Herbaceous Vegetation (CEGL006035, G2G3)
- *Nymphaea odorata - Eleocharis robbinsii* Herbaceous Vegetation (CEGL006086, G2)
- *Panicum hemitomon - Panicum verrucosum* Herbaceous Vegetation (CEGL006338, GNR)
- *Polygonum (hydropiperoides, punctatum) - Leersia* spp. Herbaceous Vegetation (CEGL004290, G4?)
- *Rhexia virginica - Crotalaria sagittalis* Herbaceous Vegetation (CEGL006300, G2)
- *Rhexia virginica - Panicum verrucosum* Herbaceous Vegetation (CEGL006264, G2G3)
- *Rhynchospora capitellata - Cyperus dentatus - Rhexia virginica - Xyris difformis* Herbaceous Vegetation (CEGL006210, G2)
- *Rhynchospora capitellata - Rhexia virginica - Rhynchospora scirpoides - Schoenoplectus hallii* Herbaceous Vegetation (CEGL005108, G2?)
- *Saccharum giganteum - (Dichanthelium spretum, Panicum verrucosum)* Herbaceous Vegetation (CEGL006609, G1G2)
- *Spartina pectinata* North Atlantic Coast Herbaceous Vegetation (CEGL006095, GNR)
- *Taxodium distichum - Nyssa (biflora, sylvatica) / Clethra alnifolia / Boehmeria cylindrica* Forest (CEGL006214, G2)
- *Vaccinium corymbosum - Rhododendron viscosum - Clethra alnifolia* Shrubland (CEGL006371, G3)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Northern Atlantic Coastal Plain Pitch Pine Barrens (CES203.269)

DISTRIBUTION

Range: This system ranges from the southern portion of the Delmarva peninsula to Cape Cod, Massachusetts, with scattered Coastal Plain occurrences north to southern Maine; also in limited, highly disjunct occurrences on sand lakeplain in Nova Scotia, near southern Lake Michigan and in southeastern Vermont. Outwash sandplains in the Connecticut River Valley of southern Massachusetts support a few degraded occurrences.
Divisions: 202:C; 203:C
Nations: CA, US
Subnations: DE, IN, MA, MD, ME, MI, NH, NJ, NS, NY, ON, VA, VT, WI
Map Zones: 49:?, 51:C, 60:C, 63:P, 64:P, 65:C
USFS Ecomap Regions: 212Ha:CCC, 212Hb:CCC, 212T:CC, 221A:CC, 222Ja:CCC, 222Jb:CCC, 222Jg:CCC, 222Jh:CCC, 222R:CC, 232A:CC
TNC Ecoregions: 48:C, 58:C, 61:C, 62:C

SOURCES

References: Comer et al. 2003, Eastern Ecology Working Group n.d., Faber-Langendoen et al. 2011, Fleming et al. 2013, Lundgren 1989, NYNHP 2013g, Schneider 1994, Sorrie 1994, Swain and Kearsley 2011, Wisheu and Keddy 1989, Zaremba and Lamont 1993, Zebryk 2004
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723074#references
Description Author: SC. Gawler, R. Evans, L.A. Sneddon, M. Pyne
Version: 14 Jan 2014 **Stakeholders:** Canada, East, Midwest, Southeast
Concept Author: S.C. Gawler, R. Evans, L. Sneddon, M. Pyne **ClassifResp:** East

NORTHERN ATLANTIC COASTAL PLAIN SEAGRASS BED (CES203.246)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Saltwater (Polyhaline); Tidal / Estuarine; Aquatic Herb
Non-Diagnostic Classifiers: Herbaceous
National Mapping Codes: ESLF 9273

CONCEPT

Summary: This ecological system represents submerged aquatic vegetation found in marine environments from Chesapeake Bay northward to the Maine coast. In contrast to Atlantic Coastal Plain Embayed Region Seagrass Bed (CES203.243) to the south, which can be generally characterized as *Zostera* - *Halodule*, this system is more typically characterized as *Zostera* - *Ruppia* (Thayer et al. 1984). A host of marine algae is also an important component of this system.

Similar Ecological Systems:

- Atlantic Coastal Plain Embayed Region Seagrass Bed (CES203.243)
- North Atlantic Tidal Sand Flat (CES201.049)

DESCRIPTION

Environment: Found in quiet, polyhaline waters of tidal embayments where saline fluctuations are relatively minor (Edinger et al. 2002).

Vegetation: The vegetation dominants are *Zostera* and *Ruppia* (Thayer et al. 1984) with some segregation along salinity gradients. *Zostera marina* is dominant in the most saline areas, while *Ruppia* tends to be most common in somewhat less saline water (Edinger et al. 2002) of the bay where salinity is highest. However, mixed beds of the two species do occur. Thayer et al. (1984) point out that these mixed beds of *Zostera* and *Ruppia* vary in seasonal dominance, with *Ruppia* largely replacing *Zostera* during the midsummer. A diverse array of algae are also present (Edinger et al. 2002).

Dynamics: The dynamics of tidal, aquatic communities dominated by vascular plants are complex and poorly understood. The distribution and abundance of vascular plants in these habitats are probably controlled by responses to water chemistry, water clarity and light penetration, the impact of currents and boat wakes, and herbivory by aquatic animals (Fleming et al. 2001).

Component Associations:

- *Ruppia maritima* Acadian/Virginian Zone Temperate Herbaceous Vegetation (CEGL006167, GNR)
- *Zostera marina* Herbaceous Vegetation (CEGL004336, G4G5)

DISTRIBUTION

Range: The southern boundary may need clarification. The conceptual boundary occurs where *Halodule* beds become important; it is presumed that this transition occurs at or around Cape Hatteras, North Carolina.

Divisions: 203:C
Nations: US
Subnations: CT, DE, MA, MD, ME, NH, NJ, NY, RI, VA
Map Zones: 60:C, 65:C, 66:C
TNC Ecoregions: 57:C, 58:C, 62:C

SOURCES

References: Comer et al. 2003, Edinger et al. 2002, Fleming et al. 2001, Orth and Moore 1988, Thayer et al. 1984

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723239#references

Description Author: R. Evans
Version: 23 Sep 2002
Concept Author: R. Evans
Stakeholders: East, Southeast
ClassifResp: East

NORTHERN ATLANTIC COASTAL PLAIN SUBTIDAL AQUATIC BED (CES203.521)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Tidal / Estuarine; Aquatic Herb
Non-Diagnostic Classifiers: Herbaceous
National Mapping Codes: ESLF 9280

CONCEPT

Summary: This system represents submerged aquatic beds of brackish - freshwater tidal upper bays, rivers, and tributaries, ranging from Chesapeake Bay northward to the Massachusetts coast. Typical species include *Stuckenia pectinata, Potamogeton perfoliatus, Zannichellia palustris*, and others.

DESCRIPTION

Vegetation: Typical species in examples of this system include *Stuckenia pectinata, Potamogeton perfoliatus, Zannichellia palustris*, and others.

Component Associations:
- *Ceratophyllum demersum - Utricularia macrorhiza - Nymphaea odorata* Herbaceous Vegetation (CEGL004661, G3?)
- *Ceratophyllum demersum - Vallisneria americana - Najas* spp. Tidal Herbaceous Vegetation (CEGL006048, GNR)
- *Potamogeton* spp. - *Ceratophyllum demersum - Crassula aquatica* Herbaceous Vegetation (CEGL006340, GNR)
- *Stuckenia pectinata - Potamogeton perfoliatus - (Zannichellia palustris)* Tidal Herbaceous Vegetation (CEGL006027, G3G5)

DISTRIBUTION

Range: This system ranges from Chesapeake Bay northward to the Maine coast.
Divisions: 203:C
Nations: US
Subnations: CT, DE, MA, MD, ME, NH, NJ, NY, RI?, VA
Map Zones: 60:C, 65:C, 66:C
USFS Ecomap Regions: 211D:CC, 221A:CC, 232A:CC, 232H:CC, 232I:CP
TNC Ecoregions: 58:C, 62:C

SOURCES

References: Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723071#references
Description Author: R. Evans
Version: 05 Feb 2009
Concept Author: R. Evans
Stakeholders: East, Southeast
ClassifResp: East

NORTHERN ATLANTIC COASTAL PLAIN TIDAL SALT MARSH (CES203.519)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: North Atlantic Coastal Plain; Tidal / Estuarine; Graminoid
Non-Diagnostic Classifiers: Herbaceous
National Mapping Codes: ESLF 9282

CONCEPT

Summary: This system encompasses the mesohaline to saline intertidal marshes of the North Atlantic Coastal Plain, ranging from Chesapeake Bay north to Cape Cod, Massachusetts, and sporadically to the southern Maine coast. It includes a number of different broad vegetation types including salt pannes, salt marshes, and salt shrublands. This system occurs on the bay side of barrier beaches and the outer mouth of tidal rivers where salinity is not much diluted by freshwater input. The typical salt marsh profile, from sea to land, can be summarized as follows: a low regularly flooded marsh strongly dominated by *Spartina alterniflora*; a higher irregularly flooded marsh dominated by *Spartina patens* and *Distichlis spicata*; low hypersaline pannes characterized by *Salicornia* spp.; and a salt scrub ecotone characterized by *Iva frutescens, Baccharis halimifolia*, and *Panicum virgatum*. Salt marsh "islands" of slightly higher elevation also support *Juniperus virginiana*. This system also includes the rare sea-level fen vegetation, which occurs at the upper reaches of the salt marsh where groundwater seepage creates a freshwater fen that differs from other poor fens in its generally higher species richness, absence of *Chamaedaphne calyculata*, and presence of *Eleocharis rostellata* and *Cladium mariscoides*.
Classification Comments: A continuous gradation in salinity presents challenges in separating salt from brackish marsh systems. This system is defined by its landscape position in saltwater bays and outer river mouths as well as actual salinity ranges. Moving up a tidal river, brackish marshes have less cover of *Spartina patens* and increased cover of associated species including tall graminoids such as *Schoenoplectus americanus* and *Typha angustifolia*. Further southward along the East Coast, salt and brackish marshes fall within the same system because the differences in hydrodynamics and landforms in that region produce less distinct habitats.
Similar Ecological Systems:
- Acadian Coastal Salt Marsh (CES201.578)

Related Concepts:
- Loblolly Pine: 81 (Eyre 1980) Finer
- Mixed Graminoid - Forb Saltmarsh (Gawler and Cutko 2010) Finer
- Spartina Saltmarsh (Gawler and Cutko 2010) Finer

DESCRIPTION

Environment: Forms behind barrier beaches or at the outer mouths of tidal rivers where freshwater input is minimal and where vegetation is protected from high-energy wave action. Substrate is organic peat, which can reach 1-2 m in depth in low marsh.
Dynamics: Tidal flooding regulated by elevation; flooding is diurnal in low marshes, decreasing to more irregular flooding in high marsh and fringing salt shrublands. Ponded water remains in depressions, causing hypersaline conditions and panne formation.

Component Associations:
- *Baccharis halimifolia - Iva frutescens / Panicum virgatum* Shrubland (CEGL003921, G5)
- *Cladium mariscoides - Drosera intermedia - Eleocharis rostellata* Herbaceous Vegetation (CEGL006310, G1)
- *Eleocharis rostellata - Spartina patens* Herbaceous Vegetation (CEGL006611, GNR)
- *Iva frutescens / Spartina patens* Shrubland (CEGL006848, G5)
- *Juncus roemerianus* Herbaceous Vegetation (CEGL004186, G5)
- *Morella cerifera / Spartina patens* Shrubland (CEGL003839, G3G4)
- *Panicum virgatum - Spartina patens - Carex silicea* Herbaceous Vegetation (CEGL006150, GNR)
- *Pinus taeda / Morella cerifera / Spartina patens* Tidal Woodland (CEGL006849, GNR)
- *Ruppia maritima - Stuckenia pectinata* Herbaceous Vegetation (CEGL006370, GNR)
- *Salicornia (virginica, bigelovii, maritima) - Spartina alterniflora* Herbaceous Vegetation (CEGL004308, G5)
- *Schoenoplectus pungens - Eleocharis parvula* Herbaceous Vegetation (CEGL006398, GNR)
- *Spartina alterniflora - Distichlis spicata* Tidal Herbaceous Vegetation (CEGL006586, GNR)
- *Spartina alterniflora / (Ascophyllum nodosum)* Acadian/Virginian Zone Herbaceous Vegetation (CEGL004192, G5)
- *Spartina patens - Distichlis spicata - (Juncus gerardii)* Herbaceous Vegetation (CEGL006006, G5)
- *Spartina patens - Distichlis spicata - (Juncus roemerianus)* Herbaceous Vegetation (CEGL004197, G4G5)
- *Spartina patens - Festuca rubra - (Spartina pectinata)* Herbaceous Vegetation (CEGL006368, GNR)
- *Spartina patens - Thinopyrum pycnanthum* Herbaceous Vegetation (CEGL006149, GNR)

DISTRIBUTION

Range: This system is found from the southern Maine coast south to the Chesapeake Bay.

Divisions: 202:C; 203:C
Nations: US
Subnations: CT, DE, MA, MD, ME, NH, NJ, NY, RI, VA
Map Zones: 60:C, 65:C, 66:C
TNC Ecoregions: 58:C, 62:C

SOURCES

References: Boon 2012, Comer et al. 2003, Faber-Langendoen et al. 2011, Kennish 2001, Manomet Center for Conservation Sciences and the National Wildlife Federation 2012, Sallenger et al. 2012

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723073#references

Description Author: R. Evans, mod. S.C. Gawler and L.A. Sneddon
Version: 14 Jan 2014 **Stakeholders:** East, Southeast
Concept Author: R. Evans **ClassifResp:** East

NORTHERN CALIFORNIA CLAYPAN VERNAL POOL (CES206.948)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Circumneutral Water; Saline Water Chemistry; Impermeable Layer; Vernal Pool Mosaic; Depressional; Forb
Non-Diagnostic Classifiers: Shallow (<15 cm) Water; Intermittent Flooding; Lowland [Foothill]; Lowland [Lowland]; Herbaceous; Mediterranean [Mediterranean Xeric-Oceanic]; Isolated Wetland [Strictly Isolated]; Depression
National Mapping Codes: ESLF 9251

CONCEPT

Summary: These systems are shallow ephemeral waterbodies found in depressions (up to several hectares in size) among grasslands and open woodlands throughout the northern Central Valley of California. Northern claypan vernal pools include a clay hardpan that retains water inputs throughout some portion of the spring, but typically the depression dries down entirely into early summer months. They tend to be circumneutral to alkaline and slightly saline wetlands with characteristic plant species including *Downingia bella, Downingia insignis, Cressa truxillensis, Plagiobothrys leptocladus (= Allocarya leptoclada), Pogogyne douglasii, Eryngium aristulatum, Veronica peregrina, Lasthenia ferrisiae, Lasthenia glaberrima*, and *Spergularia salina (= Spergularia marina)*. Due to draw-down characteristics, vernal pools typically form concentric rings of similar forb-rich vegetation. Given their relative isolation in upland-dominated landscapes, many endemic and Federally-listed plant species are common in California vernal pools.
Related Concepts:
- Valley Grassland (215) (Shiflet 1994) Intersecting. The SRM valley grassland includes vernal pools and serpentine seeps occurring in Central Valley grassland areas.

DESCRIPTION

Environment: These systems are shallow ephemeral waterbodies found in depressions (up to several hectares in size) among grasslands and open woodlands throughout the northern Central Valley of California. Northern claypan vernal pools include a clay hardpan that retains water inputs throughout some portion of the spring, but typically the depression dries down entirely into early summer months. They tend to be circumneutral to alkaline and slightly saline wetlands. Pool depth rarely exceeds 50 cm (Solomeshch et al. 2007).
Dynamics: Vernal pools are precipitation-filled seasonal wetlands inundated during the growing season, allowing for plant growth, followed by a brief water-logged terrestrial stage and culminating in complete drying of surface and subsurface soils. Inundation during the growing season eliminates establishment of upland species in the pool basins and the dry period prevents the establishment of many typical wetland taxa (Keeley and Zedler 1998). Pool filling is a combination of direct precipitation and lateral flow among pools within a complex of pools and subsurface flow from uplands which buffers pool volume, keeping them filled into the dry season (Hanes and Stromberg 1998). Subsurface soils have a hard pan of clay that prevents drainage. What is unique about vernal pools is the seasonality of the wetting period followed by the desiccation period, which generally is supported by a Mediterranean climate (Keeley and Zedler 1998) and resulted in development of diverse and highly endemic vegetation (Barbour et al. 2003, 2005, Solomeshch et al. 2007). Natural fire regimes for vernal pools are generally unknown, but are assumed to be similar to their surrounding upland grassland fire regimes (Wills 2006). Fire can have a positive effect on vernal pool vegetation as it can results in robust response by native grasses and can reduce non-native invasive woody and non-native herbaceous species (Pollak and Kan 1998).

DISTRIBUTION

Range: Found in depressions among grasslands and open woodlands throughout the northern Central Valley of California.
Divisions: 206:C
Nations: US
Subnations: CA, OR
Map Zones: 2:P, 5:C, 7:C
USFS Ecomap Regions: 262A:CC, M261C:??, M261F:??
TNC Ecoregions: 13:C

SOURCES

References: Barbour 1998, Barbour and Major 1988, Barbour et al. 2003, Barbour et al. 2005, Bjork and Dunwiddie 2004, Brown 1999, Calderaro 2011, Comer et al. 2003, Dlugolecki 2010, Hanes and Stromberg 1998, Holland 1998, Holland 2009, Holland and Keil 1995, Keeley and Zedler 1998, Marty 2005, Pollak and Kan 1998, PRBO Conservation Science 2011, Robins and Vollmar 2002, Rocchio pers. comm., Sawyer and Keeler-Wolf 1995, Shiflet 1994, Solomeshch et al. 2007, Wills 2006
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722733#references
Description Author: P. Comer and T. Keeler-Wolf, mod. G. Kittel
Version: 14 Jan 2014 **Stakeholders:** West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

NORTHERN CALIFORNIA VOLCANIC VERNAL POOL (CES206.949)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Shallow (<15 cm) Water; Impermeable Layer; Intermittent Flooding; Vernal Pool Mosaic; Mediterranean [Mediterranean Xeric-Oceanic]; Depressional; Forb
Non-Diagnostic Classifiers: Montane [Lower Montane]; Lowland [Foothill]; Herbaceous; Isolated Wetland [Strictly Isolated]; Depression
National Mapping Codes: ESLF 9250

CONCEPT

Summary: These systems are shallow ephemeral waterbodies found in very small depressions (typically no larger than 50 square meters) throughout foothills of the southern Cascades and Sierra Nevada. Where short inundation periods are characteristic, *Lasthenia californica, Downingia bicornuta, Psathyrotes* spp., and *Sedella* spp. (= *Parvisedum* spp.) are often present. Where longer inundation periods are characteristic, *Eryngium constancei* and *Eleocharis acicularis* may be found. They are often on solid volcanic bedrock, but also can be found on volcanic ash flows (lahars) over bedrock.

DESCRIPTION

Environment: These pools are often on solid volcanic bedrock, but also can be found on volcanic ash flows (lahars) over bedrock. Hydrologically, they vary from flashy to more persistent hydrological regimes, typically due to the amount and periodicity of precipitation received. Where hydrology is flashy, they fill and evaporate rapidly several times during the wet season. Typically these vernal pools do not support species requiring long inundation periods. Those on volcanic ash flows are less flashy and have pools that are larger and deeper.
Dynamics: Vernal pools are precipitation-filled seasonal wetlands inundated during the growing season, allowing for plant growth, followed by a brief water-logged terrestrial stage and culminating in complete drying of surface and subsurface soils. Inundation during the growing season eliminates establishment of upland species in the pool basins and the dry period prevents the establishment of many typical wetland taxa (Keeley and Zedler 1998). Pool filling is a combination of direct precipitation (Hanes and Stromberg 1998). Soils are shallow with underlain by volcanic substrates that prevents drainage. What is unique about vernal pools is the seasonality of the wetting period followed by the desiccation period, which generally is supported by a Mediterranean climate (Keeley and Zedler 1998) and resulted in development of diverse and highly endemic vegetation (Barbour et al. 2003, 2005, Solomeshch et al. 2007). Natural fire regimes for vernal pools are generally unknown, but are assumed to be similar to their surrounding upland grassland fire regimes (Wills 2006). Fire can have a positive effect on vernal pool vegetation as it can results in robust response by native grasses and can reduce non-native invasive woody and non-native herbaceous species (Pollak and Kan 1998).

DISTRIBUTION

Range: Throughout foothills of the southern Cascades and Sierra Nevada.
Divisions: 204:?; 206:C
Nations: US
Subnations: CA, OR
Map Zones: 6:C, 7:C
USFS Ecomap Regions: M261D:PP, M261E:PP, M261G:PP
TNC Ecoregions: 4:C, 5:P, 12:C

SOURCES

References: Barbour and Major 1988, Comer et al. 2003, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995, Wills 2006
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722732#references
Description Author: P. Comer and T. Keeler-Wolf, mod. G. Kittel
Version: 14 Jan 2014 **Stakeholders:** West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

NORTHERN COLUMBIA PLATEAU BASALT POTHOLE POND (CES304.058)

CLASSIFIERS

Conf.: 3 - Weak
Classification Status: Standard
Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Impermeable Layer; Depressional
Non-Diagnostic Classifiers: Short (50-100 yrs) Persistence; Herbaceous; Mediterranean [Mediterranean Xeric-Oceanic]; Temperate [Temperate Oceanic]; Isolated Wetland [Strictly Isolated]; Consolidated
National Mapping Codes: ESLF 9233

CONCEPT

Summary: This system includes shallow freshwater water bodies found in small depressions gouged into basalt by Pleistocene floods. These are found throughout channeled scablands of the Columbia Plateau in Washington's eastern Columbia River Gorge. They typically occupy the bottom of a basalt cliff (1-20+ m tall) lined circular or linear depression. Characteristic shoreline vegetation lining the aquatic environment is an emergent marsh that includes species of *Scirpus* and/or *Schoenoplectus, Typha, Juncus, Potamogeton, Polygonum, Nuphar*, and *Phalaris*. This system may also include areas of relatively deep water with floating-leaved plants (*Lemna, Potamogeton*, and *Brasenia*). Woody plants, including *Populus tremuloides, Salix exigua, Crataegus douglasii*, or *Rosa woodsii*, are present adjacent to more northerly potholes. Ponds are within *Artemisia* shrub-steppe and *Pinus ponderosa* savanna or woodland. The wetland vegetation occupies a narrow zone (0.5-10 m) between open water and upland vegetation.
Classification Comments: This may be a subset of North American Arid West Emergent Marsh (CES300.729), or it could be a freshwater aquatic system with primarily zoological species composition (amphibians and invertebrates).

Component Associations:
- *Carex utriculata* Herbaceous Vegetation (CEGL001562, G5)
- *Carex vesicaria* Herbaceous Vegetation (CEGL002661, G4Q)
- *Juncus balticus* Herbaceous Vegetation (CEGL001838, G5)
- *Lemna* spp. Western North American Aquatic Vegetation (CEGL005450, G5)
- *Nuphar polysepala* Herbaceous Vegetation (CEGL002001, G5)
- *Phalaris arundinacea* Western Herbaceous Vegetation (CEGL001474, G5)
- *Phragmites australis* Western North America Temperate Semi-natural Herbaceous Vegetation (CEGL001475, G5)
- *Schoenoplectus acutus* Herbaceous Vegetation (CEGL001840, G5)
- *Schoenoplectus americanus* Western Herbaceous Vegetation (CEGL001841, G3Q)
- *Schoenoplectus maritimus* Herbaceous Vegetation (CEGL001843, G4)
- *Schoenoplectus tabernaemontani* Temperate Herbaceous Vegetation (CEGL002623, G5)
- *Typha (latifolia, angustifolia)* Western Herbaceous Vegetation (CEGL002010, G5)

SPATIAL CHARACTERISTICS

Size: Depressions (50-10,000 sq m)
Adjacent Ecological System Comments: Primarily Inter-Mountain Basins Big Sagebrush Steppe (CES304.778) and Columbia Plateau Scabland Shrubland (CES304.770).

DISTRIBUTION

Range: Restricted to the northern Columbia Plateau ecoregion commonly called the Columbia Basin.
Divisions: 304:C
Nations: US
Subnations: OR, WA
Map Zones: 7:C, 8:C, 9:P
USFS Ecomap Regions: 342H:CP, 342I:CC, M333A:??
TNC Ecoregions: 6:C, 68:P

SOURCES

References: Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722653#references
Description Author: R. Crawford
Version: 08 Sep 2005
Stakeholders: West
Concept Author: R. Crawford
ClassifResp: West

NORTHERN GREAT LAKES COASTAL MARSH (CES201.722)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Laurentian-Acadian (201)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Non-Diagnostic Classifiers: Herbaceous
National Mapping Codes: ESLF 9296

CONCEPT

Summary: This system is found throughout the northern Great Lakes Basin in the United States and Canada. This system, which can include many associated wetlands, occurs along the Great Lakes shoreline directly affected by Great Lakes water regimes. Species distributions and community patterns are determined by multiple abiotic factors, including Great Lakes water-level fluctuations, surficial bedrock, glacial landform, climate, and land use. Although wetland species are generally widely distributed, those of more boreal and subarctic regions are found in the northern parts of the basin.

Vegetation types found across this diverse set of abiotic factors vary in any number of ways, but they can be placed into a number of zones, though not all are present at a given site. The first four zones are typically inundated directly by lake waters: (a) submergent marsh; (b) emergent marsh; (c) shore fen; and (d) shoreline or strand. The next set of zones are inland from the water's edge and include: (e) herbaceous and shrubby wet meadows and (f) shrub or wooded swamps.

This system can be divided into a number of geographical variants, based on the various community types found across the range of the system: (1) Lake Superior Poor Fen; (2) Northern Rich Fen; (3) Northern Great Lakes Marsh; (4) Green Bay Disturbed Marsh; (5) Lake Michigan Lacustrine Estuary; (6) Saginaw Bay Lakeplain Marsh; (7) Lake Erie-St. Clair Lakeplain Marsh; (8) Lake Ontario Lagoon Marsh; and (9) St Lawrence River Estuary.
Classification Comments: Differs from Great Lakes Freshwater Estuary and Delta (CES202.033) based on its lakeshore setting; the estuary system occurs along rivers, where there is typically more nutrient (e.g., from silts).
Similar Ecological Systems:
- Great Lakes Freshwater Estuary and Delta (CES202.033)

DESCRIPTION

Environment: Species distributions and community patterns are determined by multiple abiotic factors. Great Lakes water-level fluctuations, surficial bedrock, glacial landform, climate, and land use. Great Lakes water level fluctuate over at least three temporal time scales: first, short-term fluctuations caused by winds or barometric pressures; second, seasonal fluctuations reflecting the annual hydrologic cycle in the basin; and third, interannual fluctuations in lake level as a result of variable precipitation and evaporation within the drainage basin. Interannual fluctuations can be as much as 1.3-2.5 m, with apparently little or no periodicity. These fluctuations, which also alter turbidity, nutrient availability, ice scour zones, etc., cause locational shifts in vegetation zones, but also in the composition of these zones, as species have individual tolerance limits.

The major bedrock distinction in the Great Lakes Basin is between igneous and metamorphic bedrock of the Precambrian period and younger (Paleozoic) sedimentary bedrock. The igneous and metamorphic bedrock form the rugged north shore of Lake Superior and Georgian Bay, and line much of the St. Lawrence River; they are locally present on the south shore of western Lake Superior. They lack the shallow protected waters and fine-textured substrates that support broad coastal wetlands. Where such bedrock is at or near the surface, it forms soils that are nutrient-poor and acidic. The rest of the basin is dominated by softer, sedimentary bedrock, which, with its broad, horizontal depositions, favors broad zones of shallow waters. The sedimentary rocks are typically more alkaline (calcareous), forming soils that are nutrient- and moisture-rich loams and clays. Bedrock patterns are overlaid by glacial landforms that, in combination with recent long-shore transport processes, create the prevalent physiographic features of the shorelines. In the lakes themselves, sand lakeplains, clay lakeplains, and moraines are shaped by currents, and the long-shore transportation of sediments has created sand-spit embayments and swales, dune-swale complexes, and tombolos. Channels and rivers contain channel-side wetlands, embayments, and deltas, and estuaries form as either open or barred river mouths. It is this diversity of landforms that has given rise to a diverse set of vegetation types.

Finally, regional patterns of climate affect the basin. The strong latitudinal gradient from southern Lake Erie to northern Lake Superior creates marked differences in length of growing season and solar radiation. Although wetland species are generally widely distributed, those of more boreal and subarctic regions are found in the northern parts of the basin, whereas those of more temperate and prairie regions are found in the southern parts.
Vegetation: Vegetation types found across this diverse set of abiotic factors vary in any number of ways, but they can be placed into a number of zones, though not all are present at a given site. The first four zones are typically inundated directly by lake waters: (a) submergent marsh - containing submergent and/or floating vegetation; (b) emergent marsh - characterized by shallow water or semipermanently flooded soils, and typically dominated by bulrushes, cattails, and other emergent species, but also containing submergent and/or floating vegetation; (c) shore fen - saturated vegetation mats characterized by groundwater influence from shoreline habitats but affected by lake level fluctuations, and dominated by herbaceous or shrubby species; and (d) shoreline or strand

- a narrow zone at or just above the water level where seasonal water-level fluctuations and waves cause erosion, and which is dominated by annual or pioneer herbaceous species. The next set of zones are inland from the water's edge and include: (e) herbaceous and shrubby wet meadows - characterized by saturated or seasonally flooded soils, and typically dominated by sedges, grasses, and other herbs, but occasionally dominated by shrubs; and (f) shrub or wooded swamps - characterized by seasonal flooding and dominated by woody species. Species assemblages in these zones change depending on the interaction of factors across the Great Lakes Basin.

Component Associations:
- *Calamagrostis canadensis - Carex viridula - Cladium mariscoides - Lobelia kalmii* Herbaceous Vegetation (CEGL005115, G1G2)
- *Carex utriculata - Carex lacustris - (Carex vesicaria, Carex stricta)* Herbaceous Vegetation (CEGL002257, G4G5)
- *Dasiphora fruticosa ssp. floribunda - Myrica gale* Rich Shore Fen Shrubland (CEGL005275, G1G2)
- *Nuphar advena - Nymphaea odorata* Herbaceous Vegetation (CEGL002386, G4G5)
- *Potamogeton gramineus - Potamogeton natans* Northern Great Lakes Shore Herbaceous Vegetation (CEGL005273, G3?)
- *Potamogeton zosteriformis - Ceratophyllum demersum - Elodea canadensis* Southern Great Lakes Shore Herbaceous Vegetation (CEGL005152, G3G4)
- *Schoenoplectus acutus - Schoenoplectus subterminalis - Eleocharis palustris - (Schoenoplectus americanus)* Northern Great Lakes Shore Herbaceous Vegetation (CEGL005274, G3?)

DISTRIBUTION

Range: This system is found throughout the northern Great Lakes Basin in the United States and Canada.
Divisions: 201:C
Nations: CA, US
Subnations: MI, ON, WI
Map Zones: 41:C, 49:?, 50:C, 51:C
USFS Ecomap Regions: 212Ha:CCC, 212Hf:CCC, 212Hj:CCC, 212Hl:CCC, 212J:CC, 212Lb:CCP, 212Ra:CCC, 212Rc:CCC, 212Rd:CCC, 212Re:CCC, 212Sc:CCC, 212Sn:CCC, 212Sq:CCC, 212Te:CCC, 212Tf:CCC, 212Y:CC, 212Z:CC, 222Ja:CCC, 222Ua:CCC, 222Ud:CCC, 222Ue:CCC
TNC Ecoregions: 48:C

SOURCES

References: Comer et al. 2003, Minc and Albert 1998
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722948#references
Description Author: D. Albert
Version: 11 Apr 2007 **Stakeholders:** Canada, East, Midwest
Concept Author: D. Albert **ClassifResp:** Midwest

NORTHERN GREAT LAKES INTERDUNAL WETLAND (CES201.034)

CLASSIFIERS

Classification Status: Standard

Primary Division: Laurentian-Acadian (201)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Intermittent Flooding; Coastal Dune Mosaic; Mineral: W/ A-Horizon <10 cm
Non-Diagnostic Classifiers: Herbaceous; Depressional [Lakeshore]; Isolated Wetland [Partially Isolated]
National Mapping Codes: ESLF 9269

CONCEPT

Summary: This system occurs in scattered location along the northern Great Lakes shoreline with scattered occurrences along southern Lake Michigan where coastal dunes are low and support swales close to lake water levels. The swale immediately behind the foredune is influenced by short-term variation in lake levels and can be partially or occasionally completely filled by dune sands following major storm events. Species common to this first swale include *Juncus balticus, Juncus pelocarpus, Juncus nodosus, Eleocharis acicularis*, species of *Solidago* such as *Oligoneuron houghtonii (= Solidago houghtonii)*, and *Schoenoplectus americanus (= Scirpus americanus)*. Often, such swales contain lake-influenced, calcareous sands, and the shallow swale may contain moderately alkaline indicators, such as *Argentina anserina (= Potentilla anserina), Cladium mariscoides, Dasiphora fruticosa ssp. floribunda (= Pentaphylloides floribunda), Euthamia graminifolia, Hypericum kalmianum, Lobelia kalmii, Myrica gale, Rhynchospora capillacea, Thuja occidentalis*, and *Utricularia cornuta*, and others.
Classification Comments: While this type is most commonly described from the northern Great Lakes region, there are likely more occurrences across the southern half of the Great Lakes that may vary in floristic composition from the type described here. Interdunal wetlands are treated as a separate type from dune and swale because in more active wave environments there are single swales immediately adjacent to the shore, with no series of swales/ridges further inlands (D. Albert pers. comm.). The flora is typically herb-dominated and the dynamics are extreme due to water-level fluctuations (D. Albert pers. comm.).
Similar Ecological Systems:
- Great Lakes Wooded Dune and Swale (CES201.726)

DESCRIPTION

Environment: This system is found on the Great Lakes shoreline where coastal dunes are low and support swales close to lake water levels. This occurs mostly on the northern Great Lakes but there are examples around southern Lake Michigan. Soils are usually sands but some sites occur on loams or clays (Kost et al. 2007). The swale immediately behind the foredune is influenced by short-term variation in lake levels. Interdunal wetlands can be partially or occasionally completely filled by dune sands following major storm events. Some sites receive groundwater seepage or are formed adjacent to rivers flowing into the Great Lakes.
Dynamics: This system is affected by short-term variation in Great Lake levels, storm events that may partially or completely fill in stands. Sites draw-down and dry out in response to Great Lakes water level variation or, in smaller, shallower ponds, during the summer. Many stands are small and shallow enough that they do not show pronounced zonation in species composition, but deeper and large stands can have "rings" of vegetation around them (Herbert et al. 1986, Kost et al. 2007). Individual examples can move as the dunes are moved by wind. This dynamic system recovers from disturbance quickly if the underlying habitat variables are still present.

Component Associations:
- *Dasiphora fruticosa ssp. floribunda / Cladium mariscoides - Juncus balticus - (Rhynchospora capillacea)* Herbaceous Vegetation (CEGL005105, G3?)

SPATIAL CHARACTERISTICS

Spatial Summary: small, sometimes linear patches
Size: <0.5 up to 10s of acres
Adjacent Ecological Systems:
- Great Lakes Sand Beach (CES201.149)

Adjacent Ecological System Comments: Open dunes

DISTRIBUTION

Range: This system occurs in scattered locations along the northern Great Lakes shoreline with scattered locations around southern Lake Michigan.
Divisions: 201:C; 202:?
Nations: CA, US
Subnations: IN, MI, ON, WI
Map Zones: 49:?, 50:C, 51:C
USFS Ecomap Regions: 212Ha:CCC, 212Hf:CCC, 212Hj:CCC, 212Hl:CCC, 212Ra:CCC, 212Rc:CCC, 212Rd:CCP, 212Re:CCC, 212Sb:CCC, 212Sc:CCC, 212Sn:CCC, 212Sq:CCC, 212Te:CCC, 212Ya:CCP, 222Ja:CCC, 222Ud:CCC, 222Ue:CCC

TNC Ecoregions: 48:C

SOURCES

References: Comer and Albert 1993, Comer and Albert 1997, Comer et al. 2003, Herbert et al. 1986, Kost et al. 2007, WNHI 2012

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722673#references

Description Author: P. Comer, mod. J. Drake

Version: 14 Jan 2014 **Stakeholders:** Canada, Midwest

Concept Author: P. Comer **ClassifResp:** Midwest

NORTHERN GULF OF MEXICO SEAGRASS BED (CES203.263)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Tidal / Estuarine; Aquatic Herb
Non-Diagnostic Classifiers: Herbaceous
National Mapping Codes: ESLF 9267

CONCEPT

Summary: Northern Gulf of Mexico seagrass beds are found behind protective barrier islands and in near-shore areas ranging about 560 km (350 miles) from the panhandle of Florida (approximately St. Marks National Wildlife Refuge, Lighthouse Point) westward to Mississippi. Within this area, the drowned alluvial plain and barriers protect the seagrass beds from normal storm surges; such protection is absent in the region immediately to the east. However, such protection alone is insufficient to allow for development of expansive beds. The total acreage of submerged vegetation in this region is relatively small, and individual patches rarely exceed several thousand acres. Beds are locally abundant in St. Joseph Bay, St. Andrews Bay, Santa Rosa Sound, Perdido Bay, Mississippi Sound, and the Chandeleur Islands of Louisiana. Of the true seagrasses, *Ruppia maritima* displays the most tolerance to freshwater and consequently is an important component of this system. *Vallisneria americana*, which is not often considered a true seagrass, is a component of this system due to the prevalence of oligohaline waters. The other species, *Halodule, Thalassia,* and *Cymodocea,* are also present, usually in monospecific, typically small beds.

Similar Ecological Systems:
- East Gulf Coastal Plain Florida Big Bend Seagrass Bed (CES203.244)
- Southwest Florida Seagrass Bed (CES203.274)

Related Concepts:
- Seagrass Bed (FNAI 1990) Broader

DESCRIPTION

Environment: The largely temperate climate of the region tests the limits of many of the seagrass species which attain their best development in tropical climes. Further, the prevalence of sandy substrates is not optimal for rooting of most species which prefer softer, even mucky sediments. Finally, salinity in this region is dramatically affected by freshwater inputs from the Apalachicola, Mobile, and the Mississippi rivers, in the vicinity of which seagrasses are generally absent. Although most seagrasses are able to tolerate fluctuations in salinity, optimum salt concentrations vary by species. Long periods of exposure to freshwater kill seagrass leaves, rhizomes, and eventually decimate the entire plant (Wieland 1994a). Due to the large freshwater inputs in this system, Vallisneria americana, which is not often considered a true seagrass, is a component of this system, found in oligohaline waters.
Dynamics: *Thalassia* and *Cymodocea* do not grow in areas with low salinity levels (less than 17 ppt); significant leaf loss can occur at these levels. *Thalassia* does not photosynthesize well in less than full strength sea water (Zieman and Zieman 1989). Both species may be more damaged by the effects of freshwater runoff resulting from hurricanes than from high winds and tidal surges (Thomas et al. 1961a).

Component Associations:
- *Cymodocea filiformis - (Thalassia testudinum)* Herbaceous Vegetation (CEGL004317, G4?)
- *Halodule wrightii* Herbaceous Vegetation (CEGL004318, G4?)
- *Ruppia maritima* Louisianian Zone Herbaceous Vegetation (CEGL004450, G4G5)
- *Thalassia testudinum* Herbaceous Vegetation (CEGL004319, G4?)
- *Vallisneria americana* Estuarine Bayou Herbaceous Vegetation (CEGL004634, G3G5)

DISTRIBUTION

Range: Northern Gulf of Mexico seagrass beds range from the panhandle of Florida (approximately St. Marks National Wildlife Refuge, Lighthouse Point) westward to Mississippi and the Chandeleur Islands of Louisiana.
Divisions: 203:C
Nations: US
Subnations: AL, FL, LA, MS
Map Zones: 55:C, 98:C, 99:C
TNC Ecoregions: 53:C

SOURCES

References: Comer et al. 2003, FNAI 1990, Grech et al. 2012, Handley et al. 2007, Thomas et al. 1961a, Wieland 1994a, Yarbro and Carlson 2011, Zieman and Zieman 1989
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723223#references

Description Author: R. Evans, mod. M. Pyne
Version: 06 Feb 2014
Concept Author: R. Evans

Stakeholders: Southeast
ClassifResp: Southeast

NORTHERN POLYNESIA TIDAL SALT MARSH (CES412.224)

CLASSIFIERS

Classification Status: Standard

Primary Division: Northern Polynesia (412)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Saltwater (Polyhaline); Estuary; Marsh; Herbaceous; Tidal / Estuarine [Haline]
Non-Diagnostic Classifiers: Lowland [Lowland]
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2807; ESLF 9247; ESP 1807

CONCEPT

Summary: Intertidal salt marshes are found throughout the coastal areas of the main Hawaiian Islands. This system is defined by salinity and tidal inundation regime and is influenced by tides daily. Salt marshes occur on silt, sand, or coralline substrates, and on the main islands in depressions and on mudflats adjacent to ponds, lagoons, and anchialine pools. Relative salinity of the system is dictated in part by inflows of freshwater streams and groundwater toward coastal areas. Leeward marshes are typically of higher salinity due to less freshwater influence. They occur as small patches at mouths of annual streambeds and in depressions behind beaches and rocky shorelines. At sites along drier leeward coasts, the vegetation is dominated by a succulent dwarf scrub, the non-native *Batis maritima* sometimes forming monotypic coverage, up to 0.75 m tall. The indigenous *Sesuvium portulacastrum* sometimes shares dominance with non-native *Batis maritima* and *Pluchea indica* which occur both in the marsh and with *Atriplex semibaccata* along margins. The vegetation in windward marshes is generally less than 0.25 m tall and dominated by indigenous plants, including *Paspalum vaginatum, Sesuvium portulacastrum, Ipomoea pes-caprae, Vigna marina, Cyperus* spp., *Eleocharis* spp., and *Fimbristylis cymosa*. Under slightly brackish conditions at mouths of large windward river valleys, it merges into Hawai'i Freshwater Marsh (CES412.222), where dominance becomes shared with *Schoenoplectus* spp., *Schoenoplectus maritimus (= Bolboschoenus maritimus), Cyperus laevigatus*, and *Urochloa mutica (= Brachiaria mutica)*.
Classification Comments: It is suggested that this is not just Northern Polynesia in distribution but Pacific Oceania. This type is likely historic in the main Hawaiian Islands. Known stands are disturbed or converted to introduced coastal wetlands.

DESCRIPTION

Dynamics: *Batis* and *Pluchea* have and continue to displace native *Sesuvium* herbland. In addition, mangrove swamps (*Bruguiera gymnorrhiza* and *Rhizophora mangle)* are displacing this system in fishponds, harbors and canals. Mangrove swamps are considered to be a degraded condition of the tidal salt marsh.

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Hawai'i Freshwater Marsh (CES412.222)

Adjacent Ecological System Comments: Under slightly brackish conditions at mouths of large windward river valleys, it merges into Hawai'i Freshwater Marsh (CES412.222).

DISTRIBUTION

Range: This system occurs in the northwestern Hawaiian Islands and throughout the coastal areas of the main islands, generally in leeward coastal areas.
Divisions: 412:C
Nations: US
Subnations: HI
Map Zones: 79:C
USFS Ecomap Regions: M423:C
TNC Ecoregions: 65:C

SOURCES

References: Mueller-Dombois and Fosberg 1998, Stemmermann 1983, Wagner et al. 1999, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.770656#references
Description Author: M. Castillo
Version: 20 Apr 2005
Concept Author: M. Castillo and G. Kittel
Stakeholders: West
ClassifResp: West

OZARK-OUACHITA FEN (CES202.052)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Herbaceous; Ozark/Ouachita; Seepage-Fed Sloping; Circumneutral Soil; Aquic
Non-Diagnostic Classifiers: Isolated Wetland [Partially Isolated]
National Mapping Codes: ESLF 9227

CONCEPT

Summary: This fen system is found in the Ozarks region of the United States. Stands occur on the sideslopes of hills in narrow valleys, bases of bluffs, rock ledges, and terraces of streams and rivers, where the soil or substrate is saturated by calcareous groundwater seepage. Soils are moist to wet, mucky peat or mineral, with pH above 6.5, and vary from shallow (0-40 cm) to moderately deep (40-100 cm), depending on natural disturbance and slope. The parent material is a mixture of gravel and dolomite with fragments of deeply weathered bedrock present, or colluvium over bedrock. The bedrock strata are exposed, especially in hanging fens where the slope is greater than 35 degrees. Hydrophytic plants dominate the fen, which varies from mixed grass or sedge fen with complex zonation to more tallgrass prairie species mixed with calciphiles. Fires are possible in some of the larger prairie fens.
Classification Comments: Some fens are typically associated with riparian vegetation. Seeps in the Ozarks are typically acidic to circumneutral and differ substantially in floristics and groundwater chemistry from these alkaline fens.
Similar Ecological Systems:
- Interior Low Plateau Seepage Fen (CES202.346)
- Southern Ridge and Valley Seepage Fen (CES202.458)

Related Concepts:
- Sedge-Shrub Fen (Orzell et al. 1985) Finer
- Streamside Seep-Fen (Orzell et al. 1985) Finer

DESCRIPTION

Vegetation: Stands of this small-scale system are typically dominated by primarily wetland obligate species of sedges (*Carex* spp.), ferns (*Osmunda* spp.), and other herbaceous species such as *Impatiens capensis* and *Parnassia grandifolia*.

Component Associations:
- *(Carex interior, Carex lurida) - Carex leptalea - Parnassia grandifolia - Rhynchospora capillacea* Herbaceous Vegetation (CEGL002404, G2G3)
- *Carex interior - Carex lurida - Andropogon gerardii - Parnassia grandifolia* Herbaceous Vegetation (CEGL002416, G1G2)

DISTRIBUTION

Range: This fen community type is found in the Ozarks region of the United States.
Divisions: 202:C
Nations: US
Subnations: AR, MO
Map Zones: 44:C
TNC Ecoregions: 38:C

SOURCES

References: Comer et al. 2003, Nelson 1985, Orzell et al. 1985
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722657#references
Description Author: D. Faber-Langendoen, mod. M. Pyne
Version: 17 Jan 2006 **Stakeholders:** Midwest, Southeast
Concept Author: D. Faber-Langendoen **ClassifResp:** Midwest

ROCKY MOUNTAIN ALPINE-MONTANE WET MEADOW (CES306.812)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Alpine/AltiAndino [Alpine/AltiAndino]; Montane [Upper Montane]; Herbaceous; Seepage-Fed Sloping [Mineral]; Depressional [Lakeshore]; Depressional [Pond]; Graminoid
Non-Diagnostic Classifiers: Mesotrophic Water; Saturated Soil; Montane [Montane]; Temperate [Temperate Continental]; Mineral: W/ A-Horizon >10 cm; Mineral: W/ A-Horizon <10 cm; Forb
National Mapping Codes: ESLF 9217

CONCEPT

Summary: These are high-elevation communities found throughout the Rocky Mountains and Intermountain regions, dominated by herbaceous species found on wetter sites with very low-velocity surface and subsurface flows. They range in elevation from montane to alpine (1000-3600 m). These types occur as large meadows in montane or subalpine valleys, as narrow strips bordering ponds, lakes, and streams, and along toeslope seeps. They are typically found on flat areas or gentle slopes, but may also occur on sub-irrigated sites with slopes up to 10%. In alpine regions, sites typically are small depressions located below late-melting snow patches or on snowbeds. Soils of this system may be mineral or organic. In either case, soils show typical hydric soil characteristics, including high organic content and/or low chroma and redoximorphic features. This system often occurs as a mosaic of several plant associations, often dominated by graminoids, including *Calamagrostis stricta, Caltha leptosepala, Cardamine cordifolia, Carex illota, Carex microptera, Carex nigricans, Carex scopulorum, Carex utriculata, Carex vernacula, Deschampsia caespitosa, Eleocharis quinqueflora, Juncus drummondii, Phippsia algida, Rorippa alpina, Senecio triangularis, Trifolium parryi*, and *Trollius laxus*. Often alpine dwarf-shrublands, especially those dominated by *Salix*, are immediately adjacent to the wet meadows. Wet meadows are tightly associated with snowmelt and typically not subjected to high disturbance events such as flooding.
Classification Comments: Similar systems to this one include Temperate Pacific Subalpine-Montane Wet Meadow (CES200.998) and Boreal Wet Meadow (CES103.873). Rocky Mountain Alpine-Montane Wet Meadow (CES306.812) occurs to the east of the coastal and Sierran mountains, in the semi-arid interior regions of western North America. Boreal wet meadow systems occur farther north and east in boreal regions where the climatic regime is generally colder than that of the Rockies or Pacific Northwest regions. Floristics of these three systems are somewhat similar, but there are differences related to biogeographic affinities of the species composing the vegetation.
Similar Ecological Systems:
- Rocky Mountain Subalpine-Montane Mesic Meadow (CES306.829)
- Western North American Boreal Wet Meadow (CES105.124)

Related Concepts:
- Alpine Rangeland (410) (Shiflet 1994) Intersecting. Alpine wet meadows are included in this SRM type.
- Tall Forb (409) (Shiflet 1994) Intersecting. Forb-dominated wet meadows are included in this ecological system.
- Tufted Hairgrass - Sedge (313) (Shiflet 1994) Intersecting. Wetter portions of this SRM type overlap with this system.

DESCRIPTION

Environment: Moisture for these wet meadow community types is acquired from groundwater, stream discharge, overland flow, overbank flow, and on-site precipitation. Salinity and alkalinity are generally low due to the frequent flushing of moisture through the meadow. Depending on the slope, topography, hydrology, soils and substrate, intermittent, ephemeral, or permanent pools may be present. These areas may support species more representative of purely aquatic environments. Standing water may be present during some or all of the growing season, with water tables typically remaining at or near the soil surface. Fluctuations of the water table throughout the growing season are not uncommon, however. On drier sites supporting the less mesic types, the late-season water table may be one meter or more below the surface.

Soils typically possess a high proportion of organic matter, but this may vary considerably depending on the frequency and magnitude of alluvial deposition (Kittel et. al. 1999b). Organic composition of the soil may include a thin layer near the soil surface or accumulations of highly sapric material of up to 120 cm thick. Soils may exhibit gleying and/or mottling throughout the profile. Wet meadow ecological systems provide important water filtration, flow attenuation, and wildlife habitat functions.
Dynamics: Associations in this ecological system are adapted to soils that may be flooded or saturated throughout the growing season. They may also occur on areas with soils that are only saturated early in the growing season, or intermittently. Typically these associations are tolerant of moderate-intensity ground fires and late-season livestock grazing (Kovalchik 1987). Most appear to be relatively stable types, although in some areas these may be impacted by intensive livestock grazing.

Component Associations:
- *Betula glandulosa / Carex* spp. Shrubland (CEGL005887, GNR)
- *Betula glandulosa / Carex utriculata* Shrubland (CEGL001079, G4?)
- *Betula glandulosa* / Mesic Forbs - Mesic Graminoids Shrubland (CEGL002653, G3G4)

- *Calamagrostis canadensis - Carex scopulorum - Mertensia ciliata* Herbaceous Vegetation (CEGL001560, GUQ)
- *Calamagrostis canadensis* Western Herbaceous Vegetation (CEGL001559, G4)
- *Caltha leptosepala - Polygonum bistortoides* Herbaceous Vegetation (CEGL001956, G2Q)
- *Caltha leptosepala - Rhodiola rhodantha* Herbaceous Vegetation (CEGL001957, GNRQ)
- *Caltha leptosepala* Herbaceous Vegetation (CEGL001954, G4)
- *Camassia cusickii* Herbaceous Vegetation (CEGL003440, G2)
- *Cardamine cordifolia - Caltha leptosepala* Herbaceous Vegetation (CEGL001958, GU)
- *Cardamine cordifolia - Mertensia ciliata - Senecio triangularis* Herbaceous Vegetation (CEGL002662, G4)
- *Carex amplifolia* Herbaceous Vegetation (CEGL003427, G3)
- *Carex aperta* Herbaceous Vegetation (CEGL001801, G1?)
- *Carex aquatilis - Carex utriculata* Herbaceous Vegetation (CEGL001803, G4)
- *Carex aquatilis* Herbaceous Vegetation (CEGL001802, G5)
- *Carex aquatilis var. dives* Herbaceous Vegetation (CEGL001826, G4)
- *Carex capillaris - Polygonum viviparum* Herbaceous Vegetation (CEGL001872, GU)
- *Carex duriuscula* Herbaceous Vegetation (CEGL001874, GUQ)
- *Carex illota* Herbaceous Vegetation (CEGL001876, GUQ)
- *Carex lachenalii* Herbaceous Vegetation (CEGL001871, GU)
- *Carex microglochin* Herbaceous Vegetation (CEGL001877, GU)
- *Carex microptera* Herbaceous Vegetation (CEGL001792, G4)
- *Carex nebrascensis* Herbaceous Vegetation (CEGL001813, G4)
- *Carex nebrascensis* Slope Herbaceous Vegetation (CEGL002890, GU)
- *Carex nigricans - Juncus drummondii* Herbaceous Vegetation (CEGL001818, GU)
- *Carex nigricans - Sibbaldia procumbens* Herbaceous Vegetation (CEGL005824, G4G5)
- *Carex nigricans* Herbaceous Vegetation (CEGL001816, G4)
- *Carex pellita* Herbaceous Vegetation (CEGL001809, G3)
- *Carex praegracilis* Herbaceous Vegetation (CEGL002660, G3G4)
- *Carex pyrenaica* Herbaceous Vegetation (CEGL001860, GU)
- *Carex saxatilis* Herbaceous Vegetation (CEGL001769, G3)
- *Carex scirpoidea ssp. pseudoscirpoidea* Herbaceous Vegetation (CEGL001865, G3?)
- *Carex scopulorum - Caltha leptosepala* Herbaceous Vegetation (CEGL001823, G4)
- *Carex scopulorum* Herbaceous Vegetation (CEGL001822, G5)
- *Carex simulata* Herbaceous Vegetation (CEGL001825, G4)
- *Carex spectabilis - Arnica X diversifolia* Herbaceous Vegetation (CEGL005867, G3G4)
- *Carex straminiformis* Herbaceous Vegetation (CEGL001793, G3?)
- *Carex utriculata* Herbaceous Vegetation (CEGL001562, G5)
- *Carex vernacula - Poa fendleriana* Herbaceous Vegetation (CEGL001869, G2G3)
- *Carex vesicaria* Herbaceous Vegetation (CEGL002661, G4Q)
- *Dasiphora fruticosa ssp. floribunda / Carex* spp. Shrubland (CEGL001106, G3?)
- *Dasiphora fruticosa ssp. floribunda / Deschampsia caespitosa* Shrubland (CEGL001107, G4)
- *Dasiphora fruticosa ssp. floribunda* Shrubland (CEGL001105, G5?)
- *Deschampsia caespitosa - Geum rossii* Herbaceous Vegetation (CEGL001884, G5)
- *Deschampsia caespitosa - Mertensia ciliata* Herbaceous Vegetation (CEGL001887, GU)
- *Deschampsia caespitosa* Herbaceous Vegetation (CEGL001599, G4)
- *Eleocharis acicularis* Herbaceous Vegetation (CEGL001832, G4?)
- *Eleocharis palustris - Distichlis spicata* Herbaceous Vegetation (CEGL001834, G2G4)
- *Eleocharis palustris - Juncus balticus* Herbaceous Vegetation (CEGL001835, G2G4)
- *Eleocharis palustris* Herbaceous Vegetation (CEGL001833, G5)
- *Eleocharis quinqueflora - Carex scopulorum* Herbaceous Vegetation (CEGL001837, G3G4)
- *Eleocharis quinqueflora* Herbaceous Vegetation (CEGL001836, G4)
- *Eleocharis rostellata* Herbaceous Vegetation (CEGL003428, G3)
- *Equisetum arvense* Herbaceous Vegetation (CEGL003314, G5)
- *Equisetum fluviatile* Herbaceous Vegetation (CEGL002746, G4)
- *Equisetum laevigatum* Herbaceous Vegetation (CEGL002241, GNR)
- *Geum rossii - Polygonum bistortoides* Herbaceous Vegetation (CEGL001967, G4G5)
- *Geum rossii - Sibbaldia procumbens* Herbaceous Vegetation (CEGL001969, GU)
- *Glyceria borealis* Herbaceous Vegetation (CEGL001569, G4)
- *Glyceria grandis* Herbaceous Vegetation (CEGL003429, G2?)
- *Glyceria striata* Herbaceous Vegetation (CEGL000219, G3)
- *Heracleum maximum - Rudbeckia occidentalis* Herbaceous Vegetation (CEGL001940, G4)
- *Heracleum maximum* Herbaceous Vegetation (CEGL005857, G3G4)
- *Juncus balticus* Herbaceous Vegetation (CEGL001838, G5)
- *Juncus drummondii - Antennaria lanata* Herbaceous Vegetation (CEGL001904, G3?)

- *Juncus drummondii - Carex* spp. Herbaceous Vegetation (CEGL001905, G4)
- *Juncus parryi - Erigeron ursinus* Herbaceous Vegetation (CEGL001906, G2?)
- *Juncus parryi / Sibbaldia procumbens* Herbaceous Vegetation (CEGL005871, G3G4)
- *Phippsia algida* Herbaceous Vegetation (CEGL002892, GU)
- *Phleum alpinum - Carex aquatilis* Herbaceous Vegetation (CEGL001921, G2Q)
- *Phleum alpinum - Carex microptera* Herbaceous Vegetation (CEGL001922, G2Q)
- *Poa glauca* Herbaceous Vegetation (CEGL001926, GU)
- *Primula parryi* Herbaceous Vegetation (CEGL001983, GNR)
- *Rhodiola rhodantha* Herbaceous Vegetation (CEGL001931, GU)
- *Rorippa alpina* Herbaceous Vegetation (CEGL002009, GU)
- *Saxifraga odontoloma* Herbaceous Vegetation (CEGL001985, GU)
- *Senecio triangularis - Mimulus guttatus* Herbaceous Vegetation (CEGL001988, G3?)
- *Senecio triangularis - Veratrum californicum* Herbaceous Vegetation (CEGL001989, G4)
- *Senecio triangularis* Herbaceous Vegetation (CEGL001987, G5?)
- *Trichophorum caespitosum - Carex livida* Herbaceous Vegetation (CEGL001842, G1)
- *Trollius laxus - Parnassia fimbriata* Herbaceous Vegetation (CEGL005858, G3?)
- *Valeriana sitchensis - Veratrum viride* Herbaceous Vegetation (CEGL001998, G4)

DISTRIBUTION

Range: This system is found throughout the Rocky Mountains and Intermountain West regions, ranging in elevation from montane to alpine (1000-3600 m).
Divisions: 304:C; 306:C
Nations: CA, US
Subnations: AB, AZ, BC, CO, ID, MT, NM, NV, OR, SD, UT, WA, WY
Map Zones: 9:C, 10:C, 12:P, 13:C, 15:?, 16:C, 17:P, 18:P, 19:C, 21:C, 22:P, 23:C, 24:P, 25:C, 27:C, 28:C, 29:P
USFS Ecomap Regions: 313A:CP, 313B:CC, 313D:C?, 315A:C?, 315B:C?, 315H:CC, 321A:??, 322A:CC, 331H:CP, 331I:CP, 331J:CC, 341A:CC, 341B:CC, 341C:CC, 341F:CP, 341G:CP, 342B:CC, 342C:CC, 342D:C?, 342E:CC, 342F:CP, 342G:CC, 342H:CC, 342J:CP, M242D:PP, M313A:CC, M313B:CC, M331A:CC, M331B:CC, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M331J:CC, M332A:CC, M332B:CC, M332D:CC, M332E:CC, M332F:CC, M332G:CC, M333A:CC, M333B:CC, M333C:CC, M333D:CC, M334A:PP, M341A:CP, M341B:CC, M341C:CC, M341D:CC
TNC Ecoregions: 7:C, 8:C, 9:C, 11:C, 18:C, 19:C, 20:C, 21:C, 22:P, 25:C, 68:C

SOURCES

References: Comer et al. 2002, Comer et al. 2003, Cooper 1986b, Crowe and Clausnitzer 1997, Kittel et al. 1999b, Komarkova 1976, Komarkova 1986, Kovalchik 1987, Kovalchik 1993, Manning and Padgett 1995, Meidinger and Pojar 1991, Nachlinger 1985, Nachlinger et al. 2001, NCC 2002, Neely et al. 2001, Padgett et al. 1989, Reed 1988, Sanderson and Kettler 1996, Shiflet 1994, Tuhy et al. 2002
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722861#references
Description Author: NatureServe Western Ecology Team
Version: 14 Dec 2004 **Stakeholders:** Canada, Midwest, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

ROCKY MOUNTAIN SUBALPINE-MONTANE FEN (CES306.831)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Extreme (Mineral) Rich and Iron-Rich; Saturated Soil; Moss/Lichen (Nonvascular); Seepage-Fed Sloping [Peaty]; Organic Peat (>40 cm); Graminoid; Bryophyte
Non-Diagnostic Classifiers: Shallow (<15 cm) Water; Montane [Upper Montane]; Montane [Montane]; Montane [Lower Montane]; Temperate [Temperate Continental]; Depressional [Pond]
National Mapping Codes: ESLF 9234

CONCEPT

Summary: This system occurs infrequently throughout the Rocky Mountains from Colorado north into Canada. It is confined to specific environments defined by groundwater discharge, soil chemistry, and peat accumulation of at least 40 cm. This system includes extreme rich fens and iron fens, both being quite rare. Fens form at low points in the landscape or near slopes where groundwater intercepts the soil surface. Groundwater inflows maintain a fairly constant water level year-round, with water at or near the surface most of the time. Constant high water levels lead to accumulation of organic material. In addition to peat accumulation and perennially saturated soils, the extreme rich and iron fens have distinct soil and water chemistry, with high levels of one or more minerals such as calcium, magnesium, or iron. These fens usually occur as a mosaic of several plant associations dominated by *Carex aquatilis*, *Carex limosa*, *Carex lasiocarpa*, *Betula glandulosa*, *Kobresia myosuroides*, *Kobresia simpliciuscula*, and *Trichophorum pumilum (= Scirpus pumilus)*. *Sphagnum* spp. (peatmoss) is indicative of iron fens. The surrounding landscape may be ringed with other wetland systems, e.g., riparian shrublands, or a variety of upland systems from grasslands to forests.
Classification Comments: Need to clarify this system in relation to Boreal Fen system. In Montana, small fens are found in scattered locations in the plains and the small isolated mountain ranges of the central part of the state; these are included here.
Related Concepts:
- Tufted clubrush - Star moss (ESSFdc2/Wf11) (Steen and Coupe 1997) Intersecting

DESCRIPTION

Environment: The montane fen ecological system is a small-patch system comprised of mountain wetlands that support a unique ecology of rare plants not found in other types of wetlands. These fens are confined to specific environments defined by groundwater discharge, soil chemistry, and peat accumulation of at least 40 cm. Fens form at low points in the landscape or near slopes where groundwater intercepts the soil surface (CNHP 2010b). Groundwater inflows maintain a fairly constant water level year-round, with water at or near the surface most of the time. Constant high water levels lead to accumulations of organic material (CNHP 2010b).Within the region this system occurs at montane elevations ranging from 2440-3500 m (8000-11,480 feet) and is characterized by mosaics of plant communities. These communities typically occur in seeps and wet sub-irrigated meadows in narrow to broad valley bottoms. Surface topography is typically smooth to concave with slopes ranging from 0-10%. The soils within this system are organic Histosols with 40 cm or more of organic material. These Histosols range in texture from clayey-skeletal to loamy-skeletal and fine-loams. They may occur on a variety of parent materials including alluvial and colluvial deposits of granitic and gneiss origins. The pH of wetlands within this system in generally between 4.8 and 6.0-7.0.
Dynamics: Groundwater inflows maintain a fairly constant water level year-round, with water at or near the surface most of the time. Constant high water levels lead to accumulations of organic material. Peatlands in the southern Rocky Mountains are fens that remain saturated primarily as a result of discharging groundwater, seasonal and/or perennial surface water input, or due to their location on the fringes of lakes and ponds (Cooper 1990). Thus, peatlands only occur in confining basins, near persistent groundwater-discharge sites, or near permanent waterbodies such as lakes, ponds, and streams. Due to the limited amount of precipitation and low humidity in the southern Rocky Mountains, true bogs do not occur in the region (Cooper 1990).

Snowmelt maintains high water tables through June in many wetland types (wet meadows, fens, riparian areas, etc.); however, only those areas with soil saturation or a water table within 30 cm of the soil surface through July and August accumulate peat (Cooper 1990, Chimner and Cooper 2003). Thus, a distinguishing characteristic between wet meadows and fens is the depth of the water table in these months. Even in fens, the water table begins to drop in late-July and August. However, late-summer precipitation often replenishes local aquifers thereby raising water tables, suggesting summer precipitation may be important to maintaining high water tables in Southern Rocky Mountain fens (Cooper 1990). In the Northern Rocky Mountains that lack late-summer rains, continuous groundwater discharge is important (Chadde et al. 1998).

Mountain fens function as natural filters cleaning ground and surface water. Fens also act as sponges by absorbing heavy precipitation, slowly releasing it downstream, minimizing erosion and recharging groundwater systems (Windell et al. 1986). The persistent groundwater and cold temperatures allow organic matter to accumulate (forming peat) which allows classification of wetlands within this system as fens. Fens in the Southern Rockies produce peat that accumulates at the rate of 20 to 28 cm (8-11 inches) per 1000 years, making peatlands a repository of 10,000 years of post-glacial history (Windell et al. 1986).

Component Associations:
- *Alnus incana / Scirpus microcarpus* Shrubland (CEGL000481, G2G3)
- *Betula glandulosa / Carex* spp. Shrubland (CEGL005887, GNR)
- *Betula glandulosa / Sphagnum* spp. Shrubland (CEGL002899, GU)
- *Carex aquatilis - Sphagnum* spp. Herbaceous Vegetation (CEGL002898, G2G3)
- *Carex buxbaumii* Herbaceous Vegetation (CEGL001806, G3)
- *Carex lasiocarpa* Herbaceous Vegetation (CEGL001810, G4?)
- *Carex limosa* Herbaceous Vegetation (CEGL001811, G2)
- *Carex simulata* Herbaceous Vegetation (CEGL001825, G4)
- *Carex utriculata* Herbaceous Vegetation (CEGL001562, G5)
- *Carex utriculata* Perched Wetland Herbaceous Vegetation (CEGL002922, G3?)
- *Dulichium arundinaceum* Seasonally Flooded Herbaceous Vegetation (CEGL001831, G3)
- *Kobresia myosuroides - Thalictrum alpinum* Herbaceous Vegetation (CEGL002900, G2)
- *Kobresia simpliciuscula - Trichophorum pumilum* Saturated Herbaceous Vegetation (CEGL002901, G2)
- *Ledum glandulosum* Shrubland (CEGL002739, G4)
- *Salix farriae / Eleocharis quinqueflora* Saturated Shrubland (CEGL000229, G2)

DISTRIBUTION

Range: This system occurs infrequently throughout the Rocky Mountains from Colorado north into Canada. In Montana, small fens included here are found in scattered locations in the plains and the small isolated mountain ranges of the central part of the state. Similarly, recent inventory in Wyoming has revealed the occurrence of small fens throughout the mountain ranges of that state.
Divisions: 304:C; 306:C
Nations: CA, US
Subnations: AB, AZ, BC, CO, ID, MT, NV, OR, UT, WA, WY
Map Zones: 9:P, 10:C, 12:?, 16:C, 17:?, 19:C, 20:C, 21:C, 22:?, 23:?, 24:?, 25:?, 27:?, 28:C, 29:C
USFS Ecomap Regions: 331J:CC, 331N:C?, M331A:CC, M331B:CC, M331D:CC, M331E:CP, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M332A:CP, M332B:CP, M332D:CC, M332E:CP, M332F:CP, M332G:CP, M333A:PP, M333B:PP, M333C:PP, M333D:PP
TNC Ecoregions: 7:C, 8:P, 9:P, 11:P, 18:C, 19:P, 20:C, 21:P, 68:P

SOURCES

References: Bales et al. 2006, Bryce et al. 2012, Chadde et al. 1998, Chimner and Cooper 2003, CNHP 2010b, Comer et al. 2003, Cooper 1986b, Cooper 1990, Cooper 1993b, Cooper and Sanderson 1997, Cooper et al. 1998, Cooper et al. 2005, Garfin et al. 2010, Johnson 1996, Jones 2003, Karl et al. 2009, Knowles et al. 2006, NCC 2002, Neely et al. 2001, Peterson et al. 2008, Rondeau 2001, Steen and Coupe 1997, Stewart et al. 2004, Windell et al. 1986, Woods 2001
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722842#references
Description Author: NatureServe Western Ecology Team, mod. G. Kittel
Version: 14 Jan 2014 **Stakeholders:** Canada, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

SOUTH COASTAL CALIFORNIA VERNAL POOL (CES206.950)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Impermeable Layer; 1-29-day hydroperiod; Vernal Pool Mosaic; Herbaceous; Mediterranean [Mediterranean Xeric-Oceanic]; Forb
Non-Diagnostic Classifiers: Shallow (<15 cm) Water; Montane [Lower Montane]; Lowland [Foothill]; Lowland [Lowland]; Depressional; Isolated Wetland [Strictly Isolated]
National Mapping Codes: ESLF 9249

CONCEPT

Summary: These systems are shallow ephemeral waterbodies found in small depressions that range from Baja Norte, Mexico, north through Santa Barbara County, California. They are found from sea level to 2600 m (7800 feet), and concomitant temperature and moisture ranges, but floristically distinct from more northerly distributed vernal pool types. These vernal pool systems are found on flat-topped marine terraces with Si-Fe cemented hardpans, volcanic bedrock, and acidic intrusive rock underlying thin soils. Characteristic plant species include *Trichostema austromontanum, Pogogyne abramsii, Eryngium aristulatum, Orcuttia californica, Pogogyne nudiuscula, Navarretia fossalis, Hemizonia parryi ssp. australis,* and *Lasthenia glabrata ssp. coulteri*.
Related Concepts:
- Wetlands (217) (Shiflet 1994) Broader

DESCRIPTION

Environment: These systems are shallow ephemeral waterbodies found in depressions (up to several hectares in size) among grasslands and open woodlands throughout the northern Central Valley of California. Northern claypan vernal pools include a clay hardpan that retains water inputs throughout some portion of the spring, but typically the depression dries down entirely into early summer months. They tend to be circumneutral to alkaline and slightly saline wetlands. Pool depth rarely exceeds 50 cm (Solomeshch et al. 2007).
Dynamics: Vernal pools are precipitation-filled seasonal wetlands inundated during the growing season, allowing for plant growth, followed by a brief water-logged terrestrial stage and culminating in complete drying of surface and subsurface soils. Inundation during the growing season eliminates establishment of upland species in the pool basins and the dry period prevents the establishment of many typical wetland taxa (Keeley and Zedler 1998). Pool filling is a combination of direct precipitation and lateral flow among pools within a complex of pools and subsurface flow from uplands which buffers pool volume, keeping them filled into the dry season (Hanes and Stromberg 1998). Subsurface soils have a hard pan of clay that prevents drainage. What is unique about vernal pools is the seasonality of the wetting period followed by the desiccation period, which generally is supported by a Mediterranean climate (Keeley and Zedler 1998) and resulted in development of diverse and highly endemic vegetation (Barbour et al. 2003, 2005, Solomeshch et al. 2007). Natural fire regimes for vernal pools are generally unknown, but are assumed to be similar to their surrounding upland grassland fire regimes (Wills 2006). Fire can have a positive effect on vernal pool vegetation as it can results in robust response by native grasses and can reduce non-native invasive woody and non-native herbaceous species (Pollak and Kan 1998).

DISTRIBUTION

Range: Baja Norte, Mexico, north through Santa Barbara County, California.
Divisions: 206:C
Nations: MX, US
Subnations: CA, MXBC(MX)
Map Zones: 4:C
USFS Ecomap Regions: 261B:CC
TNC Ecoregions: 16:C

SOURCES

References: Barbour and Major 1988, Comer et al. 2003, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995, Shiflet 1994
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722731#references
Description Author: P. Comer and T. Keeler-Wolf, mod. G. Kittel
Version: 14 Jan 2014 **Stakeholders:** Latin America, West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

SOUTH FLORIDA DEPRESSION PONDSHORE (CES411.054)

CLASSIFIERS

Classification Status: Standard

Primary Division: Caribbean (411)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Non-Diagnostic Classifiers: Herbaceous; Depressional; Isolated Wetland [Partially Isolated]
National Mapping Codes: ESLF 9228

CONCEPT

Summary: This system occupies shallow depressional wetlands in southern and south-central Florida. As currently defined, this system includes a variety of wetlands occupying somewhat different environments. Included for now in this concept are isolated drainages or seasonal ponds as well as solution holes (may have only subsurface or historic water presence), and possibly the shores of large natural lakes. Examples found in these different environments tend to have obviously different landscape contexts, and often different floristics. For instance, examples embedded in Florida Dry Prairie (CES203.380) and/or South Florida Pine Flatwoods (CES411.381) tend to display distinct vegetation zones (Winchester et al. 1985, Huffman and Judd 1998). In contrast, solution holes embedded in South Florida Pine Rockland (CES411.367) and/or South Florida Hardwood Hammock (CES411.287) are small (may be less than 1 to 15 m across and less than 1 to 3+ m deep) and therefore tend to lack zonal vegetation (M. Fellows pers. comm.). More detailed information is needed on the range of vegetation present across this system. Huffman and Judd (1998) provide information on some examples of this system in southwestern Florida.
Classification Comments: Examples of South Florida Slough, Gator Hole and Willow Head (CES411.485) are generally larger and deeper water wetlands, usually connected with distinct drainageways.
Similar Ecological Systems:
- South Florida Slough, Gator Hole and Willow Head (CES411.485)

Related Concepts:
- Depression Marsh (FNAI 1990) Broader

DESCRIPTION

Vegetation: According to Huffman and Judd (1998), some examples of this system tend to display distinct vegetation zones [see also Winchester et al. (1985)]. In these cases, *Aristida palustris* is characteristic and possibly *Hypericum fasciculatum*, depending upon fire history. A large number of other wetland species may be present, such as *Xyris jupicai*, *Rhexia cubensis*, *Rhynchospora filifolia*, and others. Deeper zones dominated by *Pontederia cordata*, as well as "heads" of woody species (*Cephalanthus occidentalis*, *Salix caroliniana*, *Persea palustris*), also may be present. More floristic information is needed from examples of this system found in other parts of south Florida.

Component Associations:
- *Eleocharis cellulosa* Herbaceous Vegetation (CEGL003972, G3?)
- *Eleocharis interstincta - Pontederia cordata - Crinum americanum* Herbaceous Vegetation (CEGL003975, G2G3)
- *Hypericum fasciculatum / Rhynchospora (chapmanii, harperi)* Shrubland (CEGL003869, G2G3)
- *Panicum hemitomon* Tropical Herbaceous Vegetation (CEGL003980, G3?)
- *Schoenoplectus tabernaemontani* Tropical Herbaceous Vegetation (CEGL003986, G3G5)
- *Typha domingensis - Pontederia cordata* Herbaceous Vegetation (CEGL003988, G3?)
- *Zizaniopsis miliacea* Subtropical Herbaceous Vegetation (CEGL003989, G2G4Q)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Florida Dry Prairie (CES203.380)
- South Florida Hardwood Hammock (CES411.287)
- South Florida Pine Flatwoods (CES411.381)
- South Florida Pine Rockland (CES411.367)

Adjacent Ecological System Comments: May be embedded in Florida Dry Prairie (CES203.380), South Florida Pine Flatwoods (CES411.381), South Florida Pine Rockland (CES411.367) and/or South Florida Hardwood Hammock (CES411.287).

DISTRIBUTION

Range: Endemic to south Florida.
Divisions: 411:C
Nations: US
Subnations: FL
Map Zones: 56:C
TNC Ecoregions: 54:C

SOURCES

References: Comer et al. 2003, Fellows pers. comm., Huffman and Judd 1998

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722656#references

Description Author: R. Evans

Version: 25 Aug 2003

Concept Author: R. Evans

Stakeholders: Southeast

ClassifResp: Southeast

SOUTH FLORIDA EVERGLADES SAWGRASS MARSH (CES411.286)

CLASSIFIERS

Classification Status: Standard

Primary Division: Caribbean (411)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Extensive Wet Flat; Graminoid
Non-Diagnostic Classifiers: Herbaceous
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2483; ESLF 9204; ESP 1483

CONCEPT

Summary: This marsh system was a dominant type throughout much of the Everglades region of southeastern Florida. It consists largely of herbaceous marsh vegetation across a range of soil and hydrologic conditions, but generally falls within conditions outlined by Duever et al. (1986), i.e., hydroperiod of 225-275 days per year, maximum wet-season water level of 40 cm., and occurrence on peat soils. Several individual marsh community associations have been recognized based on species composition, structure, and aspect. Variations are largely due to the interrelated effects of fire, soils, and hydroperiod. Sawgrass beds or "glades" may have been the single most extensive component of this system (Hilsenbeck et al. 1979), and large areas may have the appearance of nearly monotypic stands of *Cladium mariscus ssp. jamaicense*. However, local variation in composition and stature are also often apparent. For example, two broad aspect types of *Cladium* marsh are often recognized based on density and/or height (Kushlan 1990, Gunderson and Loftus 1993) with denser and taller stands typically occurring on higher topographic positions and deeper organic soils, while sparser, shorter stands occur in lower topography on shallower soils. In addition, other marsh types are also interfingered in the sawgrass matrix where wetter depressions are found and/or where fires have burned away peat soils.
Classification Comments: The term "wet prairie" has often been used to describe a variety of marsh types which are included in the concept of this system. We follow the definition of Duever et al. (1986) in which prairies occupy mineral soils and marshes occupy peats. The community components of these systems are largely based on Davis (1943) and Hilsenbeck et al. (1979). Open and emergent marshes of the region are generally covered by South Florida Slough, Gator Hole and Willow Head (CES411.485); these are generally small patches included in the sawgrass matrix.
Similar Ecological Systems:
- South Florida Slough, Gator Hole and Willow Head (CES411.485)
- South Florida Wet Marl Prairie (CES411.370)

Related Concepts:
- Swale (FNAI 1990) Equivalent

DESCRIPTION

Environment: A range of conditions are present. Soils vary from shallow marl to relatively deep peat. Hydroperiod ranges from 5-12 months. The effect of fire is influenced by both factors and affects them in turn. For example, peat accumulates in the absence of fire, but under certain conditions, fires may burn away accumulated sawgrass peat resulting in a thin, residual, marly soil and relative increase of effective water depth (resulting in community change).
Vegetation: Marsh communities present in this system include tall and short-statured *Cladium mariscus ssp. jamaicense*, spikerush - beaksedge flats, and maidencane flats. In the absence of fire, portions of stands will become dominated by *Salix caroliniana.* If fire continues to be absent, these areas may succeed to *Acer rubrum* until a replacement fire or mechanical activity restores the marsh.
Dynamics: In the absence of fire, portions of stands will become dominated by *Salix caroliniana.* If fire continues to be absent, these areas may succeed to *Acer rubrum* until a replacement fire or mechanical activity restores the marsh.

Component Associations:
- Algal Periphyton Nonvascular Vegetation (CEGL004390, G3?)
- *Cladium mariscus ssp. jamaicense - Bacopa caroliniana* Herbaceous Vegetation (CEGL003969, G3)
- *Cladium mariscus ssp. jamaicense* / Algal Periphyton Herbaceous Vegetation (CEGL003970, G2?)
- *Eleocharis cellulosa - Rhynchospora tracyi* / (Algal Periphyton) Herbaceous Vegetation (CEGL003973, G2G3)
- *Panicum hemitomon* Tropical Herbaceous Vegetation (CEGL003980, G3?)
- *Salix caroliniana / Bacopa caroliniana - Blechnum serrulatum* Forest (CEGL007409, G2?)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- South Florida Slough, Gator Hole and Willow Head (CES411.485)

DISTRIBUTION

Range: This system is endemic to south Florida.
Divisions: 411:C
Nations: US

Subnations: FL
Map Zones: 56:C
USFS Ecomap Regions: 411A:CC
TNC Ecoregions: 54:C

SOURCES

References: Comer et al. 2003, Davis 1943, Duever et al. 1986, Gunderson and Loftus 1993, Hilsenbeck et al. 1979, Kushlan 1990
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723202#references
Description Author: R. Evans, mod. M. Pyne
Version: 05 Jul 2006
Concept Author: R. Evans
Stakeholders: Southeast
ClassifResp: Southeast

SOUTH FLORIDA SLOUGH, GATOR HOLE AND WILLOW HEAD (CES411.485)

CLASSIFIERS

Classification Status: Standard

Primary Division: Caribbean (411)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: >180-day hydroperiod; Woody-Herbaceous; Herbaceous; Depressional [Peaty]
National Mapping Codes: ESLF 9407

CONCEPT

Summary: This ecological system includes a series of wetlands of southern Florida, ranging in physiognomy from open and herbaceous-dominated to tree-dominated patches, including nearly monospecific stands of *Salix caroliniana*. These wetlands hold water for much of the year and have some of the longest hydroperiods (8-12 months) in a region characterized by wetlands. Most are maintained, at least historically, by American alligators. Alligators were such a dominant disturbance force in many plant communities of southern Florida that their role has been compared with that of bison in the prairies. Through constant movement, they create numerous small pools and ponds (analogous to buffalo wallows), as well as trails to and from these pools through sawgrass marshes. These paths eventually widen and deepen into creeks. Many of these small freshwater creeks have been invaded by mangroves and hardwoods, including *Salix caroliniana*, in the absence of fire and with decreases in alligator populations. Some emergent wetlands included within the concept of this system may also have originated from soil and topographic changes in former sawgrass marshes following severe fires that consume organic substrate and decrease soil elevation. One component of this system ("heads") may originate as circular or oval-shaped solution holes or basins, being maintained and possibly enhanced by the alligator activity. Without this activity, there would be a tendency for the hole or basin to fill with organic material and succeed to other systems. Soils are mucky peats. In addition, *Salix caroliniana* seeds are readily dispersed by wind and may rapidly colonize wet depressions and disturbed areas. In the absence of fire and disturbance, these areas may remain in a forested condition. Otherwise, they would cycle between different physiognomic states, including sawgrass marsh.

Similar Ecological Systems:
- Florida River Floodplain Marsh (CES203.055)
- Floridian Highlands Freshwater Marsh (CES203.077)
- South Florida Depression Pondshore (CES411.054)
- South Florida Everglades Sawgrass Marsh (CES411.286)
- South Florida Pond-apple/Popash Slough (CES411.486)

Related Concepts:
- Cabbage Palmetto: 74 (Eyre 1980) Finer
- Slough (FNAI 1990) Broader

DESCRIPTION

Environment: Examples of this system may originate as solution holes in sawgrass marsh, with a longer hydroperiod, but expand and contract in size and extent with disturbance, including fire and American alligator activity. Some examples are directly caused by alligator activity and/or the effect of severe fire in sawgrass marshes, South Florida Everglades Sawgrass Marsh (CES411.286) (Craighead 1971, Hilsenbeck et al. 1979). At least some examples attributed to this system occupy "marshes" with long hydroperiods (8-12 months) and deep organic soils (Hilsenbeck et al. 1979).

Vegetation: A number of discrete communities may be recognized as part of this system. Two of the most common types can be considered cattail marshes and flag - pickerelweed communities (Hilsenbeck et al. 1979). Also included are nearly monospecific stands of *Salix caroliniana* (Davis 1943, Loveless 1959, Craighead 1971) called "willow heads." Aquatic and wetland plants that may be present include *Bacopa caroliniana, Ceratophyllum demersum, Najas guadalupensis, Utricularia inflata, Nuphar advena, Nymphaea odorata, Chara* sp., *Pistia stratiotes, Pontederia cordata, Sagittaria lancifolia*, and *Thalia geniculata*. Ferns include *Acrostichum danaeifolium, Nephrolepis exaltata*, and *Blechnum serrulatum*. Grasses and graminoids may include *Schoenoplectus tabernaemontani, Typha domingensis*, and *Zizaniopsis miliacea*. Trees include *Sabal palmetto, Quercus virginiana, Ulmus americana, Ficus aurea*, and *Salix caroliniana*.

Dynamics: The American alligators was a dominant force that helped maintain this system, at least historically. Their role has been compared with that of bison in the prairies (Craighead 1971). Through constant movement they create numerous small pools and ponds (analogous to buffalo wallows) as well as trails to and from these pools through sawgrass marshes. These paths eventually widen and deepen into creeks. Many of these small freshwater creeks have been invaded by mangroves and hardwoods in the absence of fire and decrease in alligator populations (Craighead 1971). Some emergent wetlands included within the concept of this system may also have originated from soil and topographic changes in former sawgrass marshes following severe fires that consume organic substrate and decrease soil elevation (Gunderson and Loope 1982b).

Component Associations:
- *Najas guadalupensis - Ceratophyllum demersum - Utricularia inflata* Herbaceous Vegetation (CEGL004313, G2G4)
- *Nuphar advena / Chara* sp. Tropical Herbaceous Vegetation (CEGL004315, G2G3)

- *Nymphaea odorata* Tropical Herbaceous Vegetation (CEGL004316, G4?)
- *Pistia stratiotes* Herbaceous Vegetation (CEGL004902, G4?)
- *Pontederia cordata* Tropical Herbaceous Vegetation (CEGL004261, G3G4)
- *Sabal palmetto - Quercus virginiana - Ulmus americana - Ficus aurea / Acrostichum danaeifolium - Nephrolepis exaltata* Forest (CEGL004409, G2?)
- *Sagittaria lancifolia* Herbaceous Vegetation (CEGL004262, G3?Q)
- *Salix caroliniana / Bacopa caroliniana - Blechnum serrulatum* Forest (CEGL007409, G2?)
- *Schoenoplectus tabernaemontani* Tropical Herbaceous Vegetation (CEGL003986, G3G5)
- *Thalia geniculata - Pontederia cordata* Herbaceous Vegetation (CEGL004264, G2)
- *Typha domingensis - Pontederia cordata* Herbaceous Vegetation (CEGL003988, G3?)
- *Zizaniopsis miliacea* Subtropical Herbaceous Vegetation (CEGL003989, G2G4Q)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- South Florida Everglades Sawgrass Marsh (CES411.286)

Adjacent Ecological System Comments: This system is generally embedded in a matrix of South Florida Everglades Sawgrass Marsh (CES411.286).

DISTRIBUTION

Range: This system is endemic to south Florida.
Divisions: 411:C
Nations: US
Subnations: FL
Map Zones: 56:C
TNC Ecoregions: 54:C

SOURCES

References: Comer et al. 2003, Craighead 1971, Davis 1943, Gunderson and Loope 1982b, Hilsenbeck et al. 1979, Loveless 1959, Southeastern Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723101#references
Description Author: R. Evans and C. Nordman, mod. M. Pyne
Version: 17 Mar 2009
Concept Author: R. Evans and C. Nordman
Stakeholders: Southeast
ClassifResp: Southeast

SOUTH FLORIDA WET MARL PRAIRIE (CES411.370)

CLASSIFIERS

Classification Status: Standard

Primary Division: Caribbean (411)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Graminoid
Non-Diagnostic Classifiers: Herbaceous; Extensive Wet Flat
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2484; ESLF 9205; ESP 1484

CONCEPT

Summary: This system includes marl prairies of the southern Florida Everglades region and related vegetation of the Florida Keys. This system occurs only on shallower soils with bedrock close to the surface. Composition and variability in this system is heavily influenced by hydrology. Especially unusual are small-patch communities found on elevated areas of oolitic rocks referred to as pinnacle rock or table rock. This system also includes embedded solution holes (depressions formed from limestone collapse).
Classification Comments: Plant community components have been variously and often confusingly described. For example, the term wet prairie has often been used to describe a variety of marsh types which are NOT included in the concept of this system [see South Florida Everglades Sawgrass Marsh (CES411.286)]. We follow the definition of Duever et al. (1986) in which prairies occupy mineral soils and marshes occupy peats.
Similar Ecological Systems:
- South Florida Everglades Sawgrass Marsh (CES411.286)

Related Concepts:
- Marl Prairie (FNAI 1990) Broader

DESCRIPTION

Environment: This system occurs only on shallower soils with bedrock close to the surface (Gunderson and Loftus 1993). Composition and variability in this system are heavily influenced by hydrology, with the predominant community types occurring on marl substrates which are seasonally inundated (2-4 months per year). With diminished hydroperiod, species composition changes (Hilsenbeck et al. 1979). Examples of this ecological system can include elevated areas of oolitic rocks referred to as pinnacle rock (Gunderson and Loftus 1993) or table rock (Hilsenbeck et al. 1979), and also include embedded solution holes (depressions formed from limestone collapse).
Dynamics: Composition and variability in this system are heavily influenced by hydrology; with shortened hydroperiod, species composition changes (Hilsenbeck et al. 1979). Marl prairie depends on a hydroperiod of two to four months. Longer hydroperiods favor the development of peat and the dominance of *Cladium mariscus ssp. jamaicense*; shorter hydroperiods permit the invasion of woody species (FNAI 2010a). Marl prairie normally dries out during the winter and is subject to fires at the end of the dry season, in late spring. These late-spring fires promote flowering of the dominant grasses (FNAI 2010a). Biomass recovers to pre-fire levels after two years. The natural fire frequency may be once every two to six years, or up to ten years for marl prairies with sparse herbaceous vegetation, such as is found on shallow soils (FNAI 2010a).

Component Associations:
- *Croton linearis - Morinda umbellata / Sporobolus* spp. - *Panicum* spp. Shrub Herbaceous Vegetation (CEGL003999, G1)
- *Muhlenbergia filipes - Rhynchospora microcarpa - Centella erecta* Herbaceous Vegetation (CEGL003978, G2)
- *Schizachyrium rhizomatum - Aristida purpurascens var. tenuispica - Eragrostis spectabilis* Herbaceous Vegetation (CEGL003962, G1)
- *Schoenus nigricans* Herbaceous Vegetation (CEGL003984, G2?)

DISTRIBUTION

Range: Southern Florida Everglades region and related vegetation of the Florida Keys. Marl prairies with scattered dwarf cypress cover large areas of Big Cypress National Preserve in Collier and Monroe counties. In the Everglades region, marl prairie forms the border between the Miami Rock Ridge and the lower slough and glades marsh and occurs in the narrow finger glades on Long Pine Key (FNAI 2010a).
Divisions: 411:C
Nations: US
Subnations: FL
Map Zones: 56:C
USFS Ecomap Regions: 411A:CC
TNC Ecoregions: 54:C

SOURCES

References: Comer et al. 2003, Duever et al. 1986, FNAI 1990, FNAI 2010a, Gunderson and Loftus 1993, Hilsenbeck et al. 1979

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723146#references
Description Author: R. Evans, mod. C. Nordman
Version: 14 Jan 2014
Concept Author: R. Evans
Stakeholders: Southeast
ClassifResp: Southeast

SOUTHEASTERN COASTAL PLAIN INTERDUNAL WETLAND (CES203.258)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Depressional; Coast
Non-Diagnostic Classifiers: Herbaceous; Isolated Wetland [Partially Isolated]
National Mapping Codes: ESLF 9257

CONCEPT

Summary: This system encompasses the wettest dune swales and basins on barrier islands and coastal areas, supporting pond or marsh-like vegetation, from the Coastal Plain of Texas to southern Virginia. Most examples are permanently or semipermanently flooded with freshwater but are affected by salt spray or overwash during periodic storm events. It is broadly defined in terms of floristic composition and is wide-ranging along the Atlantic and Gulf coasts of the United States. These are graminoid-dominated sites, with species such as *Andropogon glomeratus, Cladium mariscus ssp. jamaicense, Distichlis spicata, Eleocharis* spp., *Fimbristylis castanea, Panicum virgatum, Paspalum monostachyum, Rhynchospora colorata, Rhynchospora* spp., *Schoenoplectus pungens*, and *Typha domingensis*.
Classification Comments: This system is currently defined with a much broader geographic range than most other coastal systems in the Southeast. The extreme variability within even a limited geographic range limits the ability to find broader vegetational patterns. Examples may vary regionally with regard to the amount of wind or salt spray and the texture of the sand. The northern end of the range is not clearly defined.
Similar Ecological Systems:
- Northern Atlantic Coastal Plain Dune and Swale (CES203.264)--(the primary range of which is north of this system) may have small interdunal swales embedded within it.
- Southern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.273)

Related Concepts:
- Coastal and Sandsheet: Deep Sand Grasslands Swale Marsh (6507) [CES203.258] (Elliott 2011) Equivalent
- Coastal Interdunal Swale (FNAI 1990) Intersecting

DESCRIPTION

Environment: These wetlands occur on topographic lows, including dune swales or other basins, in nearly level to steeply rolling landscapes on sands and deep sands on barrier islands along the coast and inland on the South Texas Sand Sheet. These ponds have standing water well into the growing season, and most are permanently flooded. The water is from rainfall or the local water table and is fresh, except perhaps during storm events that produce overwash. Soils are sand, sometimes with a thin layer of muck accumulated in the pond. The geology includes coastal eolian sands, extending inland on the South Texas Sand Sheet, as well as Pleistocene barrier island and beach deposits of the Beaumont Formation, such as on the Ingleside Barrier. Examples occupy topographic lows of interdunal swales and potholes. Soils are deep sands and coastal sands (Elliott 2011).
Vegetation: Vegetation is characterized by emergent or drawdown wetland plants, often tall graminoids. Vegetation varies substantially from one example to the next. These sites are alternately wet and dry (due to seasonal rainfall events) and generally lack tidal influence, but may contain halophytic species due to the influence of salt spray and repeated inundation and evaporation. They are graminoid-dominated sites, with species such as *Spartina patens, Andropogon glomeratus, Panicum virgatum, Paspalum monostachyum, Distichlis spicata, Fimbristylis castanea, Rhynchospora colorata, Eleocharis* spp., *Rhynchospora* spp., *Typha* spp., and *Schoenoplectus pungens*. Forbs such as *Hydrocotyle bonariensis, Centella erecta, Phyla nodiflora, Samolus ebracteatus, Bacopa monnieri*, and *Pluchea foetida* may be conspicuous. Woody species such as *Batis maritima, Sesbania* spp., *Prosopis glandulosa*, and *Baccharis* spp. may be present but do not typically constitute significant cover (Elliott 2011).
Dynamics: This system occurs in a geologically dynamic environment, where wind and waves may change landforms and hydrology quickly (Feagin et al. 2010). However, ponds usually occur in stable portions of islands, where they may last for decades. Salt spray, salt overwash, and heavy rainfall from storms may affect component communities, sometimes limiting vegetation to species that are somewhat salt-tolerant. Severe storms may bring about major changes in the landforms and hydrology (Feagin et al. 2010).

Component Associations:
- (*Morella cerifera*) / *Panicum virgatum - Spartina patens* Herbaceous Vegetation (CEGL004129, G2G4)
- *(Stillingia aquatica) / Panicum tenerum - Dichanthelium erectifolium* Herbaceous Vegetation (CEGL004954, G2?)
- *Carex hyalinolepis* Seasonally Flooded Herbaceous Vegetation (CEGL004724, G1G3)
- *Cladium mariscus ssp. jamaicense - Woodwardia virginica* Herbaceous Vegetation (CEGL004949, G2?)
- *Eleocharis elongata - Panicum tenerum - Nymphaea odorata* Herbaceous Vegetation (CEGL004961, G2?)
- *Fimbristylis castanea - Paspalum distichum* Herbaceous Vegetation (CEGL004110, G3)
- *Fimbristylis castanea - Schoenoplectus pungens* Seasonally Flooded Herbaceous Vegetation (CEGL003790, GNR)
- *Fuirena scirpoidea - Fuirena longa - Rhynchospora microcarpa - Rhynchospora divergens* Herbaceous Vegetation (CEGL004952,

G2)
- *Hypericum reductum - Licania michauxii / Andropogon capillipes - Polygonella gracilis - Xyris caroliniana* Dwarf-shrubland (CEGL003953, G2)
- *Leptochloa fusca ssp. fascicularis - Sesuvium maritimum* Herbaceous Vegetation (CEGL004125, G1Q)
- *Panicum hemitomon - (Cladium mariscus ssp. jamaicense, Muhlenbergia filipes)* Herbaceous Vegetation (CEGL007716, G2G3)
- *Paspalum vaginatum* Herbaceous Vegetation (CEGL004114, G3G4)
- *Spartina bakeri - Muhlenbergia filipes - Andropogon glomeratus - Rhynchospora colorata* Herbaceous Vegetation (CEGL004511, G3?)
- *Spartina patens - Fimbristylis (caroliniana, castanea) - (Panicum virgatum)* Herbaceous Vegetation (CEGL007836, G2G3)
- *Typha domingensis - Setaria magna* Herbaceous Vegetation (CEGL004138, G2G3)
- *Typha domingensis* Seasonally Flooded Gulf Coastal Plain Herbaceous Vegetation (CEGL004137, G3?)

SPATIAL CHARACTERISTICS

Spatial Summary: Small patch.
Size: Occurs as small patches, with most individual ponds an acre or less in size. Often ponds will occur in complexes of up to a dozen.
Adjacent Ecological Systems:
- Central Atlantic Coastal Plain Maritime Forest (CES203.261)

Adjacent Ecological System Comments: Surrounded by maritime forest or maritime grassland systems.

DISTRIBUTION

Range: Ranges along the Atlantic and Gulf coasts, from southern Texas to Florida and southeastern Virginia.
Divisions: 203:C
Nations: US
Subnations: AL, FL, GA, LA, MS, NC, SC, TX, VA
Map Zones: 36:C, 37:C, 55:C, 56:C, 58:C, 60:C, 99:C
USFS Ecomap Regions: 232C:CC, 232D:CC, 232E:CC, 232G:CC, 232H:CP, 232I:CC, 232L:CC, 255D:CC, 315E:CC, 411A:CC
TNC Ecoregions: 31:C, 53:C, 54:?, 55:C, 56:C, 57:C

SOURCES

References: Comer et al. 2003, Elliott 2011, Feagin et al. 2010, FNAI 1990
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723228#references
Description Author: M. Schafale and R. Evans, mod. M. Pyne, L. Elliott, C. Nordman
Version: 14 Jan 2014 **Stakeholders:** East, Southeast
Concept Author: M. Schafale and R. Evans **ClassifResp:** Southeast

SOUTHERN APPALACHIAN SEEPAGE WETLAND (CES202.317)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Seepage-Fed Sloping
Non-Diagnostic Classifiers: Herbaceous; Isolated Wetland [Partially Isolated]
National Mapping Codes: ESLF 9259

CONCEPT

Summary: This system consists of seepage-fed wetlands in the Southern Appalachians on gentle slopes, with substantial seepage flow. Vegetation is variable, both within and among examples, but lacks vegetation characteristic of bogs or floodplains. This is a small-patch system occurring over a wide elevational range, nearly to the highest peaks, but is generally lacking from flat valley bottoms.

Classification Comments: This system is fairly heterogeneous, covering a broad range of environments and vegetation, but without apparent breaks. At one extreme, the system contains rich, low-elevation, forb-dominated seeps closely related floristically to cove forests; at the other extreme, it contains acidic, sedge- and moss-dominated, bog-like, high-elevation seeps. This system is distinguished from Southern and Central Appalachian Bog and Fen (CES202.300) by occurrence in sloping settings rather than flat valley bottoms, with more rapid flow of water, and by lack of dominance by the characteristic bog or fen flora (though some of it may be present). The only other systems with wetland systems within its range, floodplains and upland pools, are more distinct floristically as well as associated with very different landforms.

Similar Ecological Systems:

- High Allegheny Wetland (CES202.069)
- North-Central and Northeastern Seep (CES202.456)
- North-Central Appalachian Seepage Fen (CES202.607)
- Piedmont Seepage Wetland (CES202.298)
- Southern and Central Appalachian Bog and Fen (CES202.300)

DESCRIPTION

Environment: This system occurs in small patches where seepage creates saturated soil conditions permanently or seasonally. Wetness may vary substantially over short distances in response to amounts of seepage, flow, and pooling by topography or impermeable substrate. The system occurs over a wide elevational range, nearly to the highest peaks. Landforms are usually concave slopes but may be convex slopes or even ridgetop gaps. This system is almost never found on flat valley bottoms, though it may be found on the edge of them. Soils may be muck or coarse boulders but are usually saturated mineral soils. They may be residual or colluvial and deep or shallow. The most extensive and wettest examples occur at elevations above 1525 m (5000 feet), where cool temperatures and high rainfall make more water available. In Kentucky, this system consists of streamhead seepages on Pine and Cumberland mountains.

Vegetation: Vegetation consists of a series of forested and open associations united by the presence of a wetland flora but lack of floodplain species and most bog species. Some tree cover by mesophytic species is usually present, but often only by trees rooted on the edge of adjacent systems. Shrubs, including *Alnus serrulata, Rosa palustris, Lindera benzoin,* and *Physocarpus opulifolius*, may be sparse or may form dense zones around the edge. Shrub species are mostly mesophytic rather than obligate wetland species. The herb layer is generally well-developed and is usually dominated either by characteristic forbs such as *Impatiens capensis, Impatiens pallida, Monarda didyma, Chelone* spp., and *Rudbeckia triloba*, or by *Carex* spp. *Sphagnum* may occur in a minority of examples.

Dynamics: The presence of seepage is the primary determinant of this system. Long-term droughts that affect seepage flow presumably have an effect, but this has not been documented. Canopy dynamics are not well known and potentially may vary substantially over short distances in response to wetness. Wetness may limit recruitment of most tree and shrub seedlings to drier microsites, making canopy gaps persist longer than in adjacent forests and creating a more open canopy. Fire may penetrate from the adjacent forest systems, but only in the driest conditions are they likely to be intense enough to have much effect within this system. Seeps are fairly permanent features of the landscape, but may potentially be created, destroyed, or changed in extent because of changes in groundwater flow, stream entrenchment or headward erosion, mass movement on slopes, or long-term climatic cycles. Examples are often left undisturbed when surrounding forests are logged. Effects of logging on water infiltration or surface flow may have significant indirect effects.

Component Associations:

- *Acer rubrum / Viburnum nudum - Photinia pyrifolia / Smilax laurifolia / Carex debilis var. pubera* Seepage Forest (CEGL007041, G2)
- *Acer rubrum var. trilobum - Nyssa sylvatica / Osmunda cinnamomea - Chasmanthium laxum - Carex intumescens / Sphagnum lescurii* Forest (CEGL007443, G3?)
- *Alnus maritima ssp. georgiensis - (Decodon verticillatus) / Hibiscus moscheutos - Sparganium americanum* Spring-run Marsh

Shrubland (CEGL004145, G1)
- *Alnus serrulata - Lindera benzoin / Scutellaria lateriflora - Thelypteris noveboracensis* Shrubland (CEGL003909, G2?)
- *Alnus serrulata* Saturated Appalachian-Piedmont Shrubland (CEGL007062, G3)
- *Calamagrostis cainii - Carex ruthii - Parnassia asarifolia / Sphagnum* spp. Herbaceous Vegetation (CEGL007877, G1Q)
- *Carex gynandra - Platanthera clavellata - Drosera rotundifolia - Carex ruthii - Carex atlantica / Sphagnum* spp. Herbaceous Vegetation (CEGL007697, G2)
- *Diphylleia cymosa - Saxifraga micranthidifolia - Laportea canadensis* Herbaceous Vegetation (CEGL004296, G3)
- *Glyceria striata - Carex gynandra - Chelone glabra - Symphyotrichum puniceum / Sphagnum* spp. Herbaceous Vegetation (CEGL008438, G2G3)
- *Impatiens (capensis, pallida) - Monarda didyma - Rudbeckia laciniata var. humilis* Herbaceous Vegetation (CEGL004293, G3)
- *Oxypolis rigidior - Drosera rotundifolia - Platanthera clavellata - Rhexia mariana var. mariana* Seep Herbaceous Vegetation (CEGL007043, G1)
- *Pinus strobus - Acer rubrum / Spiraea alba var. latifolia / Sanguisorba canadensis* Woodland (CEGL004994, G1)
- *Schoenoplectus robustus - Juncus gerardii - Hordeum jubatum - Atriplex patula* Herbaceous Vegetation (CEGL006234, G1)
- *Trichophorum caespitosum - Osmunda cinnamomea - Carex barrattii - Carex buxbaumii* Herbaceous Vegetation (CEGL007723, G1Q)

SPATIAL CHARACTERISTICS

Spatial Summary: Small-patch system, from less than one to no more than several acres in size, potentially surrounded by a number of different systems.

Size: Occurs as small patches, most less than one acre in size. The largest patches at high elevations are several acres. Patches occasionally occur in complexes but more often occur singly.

Adjacent Ecological Systems:
- Southern and Central Appalachian Cove Forest (CES202.373)
- Southern Appalachian Grass and Shrub Bald (CES202.294)
- Southern Appalachian Northern Hardwood Forest (CES202.029)

Adjacent Ecological System Comments: This system may be embedded in a variety of other systems. Most common are Southern Appalachian Northern Hardwood Forest (CES202.029) and Southern and Central Appalachian Cove Forest (CES202.373).

DISTRIBUTION

Range: This system ranges throughout the Southern Appalachians, from northern Georgia and South Carolina north through Virginia, and westward into eastern Tennessee and Kentucky.

Divisions: 202:C

Nations: US

Subnations: GA, KY, NC, SC, TN, VA

Map Zones: 57:C, 61:C

TNC Ecoregions: 50:C, 51:C, 59:?

SOURCES

References: Comer et al. 2003

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723181#references

Description Author: M. Schafale and R. Evans, mod. S.C. Gawler and C. Nordman

Version: 14 Jan 2014 **Stakeholders:** East, Southeast

Concept Author: M. Schafale and R. Evans **ClassifResp:** Southeast

SOUTHERN ATLANTIC COASTAL PLAIN DEPRESSION POND (CES203.262)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Woody-Herbaceous; Depressional [Pond]; Coastal plain
Non-Diagnostic Classifiers: Isolated Wetland [Partially Isolated]
National Mapping Codes: ESLF 9305

CONCEPT

Summary: This ecological system consists of wetlands in small basins formed in unconsolidated sediments of the Atlantic Coastal Plain, from southeastern Virginia to Florida. Many basins are formed by subsidence of surface sediments caused by solution in underlying limestone. Others may be formed as swales in mainland eolian sands, natural blockage of small drainages by sediment movement, and more obscure causes. Soils are generally sandy, with mucky surfaces in the wettest areas. Vegetation is often zonal in response to variation in duration of flooding in different parts of the depression pond. Vegetation usually ranges from open water or floating-leaved aquatic plants in the center of the deepest basins, to emergent marsh zones in semipermanent water, to drawdown zones with diverse small graminoid and forb vegetation, to dense shrub or woodland edges. A smaller number of basins may have emergent trees throughout their extent. Hydroperiod can vary substantially from year to year, and vegetation can similarly vary significantly in aspect and dominants. In addition to flooding, fire is an important natural disturbance to vegetation in the outer, drier portions of the pond.

Classification Comments: The boundary of this system with adjacent upland or wetland systems occurs where vegetation begins to reflect the influence of regular flooding and basin hydrology. This system shares much of its character with Atlantic Coastal Plain Clay-Based Carolina Bay Wetland (CES203.245) but generally accommodates all "limesink depressions" as opposed to mineral soil Carolina bay wetlands. Other basins, especially broad, gently sloped basins on the Outer Coastal Plain and steep-sided depressions farther inland, will need to be placed based on the preponderance of evidence. The northern and southern range limits of this system are not well known. It is tentatively placed at the mouth of Chesapeake Bay and in south Georgia. Northern Atlantic Coastal Plain Pond (CES203.518) of Virginia and Maryland and the wet prairies of north-central Florida are closely related systems.

Similar Ecological Systems:
- Atlantic Coastal Plain Clay-Based Carolina Bay Wetland (CES203.245)
- East Gulf Coastal Plain Depression Pond (CES203.558)
- Northern Atlantic Coastal Plain Pond (CES203.518)
- Southeastern Coastal Plain Natural Lakeshore (CES203.044)

Related Concepts:
- Depression Marsh (FNAI 1990) Broader
- Pond Pine: 98 (Eyre 1980) Finer
- Pondcypress: 100 (Eyre 1980) Finer
- Sweetgum - Willow Oak: 92 (Eyre 1980) Finer
- Water Tupelo - Swamp Tupelo: 103 (Eyre 1980) Finer
- Willow Oak - Water Oak - Diamondleaf (Laurel) Oak: 88 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs in small basins, primarily in sandy terrain of the Atlantic Coastal Plain, from southeastern Virginia to Florida. Most basins are formed by subsidence of surface sediments caused by solution in underlying limestone. Others may be formed as dune swales in mainland eolian sands, natural blockage of small drainages by sediment movement, and more obscure causes. Basins often occur in complexes of a few to dozens, which vary in size, depth, and steepness of sides. Most of these basins are considered groundwater windows, with water levels matching the level of the local water table. Rainfall is probably also a substantial contributor. The water is acidic and is apparently not influenced by the underlying limestone or deeper groundwater. Hydroperiods vary substantially, with the deepest ponds having permanent water in the center, and the shallowest normally holding water only in the winter and spring. However, water levels can fluctuate substantially over the course of a year and from year to year in response to rainfall and longer term droughts. Soils have a mucky surface layer in the centers of basins that hold water most or all of the year and are generally sandy in smaller basins and in the outer drawdown zones that are more frequently exposed. Fire is potentially an important, if infrequent, influence in the system, penetrating the portions of the basin that are dry when adjacent communities burn. The northern range limit of this system is generally consistent with the northern limit of *Pinus palustris*, although this species is not a component.

Vegetation: This system consists of wetland vegetation that is often strongly zoned within single basins and may vary substantially among basins even in close proximity. Most of the associations are herbaceous, but woody associations may be present. The center of the deepest basins generally is open water or floating-leaved aquatics. Semipermanently flooded zones may have marsh vegetation of medium to large emergents. Outer, mineral soil drawdown zones often have a species-rich flora of small to medium graminoids and

forbs. These include a number of specialized species that are rare in states, some that are globally rare, and some that are widespread but nowhere common. The aspect of this vegetation may vary substantially from year to year depending on when water level drops. Some basins have a dense shrubby edge zone. Some trees or shrubs tolerant of standing water, especially bald-cypress (*Taxodium distichum*), pond-cypress (*Taxodium ascendens*) or swamp blackgum (*Nyssa biflora*), may grow within the basins, either as scattered individuals, as a distinct zone, or forming an open canopy over the whole basin. Because the basins are isolated from larger water bodies and most dry out at least occasionally, their aquatic fauna does not include fish unless fish have been artificially introduced. These systems are well known as important breeding sites for amphibians, and may support important aquatic invertebrate communities as well.

Dynamics: Flooding hydrology is the most important dynamic process. Standing water excludes plants not characteristic of the system. Variation in hydroperiod and amount of drawdown drive vegetation changes from year to year. Because ponds are connected to the local water table, hydroperiods respond to seasonal and long-term cycles in rainfall as much as, perhaps more than, single rainfall events. They may also be affected by regional drainage and groundwater extraction which lowers the water table. Fire is also an important dynamic process in the drier portions of this system. Fire may be important for preventing invasion of trees such as *Pinus taeda* during long-running droughts, as well as for driving variation in herbaceous species.

Component Associations:

- *Amphicarpum muehlenbergianum - (Panicum hemitomon)* Herbaceous Vegetation (CEGL008588, G2G3)
- *Carex hyalinolepis* Seasonally Flooded Herbaceous Vegetation (CEGL004724, G1G3)
- *Carex striata var. striata - Xyris fimbriata - Lachnanthes caroliana* Herbaceous Vegetation (CEGL007718, G2G3)
- *Cyrilla racemiflora - Lyonia lucida* Shrubland (CEGL003844, G3?)
- *Cyrilla racemiflora / Xyris fimbriata - Utricularia purpurea - Lycopodiella alopecuroides* Scrub (CEGL007829, G2?)
- *Dichanthelium wrightianum - Dichanthelium erectifolium* Herbaceous Vegetation (CEGL004105, G2G3)
- *Hypericum fasciculatum / Rhynchospora (chapmanii, harperi)* Shrubland (CEGL003869, G2G3)
- *Leersia hexandra - (Panicum verrucosum, Scleria reticularis)* Herbaceous Vegetation (CEGL004047, G2G3)
- *Nymphaea odorata - Nuphar advena - (Nymphoides aquatica, Xyris smalliana)* Herbaceous Vegetation (CEGL004326, G3?)
- *Nyssa biflora / Itea virginica - Cephalanthus occidentalis* Depression Forest (CEGL007434, G3G4)
- *Nyssa ogeche - (Nyssa biflora)* Forest (CEGL004718, G2?)
- *Nyssa ogeche / Ilex myrtifolia / Carex turgescens - Carex striata* Forest (CEGL004641, G2?)
- *Panicum hemitomon - Eleocharis equisetoides - Rhynchospora inundata* Herbaceous Vegetation (CEGL004127, G3)
- *Panicum virgatum - Andropogon (capillipes, glaucopsis) - Aristida palustris* Herbaceous Vegetation (CEGL004100, G2?)
- *Pinus serotina / Cyrilla racemiflora - Lyonia lucida - Vaccinium fuscatum* Woodland (CEGL004434, G2G3)
- *Quercus phellos / Carex (albolutescens, intumescens, joorii) / Climacium americanum* Forest (CEGL007403, G2G3)
- *Rhynchospora (careyana, inundata)* Seasonally Flooded Herbaceous Vegetation (CEGL004132, G3?)
- *Rhynchospora alba* Saturated Herbaceous Vegetation (CEGL004463, G1?)
- *Rhynchospora filifolia - Juncus abortivus* Herbaceous Vegetation (CEGL004131, G2?)
- *Rhynchospora inundata - Eriocaulon decangulare - Panicum virgatum - Muhlenbergia expansa* Herbaceous Vegetation (CEGL004509, G1)
- *Saccharum baldwinii - Carex glaucescens - Rhynchospora corniculata* Herbaceous Vegetation (CEGL007745, G2G3)
- *Saccharum giganteum - Ludwigia sphaerocarpa - Panicum verrucosum* Herbaceous Vegetation (CEGL007744, G2G3)
- *Saccharum* spp. - *Panicum verrucosum* - (*Rhexia* spp., *Sabatia* spp.) Herbaceous Vegetation (CEGL004752, G2G3)
- *Spartina bakeri - Woodwardia virginica - Saccharum giganteum* Herbaceous Vegetation (CEGL007713, G3?)
- *Sphagnum cuspidatum* Nonvascular Vegetation (CEGL004384, G2?)
- *Taxodium ascendens - Nyssa biflora / Carex striata - Rhynchospora (careyana, cephalantha, microcephala)* Stringer Woodland (CEGL004089, G3)
- *Taxodium ascendens / (Nyssa biflora) / Leucothoe racemosa - Lyonia lucida - Morella cerifera* Depression Forest (CEGL007420, G3)
- *Taxodium ascendens / Aristida palustris* Depression Woodland (CEGL004090, G2G3)
- *Taxodium ascendens / Carex striata - Iris tridentata - (Woodwardia virginica)* Depression Woodland (CEGL004087, G3)
- *Taxodium ascendens / Cyrilla racemiflora - Zenobia pulverulenta* Woodland (CEGL003734, G2)
- *Taxodium ascendens / Ilex myrtifolia / Carex (striata, turgescens)* Stringer Forest (CEGL007419, G3?Q)
- *Taxodium ascendens / Ilex myrtifolia* Depression Forest (CEGL007418, G3?)
- *Vaccinium formosum - Vaccinium fuscatum / Sphagnum cuspidatum* Shrubland (CEGL003907, G3?)
- *Woodwardia virginica / Sphagnum cuspidatum* Herbaceous Vegetation (CEGL004475, G2?)

Spatial Characteristics

Size: Depressions often occur in complexes, in a matrix of upland or saturated wetland systems. Individual depressions range from about 100 square meters to a hectare or two. Complexes may occupy several hectares within the space of several square kilometers.

Adjacent Ecological Systems:

- Atlantic Coastal Plain Upland Longleaf Pine Woodland (CES203.281)
- Central Atlantic Coastal Plain Wet Longleaf Pine Savanna and Flatwoods (CES203.265)

Adjacent Ecological System Comments: Most often associated with Atlantic Coastal Plain Upland Longleaf Pine Woodland (CES203.281), but any upland or saturated wetland system can potentially surround them.

Distribution

Range: This system is found from southeastern Virginia to Florida, primarily in the Outer Coastal Plain, but occasional depressions in the Inner Coastal Plain and Sandhills could be included.
Divisions: 203:C
Nations: US
Subnations: FL, GA, NC, SC, VA
Map Zones: 55:C, 58:C, 60:C
TNC Ecoregions: 56:C, 57:C

SOURCES

References: Eyre 1980, FNAI 1990, Kirkman et al. 2012, Southeastern Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723224#references
Description Author: M. Schafale and R. Evans, mod. C. Nordman
Version: 14 Jan 2014 **Stakeholders:** East, Midwest, Southeast
Concept Author: M. Schafale and R. Evans **ClassifResp:** Southeast

SOUTHERN ATLANTIC COASTAL PLAIN FRESH AND OLIGOHALINE TIDAL MARSH (CES203.376)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Tidal / Estuarine [Freshwater]; Tidal / Estuarine [Oligohaline]; Graminoid
Non-Diagnostic Classifiers: Herbaceous
National Mapping Codes: ESLF 9413

CONCEPT

Summary: This ecological system represents tidally-influenced freshwater herbaceous marshes and tidal shrublands ranging from the vicinity of Morehead City, Carteret County, North Carolina (south of the Embayed Region), south to the vicinity of Marineland or Daytona Beach (Flagler/Volusia counties) in northern Florida. This system occurs where there is adequate riverflow and discharge to maintain fresh to oligohaline conditions, while still within tidal range. These marshes most often occur well inside the mouths of tidal creeks and rivers. Different vegetation types occupy areas of slightly different elevations within the marsh.
Classification Comments: Montague and Wiegert (1990) state that "Northeast Florida salt marshes" occur "south to Marineland," which is in northern Flagler County, Florida. These "Northeast Florida salt marshes" are assumed to be the Florida part of Southern Atlantic Coastal Plain Salt and Brackish Tidal Marsh (CES203.270) which ranges north to southern North Carolina. It is further assumed that the range of CES203.270 and Southern Atlantic Coastal Plain Fresh and Oligohaline Tidal Marsh (CES203.376) are basically identical. Some other sources refer to Daytona Beach (Volusia County) as the southern limit. Atlantic Coastal Plain Indian River Lagoon Tidal Marsh (CES203.257) is found to the south.
Related Concepts:
- Tidal Marsh (FNAI 1990) Broader

DESCRIPTION

Environment: This system occurs where there is adequate riverflow and discharge to maintain fresh to oligohaline conditions, while still within tidal range. These marshes most often occur upstream, well inside the mouths of tidal creeks and rivers. Most of the region where this system occurs consists of marshy shores and sea islands.
Vegetation: Shrubs may include *Alnus serrulata, Baccharis halimifolia, Iva frutescens, Morella cerifera,* and *Ilex vomitoria*. Dominant grasses and graminoids may include *Juncus roemerianus, Carex stricta, Schoenoplectus pungens, Spartina cynosuroides, Spartina patens, Zizania aquatica,* and *Zizaniopsis miliacea*. Forbs may include *Borrichia frutescens, Peltandra virginica, Sagittaria lancifolia ssp. media, Sagittaria latifolia,* and the fern *Osmunda regalis var. spectabilis*.
Dynamics: Tidal flooding is the ecological factor that distinguishes this system from others. Tides bring nutrients, making the regularly-flooded marshes fertile. Rising sea level will affect this system strongly, drowning some marsh areas, promoting shoreline erosion, and causing salt or brackish marshes to spread inland upstream into areas that have been freshwater marsh areas. Some limited natural shifting between this system and tidal swamps may occur, as trees are killed by storm-driven salt water intrusion and later trees may gradually regenerate. Fire may also have affected this boundary in the past - flammable marsh vegetation and non-flammable swamp vegetation may both have affected fire regimes in ways that helped maintain them, for instance when dry, herbaceous marsh vegetation may promote the spread of fires, which kill trees. Tidal swamps which have a shaded understory rarely have adequate dry fine fuels to carry fire.

Component Associations:
- *Alnus serrulata / (Zizania aquatica, Zizaniopsis miliacea)* Shrubland (CEGL004627, G3?)
- *Baccharis halimifolia - Iva frutescens - Morella cerifera - (Ilex vomitoria)* Shrubland (CEGL003920, G4?)
- *Borrichia frutescens / (Spartina patens, Juncus roemerianus)* Shrubland (CEGL003924, G4)
- *Carex stricta - Peltandra virginica - Sagittaria (lancifolia ssp. media, latifolia)* Tidal Herbaceous Vegetation (CEGL004314, G2?)
- *Schoenoplectus pungens - (Osmunda regalis var. spectabilis)* Herbaceous Vegetation (CEGL004189, G2G3)
- *Spartina cynosuroides* Herbaceous Vegetation (CEGL004195, G4)
- *Zizania aquatica* Tidal Herbaceous Vegetation (CEGL004202, G4?)
- *Zizaniopsis miliacea* Tidal Herbaceous Vegetation (CEGL004705, G3G5)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Southern Atlantic Coastal Plain Salt and Brackish Tidal Marsh (CES203.270)

DISTRIBUTION

Range: This system ranges from the vicinity of Morehead City, Carteret County, North Carolina (south of the Embayed Region), south to the vicinity of Marineland or Daytona Beach (Flagler/Volusia counties) in northern Florida (Montague and Wiegert 1990).
Divisions: 203:C
Nations: US

Subnations: FL, GA, NC, SC
Map Zones: 55:C, 58:C
USFS Ecomap Regions: 232C:CC, 232G:CC, 232I:CC
TNC Ecoregions: 55:C, 56:C, 57:C

SOURCES

References: Bertness et al. 2004, FNAI 1990, Montague and Wiegert 1990, Odum et al. 1984, Southeastern Ecology Working Group n.d.

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723140#references

Description Author: R. Evans, mod. M. Pyne and C. Nordman
Version: 14 Jan 2014
Concept Author: R. Evans
Stakeholders: Southeast
ClassifResp: Southeast

SOUTHERN ATLANTIC COASTAL PLAIN SALT AND BRACKISH TIDAL MARSH (CES203.270)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Tidal / Estuarine [Haline]; Graminoid
Non-Diagnostic Classifiers: Herbaceous
National Mapping Codes: ESLF 9236

CONCEPT

Summary: This system encompasses the brackish to saline intertidal marshes of the Atlantic Coast ranging from the vicinity of Morehead City, Carteret County, North Carolina (south of the Embayed Region), south to the vicinity of Marineland or Daytona Beach (Flagler/Volusia counties) in northern Florida. It is dominated by medium to extensive expanses of *Spartina alterniflora*, flooded twice daily by lunar tides. *Juncus roemerianus* and other brackish marshes occur upstream in tidal creeks, and a variety of small-patch associations occur near the inland edges. Examples of this system may also support inclusions of shrublands dominated by either *Baccharis halimifolia* and/or *Borrichia frutescens*, as well as forests or woodlands with *Juniperus virginiana var. silicicola* in the overstory.

Classification Comments: This system is distinguished from Atlantic Coastal Plain Embayed Region Tidal Salt and Brackish Marsh (CES203.260) because of the characteristic hydrology of the Embayed Region and what it implies about ecosystem dynamics. This system is dominated by salt marshes regularly flooded by lunar tides, while the Embayed Region is dominated by brackish marshes irregularly flooded by wind tides. This system is distinguished from salt marsh systems of the Gulf Coast because of the differences in tidal dynamics and energy.

The range of this system is somewhat larger than the "Embayed Region" tidal marshes (which range southward only to Cape Lookout). This is due to the fact that submerged aquatic vegetation occurs throughout the region without discernable patterns of change, whereas the tidal marshes do vary across this range.

Montague and Wiegert (1990) state that "Northeast Florida salt marshes" occur "south to Marineland," which is in northern Flagler County, Florida. These "Northeast Florida salt marshes" are assumed to be the Florida part of Southern Atlantic Coastal Plain Salt and Brackish Tidal Marsh (CES203.270) which ranges north to southern North Carolina. It is further assumed that the range of CES203.270 and Southern Atlantic Coastal Plain Fresh and Oligohaline Tidal Marsh (CES203.376) are basically identical. Some other sources refer to Daytona Beach (Volusia County) as the southern limit. Atlantic Coastal Plain Indian River Lagoon Tidal Marsh (CES203.257) is found to the south.

Similar Ecological Systems:
- Atlantic Coastal Plain Embayed Region Tidal Salt and Brackish Marsh (CES203.260)
- Atlantic Coastal Plain Indian River Lagoon Tidal Marsh (CES203.257)

Related Concepts:
- Cabbage Palmetto: 74 (Eyre 1980) Finer
- Live Oak: 89 (Eyre 1980) Finer
- Northeast Florida salt marshes (Montague and Wiegert 1990) Finer
- Southern Redcedar: 73 (Eyre 1980) Finer
- Tidal Marsh (FNAI 1990) Broader

DESCRIPTION

Environment: This system occurs on intertidal flats that are tidally-flooded with salt to brackish water along the Atlantic Coast south of the Embayed Region of North Carolina, extending to northern Florida (south to the vicinity of Flagler and Volusia counties). Regular tidal flooding occurs over most of the system, with irregular flooding in unusually high tides occurring in the upper zones. Tidal ranges vary but are two feet or more. The water is salty over most of the expanse of this system, grading to brackish upstream in tidal rivers and creeks. Upper zones tend to have vegetation suggestive of brackish water as well, but this is apparently the result of a combination of irregular saltwater flooding with freshwater input. Local depressions in upper zones may be hypersaline due to concentration of salt by evaporation. Flooding depth and salinity are the primary determinants of the boundary of this system and of the variation in associations within it. Soils are either sandy or clayey and often are sulfidic and high in organic matter. The input of cations in sea water prevents them from being strongly acidic, but they may rapidly become extremely acidic if drained.

Vegetation: Vegetation is primarily marsh. *Spartina alterniflora* is the predominant vegetation. *Juncus roemerianus* may dominate fairly large expanses along brackish portions of tidal creeks and rivers. Upper zones include a few herbaceous and shrubland associations with plants tolerant of occasional to frequent saltwater, and a few herbaceous to sparse vegetation associations in hypersaline depressions. All associations are low in plant species richness. Salt marsh communities are known for their high primary productivity, much of which is exported to estuarine systems with tidal flushing. Examples of this system may also support inclusions of shrublands dominated by either *Baccharis halimifolia* and/or *Borrichia frutescens*, as well as forests or woodlands with *Juniperus virginiana var. silicicola* in the overstory. Some shrub stands containing *Ilex vomitoria* and stunted *Quercus virginiana* may also be

included.
Dynamics: Tidal flooding is the ecological factor that distinguishes this system from others. Tides bring nutrients, making the regularly flooded marshes fertile. Storms may push saltwater into brackish areas and higher zones, acting as a disturbance to vegetation. In salt marshes, storms locally concentrate debris into piles or bands (wrack) that smother vegetation. For marshes on the back of barrier islands, storm overwash may deposit sand in the marsh. Marshes usually recover from this, but if sufficient sand is deposited, a different system may develop on the site. Fire may be a natural force in some patches that are connected to the mainland. Most salt marshes are probably too wet to burn. Rising sea level will affect this system strongly, drowning some marsh areas, promoting shoreline erosion, and causing salt or brackish marshes to spread inland into freshwater marsh areas. However, elevated atmospheric CO2 increases the productivity of marsh grasses, which can lead to marsh elevation gain (Langley et al. 2009). The marsh snail (*Littoraria irrorata*) is a native and characteristic part of the marsh ecosystem, and is eaten by blue crabs. The disruption of marsh snail predation by blue crabs can lead to a trophic cascade (Silliman and Bertness 2002, Bertness et al. 2004).

Component Associations:
- *Baccharis halimifolia - Iva frutescens / Panicum virgatum* Shrubland (CEGL003921, G5)
- *Borrichia frutescens / (Spartina patens, Juncus roemerianus)* Shrubland (CEGL003924, G4)
- *Cladium mariscus ssp. jamaicense* Tidal Herbaceous Vegetation (CEGL004178, G4?)
- *Ilex vomitoria - Quercus (geminata, virginiana) - Morella cerifera - Serenoa repens* Shrubland (CEGL003813, G2G3)
- *Juncus roemerianus* Herbaceous Vegetation (CEGL004186, G5)
- *Juniperus virginiana var. silicicola - (Quercus virginiana, Sabal palmetto)* Forest (CEGL007813, G3?)
- *Juniperus virginiana var. silicicola / Morella cerifera / Kosteletzkya virginica - Bacopa monnieri* Woodland (CEGL007166, G1?)
- *Salicornia (virginica, bigelovii, maritima) - Spartina alterniflora* Herbaceous Vegetation (CEGL004308, G5)
- *Schoenoplectus pungens* Tidal Herbaceous Vegetation (CEGL004188, GNR)
- *Spartina alterniflora* Carolinian Zone Herbaceous Vegetation (CEGL004191, G5)
- *Spartina patens - Distichlis spicata - (Juncus roemerianus)* Herbaceous Vegetation (CEGL004197, G4G5)

SPATIAL CHARACTERISTICS

Spatial Summary: Large-patch system.
Size: Occurs in small to large patches, with a few ranging up to 1000 acres or more.
Adjacent Ecological Systems:
- Central Atlantic Coastal Plain Maritime Forest (CES203.261)
- Southern Atlantic Coastal Plain Fresh and Oligohaline Tidal Marsh (CES203.376)

Adjacent Ecological System Comments: Grades to Southern Atlantic Coastal Plain Fresh and Oligohaline Tidal Marsh (CES203.376) upstream on tidal rivers. Grades to a variety of systems on adjacent higher area dune and coastal grassland types, Central Atlantic Coastal Plain Maritime Forest (CES203.261), and various mainland upland systems.

DISTRIBUTION

Range: This systems ranges from central North Carolina (Carteret County) south to the vicinity of Flagler and Volusia counties, Florida. The northern boundary is roughly the eastern end of Carteret County, North Carolina.
Divisions: 203:C
Nations: US
Subnations: FL, GA, NC, SC
Map Zones: 55:C, 58:C
USFS Ecomap Regions: 232C:CC, 232I:CC
TNC Ecoregions: 55:C, 56:C, 57:C

SOURCES

References: Bertness et al. 2004, Eyre 1980, FNAI 1990, Hackney and Cleary 1987, Langley et al. 2009, Montague and Wiegert 1990, Silliman and Bertness 2002, Southeastern Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723216#references
Description Author: R. Evans, mod. M. Pyne
Version: 06 Feb 2014 **Stakeholders:** Southeast
Concept Author: R. Evans **ClassifResp:** Southeast

SOUTHERN COASTAL PLAIN HERBACEOUS SEEP AND BOG (CES203.078)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Seepage-Fed Sloping; Graminoid
Non-Diagnostic Classifiers: Herbaceous
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2515; ESLF 9404; ESP 1515

CONCEPT

Summary: This small-patch ecological system includes wet, fire-maintained, seepage communities in the outermost portions of the East Gulf Coastal Plain, east of the Mississippi River in Louisiana, Mississippi, Alabama, and extending across northern Florida. These wetlands are generally found on gentle, almost imperceptible slopes maintained by constant seepage zones and/or perched water tables. Examples are typically grass and sedge dominated, and are often species-rich. *Sarracenia* spp. are notable indicators of many community types in this system. Shrubs frequently encroach in the absence of fire; due to greater topographic isolation, the most interior examples are often naturally shrubbier.
Classification Comments: Known from Clay County (Jennings State Forest) and Nassau County (Ralph E. Simmons State Forest), Florida, based on EORs reported from Florida (A. Johnson pers. comm.).
Similar Ecological Systems:
- East Gulf Coastal Plain Interior Shrub Bog (CES203.385)

Related Concepts:
- Longleaf Pine - Slash Pine: 83 (Eyre 1980) Finer
- Longleaf Pine: 70 (Eyre 1980) Finer
- Pond Pine: 98 (Eyre 1980) Finer
- Seepage Slope (FNAI 2010a) Intersecting
- Seepage Slope (FNAI 1990) Undetermined
- Slash Pine: 84 (Eyre 1980) Intersecting
- Wet Flatwoods (FNAI 2010a) Intersecting
- Wet Prairie (FNAI 2010a) Intersecting

DESCRIPTION

Environment: Kindell et al. (1997) document examples for the Leefield, Albany, Pactolus, Pamlico, Rutledge, and Pansey soil series. Clewell (1981) describes these bogs as commonly occurring between bay swamps and pine flatwoods. These habitats occur on gentle slopes, where seepage water maintains saturated conditions most of the time.
Vegetation: Examples are typically grass- and sedge dominated, and are often species-rich. Pitcher plants (*Sarracenia* spp.) are notable indicators of many community types in this system. *Rhynchospora* spp. are dominant or codominant in many examples. Shrubs (e.g., *Lyonia lucida, Ilex glabra, Cyrilla racemiflora*) frequently encroach in the absence of fire. Scattered *Pinus elliottii var. elliottii, Pinus palustris,* and/or *Pinus serotina* may be present.
Dynamics: Frequent fires are necessary to maintain this system. In the absence of fire, shrubs encroach, eventually shading out understory plants. Fires may have occurred every 1-4 years (FNAI 2010a).

Component Associations:
- *Andropogon arctatus - Rhynchospora chapmanii* Herbaceous Vegetation (CEGL008596, G1G2)
- *Aristida beyrichiana - Rhynchospora oligantha - Panicum nudicaule - (Eurybia eryngiifolia)* Herbaceous Vegetation (CEGL004155, G2)
- *Arundinaria gigantea ssp. tecta* Shrubland (CEGL003843, G1)
- *Hypericum fasciculatum - Hypericum chapmanii / Aristida palustris - Sarracenia (flava, psittacina)* Shrubland (CEGL008594, G1)
- *Pinus elliottii var. elliottii - (Pinus serotina) / Aristida beyrichiana - Rhynchospora oligantha - Sarracenia (flava, minor, psittacina)* Woodland (CEGL003673, G2?)
- *Pinus palustris - Pinus serotina / Ilex glabra - Lyonia lucida / Ctenium aromaticum* Woodland (CEGL003860, G3)
- *Pinus serotina / Lyonia lucida - Ilex glabra - (Cyrilla racemiflora)* Shrubland (CEGL003846, G3)
- *Rhynchospora macra - Rhynchospora stenophylla - Panicum nudicaule - Xyris chapmanii - Carex exilis* Herbaceous Vegetation (CEGL004667, G1)
- *Rhynchospora oligantha - Sarracenia (alata, psittacina) - Carphephorus pseudoliatris* Herbaceous Vegetation (CEGL004687, G2)
- *Rhynchospora stenophylla - Rhynchospora macra - Panicum nudicaule - Eriocaulon nigrobracteatum - Pleea tenuifolia* Herbaceous Vegetation (CEGL004177, G1)

DISTRIBUTION

Range: This systems is found in the northern Gulf of Mexico region, east of the Mississippi River in Louisiana, Mississippi, Alabama, and extending across northern Florida.
Divisions: 203:C
Nations: US
Subnations: AL, FL, LA, MS
Map Zones: 55:C, 99:C
USFS Ecomap Regions: 232B:CC, 232C:CC, 232D:CC, 232J:CC, 232K:CC, 232L:CC, 234A:CC
TNC Ecoregions: 53:C, 56:C

SOURCES

References: Clewell 1981, Comer et al. 2003, Eyre 1980, FNAI 1990, FNAI 2010a, Folkerts 1982, Kindell et al. 1997
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723251#references
Description Author: R. Evans, mod. M. Pyne and C. Nordman
Version: 14 Jan 2014
Concept Author: R. Evans
Stakeholders: Southeast
ClassifResp: Southeast

SOUTHERN COASTAL PLAIN SPRING-RUN STREAM AQUATIC VEGETATION (CES203.275)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Riverine / Alluvial [Whitewater]
Non-Diagnostic Classifiers: Herbaceous
National Mapping Codes: ESLF 9258

CONCEPT

Summary: Spring-run streams are perennial watercourses fed with artesian waters originating in karstic or limestone topography in the outer portions of the southeastern Coastal Plain of the United States. Such areas are rare in the Gulf and Atlantic coastal plains and apparently confined to Florida and small areas of Georgia. Waters are mineral-rich and circumneutral to alkaline with pH of 7.0-8.2. Water temperatures are relatively cool; clarity is often high. These factors contribute to sometimes lush growth of submerged aquatic vegetation which may include *Vallisneria americana, Sagittaria kurziana, Potamogeton* spp., and *Myriophyllum* spp. Emergent marshes dominated by *Cladium* and/or *Zizania* may occur along the edges. Floodplain development is not usually advanced, but many of these streams are bordered by forests in which *Taxodium distichum* is present.

Similar Ecological Systems:
- Atlantic Coastal Plain Blackwater Stream Floodplain Forest (CES203.247)
- Southern Coastal Plain Hydric Hammock (CES203.501)

Related Concepts:
- Spring-Run Stream (FNAI 1990) Equivalent

DESCRIPTION

Environment: Channels may have sandy bottoms or exposed limestone. Spring "boils" and "blue holes" are encountered with some frequency (Wharton 1978, FNAI 1990).
Dynamics: Consistent flow from groundwater springs are characteristic of these streams.

Component Associations:
- *Cladium mariscus ssp. jamaicense - Typha domingensis - Fimbristylis caroliniana - Bacopa monnieri* Herbaceous Vegetation (CEGL008591, G3?)
- *Nuphar ulvacea* Herbaceous Vegetation (CEGL004329, G2)
- *Sagittaria kurziana - Potamogeton illinoensis - Vallisneria americana* Herbaceous Vegetation (CEGL004332, G2)
- *Stuckenia pectinata - Vallisneria americana* Herbaceous Vegetation (CEGL008590, G2G3)
- *Zizania aquatica - Cicuta maculata - Hydrocotyle umbellata* Herbaceous Vegetation (CEGL004716, G2?)

DISTRIBUTION

Range: This system is endemic to Florida and Georgia.
Divisions: 203:C
Nations: US
Subnations: FL, GA
Map Zones: 55:C, 56:C, 99:C
TNC Ecoregions: 53:C, 55:C

SOURCES

References: Comer et al. 2003, FNAI 1990, Nordlie 1990, Wharton 1978
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723211#references
Description Author: R. Evans
Version: 06 Feb 2014
Concept Author: R. Evans
Stakeholders: Southeast
ClassifResp: Southeast

SOUTHERN RIDGE AND VALLEY SEEPAGE FEN (CES202.458)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Seepage-Fed Sloping
Non-Diagnostic Classifiers: Shrubland (Shrub-dominated)
National Mapping Codes: ESLF 9440

CONCEPT

Summary: This ecological system accommodates small-scale, herbaceous-dominated seepage areas found in limited areas of the southern part of the Ridge and Valley in Alabama and Georgia. These features have been generally known as "seepage fens" and are fed by mineral-rich groundwater. Examples are associated with stream drainages but are generally not affected by stream-related hydrology. Soils contain a thin organic layer over limestone gravel, over a less permeable layer of more solid rock. The vegetation is dominated by herbaceous plants. Characteristic species include *Carex atlantica, Carex lurida, Carex leptalea ssp. harperi, Parnassia grandifolia, Juncus brachycephalus, Rudbeckia fulgida var. umbrosa, Cardamine bulbosa, Impatiens capensis, Juncus coriaceus, Juncus effusus, Lobelia puberula, Lobelia cardinalis, Oxypolis rigidior, Phlox glaberrima, Rhynchospora capitellata, Scirpus atrovirens, Scirpus cyperinus, Solidago patula var. patula*, and *Thelypteris palustris var. pubescens*. Woody species include *Alnus serrulata, Salix humilis, Salix caroliniana, Cornus amomum*, and *Acer rubrum*, which may invade the herbaceous seep. The Federally-listed *Xyris tennesseensis* may be a component of this system and occurs in many of its occurrences.
Classification Comments: This system is a small-patch system, originally described from a small region.
Similar Ecological Systems:
- Interior Low Plateau Seepage Fen (CES202.346)
- North-Central Appalachian Seepage Fen (CES202.607)
- Ozark-Ouachita Fen (CES202.052)

DESCRIPTION

Environment: Examples of this system are typically a complex of seeps, springs and small streams whose hydrology is variable (and perhaps locally ambiguous), but the supply of moisture is reliable, at least during most of the year. Soils are typically circumneutral, organic sandy loams, intermixed with or overlying gravel or chert, and containing elevated levels of calcium and magnesium. These edaphic and hydrologic conditions promote a graminoid- and herbaceous-dominated community, although woody plant succession will occur without periodic disturbance (M. Moffett, GDNR, pers. comm. 2009). Seepage fens of the Southern Ridge and Valley ecoregion (including both Georgia and Alabama) reflect the influence of unique physiographic, geologic, and edaphic features. They are found primarily in the "valley" areas (Great Valley) of the ecoregion, corresponding to the Southern Limestone/Dolomite Valleys and Low Rolling Hills (67f) and the Southern Shale Valleys (67g) Level IV ecoregions of Griffith et al. (2001). These valley areas are broad, relatively deep-soiled, and offer little to moderate topographic relief. Softer and weaker sedimentary rock (i.e., limestone, dolostone, and shale) forms the valley floor, with harder and more resistant sedimentary rock (e.g., sandstone, metamorphosed sandstone [quartzite], conglomerate, and/or chert) forming the ridges. The underlying geology of these sites is principally that of the Conasauga and Rome formations (Szabo et al. 1988); shale and sandstone bedrocks, respectively, frequently interbedded with limestone and dolostone units (Butts and Gildersbee 1948). Hydrologic regimes vary by site along an ephemeral-intermittent-perennial flow gradient. Fens that developed around ephemeral (i.e., unreliable) isolated seeps, whose flow is mostly dependent upon local recharge by precipitation, may experience either low flow conditions from the late summer through mid fall, or even complete "seep-failure" during extended periods of drought. At the other extreme are sites supported by the nearby presence of a high-volume perennial spring or stream that are wet year-round and experience substrate drying only along the ecotonal margins of the fen. Slopes are relatively gentle (mostly in the range of 1-3%) and do not appear to substantially affect the moisture retention, overall structure, or floral composition among the various fens (Moffett 2008).
Vegetation: he vegetation is dominated by herbaceous plants. Characteristic species include *Carex atlantica, Carex lurida, Carex leptalea ssp. harperi, Parnassia grandifolia, Juncus brachycephalus, Rudbeckia fulgida var. umbrosa, Cardamine bulbosa, Impatiens capensis, Juncus coriaceus, Juncus effusus, Lobelia puberula, Lobelia cardinalis, Oxypolis rigidior, Phlox glaberrima, Rhynchospora capitellata, Scirpus atrovirens, Scirpus cyperinus, Solidago patula var. patula*, and *Thelypteris palustris var. pubescens*. Woody species include *Alnus serrulata, Salix humilis, Salix caroliniana, Cornus amomum*, and *Acer rubrum*, which may invade the herbaceous seep. The Federally-listed *Xyris tennesseensis* may be a component of this system and occurs in many of its occurrences. Fens with a history or presence of beaver and cattle tend to include "weedier/nutrient-loving species" among their flora, including *Typha latifolia, Leersia virginica, Ludwigia* spp., *Schoenoplectus* spp., and *Pontederia cordata*, as well as increased levels of the non-native invasive species *Murdannia keisak, Microstegium vimineum*, and *Arthraxon hispidus*.
Dynamics: Since most known fens are located in areas where the use of prescribed fire is impractical, competition from woody trees and shrubs must be controlled using mechanical/manual methods. Two invasive non-native plant species, *Microstegium vimineum* and *Arthraxon hispidus*, are present in most fens. In some instances, they form thick "lawnlike" patches and exclude native herbs and

graminoids. Control of these monocots is normally best approached chemically, but presents a difficult management challenge here. The Federally endangered *Xyris tennesseensis* inhabits more than one-half of the known fen locations, making the use of herbicides problematic and potentially ill-advised (M. Moffett pers. comm.). Disturbances that historically maintained fens in an open state likely included beaver activity, ungulate herbivory, and occasional fire. Scouring from flash floods was less likely given the gentle topography and the fen's primary association with groundwater sources. However, fens that may have once existed in Georgia along second- and third-order streams would have experienced flooding disturbance (similar to those in Alabama). Without disturbance, shrubs and trees will likely invade the fen and promote succession. Some fens, however, appear able to resist invasion and succession, due perhaps to unstable soil conditions or unfavorable hydrologic fluctuations.

Component Associations:
- *Hypericum densiflorum - Alnus serrulata / Jamesianthus alabamensis - Xyris tennesseensis* Shrubland (CEGL008494, G1G2)
- *Hypericum densiflorum - Alnus serrulata / Tripsacum dactyloides* Shrubland (CEGL008495, G1G2)

DISTRIBUTION

Range: This system is restricted to the southern end of the Ridge and Valley in Alabama and Georgia.
Divisions: 202:C
Nations: US
Subnations: AL, GA
Map Zones: 48:C
TNC Ecoregions: 43:C, 50:C

SOURCES

References: Butts and Gildersbee 1948, Griffith et al. 2001, Johnson 2000a, Keys et al. 1995, Kral 1983, Moffett 2008, Moffett pers. comm., Southeastern Ecology Working Group n.d., Szabo et al. 1988, Weakley et al. 2011
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.836308#references
Description Author: M. Pyne
Version: 23 Feb 2010 **Stakeholders:** Southeast
Concept Author: M. Pyne after M. Moffett **ClassifResp:** Southeast

SOUTHWEST FLORIDA SEAGRASS BED (CES203.274)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Tidal / Estuarine; Aquatic Herb
Non-Diagnostic Classifiers: Herbaceous
National Mapping Codes: ESLF 9224

CONCEPT

Summary: This system is found along Florida's west coast ranging from Anclote Key (Tarpon Springs) south to Charlotte Harbor. Estuarine grassbeds of this region have been among the most extensively studied in Florida [see references in Zieman and Zieman (1989)] and at least 5 types of seagrass meadows are known to be present. Some types are comprised of mixed species while others are essentially pure stands of individual species. In general, these meadows are found along the fringes of Tampa Bay and Boca Ciega Bay landward of unvegetated sandbars. Composition varies according to water depth and position relative to shoals and shorelines. Mixed beds of *Halodule, Cymodocea*, and *Thalassia* are found in mid-bay shoals. Fringing beds support *Ruppia* nearest the shore in shallowest waters, followed by almost pure stands of *Halodule, Thalassia*, and *Cymodocea*.

Similar Ecological Systems:
- Atlantic Coastal Plain Indian River Lagoon Seagrass Bed (CES203.256)
- East Gulf Coastal Plain Florida Big Bend Seagrass Bed (CES203.244)
- Florida Keys Seagrass Bed (CES411.285)
- Northern Gulf of Mexico Seagrass Bed (CES203.263)

Related Concepts:
- Seagrass Bed (FNAI 1990) Broader

DESCRIPTION

Environment: This system is found along Florida's west coast ranging from Anclote Key (Tarpon Springs) south to Charlotte Harbor. Beds in this region are found behind barrier islands and within sounds and bays, protected from normal storm surges. Within this region, by far the largest acreages of submerged vegetation are found in the Pine Island Sound and Charlotte Harbor. Other large bays with abundant submerged vegetation include Tampa Bay, Boca Ciega Bay, and Sarasota Bay (Zieman and Zieman 1989). The seagrasses are rooted primarily in soft muddy sands and are essentially absent from sandier substrates. Beds occur generally landward of unvegetated sandbars which when destabilized may lead to the disappearance of the beds.
Vegetation: Seagrasses are monocots which carry out their entire life cycle completely submerged in the marine environment.
Dynamics: Colonization of seagrasses often follows a generalized successional sequence. Non-vegetated areas may first be colonized by rhizophytic macroalgae which have some sediment-binding capacity. Possibly more importantly they contribute sedimentary particles as they die and decompose (Zieman and Zieman 1989). *Halodule beaudettei (= Halodule wrightii)* is the local pioneering species which colonizes areas from seed or vegetative reproduction. *Cymodocea* often appears next and may mix with *Halodule*. *Thalassia* occupies beds as succession advances. This pattern marks a progressive increase of biomass in the system with increased leaf areas, increased sediment-trapping capacity, and increased microbial cycling.

Component Associations:
- *Halodule wrightii* Herbaceous Vegetation (CEGL004318, G4?)
- *Halophila engelmannii* Herbaceous Vegetation (CEGL004688, G3?)
- *Ruppia maritima* Tropical Herbaceous Vegetation (CEGL004906, G4G5)
- *Thalassia testudinum - Cymodocea filiformis* Herbaceous Vegetation (CEGL008384, GNR)
- *Thalassia testudinum* Herbaceous Vegetation (CEGL004319, G4?)

DISTRIBUTION

Range: This system is found along Florida's west coast ranging from Anclote Key south to Charlotte Harbor to the outlet of the Caloosahatche River.
Divisions: 203:C
Nations: US
Subnations: FL
Map Zones: 56:C
TNC Ecoregions: 55:C

SOURCES

References: Comer et al. 2003, Lewis et al. 1985a, Zieman and Zieman 1989
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723212#references

Description Author: R. Evans, mod. M. Pyne
Version: 27 Sep 2005
Concept Author: R. Evans

Stakeholders: Southeast
ClassifResp: Southeast

TAMAULIPAN SALINE LAKE (CES301.717)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Primary Division: Madrean Semidesert (301)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Wetland
Diagnostic Classifiers: Herbaceous; Isolated Wetland; Saline Substrate Chemistry; Graminoid
National Mapping Codes: ESLF 9442

CONCEPT

Summary: This ecological system includes small to medium-sized, highly saline, interior drainage basins in the Tamaulipan region of south Texas. The edges of these basins may be sparsely to moderately vegetated by halophytic grasses and subshrubs.
Related Concepts:

- Tamaulipan Saline Lake Flats (7700) (Elliott 2011) Finer. Unvegetated or very sparsely vegetated lake margin.
- Tamaulipan Saline Lake Grassland (7707) (Elliott 2011) Finer. Sites along the margin of saline lakes where grasses, forbs, and subshrubs have sufficient cover to be mapped as vegetated.

DESCRIPTION

Environment: This system occupies broad, gently sloping, interior draining basins receiving runoff from the surrounding landscape. Solution of salts from parent material, deposition from runoff, and subsequent evaporation has lead to a highly saline situation. These areas occur over the Goliad Formation on the edge of the Texas Sandsheet on highly saline sands or sandy loams in south Texas and may be related to the formation of Quaternary-aged clay dunes that sometimes occur nearby.
Vegetation: Sites may be unvegetated or have sparse vegetation. Some areas at very slightly higher landscape positions in the basin are dominated by halophytic grasses such as *Sporobolus airoides, Distichlis spicata, Sporobolus coromandelianus (= Sporobolus pyramidatus)*, and *Monanthochloe littoralis*. Other halophytic forbs and subshrubs may also be present, including *Borrichia frutescens, Batis maritima, Salicornia* spp., *Atriplex matamorensis, Sesuvium portulacastrum*, and *Suaeda linearis*.

DISTRIBUTION

Range: This system occurs in the Tamaulipan region of south Texas and possibly Mexico.
Divisions: 301:C
Nations: MX? , US
Subnations: MXNU?(MX), MXTM?(MX), TX
USFS Ecomap Regions: 315Eb:CCC, 315Ec:CCC, 315Ef:CCC, 315Eg:CCP
TNC Ecoregions: 30:C

SOURCES

References: Elliott 2011, Johnston 1963, Southeastern Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.859602#references
Description Author: L. Elliott, mod. J. Teague
Version: 25 Feb 2011
Stakeholders: Latin America, Southeast
Concept Author: L. Elliott, D. Diamond, A. Treuer-kuehn, D. German, J. Teague
ClassifResp: Southeast

TEMPERATE PACIFIC FRESHWATER AQUATIC BED (CES200.876)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Herbaceous; Depressional [Pond]; Aquatic Herb
Non-Diagnostic Classifiers: Montane [Montane]; Montane [Lower Montane]; Lowland [Foothill]; Lowland [Lowland]; Lake; Pond; Temperate [Temperate Continental]
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - forbland, Hydromorphic-rooted grassland
National Mapping Codes: EVT 2664; ESLF 9219; ESP 1664

CONCEPT

Summary: Freshwater aquatic beds are found throughout the humid temperate regions of the Pacific Coast of North America. They are small patch in size, confined to lakes, ponds, oxbows, and slow-moving portions of rivers and streams. In large bodies of water, they are usually restricted to the littoral region where penetration of light is the limiting factor for growth. A variety of rooted or floating aquatic herbaceous species may dominate, including *Azolla* spp., *Nuphar polysepala, Polygonum* spp., *Potamogeton* spp., *Ranunculus* spp., and *Wolffia* spp. Submerged vegetation, such as *Myriophyllum* spp., *Ceratophyllum* spp., and *Elodea* spp., is often present. These communities occur in water too deep for emergent vegetation.
Classification Comments: The aquatic beds in the Alaska systems classification for the maritime region are included here. However, aquatic beds on Kodiak Island, Alaska, are placed into Aleutian Freshwater Aquatic Bed (CES105.234).
Similar Ecological Systems:
- Aleutian Freshwater Aquatic Bed (CES105.234)

Related Concepts:
- III.D.1.a - Pondlily (Viereck et al. 1992) Intersecting
- III.D.1.b - Common marestail (Viereck et al. 1992) Intersecting
- III.D.1.c - Aquatic buttercup (Viereck et al. 1992) Intersecting
- III.D.1.d - Burreed (Viereck et al. 1992) Intersecting
- III.D.1.f - Fresh pondweed (Viereck et al. 1992) Intersecting
- III.D.1.h - Cryptogam (Viereck et al. 1992) Intersecting
- Wetlands (217) (Shiflet 1994) Broader

Component Associations:
- *Brasenia schreberi* Eastern Herbaceous Vegetation (CEGL004527, G4?)
- *Ceratophyllum demersum* Western Herbaceous Vegetation (CEGL004017, G5)
- *Elodea canadensis* Herbaceous Vegetation (CEGL003303, G5)
- *Fontinalis antipyretica (var. antipyretica, var. oregonensis)* Nonvascular Vegetation (CEGL003304, G5)
- *Lemna minor* Herbaceous Vegetation (CEGL003305, G5)
- *Menyanthes trifoliata* Herbaceous Vegetation (CEGL003410, G5)
- *Nuphar polysepala* Herbaceous Vegetation (CEGL002001, G5)
- *Ranunculus aquatilis* Herbaceous Vegetation (CEGL003307, G5)

DISTRIBUTION

Range: This system is found throughout the humid temperate regions of the Pacific Coast of North America, from the Gulf of Alaska through southeastern Alaska into central California.
Divisions: 204:C; 206:C
Nations: CA, US
Subnations: AK, BC, CA, OR, WA
Map Zones: 1:C, 2:P, 3:C, 4:C, 6:P, 7:C, 8:C, 9:C, 10:C, 77:C, 78:C
USFS Ecomap Regions: 242A:CC, 242B:CC, 342I:??, M242A:CC, M242B:CC, M242C:CP, M242D:CC, M261G:CC
TNC Ecoregions: 1:C, 14:C, 15:C, 69:C, 70:C, 71:C

SOURCES

References: Boggs 2000, Boggs et al. 2008a, Chappell and Christy 2004, Comer et al. 2003, Holland and Keil 1995, Shephard 1995, Shiflet 1994, Viereck et al. 1992
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722799#references
Description Author: G. Kittel, P. Comer, C. Chappell, K. Boggs
Version: 17 Oct 2008 **Stakeholders:** Canada, West
Concept Author: G. Kittel, P. Comer, C. Chappell, K. Boggs **ClassifResp:** West

TEMPERATE PACIFIC FRESHWATER EMERGENT MARSH (CES200.877)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Herbaceous; Temperate [Temperate Continental]; Depressional [Pond]
Non-Diagnostic Classifiers: 30-180-day hydroperiod; Montane [Montane]; Montane [Lower Montane]; Lowland [Foothill]; Lowland [Lowland]; Depressional [Lakeshore]; Depressional [Sinkhole]
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2662; ESLF 9260; ESP 1662

CONCEPT

Summary: Freshwater marshes are found at all elevations below timberline throughout the temperate Pacific Coast and mountains of western North America. In the Pacific Northwest, they are mostly small-patch, confined to limited areas in suitable floodplain or basin topography. They are mostly semipermanently flooded, but some marshes have seasonal hydrologic flooding. Water is at or above the surface for most of the growing season. Soils are muck or mineral (in Alaska typically muck over a mineral soil), and water is high-nutrient. Occurrences of this system typically are found in a mosaic with other wetland systems. It is often found along the borders of ponds, lakes or reservoirs that have more open basins and a permanent water source throughout all or most of the year. Some of the specific communities will also be found in floodplain systems where more extensive bottomlands remain. By definition, freshwater marshes are dominated by emergent herbaceous species, mostly graminoids (*Carex, Scirpus* and/or *Schoenoplectus, Eleocharis, Juncus, Typha latifolia*) but also some forbs. Common emergent and floating vegetation includes species of *Scirpus* and/or *Schoenoplectus, Typha, Eleocharis, Sparganium, Sagittaria, Bidens, Cicuta, Rorippa, Mimulus*, and *Phalaris*. Maritime Alaska freshwater marshes are described as having *Carex rostrata, Equisetum fluviatile* (often pure stands), *Carex aquatilis var. dives (= Carex sitchensis), Menyanthes trifoliata, Comarum palustre, Eleocharis palustris*, and *Schoenoplectus tabernaemontani*. In relatively deep water, there may be occurrences of the freshwater aquatic bed system, where there are floating-leaved genera such as *Lemna, Potamogeton, Polygonum, Nuphar, Hydrocotyle*, and *Brasenia*. A consistent source of freshwater is essential to the function of these systems.

Classification Comments: In Alaska, freshwater marshes found in floodplain wetland mosaics are not included in this system. Also, freshwater marshes on Kodiak Island, Alaska, are placed into Aleutian Freshwater Marsh (CES105.235). This system encompasses a very large geographic range. We may want to split it into two types, on a north-south gradient. However, the species composition and environmental settings of freshwater marshes throughout the temperate Pacific region are markedly similar. Where to make a split that would make sense biogeographically is hard to determine. For now, they are maintained as one ecological system.

Similar Ecological Systems:
- Aleutian Freshwater Marsh (CES105.235)

Related Concepts:
- *Equisetum fluviatile* (Shephard 1995) Finer
- *Menyanthes trifoliata - Potentilla palustris* (Shephard 1995) Undetermined
- Cattail (IDFdk3/Wm05) (Steen and Coupe 1997) Intersecting
- Great bulrush (BGxw2/Wm06) (Steen and Coupe 1997) Intersecting
- Great bulrush (ICHwk1/Wm06) (Lloyd et al. 1990) Intersecting
- Great bulrush (IDFdk3/Wm06) (Steen and Coupe 1997) Intersecting
- Great bulrush (IDFdk4/Wm06) (Steen and Coupe 1997) Intersecting
- Great bulrush (IDFxm/Wm06) (Steen and Coupe 1997) Intersecting
- Great bulrush (SBPSmk/Wm06) (Steen and Coupe 1997) Intersecting
- Great bulrush (SBPSxc/Wm06) (Steen and Coupe 1997) Intersecting
- Great bulrush (SBSmk2/Wm06) (MacKinnon et al. 1990) Intersecting
- III.A.3.d - Fresh sedge marsh (Viereck et al. 1992) Intersecting
- III.B.3.a - Fresh herb marsh (Viereck et al. 1992) Intersecting
- Inflated sedge (CWHvm2/Wm09) (Banner et al. 1993) Intersecting
- Inflated sedge (ESSFxc/Wm09) (Steen and Coupe 1997) Intersecting
- Inflated sedge (ICHmw3/Wm09) (Steen and Coupe 1997) Intersecting
- Inflated sedge (ICHvc/Wm09) (Banner et al. 1993) Intersecting
- Inflated sedge (ICHwk1/Wm09) (Lloyd et al. 1990) Intersecting
- Inflated sedge (ICHwk4/Wm09) (Steen and Coupe 1997) Intersecting
- Inflated sedge (MSxv/Wm09) (Steen and Coupe 1997) Intersecting
- Inflated sedge (SBPSxc/Wm09) (Steen and Coupe 1997) Intersecting
- Northern mannagrass (MSxv/Wm10) (Steen and Coupe 1997) Intersecting
- Northern mannagrass (SBPSxc/Wm10) (Steen and Coupe 1997) Intersecting

- Sharp bulrush (IDFxm/Wm08) (Steen and Coupe 1997) Intersecting
- Three-way sedge (ICHwk1/Wm51) (Lloyd et al. 1990) Intersecting
- Wetlands (217) (Shiflet 1994) Broader

DESCRIPTION

Environment: In Alaska marshes, standing water is usually persistent throughout the growing season and is generally at least 10 cm above the ground surface.

Component Associations:
- *Carex exsiccata* Herbaceous Vegetation (CEGL003312, G2G3)
- *Carex obnupta - Argentina egedii ssp. egedii* Herbaceous Vegetation (CEGL001820, G4)
- *Carex obnupta - Juncus patens* Herbaceous Vegetation (CEGL003379, G3)
- *Carex obnupta* Herbaceous Vegetation (CEGL003313, G4)
- *Carex utriculata* Herbaceous Vegetation (CEGL001562, G5)
- *Deschampsia caespitosa - Artemisia lindleyana* Herbaceous Vegetation (CEGL003425, G1)
- *Dulichium arundinaceum* Seasonally Flooded Herbaceous Vegetation (CEGL001831, G3)
- *Equisetum fluviatile* Herbaceous Vegetation (CEGL002746, G4)
- *Juncus effusus var. brunneus* Pacific Coast Herbaceous Vegetation (CEGL003317, G5)
- *Oenanthe sarmentosa* Herbaceous Vegetation (CEGL003319, G4)
- *Paspalum distichum* Herbaceous Vegetation (CEGL003320, G3)
- *Ranunculus flammula - Juncus nevadensis - Carex lenticularis* Herbaceous Vegetation (CEGL003426, G1)
- *Sagittaria latifolia* Herbaceous Vegetation (CEGL003321, G3)
- *Schoenoplectus acutus* Herbaceous Vegetation (CEGL001840, G5)
- *Schoenoplectus tabernaemontani* Temperate Herbaceous Vegetation (CEGL002623, G5)
- *Scirpus microcarpus* Herbaceous Vegetation (CEGL003322, G4)
- *Sparganium angustifolium* Herbaceous Vegetation (CEGL001990, G4)
- *Sparganium eurycarpum* Herbaceous Vegetation (CEGL003323, G4)
- *Typha (latifolia, angustifolia)* Western Herbaceous Vegetation (CEGL002010, G5)

SPATIAL CHARACTERISTICS

Spatial Summary: For Alaska mapping: need to define percentage of surface water and need to differentiate from fen/wet meadow. For boreal region, we used 10-cm water depth as classifier but that may not be mappable.

DISTRIBUTION

Range: This system occurs throughout the temperate Pacific Coast and coastal mountains of western North America, from southern coastal California north into coastal areas of British Columbia and Alaska.
Divisions: 204:C; 206:C
Nations: CA, US
Subnations: AK, BC, CA, OR, WA
Map Zones: 1:C, 2:C, 3:C, 4:C, 6:P, 7:C, 8:P, 9:P, 77:C, 78:C
USFS Ecomap Regions: 242A:CC, 242B:CC, 342B:CC, 342H:CP, 342I:CC, M242A:CC, M242B:CC, M242C:CC, M242D:CC, M261D:CC, M261G:CC, M332G:CC
TNC Ecoregions: 1:C, 2:C, 3:C, 4:C, 12:P, 13:C, 14:C, 15:C, 16:C, 69:C, 70:C, 81:C

SOURCES

References: Banner et al. 1986, Banner et al. 1993, Boggs 2000, Chappell and Christy 2004, Comer et al. 2003, Holland and Keil 1995, Lloyd et al. 1990, MacKinnon et al. 1990, Shephard 1995, Steen and Coupe 1997, Viereck et al. 1992
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722798#references
Description Author: C. Chappell and G. Kittel, mod. M.S. Reid
Version: 22 Aug 2008 **Stakeholders:** Canada, West
Concept Author: C. Chappell and G. Kittel **ClassifResp:** West

TEMPERATE PACIFIC SUBALPINE-MONTANE WET MEADOW (CES200.998)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: 30-180-day hydroperiod; Herbaceous; Muck; Graminoid
Non-Diagnostic Classifiers: Circumneutral Water; Montane; Temperate [Temperate Oceanic]; Depressional; Riverine / Alluvial
National Mapping Codes: ESLF 9265

CONCEPT

Summary: Montane and subalpine wet meadows occur in open wet depressions, basins and flats among montane and subalpine forests from California's Transverse and Peninsular ranges north to British Columbian coastal forests at varying elevations depending on latitude. Sites are usually seasonally wet, often drying by late summer, and many occur in a tension zone between perennial wetlands and uplands, where water tables fluctuate in response to long-term climatic cycles. They may have surface water for part of the year, but depths rarely exceed a few centimeters. Soils are mostly mineral and may show typical hydric soil characteristics, and shallow organic soils may occur as inclusions. This system often occurs as a mosaic of several plant associations with varying dominant herbaceous species that may include *Camassia quamash, Carex bolanderi, Carex utriculata, Carex exsiccata, Dodecatheon jeffreyi, Glyceria striata (= Glyceria elata), Carex nigricans, Calamagrostis canadensis, Juncus nevadensis, Caltha leptosepala ssp. howellii, Veratrum californicum*, and *Scirpus* and/or *Schoenoplectus* spp. Trees occur peripherally or on elevated microsites and include *Picea engelmannii, Abies lasiocarpa, Abies amabilis, Tsuga mertensiana*, and *Chamaecyparis nootkatensis*. Common shrubs may include *Salix* spp., *Vaccinium uliginosum, Betula glandulosa*, and *Vaccinium macrocarpon*. Wet meadows are tightly associated with snowmelt and typically are not subjected to high disturbance events such as flooding.
Classification Comments: Rocky Mountain Alpine-Montane Wet Meadow (CES306.812) occurs to the east of the coastal and Sierran mountains, in the semi-arid interior regions of western North America. Boreal wet meadow systems occur further north and east in boreal regions where the climatic regime is generally colder than that of the Rockies or Pacific Northwest regions. Floristics of these three systems are somewhat similar, but there are differences related to biogeographic affinities of the species composing the vegetation. Wet meadows in southeastern Alaska have been placed into a new system (2008), Alaskan Pacific Maritime Fen and Wet Meadow (CES204.158).
Similar Ecological Systems:
- Alaskan Pacific Maritime Fen and Wet Meadow (CES204.158)

Related Concepts:
- Alpine Grassland (213) (Shiflet 1994) Broader. SRM type 213 includes all alpine communities in Sierra, Klamath and California Cascades, both herbaceous and shrub dominated, and wet meadows.
- Awned sedge (BGxw2/Wm03) (Steen and Coupe 1997) Intersecting
- Awned sedge (IDFdk3/Wm03) (Steen and Coupe 1997) Intersecting
- Awned sedge (IDFdk4/Wm03) (Steen and Coupe 1997) Intersecting
- Awned sedge (IDFxm/Wm03) (Steen and Coupe 1997) Intersecting
- Awned sedge (SBPSdc/Wm03) (Steen and Coupe 1997) Intersecting
- Awned sedge (SBPSdc/Wm03) (MacKenzie and Moran 2004) Intersecting
- Awned sedge (SBPSxc/Wm03) (Steen and Coupe 1997) Intersecting
- Beaked sedge - Water sedge (BWBSdk1/Wm01) (MacKinnon et al. 1990) Intersecting
- Beaked sedge - Water sedge (BWBSdk1/Wm01) (Banner et al. 1993) Intersecting
- Beaked sedge - Water sedge (BWBSmw2/Wm01) (DeLong et al. 1990) Intersecting
- Beaked sedge - Water sedge (ESSFmc/Wm01) (Banner et al. 1993) Intersecting
- Beaked sedge - Water sedge (ESSFmw/Wm01) (Steen and Coupe 1997) Intersecting
- Beaked sedge - Water sedge (ESSFxc/Wm01) (Steen and Coupe 1997) Intersecting
- Beaked sedge - Water sedge (ESSFxv2/Wm01) (Steen and Coupe 1997) Intersecting
- Beaked sedge - Water sedge (ICHmc1/Wm01) (Banner et al. 1993) Intersecting
- Beaked sedge - Water sedge (ICHmc1/Wm01) (Meidinger et al. 1988) Intersecting
- Beaked sedge - Water sedge (ICHmc2/Wm01) (Banner et al. 1993) Intersecting
- Beaked sedge - Water sedge (ICHwk1/Wm01) (Lloyd et al. 1990) Intersecting
- Beaked sedge - Water sedge (ICHwk2/Wm01) (Steen and Coupe 1997) Intersecting
- Beaked sedge - Water sedge (IDFdk3/Wm01) (Steen and Coupe 1997) Intersecting
- Beaked sedge - Water sedge (MSdc2/Wm01) (Steen and Coupe 1997) Intersecting
- Beaked sedge - Water sedge (MSxk/Wm01) (Steen and Coupe 1997) Intersecting
- Beaked sedge - Water sedge (MSxv/Wm01) (Steen and Coupe 1997) Intersecting
- Beaked sedge - Water sedge (SBPSdc/Wm01) (Steen and Coupe 1997) Intersecting
- Beaked sedge - Water sedge (SBPSdc/Wm01) (MacKenzie and Moran 2004) Intersecting

- Beaked sedge - Water sedge (SBPSxc/Wm01) (Steen and Coupe 1997) Intersecting
- Beaked sedge - Water sedge (SBSdk/Wm01) (DeLong et al. 1993) Intersecting
- Beaked sedge - Water sedge (SBSdk/Wm01) (Steen and Coupe 1997) Intersecting
- Beaked sedge - Water sedge (SBSdk/Wm01) (Banner et al. 1993) Intersecting
- Beaked sedge - Water sedge (SBSdw1/Wm01) (Steen and Coupe 1997) Intersecting
- Beaked sedge - Water sedge (SBSdw3/Wm01) (DeLong et al. 1993) Intersecting
- Beaked sedge - Water sedge (SBSdw3/Wm01) (Banner et al. 1993) Intersecting
- Beaked sedge - Water sedge (SBSmc2/Wm01) (Banner et al. 1993) Intersecting
- Beaked sedge - Water sedge (SBSmc2/Wm01) (DeLong et al. 1993) Intersecting
- Beaked sedge - Water sedge (SBSmk1/Wm01) (DeLong et al. 1993) Intersecting
- Beaked sedge - Water sedge (SBSmk2/Wm01) (MacKinnon et al. 1990) Intersecting
- Beaked sedge - Water sedge (SBSvk/Wm01) (DeLong 2003) Intersecting
- Beaked sedge - Water sedge (SBSwk1/Wm01) (Steen and Coupe 1997) Intersecting
- Beaked sedge - Water sedge (SBSwk1/Wm01) (DeLong 2003) Intersecting
- Common spike-rush (BGxw2/Wm04) (Steen and Coupe 1997) Intersecting
- Common spike-rush (IDFxm/Wm04) (Steen and Coupe 1997) Intersecting
- Common spike-rush (SBSdk/Wm04) (DeLong et al. 1993) Intersecting
- Common spike-rush (SBSdk/Wm04) (Steen and Coupe 1997) Intersecting
- Common spike-rush (SBSdk/Wm04) (Banner et al. 1993) Intersecting
- Common spike-rush (SBSmk2/Wm04) (MacKinnon et al. 1990) Intersecting
- Montane Meadows (216) (Shiflet 1994) Broader
- Seaside arrow-grass (IDFdk3/Wm13) (Steen and Coupe 1997) Intersecting
- Seaside arrow-grass (MSxv/Wm13) (Steen and Coupe 1997) Intersecting
- Seaside arrow-grass (SBPSxc/Wm13) (Steen and Coupe 1997) Intersecting
- Sitka sedge - Hemlock-parsley (CWHvh2/Wm50) (Banner et al. 1993) Intersecting
- Sitka sedge - Hemlock-parsley (CWHwm/Wm50) (Banner et al. 1993) Intersecting
- Swamp horsetail - Beaked sedge (BWBSdk1/Wm02) (Banner et al. 1993) Intersecting
- Swamp horsetail - Beaked sedge (BWBSdk1/Wm02) (MacKinnon et al. 1990) Intersecting
- Swamp horsetail - Beaked sedge (ESSFmw/Wm02) (Steen and Coupe 1997) Intersecting
- Swamp horsetail - Beaked sedge (ICHmw3/Wm02) (Steen and Coupe 1997) Intersecting
- Swamp horsetail - Beaked sedge (ICHwk4/Wm02) (Steen and Coupe 1997) Intersecting
- Swamp horsetail - Beaked sedge (MSdc2/Wm02) (Steen and Coupe 1997) Intersecting
- Swamp horsetail - Beaked sedge (MSxk/Wm02) (Steen and Coupe 1997) Intersecting
- Swamp horsetail - Beaked sedge (MSxv/Wm02) (Steen and Coupe 1997) Intersecting
- Swamp horsetail - Beaked sedge (SBPSdc/Wm02) (Steen and Coupe 1997) Intersecting
- Swamp horsetail - Beaked sedge (SBPSdc/Wm02) (MacKenzie and Moran 2004) Intersecting
- Swamp horsetail - Beaked sedge (SBPSmk/Wm02) (Steen and Coupe 1997) Intersecting
- Swamp horsetail - Beaked sedge (SBPSxc/Wm02) (Steen and Coupe 1997) Intersecting
- Swamp horsetail - Beaked sedge (SBSdk/Wm02) (Banner et al. 1993) Intersecting
- Swamp horsetail - Beaked sedge (SBSdk/Wm02) (DeLong et al. 1993) Intersecting
- Swamp horsetail - Beaked sedge (SBSdk/Wm02) (Steen and Coupe 1997) Intersecting
- Swamp horsetail - Beaked sedge (SBSdw3/Wm02) (Banner et al. 1993) Intersecting
- Swamp horsetail - Beaked sedge (SBSdw3/Wm02) (DeLong et al. 1993) Intersecting
- Swamp horsetail - Beaked sedge (SBSmk2/Wm02) (MacKinnon et al. 1990) Intersecting
- Swamp horsetail - Beaked sedge (SBSwk1/Wm02) (Steen and Coupe 1997) Intersecting
- Swamp horsetail - Beaked sedge (SBSwk1/Wm02) (DeLong 2003) Intersecting
- Wetlands (217) (Shiflet 1994) Broader
- Woolly sedge (IDFdk4/Wm12) (Steen and Coupe 1997) Intersecting
- Woolly sedge (IDFxm/Wm12) (Steen and Coupe 1997) Intersecting

Component Associations:
- *Calamagrostis canadensis* Western Herbaceous Vegetation (CEGL001559, G4)
- *Carex amplifolia* Herbaceous Vegetation (CEGL003427, G3)
- *Carex aquatilis* Herbaceous Vegetation (CEGL001802, G5)
- *Carex interior - Hypericum anagalloides* Herbaceous Vegetation (CEGL001857, G2?Q)
- *Carex lasiocarpa* Herbaceous Vegetation (CEGL001810, G4?)
- *Carex nebrascensis* Herbaceous Vegetation (CEGL001813, G4)
- *Carex nigricans - Erythronium montanum* Herbaceous Vegetation (CEGL001817, G4)
- *Carex nigricans - Luetkea pectinata* Herbaceous Vegetation (CEGL001819, G4)
- *Carex nigricans* Herbaceous Vegetation (CEGL001816, G4)
- *Carex scopulorum* Herbaceous Vegetation (CEGL001822, G5)
- *Carex simulata* Herbaceous Vegetation (CEGL001825, G4)
- *Deschampsia caespitosa* Herbaceous Vegetation (CEGL001599, G4)

- *Eleocharis acicularis* Herbaceous Vegetation (CEGL001832, G4?)
- *Eleocharis palustris* Herbaceous Vegetation (CEGL001833, G5)
- *Juncus balticus* Herbaceous Vegetation (CEGL001838, G5)
- *Senecio triangularis - Mimulus guttatus* Herbaceous Vegetation (CEGL001988, G3?)
- *Senecio triangularis - Veratrum californicum* Herbaceous Vegetation (CEGL001989, G4)
- *Tauschia stricklandii - Vaccinium deliciosum* Herbaceous Vegetation (CEGL001994, G2)
- *Vaccinium caespitosum / Sanguisorba officinalis* Dwarf-shrubland (CEGL003438, G1)
- *Vaccinium uliginosum / Deschampsia caespitosa* Dwarf-shrubland (CEGL001250, G2)
- *Veratrum californicum* Herbaceous Vegetation (CEGL001946, G3G4)
- *Xerophyllum tenax - Sanguisorba officinalis* Herbaceous Vegetation (CEGL003439, G1)

DISTRIBUTION

Range: This system is found from California's Transverse and Peninsular ranges north to British Columbian coastal forests at varying elevations depending on latitude.
Divisions: 204:C; 206:C
Nations: CA, US
Subnations: BC, CA, NV, OR, WA
Map Zones: 1:C, 2:C, 3:C, 4:C, 6:C, 7:C, 8:?, 9:P, 12:?
USFS Ecomap Regions: 262A:PP, 263A:PP, 322A:CC, 331A:PP, 341D:CC, 342B:C?, 342H:CC, 342I:CP, M242A:CC, M242B:CC, M242C:CC, M242D:CC, M261A:CC, M261B:CC, M261D:CC, M261E:CC, M261F:CC, M261G:CC
TNC Ecoregions: 3:C, 4:C, 5:C, 12:C, 16:C, 69:?, 81:C

SOURCES

References: Banner et al. 1993, Barbour and Major 1988, Comer et al. 2003, DeLong 2003, DeLong et al. 1990, DeLong et al. 1993, Holland and Keil 1995, Lloyd et al. 1990, MacKenzie and Moran 2004, MacKinnon et al. 1990, Meidinger et al. 1988, Sawyer and Keeler-Wolf 1995, Shiflet 1994, Skinner 1997, Steen and Coupe 1997
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722707#references
Description Author: P. Comer, mod. G. Kittel and C. Chappell
Version: 13 Jan 2012 **Stakeholders:** Canada, West
Concept Author: P. Comer **ClassifResp:** West

TEMPERATE PACIFIC TIDAL SALT AND BRACKISH MARSH (CES200.091)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Saline Water Chemistry; 30-180-day hydroperiod; Temperate [Temperate Hyperoceanic]; Temperate [Temperate Oceanic]; Tidal / Estuarine [Haline]; Tidal / Estuarine [Oligohaline]
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2668; ESLF 9281; ESP 1668

CONCEPT

Summary: Intertidal salt and brackish marshes are found throughout the Pacific Coast, from Kodiak Island and south-central Alaska to the central California coast. They are primarily associated with estuaries or coastal lagoons. Salt marshes are limited to bays and behind sand spits or other locations protected from wave action. Typically these areas form with a mixture of inputs from freshwater sources into coastal saltwater, so they commonly co-occur with brackish marshes. This is a small-patch system, confined to specific environments defined by ranges of salinity, tidal inundation regime, and soil texture. Patches usually occur as zonal mosaics of multiple communities. They vary in location and abundance with daily and seasonal dynamics of freshwater input from inland balanced against evaporation and tidal flooding of saltwater. Summer-dry periods result in decreased freshwater inputs from inland. Hypersaline environments within salt marshes occur in "salt pans" where tidal water collects and evaporates. Characteristic plant species include *Distichlis spicata, Limonium californicum, Jaumea carnosa, Salicornia* spp., *Suaeda* spp., and *Triglochin* spp. Low marshes are located in areas that flood every day and are dominated by a variety of low-growing forbs and low to medium-height graminoids, especially *Salicornia virginica, Distichlis spicata, Schoenoplectus maritimus (= Scirpus maritimus), Schoenoplectus americanus (= Scirpus americanus), Carex lyngbyei*, and *Triglochin maritima*. In Alaska, tidal marshes are often dominated by near-monotypic stands of *Carex lyngbyei*, while the frequently inundated lower salt marshes are often dominated by *Eleocharis palustris* or *Puccinellia* spp. Other common species in Alaska include *Hippuris tetraphylla, Plantago maritima, Cochlearia groenlandica (= Cochlearia officinalis), Spergularia canadensis, Honckenya peploides*, or *Glaux maritima*. In the Cook Inlet and Alaska Peninsula, *Carex ramenskii* may be an associated species. High marshes are located in areas that flood infrequently and are dominated by medium-tall graminoids and low forbs, especially *Deschampsia caespitosa, Argentina egedii, Juncus balticus*, and *Symphyotrichum subspicatum (= Aster subspicatus)*, and in Alaska *Poa eminens, Argentina egedii, Festuca rubra*, and *Deschampsia caespitosa*. Transition zone (slightly brackish) marshes are often dominated by *Typha* spp. or *Schoenoplectus acutus*. *Atriplex prostrata (= Atriplex triangularis), Juncus mexicanus, Phragmites* spp., *Cordylanthus* spp., and *Lilaeopsis masonii* are important species in California. The invasive weed *Lepidium latifolium* is a problem in many of these marshes. Rare plant species include *Cordylanthus maritimus ssp. maritimus*.
Classification Comments: Discussions with John Christy and Todd Keeler-Wolf led to lumping all West Coast salt and brackish marshes into one system because they co-occur so intimately and frequently, are not readily distinguished without detailed on-the-ground surveys, and are totally intergraded (seemingly continuous variation) in terms of degree of salinity and resulting vegetation. This system encompasses a very large geographic range. We may want to split it into two types, on a north-south gradient. However, the species composition and environmental settings of tidal marshes throughout the temperate Pacific region are markedly similar. Where to make a split that would make sense biogeographically is hard to determine. For now, they are maintained as one ecological system.
Related Concepts:
- III.A.3.h - Halophytic grass wet meadow (Viereck et al. 1992) Intersecting
- III.A.3.i - Halophytic sedge wet meadow (Viereck et al. 1992) Intersecting
- III.B.3.d - Halophytic herb wet meadow (Viereck et al. 1992) Intersecting
- III.D.2.a - Four-leaf marestail (Viereck et al. 1992) Intersecting
- Wetlands (217) (Shiflet 1994) Broader

DESCRIPTION

Environment: The frequency of tidal flooding and salinity vary widely. Soils are usually fine-textured and saturated. Tidal marshes have a limited distribution along the Gulf of Alaska and British Columbia coastline due to the topography and geomorphology of the coast, which features steep slopes and deep fjords and offers limited protection from wave action (National Wetlands Working Group 1988).
Dynamics: Tidal marsh zonal mosaics of multiple communities vary in location and abundance with daily and seasonal dynamics of freshwater input from inland balanced against evaporation and tidal flooding of saltwater. Summer-dry periods result in decreased freshwater inputs from inland. Hypersaline environments within salt marshes occur in "salt pans" where tidal water collects and evaporates. High marshes flood infrequently, mid marshes flood usually at higher tides and are usually brackish waters, while low marshes are inundated with saltwater daily.

Component Associations:

- *Argentina egedii - Juncus balticus* Herbaceous Vegetation (CEGL003382, G3G4)
- *Argentina egedii - Symphyotrichum subspicatum* Herbaceous Vegetation (CEGL003288, G3G4)
- *Calamagrostis nutkaensis - Argentina egedii - Juncus balticus* Herbaceous Vegetation (CEGL003421, G1)
- *Carex lyngbyei - (Distichlis spicata, Triglochin maritima)* Herbaceous Vegetation (CEGL003285, G4)
- *Carex lyngbyei - Argentina egedii* Herbaceous Vegetation (CEGL003289, G4)
- *Carex lyngbyei* Herbaceous Vegetation (CEGL003369, G4)
- *Deschampsia caespitosa - (Carex lyngbyei, Distichlis spicata)* Herbaceous Vegetation (CEGL003357, G3G4)
- *Deschampsia caespitosa - Argentina egedii* Herbaceous Vegetation (CEGL003383, G3G4)
- *Deschampsia caespitosa - Sidalcea hendersonii* Herbaceous Vegetation (CEGL003384, G2)
- *Distichlis spicata - (Salicornia virginica)* Herbaceous Vegetation (CEGL003356, G4)
- *Distichlis spicata - Frankenia salina - Jaumea carnosa* Herbaceous Vegetation (CEGL003462, G3)
- *Festuca rubra - (Argentina egedii)* Herbaceous Vegetation (CEGL003424, G1)
- *Glaux maritima* Herbaceous Vegetation (CEGL003286, G3)
- *Salicornia virginica - Distichlis spicata - Triglochin maritima - (Jaumea carnosa)* Herbaceous Vegetation (CEGL003366, G3)
- *Triglochin maritima - (Salicornia virginica)* Herbaceous Vegetation (CEGL003381, G4)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Temperate Pacific Intertidal Flat (CES204.879)

DISTRIBUTION

Range: This system is found throughout the Pacific Coast, from Kodiak Island and south-central Alaska to the California coast.
Divisions: 204:C
Nations: CA, MX, US
Subnations: AK, BC, CA, MXBC(MX), OR, WA
Map Zones: 1:C, 2:C, 3:C, 4:C, 75:C, 76:C, 77:C, 78:C
USFS Ecomap Regions: 242A:CC, 261B:CC, 263A:CC, M242A:CC
TNC Ecoregions: 1:C, 2:C, 3:C, 14:C, 15:C, 16:C, 69:C, 70:C, 71:C

SOURCES

References: Barbour and Major 1988, Boggs 2000, Boggs 2002, Chappell and Christy 2004, Holland and Keil 1995, IPCC 2013a, Keeler-Wolf pers. comm., Littell et al. 2009, National Wetlands Working Group 1988, PRBO Conservation Science 2011, Sawyer and Keeler-Wolf 1995, SFBCDC 2011, Shiflet 1994, Sparks et al. 1977, Viereck et al. 1992, Western Ecology Working Group n.d., WNHP 2011
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.768145#references
Description Author: K. Boggs, C. Chappell, G. Kittel, mod. T. Keeler-Wolf, M.S. Reid
Version: 14 Jan 2014 **Stakeholders:** Canada, Latin America, West
Concept Author: K. Boggs, C. Chappell, G. Kittel **ClassifResp:** West

TEXAS COAST FRESH AND OLIGOHALINE TIDAL MARSH (CES203.472)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Tidal / Estuarine [Freshwater]; Graminoid
Non-Diagnostic Classifiers: Herbaceous
National Mapping Codes: ESLF 9243

CONCEPT

Summary: This ecological system includes tidal marshes strongly influenced by freshwater producing a fresh to oligohaline chemistry, where salinity is maintained sufficiently low through freshwater inflows to produce fresh to oligohaline water chemistry. These marshes typically occur as small patches along bay margins and river or bayou mouths of inflowing rivers from Galveston Bay in Chambers County, Texas, south to approximately Corpus Christi Bay. Some characteristic plant species include *Paspalum vaginatum, Spartina patens, Schoenoplectus americanus, Phragmites australis, Sagittaria platyphylla, Vigna luteola,* and *Typha* spp.
Similar Ecological Systems:
- Gulf Coast Chenier Plain Fresh and Oligohaline Tidal Marsh (CES203.467)

Related Concepts:
- Coastal: Fresh and Intermediate Tidal Marsh (5907) [CES203.472] (Elliott 2011) Equivalent

DESCRIPTION

Environment: The typical geology is young Quaternary alluvium. Characteristic landforms include the mouths of rivers and bayous emptying into bays of the Galveston Bay system. The soils on which this system is found are the typical soils of the Tidal Flats and Salt Marsh Ecological Sites where they occur in areas of sufficient freshwater inflow (Elliott 2011).
Vegetation: Some characteristic plant species include *Paspalum vaginatum, Spartina patens, Schoenoplectus americanus, Phragmites australis, Sagittaria platyphylla, Vigna luteola,* and *Typha* spp.
Dynamics: This marsh system is dependent upon freshwater input, sediment input and organic matter build-up. Species richness is higher in oligohaline marshes than in mesohaline and polyhaline marshes.

Component Associations:
- *Paspalum vaginatum - Spartina patens* Oligohaline Herbaceous Vegetation (CEGL007885, G2?)
- *Phragmites australis - (Sagittaria platyphylla, Vigna luteola)* Tidal Herbaceous Vegetation (CEGL007891, G4?)
- *Schoenoplectus americanus - (Spartina patens) - Typha* spp. Herbaceous Vegetation (CEGL008476, G3?)

DISTRIBUTION

Range: This fresh and oligohaline marsh system ranges along the Texas coast south of the Chenier Plain. It is best developed along the central and upper coast of Texas from Galveston Bay in Chambers County, Texas, south to approximately Corpus Christi Bay.
Divisions: 203:C
Nations: US
Subnations: TX
Map Zones: 36:C
USFS Ecomap Regions: 232E:CC, 255D:CC
TNC Ecoregions: 31:C

SOURCES

References: Bernier 2013, Comer et al. 2003, Couvillion and Beck 2013, Elliott 2011, Howard and Mendelssohn 1999, Neubauer 2013, Willis and Hester 2004
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723114#references
Description Author: J. Teague, mod. M. Pyne and L. Elliott
Version: 14 Jan 2014
Concept Author: J. Teague
Stakeholders: Southeast
ClassifResp: Southeast

TEXAS COAST SALT AND BRACKISH TIDAL MARSH (CES203.473)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Tidal / Estuarine [Haline]; Graminoid
Non-Diagnostic Classifiers: Herbaceous
National Mapping Codes: ESLF 9244

CONCEPT

Summary: This ecological system encompasses all of the brackish to salt intertidal marshes of the Texas coast south of the Chenier Plain. It ranges from Galveston Bay in Chambers County, Texas, south. These marshes typically occur on the bay side of barrier islands. Representative examples are dominated by *Spartina alterniflora, Juncus roemerianus,* or *Avicennia germinans*. Significant areas of *Avicennia germinans* become more frequent towards the south, while extensive areas of *Spartina alterniflora* become rare south of Corpus Christi Bay. The system also includes extensive irregularly-flooded tidal flats and salt pannes, some vegetated by succulent herbs such as *Sarcocornia, Salicornia,* and *Batis*; some are nonvegetated.

Similar Ecological Systems:
- Gulf Coast Chenier Plain Salt and Brackish Tidal Marsh (CES203.468)

Related Concepts:
- Coastal: Mangrove Shrubland (5606) [CES203.473.6] (Elliott 2011) Finer
- Coastal: Salt and Brackish High Tidal Marsh (5617) [CES203.473.17] (Elliott 2011) Finer
- Coastal: Salt and Brackish High Tidal Shrub Wetland (5616) [CES203.473.16] (Elliott 2011) Finer
- Coastal: Salt and Brackish Low Tidal Marsh (5607) [CES203.473.7] (Elliott 2011) Finer
- Coastal: Sea Ox-eye Daisy Flats (5605) [CES203.473.5] (Elliott 2011) Finer
- Coastal: Tidal Flat (5600) [CES203.473.1] (Elliott 2011) Finer

DESCRIPTION

Environment: These marshes occupy relatively low-lying, coastal situations on level landforms influenced by microtidal fluctuations. Some sites are only influenced by storm tides or tides resulting from extreme wind events. These marshes typically occur on the bay side of barrier islands. This system also includes extensive irregularly-flooded tidal flats and salt pannes. The geology consists of recent marine, alluvial and eolian deposits along the coast. Landforms are nearly level to very gentle slopes and flats influenced by tides, including wind tides. Soils are coastal sands, and the system occupies various Salt Marsh Ecological Sites.

Vegetation: Representative examples are dominated by *Spartina alterniflora, Juncus roemerianus,* or *Avicennia germinans*. These marshes may be dominated by species such as *Spartina patens, Distichlis spicata, Schoenoplectus robustus, Schoenoplectus americanus, Sporobolus virginicus, Monanthochloe littoralis,* and *Spartina spartinae*. Shrubs, subshrubs and forbs, such as *Batis maritima, Borrichia frutescens, Sesuvium portulacastrum, Salicornia* spp., *Suaeda linearis, Limonium* spp., and *Lycium carolinianum*, are commonly encountered in these marshes. Some irregularly-flooded sites may become shrub-dominated with species such as *Iva frutescens* or *Baccharis halimifolia*. In the south, extensive areas are dominated by *Borrichia frutescens*, and these often occur at very slightly lower elevations and higher salinities than nearby *Spartina spartinae* salty prairie. These *Borrichia* flats may be very infrequently flooded, perhaps only under extreme storm tide conditions. Other species that may be encountered in these situations include *Maytenus phyllanthoides, Prosopis reptans, Monanthochloe littoralis, Distichlis spicata,* and *Batis maritima*. The aspect dominant on these sites is clearly *Borrichia frutescens*. Some examples may have unvegetated patches. Other plants that may be found in examples of this system include *Andropogon hallii, Artemisia filifolia, Iva frutescens ssp. frutescens, Schoenoplectus californicus, Schoenoplectus pungens*, and the exotic shrubs *Tamarix* spp (Elliott 2011).

Dynamics: Important processes and interactions in this system include the natural hydrological processes of rivers bringing freshwater and sediments to the coast, diurnal microtides, and protection from high-energy wave actions (Morton et al. 2004). The composition of these marshes is primarily influenced by the frequency and duration of tidal inundation. Salinity on some marshes, particularly in the south, is maintained by salt spray from prevailing southeasterly winds. Low marshes are regularly flooded. Areas of decreased frequency and/or duration of tidal inundation are often referred to as high, or irregularly flooded, marsh (Elliott 2011). Freshwater and sediment input are scarce in the southern part of this system's range. Sediment input is critical to marsh persistence and becomes even more important under accelerated sea-level rise scenarios. Marsh vegetation plays an equally important role in maintaining marsh elevation (Baustian et al. 2012). Salt and brackish marshes are important habitats for many animal species.

Component Associations:
- *Avicennia germinans / Spartina alterniflora* Shrubland (CEGL003801, G2?)
- *Batis maritima - Sarcocornia pacifica* Dwarf-shrubland (CEGL003956, G5)
- *Borrichia frutescens / (Spartina patens, Juncus roemerianus)* Shrubland (CEGL003924, G4)
- *Distichlis spicata - (Sporobolus virginicus)* Herbaceous Vegetation (CEGL007694, G3G5)
- *Iva frutescens ssp. frutescens - Baccharis halimifolia / Spartina spartinae* Shrubland (CEGL004616, G4?)

- *Juncus roemerianus* Herbaceous Vegetation (CEGL004186, G5)
- *Monanthochloe littoralis* Herbaceous Vegetation (CEGL003991, G2G3)
- *Sarcocornia pacifica* - (*Batis maritima, Distichlis spicata*) Dwarf-shrubland (CEGL002278, G4)
- *Spartina alterniflora - Distichlis spicata - Spartina patens* Mesohaline Tidal Herbaceous Vegetation (CEGL002230, G4?)
- *Spartina alterniflora - Juncus roemerianus - Distichlis spicata* Louisianian Zone Salt Tidal Herbaceous Vegetation (CEGL004190, G5)
- *Spartina patens - Schoenoplectus (americanus, pungens) - (Distichlis spicata)* Herbaceous Vegetation (CEGL004755, G4?)
- *Spartina spartinae - Sporobolus virginicus* Tidal Herbaceous Vegetation (CEGL004199, G4G5)

DISTRIBUTION

Range: This salt and brackish marsh system of the Texas coast ranges from Galveston Bay in Chambers County, Texas, south.
Divisions: 203:C; 301:C
Nations: US
Subnations: TX
Map Zones: 36:C, 37:C
USFS Ecomap Regions: 232E:CC, 255D:CC
TNC Ecoregions: 31:C

SOURCES

References: Baustian et al. 2012, Comer et al. 2003, Elliott 2011, Morton et al. 2004
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723113#references
Description Author: J. Teague, mod. M. Pyne and L. Elliott
Version: 14 Jan 2014
Concept Author: J. Teague
Stakeholders: Southeast
ClassifResp: Southeast

TEXAS COASTAL BEND SEAGRASS BED (CES203.474)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Tidal / Estuarine; Aquatic Herb
Non-Diagnostic Classifiers: Herbaceous
National Mapping Codes: ESLF 9287

CONCEPT

Summary: This system includes seagrass beds occurring along the Texas Coast south of San Antonio Bay. Dominants may include, individually or in admixtures with other seagrasses, *Cymodocea filiformis*, which is restricted in Texas to this ecological system, *Halophila engelmannii* or *Halodule wrightii (= Halodule beaudettei)*, which occupy thousands of acres of the Laguna Madre, and *Thalassia testudinum*. This system includes Texas' largest occurrences of *Thalassia testudinum* and *Halophila engelmannii*. Other dominants may include *Ruppia maritima*.

DESCRIPTION

Environment: This system occurs in clear shallow marine waters on muddy or sandy substrates.
Vegetation: As a result of natural climatic perturbations, such as tropical storms and hurricanes and human-induced disturbances, seagrass beds are often dynamic in their composition and size. As seagrasses are periodically uprooted by sea currents, turbulent waters, and exceptionally high tides, they are usually deposited in great masses on the beaches. *Thalassia testudinum*, along with *Cymodocea filiformis* are considered competitively superior to *Halodule wrightii (= Halodule beaudettei)* and may succeed this species in bays with optimum environments. Dramatic conversion of shoal-grass beds to beds dominated by these other two species, especially *Thalassia testudinum*, has occurred in the Laguna Madre of Texas (Onuf 1995). *Halophila engelmannii* often occurs in deeper waters than other seagrasses.

Component Associations:
- *Cymodocea filiformis - (Thalassia testudinum)* Herbaceous Vegetation (CEGL004317, G4?)
- *Halodule wrightii* Herbaceous Vegetation (CEGL004318, G4?)
- *Halophila engelmannii* Herbaceous Vegetation (CEGL004688, G3?)
- *Ruppia maritima* Louisianian Zone Herbaceous Vegetation (CEGL004450, G4G5)
- *Thalassia testudinum* Herbaceous Vegetation (CEGL004319, G4?)

DISTRIBUTION

Range: This system is found along the Gulf Coast of Texas south of San Antonio Bay.
Divisions: 203:C; 301:C
Nations: US
Subnations: TX
Map Zones: 36:C
USFS Ecomap Regions: 232E:CC, 255D:CC
TNC Ecoregions: 31:C

SOURCES

References: Comer et al. 2003, Onuf 1995
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723112#references
Description Author: J. Teague
Version: 14 Jan 2003
Concept Author: J. Teague
Stakeholders: Southeast
ClassifResp: Southeast

TEXAS SALINE COASTAL PRAIRIE (CES203.543)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Herbaceous; West Gulf Coastal Plain; Extensive Wet Flat; Saline Substrate Chemistry
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2486; ESLF 9207; ESP 1486

CONCEPT

Summary: This system encompasses grassland vegetation occurring along the Gulf Coast of Texas on saline and nonsaline soils on level topography of the Beaumont Formation and in brackish marshes. These areas are often saturated by local rainfall and periodically flooded by saline waters during major storm events. Outliers also occur as scattered patches in salt flats. It is characteristically dominated by *Spartina spartinae*, a tall (1.5 m) warm-season perennial bunchgrass; other dominants may include *Schizachyrium littorale* and *Muhlenbergia capillaris*. This system also includes depressions often dominated by *Spartina patens*. Saline prairie continues to occupy extensive areas, though quality of the system is often degraded by the invasion of woody shrubs due to the absence of regular fire. Fire is an important ecological process needed to maintain this system, though periodic submersion with saltwater during storm events also helps to control the invasion of woody species.

Similar Ecological Systems:
- Texas Saline Inland Prairie (CES301.720)

Related Concepts:
- Gulf Coast: Salty Prairie (2207) [CES203.543.7] (Elliott 2011) Finer
- Gulf Coast: Salty Shrubland (2206) [CES203.543.6] (Elliott 2011) Finer

DESCRIPTION

Environment: This system occurs on saline and nonsaline soils of the Pleistocene Beaumont Formation that are often saturated by local rainfall and periodically flooded by saline waters during major storm events. Landforms are mostly level or very gently undulating, and typically found near the coast. These sites may be inundated by saltwater during storm surges. Pimple mounds may lend some local topographic variation to the otherwise level surface. Soils are very deep, somewhat poorly to poorly drained, often with high salinity and/or sodicity, at least at some depth. These may be loams or clays. These soils may be saturated from local rainfall or occasionally from storm surges (Elliott 2011). This system often forms a band between coastal salt marshes and coastal nonsaline prairie.

Vegetation: This system is characteristically dominated by *Spartina spartinae*, which may occur in nearly monotypic stands; other dominants may include *Schizachyrium littorale* and *Muhlenbergia capillaris*. This system includes depressions often dominated by *Spartina patens*. Other graminoids that may be present to abundant include *Schizachyrium scoparium, Andropogon glomeratus, Panicum virgatum*, or *Sporobolus indicus*. On lower, somewhat wetter sites, *Aristida oligantha, Paspalum hartwegianum, Sporobolus virginicus, Paspalum vaginatum*, and *Distichlis spicata* may be common. Forbs are generally uncommon but may include species such as *Borrichia frutescens, Solidago sempervirens, Iva angustifolia, Euthamia* spp., or other species more common to the non-saline soils nearby or the salt marsh that may also be nearby. Microtopographic highs in the form of pimple mounds often have species more characteristic of less saline adjacent habitats. Shrubby species may invade the prairie, commonly including species such as *Iva frutescens, Prosopis glandulosa, Acacia farnesiana, Lycium carolinianum, Tamarix* sp., and *Baccharis halimifolia* (Elliott 2011).

Dynamics: Fire is an important ecological process needed to maintain this system. Periodic submersion with saltwater during storm events also helps to control the invasion of woody species and contributes to higher soil salinity levels.

Component Associations:
- *Muhlenbergia capillaris* Herbaceous Vegetation (CEGL004607, G1G2)
- *Spartina spartinae - Schizachyrium scoparium* Herbaceous Vegetation (CEGL002231, G3)
- *Spartina spartinae* Herbaceous Vegetation (CEGL004608, G4)

DISTRIBUTION

Range: This system is restricted to the Gulf Coast of Texas.
Divisions: 203:C
Nations: US
Subnations: TX
Map Zones: 36:C, 37:P
USFS Ecomap Regions: 255D:CC, 315E:PP
TNC Ecoregions: 31:C

SOURCES

References: Comer et al. 2003, Elliott 2011, Oefinger and Scifres 1977

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723059#references
Description Author: J. Teague, mod. M. Pyne and L. Elliott
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: J. Teague **ClassifResp:** Southeast

TEXAS-LOUISIANA COASTAL PRAIRIE PONDSHORE (CES203.541)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: West Gulf Coastal Plain; Hardpan; Depressional; Graminoid
Non-Diagnostic Classifiers: Herbaceous; Isolated Wetland [Partially Isolated]; Palustrine
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2487; ESLF 9208; ESP 1487

CONCEPT

Summary: This ecological system includes small to moderately large ponds and swales in the coastal prairie of southeastern Texas and adjacent Louisiana. These wetlands contain surface water during much of the year, desiccating only in the driest summer months. They are often fed by water runoff but may result from percolation from adjacent sandy areas. Soils in the basins are finer-textured than surrounding areas and may be underlain by pans that enhance perched water tables in the winter. These wetlands occur within the coastal prairie matrix of southeastern Texas and Louisiana and are wetter than wet prairie dominated by *Tripsacum dactyloides* and *Panicum virgatum*. These wetlands may be dominated by *Eleocharis quadrangulata*. Other species that may be present include *Sagittaria papillosa, Sagittaria longiloba, Steinchisma hians, Panicum virgatum, Cyperus haspan, Cyperus virens, Ludwigia glandulosa, Ludwigia linearis, Fuirena squarrosa, Xyris jupicai, Leersia hexandra, Centella erecta, Symphyotrichum subulatum (= Aster subulatus), Sesbania* spp., and *Rhynchospora* spp. Open areas in the ponds may contain floating and submersed aquatic vegetation, including *Utricularia gibba, Stuckenia pectinata, Ceratophyllum demersum, Brasenia schreberi, Nymphoides aquatica, Nuphar advena,* and *Nelumbo lutea*.

Similar Ecological Systems:
- Texas-Louisiana Coastal Prairie (CES203.550)

Related Concepts:
- Gulf Coast: Coastal Prairie Pondshore (5307) [CES203.541] (Elliott 2011) Equivalent

DESCRIPTION

Environment: This small-patch system occurs in shallow depressions (microtopographic lows) on coastal Pleistocene terraces, including the Beaumont and Lissie formations, within the matrix of the generally level landscape of the Texas-Louisiana Coastal Prairie (CES203.550). Soils tend to be fine-textured, or are characterized by a relatively impermeable subsurface horizon (Elliott 2011). Examples of this system are often fed by water runoff but may result from groundwater percolation from adjacent sandy areas. Studies have shown that coastal prairie ponds may collectively occupy a large percentage of the land area within the coastal prairie (Enwright et al. 2011).

Vegetation: This system occurs as ponds or swales within the coastal prairie matrix. These wetlands are primarily herbaceous, sometimes with sparse woody cover, and are composed of various species, including *Eleocharis quadrangulata* (which may dominate some stands), *Fuirena squarrosa, Cyperus haspan, Cyperus virens, Rhynchospora* spp., *Leersia hexandra, Steinchisma hians, Panicum virgatum, Andropogon glomeratus, Xyris jupicai, Centella erecta, Sagittaria papillosa, Sagittaria longiloba, Ludwigia glandulosa, Ludwigia linearis, Bacopa* spp., *Hydrocotyle* spp., *Symphyotrichum subulatum (= Aster subulatus),* and *Sesbania* spp. Large areas of some of the occurrences may be relatively homogeneous, dominated by one or a few species. Areas of open water within the ponds may contain floating and submerged aquatic species, including *Stuckenia pectinata, Ceratophyllum demersum, Brasenia schreberi, Nymphoides aquatica,* and *Nelumbo lutea*. Occurrences are wetter than *Tripsacum dactyloides*- or *Panicum virgatum*-dominated prairie sites of Texas-Louisiana Coastal Prairie (CES203.550).

Dynamics: These wetlands are part of the larger hydrologic cycle of the coastal prairie ecosystem. They store surface water and in some cases groundwater during much of the year, desiccating only in the driest summer months. Soils in the basins are finer-textured than surrounding areas and may be underlain by pans that enhance perched water tables in the winter. They have been shown to play a role in landscape-level water quality regulation (Forbes et al. 2012). The herbaceous wetlands are maintained by fire.

Component Associations:
- *Brasenia schreberi* Eastern Herbaceous Vegetation (CEGL004527, G4?)
- *Eleocharis quadrangulata - Sagittaria* spp. Herbaceous Vegetation (CEGL007929, G3?)
- *Nelumbo lutea* Herbaceous Vegetation (CEGL004323, G4?)
- *Nuphar advena - Nymphaea odorata* Herbaceous Vegetation (CEGL002386, G4G5)
- *Potamogeton nodosus* Herbaceous Vegetation (CEGL004529, GNR)
- *Stuckenia pectinata - Ceratophyllum demersum* Texas Coastal Herbaceous Vegetation (CEGL004147, G3G4)

DISTRIBUTION

Range: This system is restricted to the coastal prairie of southeastern Texas and Louisiana.
Divisions: 203:C

Nations: US
Subnations: LA, TX
Map Zones: 36:C, 37:C, 98:C
USFS Ecomap Regions: 232E:CC, 255D:CC
TNC Ecoregions: 31:C

SOURCES

References: Comer et al. 2003, Elliott 2011, Enwright et al. 2011, Forbes et al. 2012, LDWF 2005, Moulton et al. 1997, TPDW 2012b, USFWS and USGS 1999

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723061#references

Description Author: J. Teague, mod. M. Pyne and L. Elliott

Version: 14 Jan 2014

Concept Author: J. Teague

Stakeholders: Southeast

ClassifResp: Southeast

TEXAS-LOUISIANA FRESH-OLIGOHALINE SUBTIDAL AQUATIC VEGETATION (CES203.511)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Tidal / Estuarine; Aquatic Herb
Non-Diagnostic Classifiers: Herbaceous
National Mapping Codes: ESLF 9277

CONCEPT

Summary: This system includes subtidal beds of aquatic vegetation in fresh to oligohaline tidal waters of the Gulf of Mexico in Louisiana and Texas. Species composition may include *Stuckenia pectinata (= Potamogeton perfoliatus), Zannichellia palustris, Vallisneria americana, Najas guadalupensis,* and *Ruppia maritima*. It is found in the Trinity Bay portion of the Galveston Bay complex along the upper coast of Texas. Although the substrate of most Texas bays is sand, this system occurs on mud-dominated substrates (Adair et al. 1994). This system is also distinguished by the prevalence of oligohaline waters, whereas other Texas bays are considerably more saline. As a consequence, the predominant species, *Najas guadalupensis* and *Vallisneria americana*, which are salt intolerant, are able to attain dominance here. Both species are largely restricted to the northeastern portions of the bay where they are protected by a sand bar system which restricts wave action and turbidity. The extent and quality of this system have been heavily reduced by shoreline development and associated draining and filling, bulkheading, and channelization. Seagrass communities are declining in many bays along the Texas coast.

Component Associations:
- *Potamogeton perfoliatus - (Stuckenia pectinata, Zannichellia palustris)* Permanently Flooded - Tidal Herbaceous Vegetation (CEGL007689, GNR)
- *Vallisneria americana* Estuarine Bayou Herbaceous Vegetation (CEGL004634, G3G5)

DISTRIBUTION

Range: This system occurs primarily from Trinity Bay in Texas north along the Gulf of Mexico into Louisiana.
Divisions: 203:C
Nations: US
Subnations: LA, TX
Map Zones: 36:?, 37:C
USFS Ecomap Regions: 232E:CC, 255D:CC
TNC Ecoregions: 31:C

SOURCES

References: Adair et al. 1994, Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723078#references
Description Author: J. Teague and R. Evans, mod. M. Pyne
Version: 30 Jan 2006
Concept Author: J. Teague and R. Evans
Stakeholders: Southeast
ClassifResp: Southeast

UPPER TEXAS COAST SEAGRASS BED (CES203.545)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Saltwater (Polyhaline)
Non-Diagnostic Classifiers: Herbaceous
National Mapping Codes: ESLF 9401

CONCEPT

Summary: This system includes seagrass communities occurring in bays along the upper Texas coast north of and including San Antonio Bay. It includes vegetation dominated by *Thalassia testudinum*, *Halophila engelmannii*, *Ruppia maritima*, or *Halodule wrightii (= Halodule beaudettei)*. Many of these occurrences have declined in extent. Seagrass communities are declining in many bays along the Texas coast.

DESCRIPTION

Environment: See Adair et al. (1994). Examples are found in Christmas Bay, San Antonio Bay, and Copano Bay.
Vegetation: Some of the seagrass species found in examples of this system include *Halodule wrightii (= Halodule beaudettei)*, *Halophila engelmannii*, *Ruppia maritima*, and *Thalassia testudinum*.

Component Associations:
- *Halodule wrightii* Herbaceous Vegetation (CEGL004318, G4?)
- *Halophila engelmannii* Herbaceous Vegetation (CEGL004688, G3?)
- *Ruppia maritima* Louisianian Zone Herbaceous Vegetation (CEGL004450, G4G5)
- *Thalassia testudinum* Herbaceous Vegetation (CEGL004319, G4?)

DISTRIBUTION

Range: This system is found in bays along the upper Texas coast north of and including San Antonio Bay.
Divisions: 203:C
Nations: US
Subnations: TX
Map Zones: 37:C
USFS Ecomap Regions: 232E:CC, 255D:CC
TNC Ecoregions: 31:C

SOURCES

References: Adair et al. 1994, Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723057#references
Description Author: J. Teague, mod. M. Pyne
Version: 17 Jan 2006
Concept Author: J. Teague
Stakeholders: Southeast
ClassifResp: Southeast

WEST GULF COASTAL PLAIN FLATWOODS POND (CES203.547)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: West Gulf Coastal Plain; Depressional; Graminoid
Non-Diagnostic Classifiers: Forest and Woodland (Treed); Isolated Wetland [Partially Isolated]
National Mapping Codes: ESLF 9349

CONCEPT

Summary: This system represents predominantly graminoid-dominated flatwoods ponds of the West Gulf Coastal Plain of eastern Texas and western Louisiana. These ponds are generally circular or elliptical, flat-bottomed depressions on flat terraces in the Outer Coastal Plain. The slowly permeable soils trap local runoff and precipitation resulting in higher water tables than surrounding areas. Water depth may be 3-5 feet in the winter and even deeper toward the center of some examples. Examples range from shallow to several meters in depth; the large and deeper examples may exhibit distinct vegetation zonation. Most examples have a layer of tall wetland grasses and sedges above a layer of semi-aquatic herbs. Many lack a significant woody layer due in part to periodic fires originating in the pine savanna matrix. However, scattered, often stunted *Nyssa biflora* and stems of *Cephalanthus occidentalis* may be present. The following species are characteristic of this type: *Eriocaulon compressum, Xyris fimbriata, Eleocharis equisetoides, Eleocharis quadrangulata*, as well as two additional species, *Carex verrucosa* and *Rhynchospora cephalantha*, which are more frequent in other pond types. Some other species frequently found in this type include *Eriocaulon compressum, Rhynchospora corniculata, Panicum hemitomon, Ludwigia sphaerocarpa, Xyris laxifolia var. iridifolia (= Xyris iridifolia)*, and *Sagittaria graminea*. Other herbaceous species may include *Gratiola brevifolia, Hydrolea ovata, Proserpinaca pectinata, Pluchea rosea, Ludwigia pilosa, Bacopa caroliniana, Xyris* sp., and *Rhynchospora capitellata*.

Similar Ecological Systems:
- West Gulf Coastal Plain Nonriverine Wet Hardwood Flatwoods (CES203.548)

Related Concepts:
- Pineywoods: Herbaceous Flatwoods Pond (3507) [CES203.547] (Elliott 2011) Equivalent
- Sweetbay - Swamp Tupelo - Redbay: 104 (Eyre 1980) Finer
- Water Tupelo - Swamp Tupelo: 103 (Eyre 1980) Finer

DESCRIPTION

Environment: This system tends to occur as inclusions within wetland pine savannas in depression ponds or ancient stream channels and sloughs. Occurrences range in size from less than an acre to 30-40 acres. Local runoff and rainfall collect in these depressions with slowly permeable soils. Resulting water tables persist for long periods after rain, at higher levels than surrounding parts of the landscape. Water depth in this pond type ranges from a few inches to several feet and is often 3-5 feet deep in winter, and even deeper areas (with floating aquatic vegetation) may occur in the center of some sites (Bridges 1988, Bridges and Orzell 1989a, LDWF 2005). They tend to occur as inclusions within wetland pine savannas, but may also be bordered by upland depression swamps. The depressions are typically closed, with no surface outlet. Water collects from local rainfall and runoff from small watersheds. There is typically no input from streamflow and little or no outflow (Bridges and Orzell 1989a). The geological setting is the Pleistocene terraces, including the upper Beaumont Formation, but also mapped on the high Pleistocene terraces in the northern part of Texas. These are estimated to occur on Quaternary Fluviatile Terrace (Tile) Deposits along the Red, Sulphur, and Sabine rivers. Stands occupy local topographic lows within the flatwoods. Soils are relatively fine-textured, with an impermeable subsoil horizon, giving rise to a perched water table and saturated conditions during extended periods of the year (Elliott 2011).

Vegetation: Plant species dominance varies greatly depending upon water depth and the spread of colonial, rhizomatous species, and may also be related to geographic isolation of individual ponds and variations in local fire regimes. Most examples have a layer of tall wetland grasses and sedges above a layer of semi-aquatic herbs. Many lack a significant woody layer due in part to periodic fires originating in the pine savanna matrix. Scattered woody plants, especially stunted *Nyssa biflora* or stems of *Cephalanthus occidentalis*, may be present. In some instances woody stems may develop sufficient density to be classified as woodlands. The following species are characteristic of this type: *Eriocaulon compressum, Xyris fimbriata, Eleocharis equisetoides, Eleocharis quadrangulata*, as well as two additional species, *Carex verrucosa* and *Rhynchospora cephalantha*, which are more frequent in other pond types. Some other species frequently found include *Eriocaulon compressum, Rhynchospora corniculata, Panicum hemitomon, Ludwigia sphaerocarpa, Xyris laxifolia var. iridifolia (= Xyris iridifolia)*, and *Sagittaria graminea*. Other herbaceous species may include *Gratiola brevifolia, Hydrolea ovata, Proserpinaca pectinata, Pluchea rosea, Ludwigia pilosa, Bacopa caroliniana, Xyris* sp., and *Rhynchospora capitellata*. Areas mapped as this system by TPWD (Elliott 2011) are likely dominated by *Panicum hemitomon, Carex* spp., *Rhynchospora* spp., *Eleocharis* spp., *Andropogon glomeratus*, and *Ludwigia* spp. On drier sites *Schizachyrium scoparium* may be present. Some sites may be dominated by the non-native *Cynodon dactylon*. A few woody species may occur, including *Nyssa biflora, Liquidambar styraciflua, Quercus nigra, Planera aquatica*, and *Cephalanthus occidentalis*. Flatwood ponds, as described by Bridges and Orzell (1989a), represent a more restricted subset of herbaceous-dominated sites with saturated soils resulting from a

perched water table due to an impermeable subsurface.
Dynamics: Water table fluctuations are probably the most important factor affecting examples of this system (Bridges and Orzell 1989a). Water collects in these depressions mostly through surface runoff after rainfall events but generally not as a result of overbank flooding. Water tends to be deepest during the wintertime when precipitation is concentrated (although other factors may also be important, such as the amount of evapotranspiration). Standing water may be evident from approximately November through May, and sporadically afterwards. This system is located within the frequently burned longleaf pine matrix and is kept at an herbaceous or mostly herbaceous state by fire.

Component Associations:
- *Aristida palustris - Panicum virgatum - Eriocaulon compressum - Eleocharis equisetoides* Herbaceous Vegetation (CEGL004577, G2G3)
- *Aristida palustris - Panicum virgatum - Eriocaulon decangulare var. decangulare - Rhynchospora elliottii* Herbaceous Vegetation (CEGL004576, G2G3)
- *Nymphoides aquatica - Nymphaea odorata - Gratiola brevifolia* Herbaceous Vegetation (CEGL004601, G3?)
- *Nyssa biflora - Crataegus opaca - (Fraxinus caroliniana) / Rhynchospora mixta* Woodland (CEGL007873, G2?)
- *Nyssa biflora / Panicum hemitomon - Woodwardia virginica* Woodland (CEGL004586, G3?)
- *Panicum hemitomon - Eriocaulon compressum - Rhynchospora corniculata* Herbaceous Vegetation (CEGL004578, G2)

SPATIAL CHARACTERISTICS

Size: Most are quite small features; although specific data are not available, most are believed to be less than 1 acre in size.
Adjacent Ecological Systems:
- West Gulf Coastal Plain Nonriverine Wet Hardwood Flatwoods (CES203.548)

DISTRIBUTION

Range: West Gulf Coastal Plain of eastern Texas and western Louisiana.
Divisions: 203:C
Nations: US
Subnations: LA, TX
Map Zones: 36:?, 37:C, 44:?
TNC Ecoregions: 31:?, 40:C, 41:C

SOURCES

References: Bridges 1988, Bridges and Orzell 1989a, Comer et al. 2003, Elliott 2011, Eyre 1980, LDWF 2005
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723055#references
Description Author: R. Evans, mod. M. Pyne, L. Elliott, J. Teague
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: R. Evans **ClassifResp:** Southeast

WEST GULF COASTAL PLAIN HERBACEOUS SEEP AND BOG (CES203.194)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: West Gulf Coastal Plain; Seepage-Fed Sloping; Very Short Disturbance Interval; Graminoid
Non-Diagnostic Classifiers: Herbaceous; Palustrine
National Mapping Codes: ESLF 9298

CONCEPT

Summary: This wet, small-patch, fire-maintained, hillside seepage system occurs in the Gulf Coastal Plain west of the Mississippi River where it is documented from east-central Texas to western Louisiana, and adjacent areas of southern Arkansas. This oligotrophic wetland is maintained by seepage at the zone between an overlaying, permeable sandy layer and a lower layer of relatively impermeable material such as sandstone or clay. The vegetation of intact examples is dominated by a dense, species-rich graminoid-forb layer less than 1 m tall with continuous to nearly continuous cover, typically 80-90%. This type is intended to encompass the range of variation present in West Gulf Coastal Plain seepage bogs, although various authors have recognized a number of different subtypes. One of the most distinct variants that is included here for now is the "muck bog" of the Post Oak Savanna and Cross Timbers regions. It differs in a number of ways from most other examples of this system and may need to be recognized as a distinct ecological system.

Related Concepts:

- Pineywoods: Herbaceous Seepage Bog (2307) [CES203.194.7] (Elliott 2011) Equivalent

DESCRIPTION

Environment: This small patch oligotrophic wetland is maintained by seepage at the zone between an overlaying, permeable sandy layer and a lower layer of relatively impermeable material such as sandstone or clay. Examples are often associated with Eocene sand formations such as Queen City, Sparta, and particularly Carrizo sands. It is generally found on slopes, as well as on valley floors and toeslopes where seepage from upslope occurs through the deep sands on site. Soils are sands. Deep Sand, Very Deep Sand, or Wet Sandy Draw Ecological Sites are typical of this system and surrounding areas.

Vegetation: This small-patch system typically presents as an herbaceous wetland, though sometimes significant shrub cover by *Morella cerifera* and/or other species may be conspicuous. The herbaceous layer is dominated by a dense, species-rich, graminoid-forb layer less than 1 m tall with continuous to nearly continuous cover, typically 80-90%. Seepage, which controls the floristic composition, results from the percolation of water through a porous sand layer until it encounters a more impermeable layer and flows to the surface. *Sarracenia alata* is often the aspect dominant of this system. Grass species present may include *Andropogon glomeratus, Dichanthelium scoparium, Panicum anceps, Panicum brachyanthum, Panicum virgatum, Paspalum laeve, Saccharum giganteum,* and *Steinchisma hians*. Sedges and rushes are well-represented and may include *Cyperus strigosus, Eleocharis acicularis, Fuirena squarrosa, Juncus dichotomus, Juncus diffusissimus, Juncus effusus,* and *Rhynchospora* spp. (including *Rhynchospora gracilenta, Rhynchospora oligantha,* and/or *Rhynchospora rariflora*). A diverse forb assemblage is typically present and may include *Eryngium integrifolium, Eupatorium perfoliatum, Habenaria repens, Hypericum mutilum, Ludwigia alternifolia, Lycopodiella* spp., *Osmunda cinnamomea, Osmunda regalis, Pogonia ophioglossoides, Polygala cruciata, Rhexia mariana, Sarracenia alata, Symphyotrichum dumosum var. dumosum, Woodwardia* spp., and/or *Xyris* spp. (*Xyris ambigua, Xyris baldwiniana, Xyris difformis, Xyris jupicai, Xyris laxifolia,* and/or *Xyris torta*). Seeps may feed downslope depressional wetlands which may be overtaken by shrub species such as *Morella cerifera* or may be dominated by *Eleocharis* spp., *Juncus* spp., *Panicum hemitomon,* and/or *Rhynchospora* spp. (Elliott 2011).

The bog of portions of East-Central Texas Plains Post Oak Savanna and Woodland (CES205.679), commonly referred to as "muck bogs," differ from similar bogs within the West Gulf Coastal Plain by a decrease in species richness towards the west. These bogs can become dominated by woody species such as *Morella cerifera, Ilex vomitoria,* and *Smilax laurifolia*. East of the Post Oak Savanna, other woody species such as *Toxicodendron vernix, Magnolia virginiana, Persea borbonia,* and *Pinus palustris* may form a sparse emergent canopy, even in well-burned examples. Sites east of the Post Oak Savanna may contain broad-leaved evergreen woody species such as *Magnolia virginiana, Cyrilla racemiflora, Morella caroliniensis, Persea palustris,* and *Ilex coriacea*. Herbaceous species more characteristic of eastern occurrences include *Gelsemium sempervirens, Hypericum galioides, Lachnocaulon anceps, Ludwigia hirtella, Marshallia graminifolia, Rhexia petiolata, Rhynchospora inexpansa, Rhynchospora plumosa, Rudbeckia scabrifolia,* and *Xyris drummondii*. Woody shrubs have a cover of less than 10% in frequently burned examples but increase greatly with reductions in fire frequency. This type is intended to encompass the range of variation present in West Gulf Coastal Plain seepage bogs, although various authors have recognized a number of different subtypes. For more information, see Bridges and Orzell (1989a).

Dynamics: This system is maintained by groundwater seepage. The size of the recharge zone helps determine the amount of groundwater present within the system. Frequent fires are essential to control invasion by wetland shrubs, although the wettest areas may persist in an herbaceous-dominated condition without fire. However, fire may also be necessary to stimulate growth, flowering and seed production of many herbaceous species found in this community. In the absence of fire, these bogs may become heavily

wooded, resulting in the eventual elimination of the bog (Folkerts 1982). Increased development of woody species suppresses herbaceous species and potentially produces some drying effect by pumping larger volumes of water.

Component Associations:
- *Carex lurida - Andropogon glomeratus - Sarracenia alata - Symphyotrichum puniceum var. scabricaule - Doellingeria sericocarpoides* Herbaceous Vegetation (CEGL008417, G1)
- *Dichanthelium scoparium - Boehmeria cylindrica / Sphagnum* spp. - *Polytrichum commune* Herbaceous Vegetation (CEGL004916, G2Q)
- *Sarracenia alata - Rhynchospora gracilenta - Rudbeckia scabrifolia - Schoenolirion croceum* Herbaceous Vegetation (CEGL004175, G2G3)

DISTRIBUTION

Range: This system occurs in the Gulf Coastal Plain west of the Mississippi River where it is documented from east-central Texas to western Louisiana, and adjacent areas of southern Arkansas.
Divisions: 203:C; 205:C
Nations: US
Subnations: AR?, LA, TX
Map Zones: 32:?, 35:?, 36:C, 37:C
USFS Ecomap Regions: 231E:CC, 232F:CC, 234E:??
TNC Ecoregions: 32:C, 40:C, 41:C

SOURCES

References: Bridges and Orzell 1989a, Comer et al. 2003, Elliott 2011, Folkerts 1982, LDWF 2005
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723247#references
Description Author: R. Evans, mod. M. Pyne, L. Elliott, J. Teague
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: R. Evans **ClassifResp:** Southeast

WESTERN GREAT PLAINS CLOSED DEPRESSION WETLAND (CES303.666)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Western Great Plains (303)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Non-Diagnostic Classifiers: Clay Subsoil Texture; Impermeable Layer; Saturated Soil; Lowland [Lowland]; Playa; Herbaceous; Depressional; Isolated Wetland [Strictly Isolated]; Depression
National Mapping Codes: ESLF 9252

CONCEPT

Summary: Communities associated with the playa lakes in the southern areas of this province and the rainwater basins in Nebraska characterize this system. They are primarily upland depressional basins. This hydric system is typified by the presence of an impermeable layer such as a dense clay, hydric soil and is usually recharged by rainwater and nearby runoff. They are rarely linked to outside groundwater sources and do not have an extensive watershed. Ponds and lakes associated with this system can experience periodic drawdowns during drier seasons and years, and are often replenished by spring rains. *Eleocharis* spp., *Hordeum jubatum*, along with common forbs such as *Coreopsis tinctoria, Symphyotrichum subulatum (= Aster subulatus),* and *Polygonum pensylvanicum (= Polygonum bicorne)* are common vegetation in the wetter and deeper depression, while *Pascopyrum smithii* and *Buchloe dactyloides* are more common in shallow depressions in rangeland. Species richness can vary considerably among individual examples of this system and is especially influenced by adjacent land use, which is often agriculture, and may provide nutrient and herbicide runoff. Dynamic processes that affect these depressions are hydrological changes, grazing, and conversion to agricultural use.
Classification Comments: Open and emergent marshes may be a separate system from wet meadows and wet prairies. This system needs to be more clearly distinguished from the similar open depressional wetlands of the western Great Plains, as well as from Great Plains Prairie Pothole (CES303.661).
Similar Ecological Systems:
- Inter-Mountain Basins Alkaline Closed Depression (CES304.998)
- North American Arid West Emergent Marsh (CES300.729)
- Tamaulipan Closed Depression Wetland (CES301.197)
- Western Great Plains Open Freshwater Depression Wetland (CES303.675)
- Western Great Plains Saline Depression Wetland (CES303.669)

Related Concepts:
- Bluestem Prairie (601) (Shiflet 1994) Intersecting. Spartina pectinata wet swales occur as inclusions in this SRM type, but are classed into a wetland ecological system.
- Western Great Plains Closed Depression Wetland (Rolfsmeier and Steinauer 2010) Equivalent

DESCRIPTION

Environment: This system is typified by circular upland depressional basins with an impermeable layer such as dense clay which slows infiltration and promotes retention of water. Soils are hydric and fine-grained. Rainwater and runoff recharge this system and it is rarely linked to outside groundwater sources. Water is lost through both evapotranspiration and percolation to aquifers. It has been estimated that 20-80% of water in playas infiltrates into the aquifers, principally along the margins of the wetlands where subsurface clay content is less (Osterkamp and Wood 1987). Playas are shallow, generally less than 1 m deep, with very shallow sloping sides. This results in nearly equal water depths throughout the playa, and small changes in water depth have effects across a relatively large surface area. Playas in the Southern High Plains average 6.3 ha in area. These ephemeral wetlands have small watersheds. The average watershed size is 55.5 ha (Guthery and Bryant 1982). Playas are isolated, with no surface outflow except in unusually wet periods.
Vegetation: Species richness varies considerably among individual examples of this system. Commonly, *Eleocharis* spp., *Hordeum jubatum*, along with *Coreopsis tinctoria, Symphyotrichum subulatum (= Aster subulatus),* and *Polygonum pensylvanicum (= Polygonum bicorne)* are found in the wetter and deeper depression. Shallower depressions in rangelands commonly contain *Pascopyrum smithii* and *Buchloe dactyloides.*
Dynamics: Playas have a large change in hydrologic status over much of their areas. That is, most of the area of an individual playa is wet or flooded at one point in the growing season and also dry during another point in the growing season. Some do have deeper areas that are wet or flooded for nearly the entire growing season. More common is having multiple wet-dry cycles during one growing season in response to rain and dry periods. This rapid change in available moisture and in exposed soil limits the species that can grow. This often results in strong dominance by a few perennial species able to tolerate these conditions or by annuals that can go through their life cycle before conditions change (Haukos and Smith 1993). However, the unconnected nature of playas combined with the variable environmental conditions throughout the year favors the formation of differing assemblages of vegetation at any one time on playas across the landscape. This contributes to regional diversity of plant and animal habitats throughout the year (Haukos and Smith 1994). Fire can spread into this system from surrounding grasslands but it is uncommon. The surrounding grasslands are typically short and do not have sufficient fuel to carry fire well, and while playas usually have more dense vegetation cover than the

adjacent uplands, they may be wet.

Component Associations:
- *Eleocharis palustris - (Eleocharis compressa) - Leptochloa fusca ssp. fascicularis* Herbaceous Vegetation (CEGL002259, GNR)
- *Eleocharis palustris* Great Plains Herbaceous Vegetation (CEGL005291, GNR)
- *Heteranthera limosa - Bacopa rotundifolia - Sagittaria latifolia* Herbaceous Vegetation (CEGL002279, GNR)
- *Hordeum jubatum* Great Plains Herbaceous Vegetation (CEGL005286, G4)
- *Panicum obtusum - Buchloe dactyloides* Herbaceous Vegetation (CEGL001573, GNRQ)
- *Panicum obtusum - Panicum hallii* Herbaceous Vegetation (CEGL001575, GNR)
- *Pascopyrum smithii - (Elymus trachycaulus)* Clay Pan Herbaceous Vegetation (CEGL002239, GNR)
- *Pascopyrum smithii - Buchloe dactyloides - (Phyla cuneifolia, Oenothera canescens)* Herbaceous Vegetation (CEGL002038, G2G3)
- *Pascopyrum smithii - Distichlis spicata* Herbaceous Vegetation (CEGL001580, G4)
- *Pascopyrum smithii - Eleocharis* spp. Herbaceous Vegetation (CEGL001581, G1)
- *Pascopyrum smithii - Hordeum jubatum* Herbaceous Vegetation (CEGL001582, G4)
- *Pleuraphis mutica - Panicum obtusum* Herbaceous Vegetation (CEGL001639, G3)
- *Polygonum* spp. - *Echinochloa* spp. - *Distichlis spicata* Playa Lake Herbaceous Vegetation (CEGL002039, G2G4)
- *Sarcobatus vermiculatus / Leymus cinereus* Shrubland (CEGL001366, G3)
- *Schoenoplectus americanus - Eleocharis* spp. Herbaceous Vegetation (CEGL001586, GNR)
- *Spartina pectinata - Eleocharis* spp. - *Carex* spp. Herbaceous Vegetation (CEGL002223, G2G4)

DISTRIBUTION

Range: This system can be found throughout the eastern portion of the Western Great Plains Division, however, it is most prevalent in the central states of Nebraska, Kansas and Oklahoma. In addition, it does occur farther to the west, in central and eastern Montana and eastern Wyoming.
Divisions: 205:P; 303:C
Nations: US
Subnations: CO, KS, MT, NE, NM, OK, SD, TX, WY
Map Zones: 20:?, 22:C, 25:?, 26:P, 29:P, 30:P, 31:P, 32:P, 33:C, 34:C, 35:?, 36:P, 38:C
USFS Ecomap Regions: 251F:CC, 251G:CC, 251H:CC, 315F:PP, 331B:CP, 331C:CC, 331D:C?, 331E:CC, 331F:CC, 331G:CP, 331H:CC, 331K:CP, 331L:CP, 331M:CP, 332B:CC, 332C:CC, 332D:CC, 332E:CC, 332F:CC
TNC Ecoregions: 26:C, 27:C, 28:C, 32:P, 33:C

SOURCES

References: Bolen et al. 1979, Comer et al. 2003, Faber-Langendoen et al. 2011, Guthery and Bryant 1982, Haukos and Smith 1993, Haukos and Smith 1994, Hoagland 2000, Lauver et al. 1999, Luo et al. 1997, Osterkamp and Wood 1987, Rolfsmeier and Steinauer 2010, Shiflet 1994
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722992#references
Description Author: S. Menard and K. Kindscher, mod. J. Drake
Version: 14 Jan 2014 **Stakeholders:** Midwest, Southeast, West
Concept Author: S. Menard and K. Kindscher **ClassifResp:** Midwest

WESTERN GREAT PLAINS OPEN FRESHWATER DEPRESSION WETLAND (CES303.675)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Western Great Plains (303)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Non-Diagnostic Classifiers: Saturated Soil; Herbaceous; Depressional; Isolated Wetland [Partially Isolated]; Depression
National Mapping Codes: ESLF 9218

CONCEPT

Summary: This Great Plains emergent marsh ecological system is composed of lowland depressions; it also occurs along lake borders that have more open basins and a permanent water source through most of the year, except during exceptional drought years. These areas are distinct from Western Great Plains Closed Depression Wetland (CES303.666) by having a large watershed and/or significant connection to the groundwater table. A variety of species are part of this system, including emergent species of *Typha, Carex, Eleocharis, Juncus, Spartina,* and *Schoenoplectus,* as well as floating genera such as *Potamogeton, Sagittaria, Stuckenia,* or *Ceratophyllum*. The system includes submergent and emergent marshes and associated wet meadows and wet prairies. These types can also drift into stream margins that are more permanently wet and linked directly to the basin via groundwater flow from/into the pond or lake. Some of the specific communities will also be found in the floodplain system and should not be considered a separate system in that case. These types should also not be considered a separate system if they are occurring in lowland areas of the prairie matrix only because of an exceptional wet year.
Classification Comments: This system occurs widely throughout the western Great Plains, but in the arid shortgrass region, it is replaced by North American Arid West Emergent Marsh (CES300.729). Open and emergent marshes may be a separate system from wet meadows and wet prairies. More clarification needs to be made between this system and other depressional wetlands occurring in Wyoming and Montana, such as the Inter-Mountain Basins Alkaline Closed Depression (CES304.998), Great Plains Prairie Pothole (CES303.661), and the other western Great Plains depressional wetland systems.
Similar Ecological Systems:
- North American Arid West Emergent Marsh (CES300.729)
- Western Great Plains Closed Depression Wetland (CES303.666)
- Western Great Plains Saline Depression Wetland (CES303.669)

Related Concepts:
- Western Great Plains Open Freshwater Depression Wetland (Rolfsmeier and Steinauer 2010) Equivalent

DESCRIPTION

Environment: This system is found within lowland depressions and along lakes that have more permanent water sources throughout the year. These areas typically have a large watershed and are connected to the groundwater sources, resulting in a relatively consistent source of water for the semi-arid climate they occur in. Examples may also drift into stream margins that are more permanently wet and linked to a basin via groundwater flow from/into a pond or lake. Those areas that are found within larger prairie matrix that are only lowland or wet because of an exceptional wet year are not part of this system. This system occurs south of the limit of recent glaciation. Salinity ranges from fresh to brackish. Soils range from clay and silt to sandy loam. Marshes with coarser soils are usually connected more directly to the water table, which prevents rapid draining of the wetland.
Vegetation: Many species can be associated with this system with *Typha* spp. and *Schoenoplectus* spp. being common.
Dynamics: Hydrology is the primary process influencing this system. Examples of this system have a core area that is saturated or flooded much or all of the growing season. In some sites, water levels exceed 1 m throughout the growing season. Examples of this system receive water from groundwater flow, surface drainage from the watershed, and direct precipitation. In the northern half of the range of this system, snowmelt can cause a relatively large influx of water in the spring. Water levels are typically highest in the spring and generally fall throughout the growing season, with occasional refilling of the basin after very heavy summer rains. Changes in precipitation over a period of years or decades (wetter or drier periods) will increase or decrease the extent of individual examples of this system and can move the range of the entire system slightly.

Fires can occur in this system, often spreading from adjacent upland prairie. Fire is more common in the fall when water levels are lower and the vegetation has dried out. Fire is also more common in the eastern portion of the range of this system where surrounding uplands had more dense upland tallgrass prairie rather than the sparser mixedgrass uplands typical of the western range of this system.

Component Associations:
- *Alnus incana* Swamp Shrubland (CEGL002381, G5)
- *Betula occidentalis - Dasiphora fruticosa ssp. floribunda* Shrubland (CEGL001083, G2Q)
- *Calamagrostis canadensis - Juncus* spp. - *Carex* spp. Sandhills Herbaceous Vegetation (CEGL002028, G3G4)
- *Calamagrostis stricta - Carex sartwellii - Carex praegracilis - Plantago eriopoda* Saline Herbaceous Vegetation (CEGL002255, G2G3)
- *Carex aquatilis - Carex* spp. Herbaceous Vegetation (CEGL002262, G4?)
- *Carex aquatilis* Herbaceous Vegetation (CEGL001802, G5)

- *Carex atherodes* Herbaceous Vegetation (CEGL002220, G3G5)
- *Carex interior - Eleocharis elliptica - Thelypteris palustris* Herbaceous Vegetation (CEGL002390, G1G2)
- *Carex nebrascensis* Herbaceous Vegetation (CEGL001813, G4)
- *Carex pellita - Calamagrostis stricta* Herbaceous Vegetation (CEGL002254, G3G5)
- *Carex prairea - Schoenoplectus pungens - Rhynchospora capillacea* Herbaceous Vegetation (CEGL002267, G2)
- *Carex* spp. - *Triglochin maritima - Eleocharis quinqueflora* Marl Fen Herbaceous Vegetation (CEGL002268, G1?)
- *Carex stricta - Carex* spp. Herbaceous Vegetation (CEGL002258, G4?)
- *Carex utriculata - Carex lacustris - (Carex vesicaria, Carex stricta)* Herbaceous Vegetation (CEGL002257, G4G5)
- *Ceratophyllum demersum - Stuckenia pectinata* Herbaceous Vegetation (CEGL004528, G4G5)
- *Cornus sericea - Salix (bebbiana, discolor, petiolaris) / Calamagrostis stricta* Shrubland (CEGL002187, G3G4)
- *Eleocharis palustris - (Eleocharis compressa) - Leptochloa fusca ssp. fascicularis* Herbaceous Vegetation (CEGL002259, GNR)
- *Eleocharis palustris* Great Plains Herbaceous Vegetation (CEGL005291, GNR)
- *Glyceria borealis* Herbaceous Vegetation (CEGL001569, G4)
- *Juncus balticus* Herbaceous Vegetation (CEGL001838, G5)
- *Ludwigia peploides* Herbaceous Vegetation (CEGL007835, G4G5)
- *Panicum virgatum - (Pascopyrum smithii)* Herbaceous Vegetation (CEGL001484, G2Q)
- *Phalaris arundinacea* Western Herbaceous Vegetation (CEGL001474, G5)
- *Polygonum pensylvanicum - Polygonum lapathifolium* Herbaceous Vegetation (CEGL002277, G4?)
- *Polygonum* spp. - *Echinochloa* spp. - *Distichlis spicata* Playa Lake Herbaceous Vegetation (CEGL002039, G2G4)
- *Potamogeton nodosus* Herbaceous Vegetation (CEGL004529, GNR)
- *Potamogeton richardsonii - Myriophyllum spicatum* Herbaceous Vegetation (CEGL002006, G2Q)
- *Potamogeton* spp. - *Ceratophyllum demersum* Great Plains Herbaceous Vegetation (CEGL002044, G4G5)
- *Sagittaria cuneata - Sagittaria longiloba* Herbaceous Vegetation (CEGL004525, GNR)
- *Sagittaria latifolia - Leersia oryzoides* Herbaceous Vegetation (CEGL005240, GNR)
- *Salix nigra / (Cephalanthus occidentalis)* Forest (CEGL004773, G4G5)
- *Schoenoplectus acutus - (Schoenoplectus fluviatilis)* Freshwater Herbaceous Vegetation (CEGL002225, G4G5)
- *Schoenoplectus acutus - Typha latifolia - (Schoenoplectus tabernaemontani)* Sandhills Herbaceous Vegetation (CEGL002030, G4)
- *Schoenoplectus tabernaemontani - Typha* spp. - (*Sparganium* spp., *Juncus* spp.) Herbaceous Vegetation (CEGL002026, G4G5)
- *Schoenoplectus tabernaemontani* Temperate Herbaceous Vegetation (CEGL002623, G5)
- *Scolochloa festucacea* Herbaceous Vegetation (CEGL002260, G4G5)
- *Spartina pectinata - Calamagrostis stricta - Carex* spp. Herbaceous Vegetation (CEGL002027, G3?)
- *Spartina pectinata - Carex* spp. Herbaceous Vegetation (CEGL001477, G3?)
- *Spartina pectinata - Eleocharis* spp. - *Carex* spp. Herbaceous Vegetation (CEGL002223, G2G4)
- *Spartina pectinata - Schoenoplectus pungens* Herbaceous Vegetation (CEGL001478, G3?)
- *Stuckenia pectinata - Myriophyllum (sibiricum, spicatum)* Herbaceous Vegetation (CEGL002003, G3G4)
- *Stuckenia pectinata - Zannichellia palustris* Herbaceous Vegetation (CEGL002005, G3G4)
- *Typha (angustifolia, domingensis, latifolia) - Schoenoplectus americanus* Herbaceous Vegetation (CEGL002032, G3G4)
- *Typha (latifolia, angustifolia)* Western Herbaceous Vegetation (CEGL002010, G5)
- *Typha latifolia - Equisetum hyemale - Carex (hystericina, pellita)* Seep Herbaceous Vegetation (CEGL002033, G3)
- *Typha* spp. - *Schoenoplectus* spp. - Mixed Herbs Great Plains Herbaceous Vegetation (CEGL002228, G4G5)
- *Typha* spp. Great Plains Herbaceous Vegetation (CEGL002389, G4G5)

DISTRIBUTION

Range: This system can occur throughout the Northwestern Great Plains Division but not in the arid shortgrass region.
Divisions: 205:P; 303:C
Nations: US
Subnations: KS, MT, ND, NE, OK, SD, TX, WY
Map Zones: 25:P, 26:C, 27:C, 29:C, 30:C, 31:C, 33:C, 34:C, 38:C
USFS Ecomap Regions: 331F:??
TNC Ecoregions: 26:C, 28:C, 29:C, 33:C, 34:C, 37:?, 66:?, 67:?

SOURCES

References: Comer et al. 2003, Gleason and Euliss 1998, Hoagland 2000, Lauver et al. 1999, Preston et al. 2013, Rolfsmeier and Steinauer 2010, Steinauer and Rolfsmeier 2000
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722983#references
Description Author: S. Menard and K. Kindscher, mod. J. Drake
Version: 14 Jan 2014 **Stakeholders:** Midwest, Southeast, West
Concept Author: S. Menard and K. Kindscher **ClassifResp:** Midwest

WESTERN GREAT PLAINS SALINE DEPRESSION WETLAND (CES303.669)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Western Great Plains (303)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Non-Diagnostic Classifiers: Saline Water Chemistry; Herbaceous; Depressional; Isolated Wetland [Partially Isolated]; Depression
National Mapping Codes: ESLF 9256

CONCEPT

Summary: This ecological system is very similar to Western Great Plains Open Freshwater Depression Wetland (CES303.675) and Western Great Plains Closed Depression Wetland (CES303.666). However, strongly saline soils cause both the shallow lakes and depressions and the surrounding areas to be more brackish. Salt encrustations can occur on the surface in some examples of this system, and the soils are severely affected and have poor structure. Species that typify this system are salt-tolerant and halophytic species such as *Distichlis spicata, Sporobolus airoides*, and *Hordeum jubatum*. Other commonly occurring taxa include *Puccinellia nuttalliana, Salicornia rubra, Schoenoplectus maritimus, Schoenoplectus americanus, Suaeda calceoliformis, Spartina* spp., *Triglochin maritima*, and shrubs such as *Sarcobatus vermiculatus* and *Krascheninnikovia lanata*. During exceptionally wet years, an increase in precipitation can dilute the salt concentration in the soils of some examples of this system which may allow for less salt-tolerant species to occur. Communities found within this system may also occur in floodplains (i.e., more open depressions) but probably should not be considered a separate system unless they transition to areas outside the immediate floodplain.
Classification Comments: Open and emergent saline marshes may be a separate system from saline wet meadows and prairies. This system is often intimately associated (in space) with greasewood flats, and there is some overlap in the associations between the two. This system tends to be more of an herbaceous wetlands, whereas Inter-Mountain Basins Greasewood Flat (CES304.780) is more strongly shrub-dominated with patches of herb-dominance.
Similar Ecological Systems:
- North American Arid West Emergent Marsh (CES300.729)
- Western Great Plains Closed Depression Wetland (CES303.666)
- Western Great Plains Open Freshwater Depression Wetland (CES303.675)

Related Concepts:
- Western Great Plains Saline Depression Wetland (Rolfsmeier and Steinauer 2010) Equivalent
- Wheatgrass - Saltgrass - Grama (615) (Shiflet 1994) Intersecting

DESCRIPTION

Environment: This system is found in basins and low parts of floodplains where water collects. The soils and water are moderately to strongly saline (>0.5-1%) (Ungar 1967, 1970). The salts are leached from saline soils in the watershed or, rarely, come from saline groundwater discharge. Salts accumulate as the water in which they were dissolved evaporates. Salt crusts are present on the soil surface of some stands. Soils are fine-grained, typically with a silt or clay component, and poorly drained. The wettest examples of this system are flooded through most or all of the growing season and can support aquatic species. Other aspects of the system can be flooded or saturated for short periods (Dodd and Coupland 1966, Stewart and Kantrud 1971).
Vegetation: Salt-tolerant and halophytic species such as *Distichlis spicata, Sporobolus airoides*, and *Hordeum jubatum* typify the system.
Dynamics: Unusually wet periods or high spring snowmelt may flush some salt away, shifting the boundaries of this system temporarily until more salt accumulates. Salinity varies during the growing season, decreasing in the spring or after heavy rains and increasing during dry periods. The increased salinity due to concentration of the salt as the water evaporates - common in the late summer and early fall - creates a seasonally shifting environment. Species composition is strongly linked to salinity and soil moisture, so there is usually notable zonation within this system with the species tolerant of the wettest and most saline conditions in the center, grading towards midgrass prairie at the edges (Ungar 1967, 1970). Fire may spread into this system from adjacent upland prairies and can burn areas with higher vegetation cover, but the low vegetation cover and wet soils typical of many stands do not carry fire well.

Component Associations:
- *Calamagrostis stricta - Carex sartwellii - Carex praegracilis - Plantago eriopoda* Saline Herbaceous Vegetation (CEGL002255, G2G3)
- *Distichlis spicata - (Hordeum jubatum, Poa arida, Sporobolus airoides)* Herbaceous Vegetation (CEGL002042, G3)
- *Distichlis spicata - Hordeum jubatum - (Poa arida, Iva annua)* Herbaceous Vegetation (CEGL002031, G2G3)
- *Distichlis spicata - Hordeum jubatum - Puccinellia nuttalliana - Suaeda calceoliformis* Herbaceous Vegetation (CEGL002273, G2G3)
- *Distichlis spicata - Schoenoplectus maritimus - Salicornia rubra* Herbaceous Vegetation (CEGL002043, G1G2)
- *Distichlis spicata - Spartina* spp. Herbaceous Vegetation (CEGL002275, G4)
- *Distichlis spicata* Herbaceous Vegetation (CEGL001770, G5)
- *Hordeum jubatum* Great Plains Herbaceous Vegetation (CEGL005286, G4)

- *Pascopyrum smithii - Distichlis spicata* Herbaceous Vegetation (CEGL001580, G4)
- *Pascopyrum smithii - Hordeum jubatum* Herbaceous Vegetation (CEGL001582, G4)
- *Puccinellia nuttalliana* Herbaceous Vegetation (CEGL001799, G3?)
- *Salicornia rubra* Herbaceous Vegetation (CEGL001999, G2G3)
- *Sarcobatus vermiculatus / Distichlis spicata - (Puccinellia nuttalliana)* Shrub Herbaceous Vegetation (CEGL002146, GNR)
- *Sarcobatus vermiculatus / Pascopyrum smithii - (Elymus lanceolatus)* Shrub Herbaceous Vegetation (CEGL001508, G4)
- *Schoenoplectus americanus - Carex* spp. Herbaceous Vegetation (CEGL004144, GNR)
- *Schoenoplectus americanus* Great Plains Herbaceous Vegetation (CEGL002226, GNR)
- *Schoenoplectus maritimus - Schoenoplectus acutus - (Triglochin maritima)* Herbaceous Vegetation (CEGL002227, G3G5)
- *Schoenoplectus maritimus* Herbaceous Vegetation (CEGL001843, G4)
- *Schoenoplectus pungens - Suaeda calceoliformis* Alkaline Herbaceous Vegetation (CEGL002040, G3G4)
- *Schoenoplectus pungens* Herbaceous Vegetation (CEGL001587, G3G4)
- *Scolochloa festucacea* Herbaceous Vegetation (CEGL002260, G4G5)
- *Spartina pectinata - Schoenoplectus pungens* Herbaceous Vegetation (CEGL001478, G3?)
- *Sporobolus airoides* Monotype Herbaceous Vegetation (CEGL001688, GUQ)
- *Sporobolus airoides* Northern Plains Herbaceous Vegetation (CEGL002274, GNR)
- *Sporobolus airoides* Southern Plains Herbaceous Vegetation (CEGL001685, G3Q)
- *Stuckenia pectinata - Ruppia maritima* Herbaceous Vegetation (CEGL002004, G2?)
- *Stuckenia pectinata - Zannichellia palustris* Herbaceous Vegetation (CEGL002005, G3G4)
- *Typha* spp. - *Schoenoplectus* spp. - Mixed Herbs Great Plains Herbaceous Vegetation (CEGL002228, G4G5)
- *Typha* spp. Great Plains Herbaceous Vegetation (CEGL002389, G4G5)

DISTRIBUTION

Range: This system can occur throughout the western Great Plains but is likely more prevalent in the south-central portions of the division. Its distribution extends as far west as central Montana and eastern Wyoming where it occurs in the matrix of Northwestern Great Plains Mixedgrass Prairie (CES303.674).
Divisions: 303:C
Nations: CA, US
Subnations: CO, KS, MT, ND, NE, NM, OK, SD, SK, TX, WY
Map Zones: 20:C, 25:?, 26:C, 27:C, 29:C, 30:C, 31:C, 33:C, 34:C, 35:?, 38:C, 39:?, 40:?
USFS Ecomap Regions: 315A:CC, 315B:CC, 315F:CC, 321A:CC, 331B:CC, 331C:CC, 331D:CP, 331E:CP, 331F:C?, 331G:CP, 331H:C?, 331I:CC, 331K:CC, 331L:CP, 331M:CP, 332E:CC, 332F:C?, M313B:CC
TNC Ecoregions: 26:C, 27:C, 28:C, 33:C, 34:?

SOURCES

References: Comer et al. 2003, Dodd and Coupland 1966, Faber-Langendoen et al. 2011, Hoagland 2000, Lauver et al. 1999, Rolfsmeier 1993a, Rolfsmeier and Steinauer 2010, Shiflet 1994, Steinauer and Rolfsmeier 2000, Stewart and Kantrud 1971, Ungar 1967, Ungar 1970
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722989#references
Description Author: S. Menard and K. Kindscher, mod. M.S. Reid and J. Drake
Version: 14 Jan 2014 **Stakeholders:** Canada, Midwest, Southeast, West
Concept Author: S. Menard and K. Kindscher **ClassifResp:** Midwest

WESTERN NORTH AMERICAN BOREAL FRESHWATER EMERGENT MARSH (CES105.123)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Herbaceous; Graminoid
Non-Diagnostic Classifiers: Lake; Pond; Boreal [Boreal Subcontinental]
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2625; ESLF 9434; ESP 1625

CONCEPT

Summary: Freshwater marshes are found throughout boreal transition and boreal regions of western and northern Alaska. They are characterized by emergent herbaceous vegetation. Freshwater marshes typically occur with other wetland systems. They occur on the margins of ponds, lakes, and riparian systems and on inland deltas where rivers drain into large lakes. Inland marshes are mostly small patch, confined to limited areas in suitable floodplain or basin topography. They are typically semipermanently flooded, but some marshes have seasonal flooding. Water is at or above the surface for most of the growing season (typically 10 cm above the surface). Soils are muck or mineral, and water is nutrient-rich. These systems are highly productive and have high rates of decomposition. Freshwater marsh vegetation is dominated by emergent vegetation such as *Carex utriculata, Schoenoplectus tabernaemontani (= Scirpus validus), Typha latifolia, Menyanthes trifoliata,* and *Equisetum fluviatile*. *Arctophila fulva* becomes more common in the northern portions of boreal Alaska.
Classification Comments: This system is known as Boreal Freshwater Marsh by the Alaska Natural Heritage Program. See Viereck et al. (1992) for references on *Arctophila fulva* types.
Similar Ecological Systems:
- North American Boreal Freshwater Aquatic Bed (CES103.125)

Related Concepts:
- III.A.3.d - Fresh sedge marsh (Viereck et al. 1992) Intersecting
- III.A.3.e - Fresh grass marsh (Viereck et al. 1992) Intersecting
- III.B.3.a - Fresh herb marsh (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: Freshwater marshes are found throughout boreal transition and boreal regions of western and northern Alaska. They are characterized by emergent herbaceous vegetation. Freshwater marshes typically occur with other wetland systems. They occur on the margins of ponds, lakes, and riparian systems and on inland deltas where rivers drain into large lakes. Inland marshes are mostly small patch, confined to limited areas in suitable floodplain or basin topography. They are typically semipermanently flooded, but some marshes have seasonal flooding. Water is at or above the surface for most of the growing season (typically 10 cm above the surface). Soils are muck or mineral, and water is nutrient-rich. These systems are highly productive and have high rates of decomposition (National Wetlands Working Group 1997).
Vegetation: Freshwater marsh vegetation may be dominated by emergent sedges, forbs, or grasses. Species that often dominate or codominate include *Carex utriculata, Schoenoplectus tabernaemontani (= Scirpus validus), Arctophila fulva, Eleocharis palustris, Myriophyllum spicatum, Typha latifolia, Menyanthes trifoliata, Comarum palustre, Hippuris vulgaris,* and *Equisetum fluviatile* (Jorgenson 1999, Gracz et al. 2005). *Arctophila fulva* becomes more common in the northern portions of boreal Alaska [see Viereck et al. (1992) for references on *Arctophila fulva* types].
Dynamics: This system requires a source of freshwater. Seasonal flooding is characteristic of inland deltas. Marsh zonation is related to water depth and duration of flooding. A typical sequence progresses from open water to emergent deep marsh to shallow marsh to wet meadow or fen. Floating marsh mats may be seral to fens.

DISTRIBUTION

Range: This system is found from lowlands through subalpine valley bottoms in the boreal and boreal transition regions of Alaska.
Divisions: 105:C
Nations: US
Subnations: AK
Map Zones: 68:?, 69:C, 70:C, 71:C, 72:?, 73:C, 74:C, 75:C
TNC Ecoregions: 71:C, 74:C, 75:C, 76:C, 77:C, 78:C

SOURCES

References: Gracz et al. 2005, Jorgenson 1999, National Wetlands Working Group 1997, Viereck et al. 1992, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817427#references

Description Author: T. Boucher
Version: 08 Aug 2008
Concept Author: Western Ecology Group and Alaska Natural Heritage Program

Stakeholders: West
ClassifResp: West

WESTERN NORTH AMERICAN BOREAL HERBACEOUS FEN (CES105.119)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Herbaceous; Boreal [Boreal Subcontinental]; Depressional; Eutrophic Soil; Acidic Soil; Organic Peat (>40 cm); Forb; Graminoid
Non-Diagnostic Classifiers: Seepage-Fed Sloping
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2618; ESLF 9435; ESP 1618

CONCEPT

Summary: This system occurs in shallow depressions and basins, pond margins, and thermokarst pits with an open hydrologic regime. Fens are nutrient-rich and have a thick peat layer that may be floating or submerged. Standing water is usually present. Dominant species may include *Menyanthes trifoliata, Equisetum fluviatile, Comarum palustre, Calla palustris, Eriophorum angustifolium*, and *Carex aquatilis*. Other common but non-dominant species include *Caltha palustris, Cicuta virosa (= Cicuta mackenzieana), Galium trifidum, Rumex arcticus*, and *Utricularia* spp. Shrubs, including *Myrica gale, Salix candida, Betula nana*, and *Alnus incana ssp. tenuifolia*, are occasionally present but do not exceed 25% cover. Aquatic plants such as *Myriophyllum spicatum, Hippuris vulgaris, Potamogeton* spp., and *Sparganium* spp. may be present, and aquatic mosses are often present.This system is not associated with permafrost processes.
Classification Comments: This system combines those known as Boreal Transition Herbaceous Fen and Boreal Herbaceous Fen by the Alaska Natural Heritage Program.
Related Concepts:
- III.B.3.c - Subarctic lowland herb bog meadow (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: This system occurs in shallow depressions and basins, pond margins, and thermokarst pits with an open hydrologic regime. Fens are nutrient-rich and have a thick peat layer that may be floating or submerged. Standing water is usually present (Viereck et al. 1992).
Vegetation: Dominant species may include *Menyanthes trifoliata, Equisetum fluviatile, Comarum palustre, Calla palustris, Eriophorum angustifolium*, and *Carex aquatilis* (Viereck et al. 1992). Other common but non-dominant species include *Caltha palustris, Cicuta virosa (= Cicuta mackenzieana), Galium trifidum, Rumex arcticus*, and *Utricularia* spp. (Racine and Walters 1994). Shrubs, including *Myrica gale, Salix candida, Betula nana*, and *Alnus incana ssp. tenuifolia*, are occasionally present but do not exceed 25% cover. Aquatic plants such as *Myriophyllum spicatum, Hippuris vulgaris, Potamogeton* spp., and *Sparganium* spp. may be present, and aquatic mosses are often present (Viereck et al. 1992).
Dynamics: In boreal wetlands the general successional trend is from marsh to fen to treed bog; however, succession is not necessarily directional, and environmental conditions, such as nutrient content and abundance of groundwater, may prevent fens from developing into bogs (Zoltai et al. 1988). Succession begins in ponds or low-lying wetlands formed by processes such as glacial recession and floodplain dynamics (oxbows). An organic root mat typically develops and is either anchored to the mineral soil or floating on water such as a pond's edge. Over time, peat-forming mosses and sedges may fill in the basin. As the peat layer develops, low and/or dwarf-shrubs become established. Dwarf-trees may establish on the well-developed peat and also around the margin of the peatland.

Many peatlands on the Kenai Lowland formed in kettles after remnant glacial ice melted. In this region, there is a trend toward peatlands drying and ponds shrinking and filling in (Klein et al. 2005). In the boreal region, fens are often associated with themokarst processes.

Component Associations:
- *Menyanthes trifoliata* Herbaceous Vegetation (CEGL003410, G5)

DISTRIBUTION

Range: This system is found in lowlands of the boreal transition and boreal regions of Alaska.
Divisions: 105:C
Nations: US
Subnations: AK
Map Zones: 68:C, 69:C, 70:C, 71:C, 72:?, 73:C, 74:C, 75:C, 76:?
TNC Ecoregions: 71:C, 72:C, 74:C, 75:C, 76:C, 77:C, 78:C

SOURCES

References: Klein et al. 2005, Racine and Walters 1994, Viereck et al. 1992, Western Ecology Working Group n.d., Zoltai et al. 1988
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817415#references

Description Author: T. Boucher and A. Batten
Version: 08 Aug 2008
Concept Author: Western Ecology Group and Alaska Natural Heritage Program

Stakeholders: West
ClassifResp: West

WESTERN NORTH AMERICAN BOREAL TUSSOCK TUNDRA (CES105.127)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Permafrost; Saturated Soil; Herbaceous; Boreal [Boreal Subcontinental]; Aquic; Tussock-forming grasses; Eriophorum vaginatum
Non-Diagnostic Classifiers: Montane [Upper Montane]; Carex bigelowii
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2629; ESLF 9436; ESP 1629

CONCEPT

Summary: This ecological system is dominated by sedges in a tussock growth form. *Eriophorum vaginatum* is the primary tussock-former in most stands and *Carex bigelowii* is also common. On wetter sites, *Vaccinium* spp. (= *Oxycoccus* spp.) and *Chamaedaphne calyculata* may be present. Total shrub cover is less than 25%, although shrubs such as *Betula nana, Ledum palustre ssp. decumbens, Ledum groenlandicum, Vaccinium vitis-idaea, Vaccinium uliginosum* may be present. Mosses (*Sphagnum* spp., *Pleurozium schreberi, Hylocomium splendens*) may form a nearly continuous mat between tussocks.
Classification Comments: This system is known as Boreal Tussock Tundra by the Alaska Natural Heritage Program.
Related Concepts:
- III.A.2.d - Tussock tundra (Viereck et al. 1992) Broader

DESCRIPTION

Environment: Permafrost is usually present at depths of 30-50 cm. Soils are generally poorly drained, gleyed, and often with a poorly decomposed organic horizon at the surface, which may constitute most of the active layer. Frost scars are common. Tussock bog communities occur on lowlands of boreal and boreal transition Alaska, on filled-in sloughs on floodplains and on cold, poorly drained slopes and terraces. These sites are underlain by wet, silty mineral soils with a surface peat layer 10 to 40 cm thick surrounding the tussocks (Viereck et al. 1992).
Dynamics: The fuel layer in sedge-shrub tussock tundra is dense and continuous and leads to large, fast-spreading fires (Racine et al. 1987, Duchesne and Hawkes 2000). Differences in topography, moisture, vegetation composition, and organic matter depth cause variation in burn severity and lead to a patchy burn pattern (Racine 1979). Fire severity in *Eriophorum* tussock tundra types tends to be light because of the wet soil profile (Wein 1976). Burns in this type usually consume all aerial woody and herbaceous plant material and litter; regeneration is vigorous via rhizomes and root sprouts. In most areas of tussock-shrub tundra on the Seward Peninsula, less than one half of accumulated organic soil layer was removed by fire (Racine 1979). Thaw depths increased to reach into the mineral soil, but were not greatly increased except where organics were removed. Subsidence and thermal erosion following fire are usually minimal in tundra ecosystems (Walker 1996).

Estimates of the mean fire-return interval for tussock tundra ecosystems range from 50-600 years (Racine et al. 1983, Payette et al. 1989). The fire regime of tundra systems are likely variable from one region to another making generalizations difficult (Viereck and Schandelmeier 1980).

On interior and south-central Alaska tussock tundra sites, the thaw pond cycle and paludification are important disturbances. On the Seward Peninsula and western Alaska, frost action creates polygonal ground and other periglacial features and is a widespread, small-scale and continuous disturbance. Change in the arctic and subarctic climate is another source of disturbance that is currently affecting tundra ecosystems.

After a severe fire, it would be possible to get paper birch and low shrubs.

DISTRIBUTION

Range: This system is found in lowland through subalpine zones of boreal and boreal transition (northern portion and higher elevation) regions of Alaska.
Divisions: 102:?; 105:C
Nations: CA, US
Subnations: AK
Map Zones: 69:C, 70:C, 71:C, 72:?, 73:C, 74:C, 75:C, 76:?
TNC Ecoregions: 74:?, 75:C, 76:C, 77:C, 78:C

SOURCES

References: Duchesne and Hawkes 2000, Heinselman 1981, Payette et al. 1989, Racine et al. 1983, Racine et al. 1987, Viereck and Schandelmeier 1980, Viereck et al. 1992, Walker 1996, Wein 1976, Western Ecology Working Group n.d., Witten 2004
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817439#references

Description Author: T. Boucher after Witten (2004)
Version: 08 Aug 2008
Concept Author: Western Ecology Group and Alaska Natural Heritage Program

Stakeholders: Canada, West
ClassifResp: West

WESTERN NORTH AMERICAN BOREAL WET MEADOW (CES105.124)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Saturated Soil [Periodicity/Seasonality]; Boreal [Boreal Subcontinental]; Seepage-Fed Sloping [Mineral]; Eutrophic Soil; Muck; Graminoid
Non-Diagnostic Classifiers: Montane; Lowland; Herbaceous; Mineral: W/ A-Horizon >10 cm
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2626; ESLF 9437; ESP 1626

CONCEPT

Summary: This ecological system is common throughout the boreal and boreal transition regions of Alaska in wet depressions, low-lying areas, and shallow drainage ways. These systems are minerotrophic with high nutrient levels and high rates of decomposition. Soils are mineral or muck and are saturated at some point during the growing season, but do not have standing water (water may be up to 5-10 cm deep during portions of the growing season, but it is not persistent). Wet meadows typically have a well-developed organic mat but not deep enough to be considered peatlands. Wet meadow vegetation may be seral to fens. Dominant species include *Carex aquatilis, Carex utriculata, Carex lasiocarpa, Eriophorum angustifolium, Calamagrostis canadensis*, and *Equisetum palustre*. *Comarum palustre, Menyanthes trifoliata, Equisetum fluviatile* are often present but not dominant. Shrubs may be a minor component of the canopy cover (less than 25% cover) and include *Myrica gale, Alnus incana ssp. tenuifolia*, and *Salix* spp.
Classification Comments: This system is known as Boreal Wet Meadow by the Alaska Natural Heritage Program. Wet meadows are closely related to freshwater marshes but have less standing water.
Similar Ecological Systems:
- Rocky Mountain Alpine-Montane Wet Meadow (CES306.812)

Related Concepts:
- Bluejoint Reedgrass (905) (Shiflet 1994) Intersecting
- III.A.3.c - Wet sedge-herb meadow tundra (Viereck et al. 1992) Intersecting
- III.A.3.f - Subarctic lowland sedge wet meadow (Viereck et al. 1992) Intersecting
- III.A.3.g - Subarctic lowland sedge-shrub wet meadow (Viereck et al. 1992) Intersecting
- III.B.3.b - Subarctic lowland herb wet meadow (Viereck et al. 1992) Intersecting
- Wet Meadow Tundra (919) (Shiflet 1994) Intersecting

DESCRIPTION

Environment: This ecological system is common throughout the boreal and boreal transition regions of Alaska in wet depressions, low-lying areas, and shallow drainage ways. These systems are minerotrophic with high nutrient levels and high rates of decomposition. Soils are mineral or muck and are saturated at some point during the growing season, but do not have standing water (water may be up to 5-10 cm deep during portions of the growing season, but it is not persistent). Wet meadows typically have a well-developed organic mat but not deep enough to be considered peatlands. Wet meadow vegetation may be seral to fens (National Wetlands Working Group 1997, Gracz et al. 2005).
Vegetation: Dominant species include *Carex aquatilis, Carex utriculata, Carex lasiocarpa, Eriophorum angustifolium, Calamagrostis canadensis*, and *Equisetum palustre*. *Comarum palustre, Menyanthes trifoliata, Equisetum fluviatile* are often present but not dominant. Shrubs may be a minor component of the canopy cover (less than 25% cover) and include *Myrica gale, Alnus incana ssp. tenuifolia*, and *Salix* spp.
Dynamics: This system may be fairly stable or occur as seral stages in wetland succession, such as in thaw ponds or drained lake basins.

Component Associations:
- *Calamagrostis canadensis* Boreal Herbaceous Vegetation (CEGL005287, G4)
- *Carex aquatilis* Boreal Herbaceous Vegetation (CEGL005289, GNR)
- *Carex aquatilis var. dives* Herbaceous Vegetation (CEGL001826, G4)
- *Carex atherodes* Herbaceous Vegetation (CEGL002220, G3G5)
- *Carex exsiccata* Herbaceous Vegetation (CEGL003312, G2G3)
- *Carex interior - Hypericum anagalloides* Herbaceous Vegetation (CEGL001857, G2?Q)
- *Carex scopulorum* Herbaceous Vegetation (CEGL001822, G5)
- *Carex utriculata* Boreal Herbaceous Vegetation (CEGL005288, GNR)
- *Dulichium arundinaceum* Seasonally Flooded Herbaceous Vegetation (CEGL001831, G3)
- *Eleocharis palustris - Carex unilateralis* Herbaceous Vegetation (CEGL003411, G2)
- *Eleocharis palustris* Herbaceous Vegetation (CEGL001833, G5)
- *Equisetum fluviatile* Boreal Herbaceous Vegetation (CEGL005292, GNR)

- *Hippuris vulgaris* Herbaceous Vegetation (CEGL003315, G5)
- *Juncus balticus* Herbaceous Vegetation (CEGL001838, G5)
- *Juncus falcatus - Trifolium wormskioldii* Herbaceous Vegetation (CEGL001570, G4)
- *Menyanthes trifoliata* Herbaceous Vegetation (CEGL003410, G5)
- *Oenanthe sarmentosa* Herbaceous Vegetation (CEGL003319, G4)
- *Paspalum distichum* Herbaceous Vegetation (CEGL003320, G3)

DISTRIBUTION

Range: This system is known from lowlands through mid-alpine valleys and benches in the boreal and boreal transition regions of Alaska.
Divisions: 105:C
Nations: US
Subnations: AK
Map Zones: 68:?, 69:C, 70:C, 71:C, 72:?, 73:C, 74:C, 75:C, 76:P
TNC Ecoregions: 71:C, 74:C, 75:C, 77:C, 78:C

SOURCES

References: Gracz et al. 2005, National Wetlands Working Group 1997, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817430#references
Description Author: T. Boucher
Version: 10 Dec 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

WILLAMETTE VALLEY WET PRAIRIE (CES204.874)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Non-Diagnostic Classifiers: Saturated Soil; Lowland [Lowland]; Herbaceous; Extensive Wet Flat; Isolated Wetland [Partially Isolated]
National Mapping Codes: ESLF 9221

CONCEPT

Summary: This system is largely restricted to the Willamette Valley of Oregon and adjacent Washington. It is nearly extirpated from the Puget Trough of Washington. These are high-nutrient wetlands that are temporarily and seasonally flooded. They are dominated primarily by graminoids, especially *Deschampsia caespitosa*, *Camassia quamash*, *Carex densa*, and *Carex unilateralis*, and to a lesser degree by forbs (e.g., *Isoetes nuttallii*) or shrubs (e.g., *Rosa nutkana*). Wet prairies historically covered large areas of the Willamette Valley where they were maintained by a combination of wetland soil hydrology and frequent burning. They have been reduced to tiny fragments of their former extent.

DESCRIPTION

Environment: This ecosystem occurred in areas with seasonally high water tables often perched on clay-rich soils (e.g., local depressions, swales and low-gradient riparian areas) within the matrix of a fire-maintained prairie landscape.
Dynamics: Given their location within a fire-maintained, open grassland landscape, these wet prairies experienced periodic fire, which is what distinguishes them from similar wetland types found elsewhere in western Washington and Oregon. This system was productive and likely dynamic due to frequency of fire.

Component Associations:
- *Camassia quamash* Wet Prairie Herbaceous Vegetation (CEGL003341, G3)
- *Carex aperta* Herbaceous Vegetation (CEGL001801, G1?)
- *Deschampsia caespitosa - Artemisia lindleyana* Herbaceous Vegetation (CEGL003425, G1)
- *Deschampsia caespitosa - Danthonia californica* Herbaceous Vegetation (CEGL001604, G2)
- *Eleocharis palustris - Carex unilateralis* Herbaceous Vegetation (CEGL003411, G2)
- *Eleocharis palustris* Herbaceous Vegetation (CEGL001833, G5)
- *Isoetes nuttallii* Herbaceous Vegetation (CEGL003343, G3)
- *Rosa nutkana / Oenanthe sarmentosa* Shrubland (CEGL003457, G1)

DISTRIBUTION

Range: Restricted to the Willamette Valley of Oregon and adjacent Washington.
Divisions: 204:C
Nations: US
Subnations: OR, WA
Map Zones: 1:C, 2:C, 7:C
USFS Ecomap Regions: 242A:CC, 242B:CC, M242A:??, M261A:CC, M261D:C?
TNC Ecoregions: 2:C

SOURCES

References: Chappell and Christy 2004, Comer et al. 2003, Easterly et al. 2005, Littell et al. 2009, WNHP 2011
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722801#references
Description Author: C. Chappell, mod. G. Kittel
Version: 14 Jan 2014 **Stakeholders:** West
Concept Author: C. Chappell **ClassifResp:** West

MIXED UPLAND AND WETLAND

ACADIAN SUB-BOREAL SPRUCE BARRENS (CES201.561)

CLASSIFIERS

Classification Status: Standard

Primary Division: Laurentian-Acadian (201)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Forest and Woodland (Treed); Sandplains/Glacial Outwash or Flats; Glaciated; Acidic Soil; Picea (glauca, mariana, rubens) - Abies
Non-Diagnostic Classifiers: Acidic Water; Lowland; Toeslope/Valley Bottom; Oligotrophic Soil; Mineral: W/ A-Horizon >10 cm; Udic; Unconsolidated; Long Disturbance Interval; F-Landscape/Medium Intensity; Needle-Leaved Tree; Broad-Leaved Deciduous Shrub; Broad-Leaved Evergreen Shrub
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2464; ESLF 9133; ESP 1464

CONCEPT

Summary: These barrens occur at the southeastern periphery of the boreal forest in northeastern North America. They form on sandplains and coarse outwash that often have undulating topography. Substrate microtopography can result in wetland pockets interspersed with upland areas. North of the range of most pine (except *Pinus banksiana*), *Picea mariana* tends to be the dominant tree. *Picea rubens* and red/black spruce hybrids are also common in the southern part of the range. Dwarf heath shrubs are extensive and diagnostic. Lichens, especially reindeer lichens, are often abundant in the ground layer. Vegetation physiognomy can vary within sites and can range from nearly closed forest to sparse trees over a dense dwarf heath understory. Fire is an important disturbance vector.
Classification Comments: This system is ecologically similar to open expressions of Boreal Jack Pine-Black Spruce Forest (CES103.022) of the upper Midwest and adjacent Canada but differs in lacking *Pinus banksiana* and in frequently having *Picea rubens* or its hybrids.
Related Concepts:
- Black Spruce Woodland (Gawler and Cutko 2010) Finer
- Blueberry - Lichen Barren (Gawler and Cutko 2010) Finer
- Spruce - Heath Barren (Gawler and Cutko 2010) Finer

Component Associations:
- *Picea mariana - Picea rubens / Rhododendron canadense / Cladina* spp. Woodland (CEGL006421, GNR)
- *Vaccinium (angustifolium, myrtilloides, pallidum) - Cladina rangiferina* Dwarf-shrubland (CEGL006426, GNR)

DISTRIBUTION

Range: This system is found in far-northern New England and is more widely distributed in adjacent eastern Canada.
Divisions: 103:C; 201:C
Nations: CA, US
Subnations: ME, NB, NH, QC, VT
Map Zones: 66:C
TNC Ecoregions: 48:P, 63:C

SOURCES

References: Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723043#references
Description Author: S.C. Gawler
Version: 29 Oct 2008
Concept Author: S.C. Gawler
Stakeholders: Canada, East, Midwest
ClassifResp: East

ACADIAN SUB-BOREAL SPRUCE FLAT (CES201.562)

CLASSIFIERS

Classification Status: Standard

Primary Division: Laurentian-Acadian (201)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Lowland; Forest and Woodland (Treed); Toeslope/Valley Bottom; Glaciated; Picea (glauca, mariana, rubens) - Abies
Non-Diagnostic Classifiers: Short (<5 yrs) Flooding Interval [Short interval, Spring Flooding]; Extensive Wet Flat; Isolated Wetland [Partially Isolated]; Mesotrophic Soil; Acidic Soil; Mineral: W/ A-Horizon >10 cm; Udic; Very Long Disturbance Interval; F-Landscape/Medium Intensity; Needle-Leaved Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2465; ESLF 9134; ESP 1465

CONCEPT

Summary: These spruce-fir forests are found in the colder regions of the northern Appalachians-Acadian region, in areas of imperfectly drained soils where they often form extensive flats along valley bottoms. The nutrient-poor acidic soils are typically saturated at snowmelt but are moderately well-drained for much of the growing season and may be reasonably dry at the soil surface. The mostly closed-canopy forests have *Picea rubens*, *Picea mariana*, and *Abies balsamea* as the dominant trees; other conifers are often present. Bryophytes are abundant in the ground layer; other layers are typically rather sparse. Many occurrences may be jurisdictional wetlands due to seasonal saturation, but the vegetation is primarily made up of upland or facultative species. The distribution in the Laurentian-Acadian Division is mostly Canadian.
Classification Comments: This might be considered as a component of Acadian Low-Elevation Spruce-Fir-Hardwood Forest (CES201.565) but differs from that type *sensu stricto* in its hydrology (wetland vs. upland) and in that its range is somewhat more boreal. Alternatively, it shares some characteristics with Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp (CES201.574) but is more boreal in nature and appears to be typically not on consistently saturated soils. Information from Quebec and New Brunswick would be helpful in assessing its placement.
Similar Ecological Systems:
- Acadian Low-Elevation Spruce-Fir-Hardwood Forest (CES201.565)
- Laurentian-Acadian Swamp Systems (CES201.637)
- Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp (CES201.574)

Related Concepts:
- Black Spruce (eastern type): 12 (Eyre 1980) Finer
- Red Spruce: 32 (Eyre 1980) Finer
- Spruce - Fir - Cinnamon Fern Forest (Gawler and Cutko 2010) Finer

Component Associations:
- *Picea mariana - Picea rubens / Pleurozium schreberi* Forest (CEGL006361, GNR)

DISTRIBUTION

Range: This system is found in the northernmost parts of New England, north and east into Canada.
Divisions: 103:C; 201:C
Nations: CA, US
Subnations: ME, NB, NH, NY, QC, VT
Map Zones: 64:C, 66:C
TNC Ecoregions: 63:C

SOURCES

References: Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723042#references
Description Author: S.C. Gawler
Version: 29 Oct 2008
Concept Author: S.C. Gawler
Stakeholders: Canada, East
ClassifResp: East

BOREAL ICE-SCOUR RIVERSHORE (CES103.589)

CLASSIFIERS

Classification Status: Standard

Primary Division: Boreal (103)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Intermittent Flooding [Intermittent interval, Spring Flooding]; Intermittent Flooding [Intermittent interval, Summer Flooding]; Moderate (100-500 yrs) Persistence; Shrubland (Shrub-dominated); Herbaceous; Riverine / Alluvial; Glaciated; Very Short Disturbance Interval; Flood Scouring
Non-Diagnostic Classifiers: Mesotrophic Water; Saturated Soil; Lowland; Toeslope/Valley Bottom; Mesotrophic Soil; Circumneutral Soil; Acidic Soil; Mineral: W/ A-Horizon <10 cm; Udic
National Mapping Codes: ESLF 9332

CONCEPT

Summary: This riparian system occurs in the extreme northeastern and north-central U.S. and adjacent Canada. It develops along the shores of northern rivers, where early spring snowmelt and ice-scour exert a strong influence on the vegetation. The ice prevents floodplain forests from developing; the vegetation consists of shrublands, tall grasslands, graminoid-forb-dwarf shrub shoreline seeps, and rivershore outcrops. Characteristic shrubs include *Alnus incana* and *Alnus viridis ssp. crispa (= Alnus crispa), Myrica gale, Spiraea alba, Cornus sericea, Salix eriocephala* and many other *Salix* spp., and *Dasiphora fruticosa ssp. floribunda*. Characteristic herbaceous species vary with the setting; *Calamagrostis canadensis* is ubiquitous, and other herbs include *Symphyotrichum novi-belgii, Carex* spp. (including *Carex flava, Carex garberi, Carex viridula*), *Deschampsia caespitosa, Andropogon gerardii, Schizachyrium scoparium, Allium schoenoprasum, Triantha glutinosa, Spartina pectinata, Solidago uliginosa, Doellingeria umbellata (= Aster umbellatus), Agrostis scabra*, and many others. Soils in some areas remain saturated; other patches are well-drained for most of the growing season. The location and extent of shrub versus herb cover will vary in time and space according to how recent and severe the scour events have been. The continual weathering of glacial deposits in the river channel can produce relatively high pH conditions; this and periodic natural disturbance create conditions for many regionally rare plant species.
Classification Comments: Need to clarify the conceptual boundaries between this and the boreal rivershores in central and eastern Canada. This ecological system undoubtedly occurs further west into central Canada, as far west as northern Alberta. It was not mapped in the SunCor Alberta boreal forest mapping project.
Related Concepts:
- Bluebell - Balsam Ragwort Shoreline Outcrop (Gawler and Cutko 2010) Finer
- Bluejoint Meadow (Gawler and Cutko 2010) Finer
- Circumneutral Riverside Seep (Gawler and Cutko 2010) Finer
- Dogwood - Willow Shoreline Thicket (Gawler and Cutko 2010) Finer
- Sand Cherry - Tufted Hairgrass River Beach (Gawler and Cutko 2010) Finer
- Twisted Sedge Cobble Rivershore (Gawler and Cutko 2010) Finer

Component Associations:
- *Alnus incana - Cornus (amomum, sericea) / Clematis virginiana* Shrubland (CEGL006062, G4G5)
- *Calamagrostis canadensis - Doellingeria umbellata - Spartina pectinata* Herbaceous Vegetation (CEGL006427, GNR)
- *Campanula rotundifolia - Packera paupercula - (Aquilegia canadensis)* Sparse Vegetation (CEGL006532, GNR)
- *Cornus sericea - Salix* spp. - (*Rosa palustris*) Shrubland (CEGL002186, G5)
- *Prunus pumila var. depressa / Deschampsia caespitosa* Herbaceous Vegetation (CEGL006437, GNR)
- River Mudflats Sparse Vegetation (CEGL002314, GNR)
- *Triantha glutinosa - Carex garberi* Herbaceous Vegetation (CEGL006142, G3?)

DISTRIBUTION

Range: Far northern New England, extending into adjacent Canada and with scattered locations southward to central New England. Distribution west of New England is not well documented.
Divisions: 103:C; 201:C; 202:P
Nations: CA, US
Subnations: ME, NB, NH?, QC
Map Zones: 64:P, 66:C
TNC Ecoregions: 48:C, 63:C

SOURCES

References: Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723017#references
Description Author: S.C. Gawler

Version: 11 Apr 2007
Concept Author: S.C. Gawler

Stakeholders: Canada, East, Midwest
ClassifResp: East

CALIFORNIA CENTRAL VALLEY RIPARIAN WOODLAND AND SHRUBLAND (CES206.946)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Riparian Mosaic; Forest and Woodland (Treed); Mediterranean [Mediterranean Xeric-Oceanic]; Riverine / Alluvial; Deep Soil; Flood Scouring
Non-Diagnostic Classifiers: Floodplain; Fluvial; Lowland [Foothill]; Lowland [Lowland]; Shrubland (Shrub-dominated); Herbaceous; Toeslope/Valley Bottom; Silt Soil Texture; Sand Soil Texture; Aquic; Udic; Very Short Disturbance Interval
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Deciduous open tree canopy
National Mapping Codes: EVT 2151; ESLF 9101; ESP 1151

CONCEPT

Summary: This system occurs in the floodplains of rivers of California's Central Valley. Alluvial soils and late winter/early spring flooding (usually every year) from snowmelt typify this system. Communities are predominantly floodplain woodlands, but also include shrublands, wet meadows and gravel/s and flats. Important trees and shrubs include *Populus fremontii, Platanus racemosa, Quercus lobata, Salix gooddingii, Acer negundo, Cephalanthus occidentalis*, and *Vitis californica*. *Juglans nigra* hybrids and *Ailanthus altissima* are problem invasive trees. *Tamarix* spp. extend as far north as Shasta County. Herbaceous components can include *Carex barbarae, Artemisia douglasiana*, and various marsh species along riverbanks and backwater (*Schoenoplectus californicus (= Scirpus californicus), Typha* spp.). *Arundo donax* is another common invasive and introduced forage species that often invades degraded areas within the floodplains. Periodic flooding and associated sediment scour are necessary to maintain growth and reproduction of vegetation. Flooding regimes have been significantly altered in all but a few tributaries that support this system.
Related Concepts:
- Riparian Woodland (203) (Shiflet 1994) Broader

DESCRIPTION

Environment: This system is found on alluvial soils adjacent to perennial rivers and streams and their associated floodplains and riverbanks below approximately 550 m (1800 feet).
Dynamics: Periodic flooding and associated sediment scour are necessary to maintain growth and reproduction of vegetation (Sawyer et al. 2009). Major flood events and consequent flood scour, overbank deposition of water and sediments, and stream meandering are the key fluvial processes that provide new substrates, remove old banks and stimulate renewed growth of cottonwood and willow species (Sawyer et al. 2009). Natural fire-return interval was long or moderate with low-intensity surface fires.

DISTRIBUTION

Range: Occurs in the floodplains of rivers of California's Central Valley.
Divisions: 206:C
Nations: US
Subnations: CA
Map Zones: 3:P, 4:C, 5:C, 6:P, 13:P
USFS Ecomap Regions: 261B:??, 262A:CC, 263A:??, 322A:??, M261A:C?, M261B:C?, M261C:CC, M261F:CC
TNC Ecoregions: 13:C

SOURCES

References: Barbour and Major 1988, Brooks and Minnich 2006, Coffman 2007, Comer et al. 2003, Holland and Keil 1995, Keeler-Wolf pers. comm., Ohmart and Anderson 1986, PRBO Conservation Science 2011, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Shiflet 1994
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722735#references
Description Author: P. Comer and T. Keeler-Wolf, mod. G. Kittel
Version: 14 Jan 2014 **Stakeholders:** West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

CENTRAL APPALACHIAN RIVER FLOODPLAIN (CES202.608)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Intermittent Flooding; Short (<5 yrs) Flooding Interval; Forest and Woodland (Treed); Toeslope/Valley Bottom; Riverine / Alluvial; Broad-Leaved Deciduous Tree
Non-Diagnostic Classifiers: 1-29-day hydroperiod; 30-180-day hydroperiod; Moderate (100-500 yrs) Persistence; Lowland; Temperate; Eutrophic Soil; Deep Soil; Mineral: W/ A-Horizon >10 cm; Silt Soil Texture; Udic; Ustic; Unconsolidated; Short Disturbance Interval; Flood Scouring
National Mapping Codes: ESLF 9333

CONCEPT

Summary: This system encompasses floodplains of medium to large rivers in Atlantic drainages from southern New England to Virginia. This system can include a complex of wetland and upland vegetation on deep alluvial deposits and scoured vegetation on depositional bars and on bedrock where rivers cut through resistant geology. This complex includes floodplain forests in which *Acer saccharinum, Populus deltoides*, and *Platanus occidentalis* are characteristic, as well as herbaceous sloughs, shrub wetlands, riverside prairies and woodlands. Microtopography and soil texture determine how long the various habitats are inundated. Depositional and erosional features may both be present depending on the particular floodplain.
Classification Comments: This system is distinguished from related floodplain systems; northward, Laurentian-Acadian Floodplain Forest (CES201.587) is characterized by the lack or unimportance of *Platanus occidentalis* and *Betula nigra*, for example; and westward, North-Central Interior Floodplain (CES202.694) drains to the midwestern rivers rather than northeastern rivers. Determining the distinctions from South-Central Interior Large Floodplain (CES202.705), which overlaps the southern and western portions of this system, needs work.
Similar Ecological Systems:
- Central Appalachian Stream and Riparian (CES202.609)
- Laurentian-Acadian Floodplain Forest (CES201.587)
- North-Central Interior Floodplain (CES202.694)
- South-Central Interior Large Floodplain (CES202.705)

Related Concepts:
- Cottonwood: 63 (Eyre 1980) Finer
- Pin Oak - Sweetgum: 65 (Eyre 1980) Finer
- River Birch - Sycamore: 61 (Eyre 1980) Finer
- Silver Maple - American Elm: 62 (Eyre 1980) Finer
- Sugarberry - American Elm - Green Ash: 93 (Eyre 1980) Finer
- Sycamore - Sweetgum - American Elm: 94 (Eyre 1980) Finer

DESCRIPTION

Environment: This system forms on broad, relatively flat floodplains along medium-sized to large rivers. Rivershores often exhibit development of one or more terraces formed in relation to hydroperiod and height from river channel. Backswamps may occur in poorly drained depressions behind the main river channel, where substrate is deep muck. Soils range from sandy and silty on point bars to deep muck in backswamps.
Dynamics: Spring and summer flooding brings large amounts of sediment carried from tributaries, as well as other debris that is deposited on the floodplain as flood waters recede. Floodplain canopy trees often topple as a result of prolonged saturation of sediments; vegetation structure is highly variable and dynamic as a result. Dynamic disturbance regime and high fertility make this system highly susceptible to invasions of non-native plants.

Component Associations:
- *(Hypericum prolificum, Leucothoe racemosa) / Schizachyrium scoparium - Solidago simplex var. racemosa - Ionactis linariifolius* Sparse Vegetation (CEGL006491, G2)
- *Acer (rubrum, saccharinum) - Fraxinus pennsylvanica - Ulmus americana / Boehmeria cylindrica* Forest (CEGL006548, G4)
- *Acer (rubrum, saccharinum) - Ulmus americana* Forest (CEGL006975, GNR)
- *Acer negundo* Forest (CEGL005033, G4G5)
- *Acer saccharinum - (Populus deltoides) / Matteuccia struthiopteris - Laportea canadensis* Forest (CEGL006147, G4G5)
- *Acer saccharinum - Acer negundo / Ageratina altissima - Laportea canadensis - (Elymus virginicus)* Forest (CEGL006217, G4)
- *Acer saccharinum - Fraxinus pennsylvanica - Ulmus americana* Forest (CEGL002586, G4?)
- *Acer saccharinum - Ulmus americana / Onoclea sensibilis* Forest (CEGL006001, GNR)
- *Acer saccharinum - Ulmus americana / Physocarpus opulifolius* Forest (CEGL006042, GNR)
- *Acer saccharinum / Onoclea sensibilis - Boehmeria cylindrica* Forest (CEGL006176, GNR)

- *Acer saccharum - Fraxinus americana / Carpinus caroliniana / Podophyllum peltatum* Forest (CEGL006459, G3?)
- *Acer saccharum - Fraxinus* spp. - *Tilia americana / Matteuccia struthiopteris - Ageratina altissima* Forest (CEGL006114, GNR)
- *Acer saccharum - Liriodendron tulipifera / Galium concinnum - Carex laxiculmis* Forest (CEGL006473, GNR)
- *Alnus incana - Viburnum recognitum / Calamagrostis canadensis* Shrubland (CEGL006546, GNR)
- *Alnus serrulata - Physocarpus opulifolius* Shrubland (CEGL006251, G5)
- *Alnus serrulata* Swamp Shrubland (CEGL005082, G4G5)
- *Andropogon gerardii - Panicum virgatum - Baptisia australis* Herbaceous Vegetation (CEGL006283, G3)
- *Betula nigra - Platanus occidentalis / Impatiens capensis* Forest (CEGL006184, G3Q)
- *Betula nigra - Platanus occidentalis* Forest (CEGL002086, G5)
- *Calamagrostis canadensis* North-Central Wet Meadow (CEGL005449, G4G5)
- *Carex torta - Apocynum cannabinum - Cyperus* spp. Herbaceous Vegetation (CEGL006536, G4G5)
- *Carex torta* Herbaceous Vegetation (CEGL004103, G3G4)
- *Carex trichocarpa* Herbaceous Vegetation (CEGL006447, G4?)
- *Carpinus caroliniana - Ilex decidua* Shrubland (CEGL006484, G1?)
- *Carya cordiformis - Prunus serotina / Ageratina altissima* Forest (CEGL006445, G2G3)
- *Cephalanthus occidentalis - Decodon verticillatus* Shrubland (CEGL006069, G4G5)
- *Cephalanthus occidentalis / Carex* spp. - *Lemna* spp. Southern Shrubland (CEGL002191, G4)
- *Eragrostis hypnoides - Ludwigia palustris - Lindernia dubia - Cyperus squarrosus* Herbaceous Vegetation (CEGL006483, G3)
- *Eupatorium serotinum - Polygonum (lapathifolium, punctatum, pensylvanicum)* Herbaceous Vegetation (CEGL006481, GNR)
- *Fagus grandifolia - Quercus* spp. - *Acer rubrum - Juglans nigra* Forest (CEGL005014, G2G3)
- *Fraxinus americana / Andropogon gerardii - Sorghastrum nutans - Schizachyrium scoparium - Pycnanthemum tenuifolium* Herbaceous Vegetation (CEGL006478, G1)
- *Fraxinus pennsylvanica - (Juglans nigra, Platanus occidentalis)* Forest (CEGL006575, GNR)
- *Fraxinus pennsylvanica - Ulmus* spp. - *Celtis occidentalis* Forest (CEGL002014, G3G5)
- *Justicia americana* Herbaceous Vegetation (CEGL004286, G4G5)
- *Liriodendron tulipifera - Fraxinus* spp. / *Lindera benzoin - Viburnum prunifolium / Podophyllum peltatum* Forest (CEGL006314, GNR)
- *Liriodendron tulipifera - Pinus strobus - (Tsuga canadensis) / Carpinus caroliniana / Amphicarpaea bracteata* Forest (CEGL008405, G3)
- *Liriodendron tulipifera - Platanus occidentalis - Betula lenta / Lindera benzoin / Circaea lutetiana ssp. canadensis* Forest (CEGL006255, G3?)
- *Peltandra virginica - Polygonum amphibium var. emersum - Carex emoryi - Impatiens capensis* Herbaceous Vegetation (CEGL006244, G1)
- *Peltandra virginica - Saururus cernuus - Boehmeria cylindrica / Climacium americanum* Herbaceous Vegetation (CEGL007696, G3)
- *Pinus virginiana - Juniperus virginiana var. virginiana - Quercus stellata / Amelanchier stolonifera / Danthonia spicata / Leucobryum glaucum* Woodland (CEGL008449, G1)
- *Platanus occidentalis - Acer negundo - Juglans nigra / Asimina triloba / Mertensia virginica* Forest (CEGL004073, G4)
- *Platanus occidentalis - Acer saccharinum - Betula nigra - Fraxinus pennsylvanica / Boehmeria cylindrica - Carex emoryi* Woodland (CEGL006476, G2?)
- *Platanus occidentalis - Betula nigra - Salix (caroliniana, nigra)* Woodland (CEGL003896, G4G5)
- *Platanus occidentalis - Fraxinus pennsylvanica* Forest (CEGL006036, G4?)
- *Platanus occidentalis / Aesculus flava* Forest (CEGL006466, GNR)
- *Prunus pumila / Andropogon gerardii - Sorghastrum nutans* Herbaceous Vegetation (CEGL006518, G3)
- *Quercus bicolor - Acer rubrum / Carpinus caroliniana* Forest (CEGL006386, GNR)
- *Quercus bicolor - Fraxinus pennsylvanica - (Platanus occidentalis) / Chasmanthium latifolium - Dichanthelium clandestinum - Zizia aurea* Woodland (CEGL006218, G1G2)
- *Quercus palustris - Acer rubrum / Carex grayi - Geum canadense* Forest (CEGL006185, G3)
- *Quercus palustris - Quercus bicolor / Carex tribuloides - Carex radiata - (Carex squarrosa)* Forest (CEGL006497, G3G4)
- *Quercus rubra - Quercus shumardii / Cercis canadensis* Temporarily Flooded Forest (CEGL006495, GNR)
- *Salix nigra - Betula nigra / Schoenoplectus pungens* Wooded Herbaceous Vegetation (CEGL006463, G1?)
- *Salix sericea* Shrubland (CEGL006305, GNR)
- *Spiraea alba* Shrubland (CEGL006595, GNR)
- *Tilia americana - Acer saccharum - Acer nigrum / Laportea canadensis* Forest (CEGL006405, GNR)
- *Verbesina alternifolia - Elymus riparius - Solidago gigantea - (Teucrium canadense)* Herbaceous Vegetation (CEGL006480, GNR)

DISTRIBUTION

Range: Southern New England west to Lake Erie and south to Virginia. The James River in Virginia marks the southern extent of this system.
Divisions: 201:C; 202:C
Nations: US
Subnations: CT, MA, MD, NH, NJ?, NY, OH, PA, VA, VT, WV

Map Zones: 53:C, 59:C, 60:C, 61:C, 62:C, 63:C, 64:C, 65:C
TNC Ecoregions: 49:C, 52:C, 59:C, 60:C, 61:C

SOURCES

References: Comer et al. 2003, Faber-Langendoen et al. 2011, Kearsley 1999c, PNHP 2002, Rhoads and Block 1999, Swain and Kearsley 2011, Zimmerman 2011m, Zimmerman et al. 2012
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723001#references
Description Author: S.C. Gawler, mod. J. Teague and L.A. Sneddon
Version: 14 Jan 2014 **Stakeholders:** East, Midwest, Southeast
Concept Author: S.C. Gawler, mod. NCR Review Team **ClassifResp:** East

CENTRAL APPALACHIAN STREAM AND RIPARIAN (CES202.609)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Intermittent Flooding; Lowland; Riverine / Alluvial; Very Short Disturbance Interval; Flood Scouring
Non-Diagnostic Classifiers: Short (<5 yrs) Flooding Interval; Short (50-100 yrs) Persistence; Forest and Woodland (Treed); Sideslope; Toeslope/Valley Bottom; Temperate; Mesotrophic Soil; Udic; Ustic
National Mapping Codes: ESLF 9331

CONCEPT

Summary: This riparian system ranges from southern New England to Virginia and West Virginia and occurs over a wide range of elevations. It develops on floodplains and shores along river channels that lack a broad flat floodplain due to steeper sideslopes, higher gradient, or both. It may include communities influenced by flooding, erosion, or groundwater seepage. The vegetation is often a mosaic of forest, woodland, shrubland, and herbaceous communities. Common trees include *Betula nigra* and *Platanus occidentalis*. Open, flood-scoured rivershore prairies feature *Panicum virgatum* and *Andropogon gerardii*, and *Carex torta* is typical of wetter areas near the channel.
Classification Comments: This is a high-gradient system, unlike the low-gradient system described in Central Appalachian River Floodplain (CES202.608). To the south in the Appalachians and interior, this system is replaced by South-Central Interior Small Stream and Riparian (CES202.706).
Similar Ecological Systems:
- Central Appalachian River Floodplain (CES202.608)
- Cumberland Riverscour (CES202.036)
- South-Central Interior Small Stream and Riparian (CES202.706)

Related Concepts:
- Black Willow: 95 (Eyre 1980) Finer
- Eastern Hemlock: 23 (Eyre 1980) Finer
- Sycamore - Sweetgum - American Elm: 94 (Eyre 1980) Finer

DESCRIPTION

Environment: This alluvial system forms on the shores of rivers and streams influenced by flood scour and deposition. It includes vegetation on various substrates ranging from silty sediments low on the channel to rock outcrops, gorge walls, and cobbles.
Vegetation: The vegetation is often a mosaic of forest, woodland, shrubland, and herbaceous communities. Common trees include *Betula nigra, Platanus occidentalis*, and *Acer negundo*. Open, flood-scoured rivershore prairies feature *Panicum virgatum* and *Andropogon gerardii*, and *Carex torta* is typical of wetter areas near the channel.
Dynamics: High-gradient waterflow causes scouring of rivershores, removing soils and depositing them in slower-moving portions of the river. High amounts of debris cause flood-battering of trees and shrubs, and removal of woody vegetation during extreme flooding events. Seepage from uplands may emerge from shores, and the often specialized flora of these environments is maintained by repeated removal, or prevention of establishment, of woody vegetation. Flood-battering of trees prevents succession; scouring by water, and sometimes ice, exposes substrate.

Component Associations:
- *Acer rubrum - Fraxinus (pennsylvanica, americana) / Lindera benzoin / Symplocarpus foetidus* Forest (CEGL006406, G4G5)
- *Acer rubrum - Fraxinus americana - Fraxinus nigra - Betula alleghaniensis / Veratrum viride - Carex bromoides* Forest (CEGL008416, G3)
- *Acer rubrum - Nyssa sylvatica / Ilex verticillata - Vaccinium fuscatum / Osmunda cinnamomea* Forest (CEGL007853, G2)
- *Alnus serrulata - Physocarpus opulifolius* Shrubland (CEGL006251, G5)
- *Andropogon gerardii - Campanula rotundifolia - Solidago simplex* Sparse Vegetation (CEGL006284, G2)
- *Andropogon gerardii - Panicum virgatum - Baptisia australis* Herbaceous Vegetation (CEGL006283, G3)
- *Carex torta - Apocynum cannabinum - Cyperus* spp. Herbaceous Vegetation (CEGL006536, G4G5)
- *Carex torta* Herbaceous Vegetation (CEGL004103, G3G4)
- *Carex trichocarpa* Herbaceous Vegetation (CEGL006447, G4?)
- *Deschampsia caespitosa - Carex viridula* Herbaceous Vegetation (CEGL006969, G1)
- *Eragrostis hypnoides - Ludwigia palustris - Lindernia dubia - Cyperus squarrosus* Herbaceous Vegetation (CEGL006483, G3)
- *Eupatorium serotinum - Polygonum (lapathifolium, punctatum, pensylvanicum)* Herbaceous Vegetation (CEGL006481, GNR)
- *Fraxinus americana / Andropogon gerardii - Sorghastrum nutans - Schizachyrium scoparium - Pycnanthemum tenuifolium* Herbaceous Vegetation (CEGL006478, G1)
- *Hudsonia tomentosa - Paronychia argyrocoma* Dwarf-shrubland (CEGL006232, G1)
- *Justicia americana* Herbaceous Vegetation (CEGL004286, G4G5)

- *Leersia oryzoides - Sagittaria latifolia* Herbaceous Vegetation (CEGL006461, GNR)
- *Liriodendron tulipifera - Acer (rubrum, negundo) - (Platanus occidentalis) / Carpinus caroliniana / Polygonum virginianum* Forest (CEGL006492, G4)
- *Liriodendron tulipifera - Platanus occidentalis - Betula lenta / Lindera benzoin / Circaea lutetiana ssp. canadensis* Forest (CEGL006255, G3?)
- *Lysimachia ciliata - Apocynum cannabinum* Sparse Vegetation (CEGL006554, GNR)
- *Panicum virgatum - Andropogon gerardii* Gravel Wash Herbaceous Vegetation (CEGL006477, G2G3)
- *Pinus rigida - Hudsonia tomentosa - Pityopsis falcata* Sparse Vegetation (CEGL006391, GNR)
- *Pinus rigida / Osmunda cinnamomea - Carex stricta - Eriophorum virginicum / Sphagnum* spp. Woodland (CEGL007056, G1)
- *Pinus strobus - Betula populifolia / Comptonia peregrina / Schizachyrium scoparium* Woodland (CEGL006004, G2)
- *Pinus virginiana - (Pinus rigida) - Nyssa sylvatica / Xanthorhiza simplicissima / Euphorbia corollata* Forest (CEGL006624, GNR)
- *Platanus occidentalis - Acer negundo - Juglans nigra / Asimina triloba / Mertensia virginica* Forest (CEGL004073, G4)
- *Platanus occidentalis - Acer saccharinum - Betula nigra - Fraxinus pennsylvanica / Boehmeria cylindrica - Carex emoryi* Woodland (CEGL006476, G2?)
- *Platanus occidentalis - Betula nigra - Salix (caroliniana, nigra)* Woodland (CEGL003896, G4G5)
- *Platanus occidentalis / Dichanthelium clandestinum - Festuca subverticillata* Woodland (CEGL004031, G4)
- *Podostemum ceratophyllum* Herbaceous Vegetation (CEGL004331, G3G5)
- *Quercus palustris - Quercus bicolor / Carex tribuloides - Carex radiata - (Carex squarrosa)* Forest (CEGL006497, G3G4)
- *Rhododendron arborescens / Marshallia grandiflora - Triantha glutinosa - Platanthera flava var. herbiola* Herbaceous Vegetation (CEGL006598, G1)
- *Salix nigra / Phalaris arundinacea - Apocynum cannabinum* Temporarily Flooded Shrubland (CEGL006065, G4?)
- *Salix nigra* Temporarily Flooded Shrubland (CEGL003901, G4?)
- *Tsuga canadensis - Betula alleghaniensis / Veratrum viride - Carex scabrata - Oclemena acuminata* Forest (CEGL008533, G2)
- *Verbesina alternifolia - Elymus riparius - Solidago gigantea - (Teucrium canadense)* Herbaceous Vegetation (CEGL006480, GNR)

DISTRIBUTION

Range: This system ranges from southern New England west to Lake Erie and south to Virginia and West Virginia. The James River in Virginia marks its southern extent.
Divisions: 202:C
Nations: US
Subnations: CT, DE, MA, MD, NH, NJ?, NY, OH, PA, VA, VT, WV
Map Zones: 53:C, 60:C, 61:C, 62:C, 63:P, 64:P, 65:C
TNC Ecoregions: 49:C, 52:C, 59:C, 60:C, 61:C

SOURCES

References: Comer et al. 2003, Faber-Langendoen et al. 2011, PNHP 2002, Zimmerman 2011j, Zimmerman 2011m, Zimmerman and Podniesinski 2008, Zimmerman et al. 2012
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723000#references
Description Author: S.C. Gawler, mod. J. Teague and L.A. Sneddon
Version: 14 Jan 2014 **Stakeholders:** East, Midwest, Southeast
Concept Author: S.C. Gawler, mod. NCR Review Team **ClassifResp:** East

CENTRAL FLORIDA PINE FLATWOODS (CES203.382)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Forest and Woodland (Treed); Woody-Herbaceous; Short Disturbance Interval; Needle-Leaved Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2453; ESLF 9122; ESP 1453

CONCEPT

Summary: This system is endemic to Florida, ranging from Levy and St. Johns counties in the north (ca. 30 degrees N latitude) southward to Hillsborough, Osceola and Polk counties. It was once an extensive system within its historic range. As currently conceived, this system includes both "scrubby flatwoods" that occur on well-drained soils and typical flatwoods that occur on more poorly drained soils. The vegetation is naturally dominated by either *Pinus palustris* or *Pinus elliottii var. elliottii*, and less frequently includes *Pinus serotina*. Examples vary in aspect from well-developed understory layers or scrub species to more herbaceous, savanna-like conditions. There is a dense ground cover of low shrubs, grasses, and herbs. Frequent, low-intensity fire is the dominant natural ecological force.
Classification Comments: This system includes at least two predominant expressions which could individually constitute distinct systems. Scrubby flatwoods are much more well-drained, uplands with characteristically shrubby understories, while flatwoods are much more poorly drained and savanna-like in aspect (Abrahamson et al. 1984).
Similar Ecological Systems:
- East Gulf Coastal Plain Near-Coast Pine Flatwoods (CES203.375)--is closely related and found to the north.

Related Concepts:
- Longleaf Pine - Slash Pine: 83 (Eyre 1980) Finer
- Longleaf Pine: 70 (Eyre 1980) Finer
- Pond Pine: 98 (Eyre 1980) Finer
- Slash Pine: 84 (Eyre 1980) Finer

DESCRIPTION

Environment: As currently conceived, this system includes both "scrubby flatwoods" that occur on well-drained soils and typical mesic and wet flatwoods that occur on more poorly drained soils. Wetter pine flatwoods sites with an herbaceous ground cover are included, these are sometimes called wet pine savannas.
Vegetation: The southern limit of this system marks the approximate natural distribution limit for both *Pinus serotina* and *Pinus elliottii var. elliottii* (Abrahamson and Hartnett 1990). The associations comprising this system are not well documented; more information is needed to describe additional communities that are believed to be present. The vegetation varies between examples of this system based on fire history, geographic location, and the soils on which it occurs. The most well-drained examples may be considered "scrubby flatwoods" that support a characteristic understory layer of xeromorphic adapted species, such as *Quercus geminata, Lyonia fruticosa, Lyonia ferruginea, Sideroxylon tenax (= Bumelia tenax)*, and *Persea humilis*; *Quercus inopina* is especially diagnostic (Abrahamson et al. 1984). These conditions range to examples on more poorly drained soils that include scattered *Pinus elliottii var. elliottii* or *Pinus palustris* over *Serenoa repens* and other species such as *Panicum abscissum* and *Aristida beyrichiana*.
Dynamics: Fire is naturally frequent, with a fire-return time of from one to four years. Disturbances are an important part of the natural functions of this system. In order for these habitats to burn frequently there needs to be enough fine fuel, such as needles from *Pinus palustris* trees, healthy populations of native warm-season grasses, and evergreen shrubs with volatile oils in their leaves, such as *Ilex glabra, Lyonia* spp., *Morella cerifera (= Morella pumila), Quercus geminata, Quercus minima, Serenoa repens*, and *Vaccinium* spp. The frequent fires promote flowering, seed production, and seed germination of many plants and provide open areas in patches (Van Lear et al. 2005).

Component Associations:
- *Pinus elliottii var. densa / Quercus minima / Panicum abscissum* Woodland (CEGL003650, G2?)
- *Pinus elliottii var. elliottii / Serenoa repens - Ilex glabra* Woodland (CEGL003643, G4?)
- *Pinus palustris - (Pinus elliottii var. elliottii) / Quercus (chapmanii, myrtifolia) - Serenoa repens / Aristida beyrichiana - Chapmannia floridana* Woodland (CEGL007750, G2G3)
- *Pinus palustris - Pinus serotina / Ilex glabra - Lyonia lucida - (Serenoa repens)* Woodland (CEGL004791, G3G4)
- *Pinus serotina / Gordonia lasianthus - Persea palustris* Saturated Woodland (CEGL007996, G3?Q)
- *Pinus serotina / Ilex glabra / Aristida beyrichiana* Woodland (CEGL003795, G2G3)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:

- Central Florida Herbaceous Pondshore (CES203.890)
- Central Florida Wet Prairie and Herbaceous Seep (CES203.491)
- Florida Longleaf Pine Sandhill (CES203.284)
- Southern Coastal Plain Hydric Hammock (CES203.501)

DISTRIBUTION

Range: Endemic to Florida, ranging in the north from Levy and St. Johns counties southward to Hillsborough and Polk counties. It was once an extensive ecological system within its historic range (Stout and Marion 1993).
Divisions: 203:C
Nations: US
Subnations: FL
Map Zones: 55:C, 56:C
USFS Ecomap Regions: 232D:CC, 232G:CC, 232K:CC
TNC Ecoregions: 55:C

SOURCES

References: Abrahamson and Hartnett 1990, Abrahamson et al. 1984, Brewer 2008, Carr et al. 2010, Comer et al. 2003, Eyre 1980, NatureServe 2011, Oswalt et al. 2012, Stout and Marion 1993, Van Lear et al. 2005, Wahlenberg 1946
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723134#references
Description Author: R. Evans, mod. M. Pyne and C. Nordman
Version: 14 Jan 2014
Concept Author: R. Evans
Stakeholders: Southeast
ClassifResp: Southeast

CENTRAL TEXAS COASTAL PRAIRIE RIPARIAN (CES203.714)

CLASSIFIERS

Conf.: 3 - Weak **Classification Status:** Standard
Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Forest and Woodland (Treed); Riverine / Alluvial; Broad-Leaved Deciduous Tree
National Mapping Codes: ESLF 9390

CONCEPT

Summary: This system occurs in upland drainages as they coarse through the relatively level landscape of the coastal prairie in Texas. It represents vegetation bordering upland drainages that are mostly incised, erosional features with very little alluvial deposition. Woody vegetation often shares composition with that of floodplains along larger rives and streams of the region. Species may include *Celtis laevigata, Ulmus crassifolia, Carya illinoinensis, Salix nigra, Prosopis glandulosa, Acacia farnesiana, Quercus nigra, Quercus fusiformis, Prosopis glandulosa, Acacia farnesiana, Diospyros texana, Condalia hookeri, Ziziphus obtusifolia,* and *Aloysia gratissima*. The herbaceous layer may contain species such *Elymus virginicus, Chasmanthium latifolium, Calyptocarpus vialis, Verbesina virginica*, and *Chloracantha spinosa*. Though woody vegetation is the predominant vegetation type in this system, it may also include small areas that lack a significant woody component.
Classification Comments: The relationship of the vegetation of this system (CES203.714) needs further differentiation from the vegetation of Central Texas Coastal Prairie River Floodplain (CES203.713). They are currently separated more on site conditions and processes rather than vegetation dominants. More information is needed.
Similar Ecological Systems:
- Central Texas Coast River Terrace Sandyland Grassland (CES203.712)
- Central Texas Coastal Prairie River Floodplain (CES203.713)

Related Concepts:
- Central Texas Coastal Prairie Riparian Deciduous Forest and Woodland (4604) (Elliott 2011) Finer. As described for the system, where deciduous canopy species predominate.
- Central Texas Coastal Prairie Riparian Deciduous Shrubland (4606) (Elliott 2011) Finer. Primarily disturbance shrublands of upland drainages dominated by species such as *Prosopis glandulosa, Acacia farnesiana,* small *Celtis laevigata, Salix nigra,* or *Cephalanthus occidentalis*.
- Central Texas Coastal Prairie Riparian Evergreen Shrubland (4605) (Elliott 2011) Finer. Upland drainages where shrubs such as *Ilex vomitoria, Zanthoxylum fagara, Rosa bracteata,* or *Acacia farnesiana* dominate. *Celtis laevigata, Celtis pallida (= Celtis ehrenbergiana),* and *Prosopis glandulosa* are often present.
- Central Texas Coastal Prairie Riparian Herbaceous Vegetation (4607) (Elliott 2011) Finer. Sites on upland drainages that often represent managed grasslands dominated by *Cynodon dactylon, Paspalum notatum,* or *Bothriochloa ischaemum var. songarica*.
- Central Texas Coastal Prairie Riparian Herbaceous Wetland (4617) (Elliott 2011) Finer. Herbaceous-dominated wetlands along upland drainages.
- Central Texas Coastal Prairie Riparian Live Oak-Deciduous Forest and Woodland (4602) (Elliott 2011) Finer. About 12% of this system is composed of this type, where *Quercus fusiformis* or, in some cases *Ehretia anacua* dominates the overstory.
- Central Texas Coastal Prairie Riparian Live Oak-Deciduous Forest and Woodland (4603) (Elliott 2011) Finer. Forests or woodlands where canopy dominance is shared by broadleaf evergreen species such as *Quercus fusiformis* or *Ehretia anacua* and deciduous species such as *Celtis laevigata, Ulmus crassifolia,* and others.

DESCRIPTION

Environment: This system represents vegetation bordering upland drainages occurring in the unconsolidated sediments of the Beaumont or Lissie geologic formations. These areas accumulate flow from the surrounding landscape but rarely accrete significant alluvial deposition. They occupy locally low landscape positions and accumulate moisture from the surrounding landscape but are not bottomland sites.
Vegetation: Forested sites typically have a deciduous canopy with species such as *Celtis laevigata, Ulmus crassifolia, Carya illinoinensis, Salix nigra, Prosopis glandulosa, Acacia farnesiana*, and/or *Quercus nigra*. *Quercus fusiformis* may share, or sometimes dominate, the canopy. The shrub layer may be well-developed and include species such *Prosopis glandulosa, Acacia farnesiana, Diospyros texana, Condalia hookeri, Ziziphus obtusifolia*, and/or *Aloysia gratissima*. Some areas may lack a significant overstory and be mapped as shrublands of these species. The herbaceous layer may contain species such *Elymus virginicus, Chasmanthium latifolium, Calyptocarpus vialis, Verbesina virginica*, and *Chloracantha spinosa*.

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Texas-Louisiana Coastal Prairie (CES203.550)

DISTRIBUTION

Range: This system occurs in upland drainages on the Coastal Prairie surface of the Lissie and Beaumont geologic formations in the Coastal Plain of Texas.
Divisions: 203:C
Nations: US
Subnations: TX
Map Zones: 34:C
USFS Ecomap Regions: 255Cg:CPP, 255Da:CCC, 255Dd:CCC, 315Ed:???
TNC Ecoregions: 31:C

SOURCES

References: Elliott 2011, Southeastern Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.859580#references
Description Author: L. Elliott, mod. J. Teague
Version: 25 Feb 2011 **Stakeholders:** Southeast
Concept Author: L. Elliott, D. Diamond, A. Treuer-kuehn, D. German, J. Teague **ClassifResp:** Southeast

CENTRAL TEXAS COASTAL PRAIRIE RIVER FLOODPLAIN (CES203.713)

CLASSIFIERS

Conf.: 3 - Weak **Classification Status:** Standard
Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Forest and Woodland (Treed); Riverine / Alluvial; Broad-Leaved Deciduous Tree
National Mapping Codes: ESLF 9389

CONCEPT

Summary: This system occurs in the Gulf Coast Prairies and Marshes region of Texas. It occupies alluvial settings along rivers, streams and larger drainages. This wetland and upland transition area supports a correspondingly similar mixture of wetland/upland vegetation types that are primarily deciduous or mixed evergreen-deciduous forests. In addition, this system also expresses a transition from northeast to southwest. In the northeastern parts of the range, *Quercus fusiformis* is a common component, as are a few other trees and shrubs with a more eastern affinity such as *Celtis laevigata, Ulmus crassifolia, Sabal minor, Cephalanthus occidentalis, Forestiera acuminata,* and/or *Cornus drummondii*. In the southwestern parts of the range, trees and shrubs with a western and subtropical affinity such as *Fraxinus berlandieriana, Prosopis glandulosa, Acacia farnesiana,* and *Ehretia anacua* become more prominent.

Similar Ecological Systems:
- Central Texas Coast River Terrace Sandyland Grassland (CES203.712)
- Central Texas Coastal Prairie Riparian (CES203.714)

Related Concepts:
- Central Texas Coastal Prairie River Floodplain Deciduous Forest and Woodland (4504) (Elliott 2011) Finer
- Central Texas Coastal Prairie River Floodplain Deciduous Shrubland (4506) (Elliott 2011) Finer. dominated by species such as *Prosopis glandulosa, Acacia farnesiana, Cephalanthus occidentalis, Forestiera acuminata*, and/or *Cornus drummondii*). Some sites mapped as this type may be dominated by *Chloracantha spinosa*. *Celtis laevigata* and *Ulmus crassifolia* are common within this type.
- Central Texas Coastal Prairie River Floodplain Evergreen Shrubland (4505) (Elliott 2011) Finer. shrubland with *Sabal minor, Rosa bracteata, Zanthoxylum fagara, Ehretia anacua, Baccharis halimifolia, Acacia farnesiana*.
- Central Texas Coastal Prairie River Floodplain Herbaceous Vegetation (4507) (Elliott 2011) Finer. More than 22% of this system is mapped as this type, though most sites represent managed pasture and may be dominated by species such as *Cynodon dactylon, Bothriochloa ischaemum var. songarica*, and *Paspalum notatum.*
- Central Texas Coastal Prairie River Floodplain Herbaceous Wetland (4517) (Elliott 2011) Finer. Wetlands typically dominated by sedges, wetland grasses, such as *Paspalum lividum (= Paspalum denticulatum)* or *Zizaniopsis miliacea*, and wetland forbs such as *Polygonum* spp.
- Central Texas Coastal Prairie River Floodplain Live Oak Forest and Woodland (4502) (Elliott 2011) Finer. canopy dominated by *Quercus fusiformis*.
- Central Texas Coastal Prairie River Floodplain Live Oak-Hardwood Forest and Woodland (4503) (Elliott 2011) Finer. mix of broadleaf and evergreen trees, including *Quercus fusiformis* and *Ehretia anacua*.

DESCRIPTION

Environment: This system occurs on bottomland soils along rivers, streams and larger drainages. It typically occupies Quaternary alluvium that forms terraces adjacent to the Beaumont or Lissie geologic formations. It is found in bottomland ecological site types with loamy, clayey, and sandy soils.

Vegetation: This system is characterized by woodlands and forests dominated by species such as *Celtis laevigata, Celtis laevigata var. reticulata, Ulmus crassifolia, Carya illinoinensis, Ulmus americana, Prosopis glandulosa*, and *Fraxinus berlandieriana* or *Fraxinus pennsylvanica*. The mixed deciduous-evergreen canopy may include *Quercus fusiformis* and *Ehretia anacua* as significant components of the overstory. Sites dominated by *Quercus fusiformis* typically occur on less-saturated sites such as slightly elevated situations. Less common species in the canopy may include *Acer negundo, Gleditsia triacanthos, Quercus macrocarpa, Populus deltoides, Platanus occidentalis, Morus rubra*, and *Acacia farnesiana*. Some wetter sites may be dominated by *Salix nigra* or, less commonly, *Taxodium distichum*. *Acer negundo, Sapindus saponaria var. drummondii, Ungnadia speciosa*, and saplings of the overstory species may form a subcanopy. The shrub layer is often not well-developed and contains species such as *Sabal minor, Ilex vomitoria, Ilex decidua, Diospyros texana, Sideroxylon lanuginosum, Prosopis glandulosa, Acacia farnesiana, Condalia hookeri,* and/or *Cornus drummondii*. *Sabal minor* or *Ilex vomitoria* may sometimes form a dense shrub understory. Some sites may represent dense shrublands dominated by *Cephalanthus occidentalis* or *Forestiera acuminata*, with a sparse overstory. Vines are commonly encountered, including species such as *Ampelopsis arborea, Vitis mustangensis, Smilax bona-nox, Toxicodendron radicans,* and *Campsis radicans*. The ground layer can be well-developed and often dominated by graminoids, including *Carex cherokeensis, Carex crus-corvi, Elymus virginicus, Phanopyrum gymnocarpon, Chasmanthium latifolium, Leersia* spp., *Paspalum langei, Panicum obtusum, Tripsacum dactyloides, Carex bulbostylis, Carex tetrastachya, Oplismenus hirtellus*, and *Dichanthelium sphaerocarpon*.

Forbs, such as *Malvaviscus arboreus var. drummondii, Chloracantha spinosa, Verbesina virginica, Calyptocarpus vialis, Commelina erecta, Allium canadense var. canadense, Myosotis macrosperma, Nemophila phacelioides*, and the somewhat rare *Tauschia texana* and *Spigelia loganioides (= Spigelia texana)*, may also be found in these woodlands. *Chloracantha spinosa* may sometimes form large, nearly monotypic in aspect stands. Wetter, herbaceous-dominated sites occur in these floodplains and may contain species such as *Cyperus* spp., *Eleocharis* spp., *Zizaniopsis miliacea, Paspalum lividum (= Paspalum denticulatum),* and *Typha domingensis*. The non-native *Triadica sebifera* may be present to dominant in the canopy of occurrences of this system. Non-native grasses such as *Cynodon dactylon, Bothriochloa ischaemum var. songarica, Urochloa maxima*, and *Sorghum halepense* may also be present and sometimes dominate the ground layer to the exclusion of other species.

Spatial Characteristics

Adjacent Ecological Systems:

- Columbia Bottomlands Forest and Woodland (CES203.715)
- Southeastern Great Plains Floodplain Forest (CES205.710)
- Tamaulipan Floodplain (CES301.990)
- Texas-Louisiana Coastal Prairie (CES203.550)

Adjacent Ecological System Comments: Upstream, beyond the Pleistocene formations traversed by ##Central Texas Coastal Prairie River Floodplain (CES203.713), floodplain forests transition to Southeastern Great Plains Floodplain Forest (CES205.710). The Nueces River shares some affinity with Tamaulipan Floodplain (CES301.990) to the south, which occurs along drainages further to the south and west of the Nueces, as well as the Nueces upstream of the prairie geologic formations. Floodplain systems north and east of the Navidad River are included in Columbia Bottomlands Forest and Woodland (CES203.715).

Distribution

Range: This system occurs along the Texas coast where it occupies bottomland soils along the coastal portions of the Navidad, Lavaca, Guadalupe, San Antonio, Mission, Aransas, and Nueces rivers (and their tributaries) as they cross the prairie surface of the Lissie and Beaumont geologic formations.
Divisions: 203:C
Nations: US
Subnations: TX
Map Zones: 34:C
USFS Ecomap Regions: 255Cg:CPP, 255Da:CCC, 255Dd:CCC, 315Ed:???
TNC Ecoregions: 31:C

Sources

References: Elliott 2011, Southeastern Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.859577#references
Description Author: L. Elliott, mod. J. Teague
Version: 25 Feb 2011 **Stakeholders:** Southeast
Concept Author: L. Elliott, D. Diamond, A. Treuer-kuehn, D. German, J. Teague **ClassifResp:** Southeast

CHIHUAHUAN-SONORAN DESERT BOTTOMLAND AND SWALE GRASSLAND (CES302.746)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: North American Warm Desert (302)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Lowland [Lowland]; Herbaceous; Swale; Toeslope/Valley Bottom; Depressional
Non-Diagnostic Classifiers: Clay Subsoil Texture; Intermittent Flooding [Intermittent interval, Summer Flooding]; Mesa; Plain; Tropical/Subtropical [Tropical Xeric]; Temperate [Temperate Continental]; Temperate [Temperate Xeric]; Isolated Wetland [Partially Isolated]
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2504; ESLF 9411; ESP 1504

CONCEPT

Summary: This ecological system is named based on the regions (Chihuahuan and Sonoran deserts) where it is best developed and occupies significant areas, however, it does occur well outside these regions, at least as far north and east as the Rolling Plains of Texas. The system occurs in relatively small depressions or swales and along drainages throughout the northern and central Chihuahuan Desert and adjacent Sky Islands and Sonoran Desert, as well as limited areas of the southern Great Plains on broad mesas, plains and valley bottoms that receive runoff from adjacent areas. Occupying low topographic positions, these sites generally have deep, fine-textured soils that are neutral to slightly or moderately saline/alkaline. During summer rainfall events, ponding is common. Vegetation is typically dominated by *Sporobolus airoides, Sporobolus wrightii, Pleuraphis mutica* (tobosa swales), or other mesic graminoids such as *Pascopyrum smithii* or *Panicum obtusum*. With tobosa swales, sand-adapted species such as *Yucca elata* may grow at the swale's edge in the deep sandy alluvium that is deposited there from upland slopes. *Sporobolus airoides* and *Sporobolus wrightii* are more common in alkaline soils and along drainages. Other grass species may be present, but these mesic species are diagnostic. Scattered shrubs such as *Atriplex canescens, Prosopis glandulosa, Ericameria nauseosa, Fallugia paradoxa, Krascheninnikovia lanata,* or *Rhus microphylla* may be present.
Classification Comments: NRCS Ecological Site Description MLRA 42 SD-2 Bottomland Ecological Site (NRCS 2006) describes this system on the Jornada Experimental Range with State-and-Transition Model showing shifts in species composition with land use.

This bottomland/depressional wetland system can be similar to the upland Chihuahuan Loamy Plains Desert Grassland (CES302.061) but is restricted to moist depressions and intermittently flooded drainage terraces and adjacent flats. Alkali sacaton (*Sporobolus airoides*) is often associated with more alkaline (to gypsic), poorly drained areas and giant sacaton (*Sporobolus wrightii*) with less alkaline better drained areas. *Distichlis spicata, Allenrolfea occidentalis,* and *Suaeda* spp. are characteristic of more saline and alkaline sites.

Similar Ecological Systems:
- Chihuahuan Loamy Plains Desert Grassland (CES302.061)

Related Concepts:
- Alkali Sacaton - Tobosagrass (701) (Shiflet 1994) Broader
- Grama -Muhly - Threeawn (713) (Shiflet 1994) Intersecting
- Southwest: Tobosa Grassland (407) [CES302.746.9] (Elliott 2011) Equivalent

DESCRIPTION

Environment: This ecological system occurs in relatively small depressions or swales and along drainages on broad mesas, plains and valley bottoms that receive runoff from adjacent areas. These sites occupy low topographic positions and generally have deep, fine-textured soils that are neutral to slightly or moderately saline/alkaline. The system typically occurs in local topographic lows that may be associated with drainages, or may represent swales or basins, but typically receives run-off from the surrounding landscape. Soils are generally clayey, and in some cases the shrink-swell characteristics of the soil may limit the development of woody species. Stands of the system typically occur on Quaternary alluvium, but may be local in nature and mapped within various geological formations. It is generally found on local topographic lows that may be associated with a drainage or may occur as basins or swales. Soils are typically tight ones, and Clay Flat Ecological Sites are typical.
Vegetation: The vegetation of this grassland system is typically dominated by *Sporobolus airoides, Sporobolus wrightii, Pleuraphis mutica* (in tobosa swales), or other mesic graminoids such as *Pascopyrum smithii* or *Panicum obtusum*. In tobosa swales, sand-adapted species such as *Yucca elata* may grow at the swale's edge in the deep sandy alluvium that is deposited there from upland slopes. *Sporobolus airoides* and *Sporobolus wrightii* are more common in alkaline soils and along drainages. Other grass species may be present, but these mesic species are diagnostic. *Prosopis glandulosa* may be present and, in some cases, may develop into a significant canopy. Other scattered shrubs such as *Atriplex canescens, Ericameria nauseosa, Fallugia paradoxa, Krascheninnikovia lanata,* or *Rhus microphylla* may be present. *Sporobolus airoides* is often associated with more alkaline (to gypsic), poorly drained areas and *Sporobolus wrightii* with less alkaline better drained areas. *Distichlis spicata, Allenrolfea occidentalis,* and *Suaeda* spp. are characteristic of more saline and alkaline sites.

Component Associations:

- *Panicum obtusum - Helianthus ciliaris* Herbaceous Vegetation (CEGL001574, G1)
- *Panicum obtusum - Panicum hirsutum* Herbaceous Vegetation (CEGL001576, GNRQ)
- *Pleuraphis mutica - Panicum obtusum* Herbaceous Vegetation (CEGL001639, G3)
- *Pleuraphis mutica - Scleropogon brevifolius* Herbaceous Vegetation (CEGL001640, G5)
- *Pleuraphis mutica* Monotype Herbaceous Vegetation (CEGL001637, G5?)
- *Sporobolus airoides - Distichlis spicata* Herbaceous Vegetation (CEGL001687, G4?)
- *Sporobolus airoides - Scleropogon brevifolius* Herbaceous Vegetation (CEGL001692, G5)
- *Sporobolus airoides* Monotype Herbaceous Vegetation (CEGL001688, GUQ)
- *Sporobolus airoides* Southern Plains Herbaceous Vegetation (CEGL001685, G3Q)
- *Sporobolus wrightii - Panicum hallii* Herbaceous Vegetation (CEGL001485, GNRQ)
- *Sporobolus wrightii - Panicum obtusum* Herbaceous Vegetation (CEGL001486, G2)

DISTRIBUTION

Range: This system is found in the central and northern Chihuahuan Desert and adjacent Sky Islands and Sonoran Desert, as well as limited areas of the southern Great Plains.
Divisions: 302:C; 303:C
Nations: MX, US
Subnations: AZ, MXCH(MX), MXCO(MX), MXSO(MX), NM, TX
Map Zones: 14:C, 23:C, 24:C, 25:C, 26:P, 27:C, 34:?, 35:?
USFS Ecomap Regions: 313C:PP, 315A:CC, 321A:CC, 322B:CC, M313A:CC, M313B:CC
TNC Ecoregions: 22:C, 23:C, 24:C, 28:C

SOURCES

References: Brown 1982a, Comer et al. 2003, Dick-Peddie 1993, Elliott 2011, MacMahon and Wagner 1985, Muldavin et al. 1998a, Muldavin et al. 1998d, Muldavin et al. 2000b, NRCS 2006a, Shiflet 1994
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722926#references
Description Author: K.A. Schulz, mod. M. Pyne and L. Elliott
Version: 24 Feb 2011 **Stakeholders:** Latin America, Southeast, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

COLUMBIA BOTTOMLANDS FOREST AND WOODLAND (CES203.715)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Forest and Woodland (Treed)
National Mapping Codes: ESLF 9391

CONCEPT

Summary: This system occupies a generally level landscape encompassing the historic floodplains of the Brazos, Colorado, and San Bernard rivers of the Coastal Prairie region of Texas. The level to gently rolling uplands are punctuated by a series of swales, depressions, terraces, and natural levees. Significant local topographic relief can be associated with these features. Much of the flooding experienced by this system results from seasonal precipitation and tropical storms, not from overbank flooding. A range of communities are expressed along a moisture gradient ranging from the wettest sites along stream margins and depressions, to somewhat drier sites on ridges and natural levees. Soils are frequently clayey or loamy bottomlands.

Related Concepts:

- Columbia Bottomlands Deciduous Forest and Woodland (4704) (Elliott 2011) Finer. Forest and woodland characterized by a deciduous canopy of species described for the system.
- Columbia Bottomlands Deciduous Shrubland (4706) (Elliott 2011) Finer. Shrub-dominated sites that may have a sparse woody overstory with species in the shrub layer such as *Cephalanthus occidentalis, Salix nigra, Forestiera acuminata,* and/or *Cornus drummondii*. *Triadica sebifera* may be a conspicuous component of these shrublands, which often result from disturbance.
- Columbia Bottomlands Evergreen Shrubland (4705) (Elliott 2011) Finer. Shrublands or sparse woodlands with a well-developed shrub layer with species such as *Ilex vomitoria, Sabal minor, Quercus virginiana, Rosa bracteata,* or *Baccharis* spp. These shrublands are often the result of disturbance. This subtype may include areas where cover in the shrub layer is dominated by *Triadica sebifera*. Species such as *Celtis laevigata, Quercus virginiana,* and *Salix nigra* may also be present.
- Columbia Bottomlands Herbaceous Vegetation (4707) (Elliott 2011) Finer. These are herbaceous-dominated sites occupying bottomland soils and lacking significant shrub or overstory canopy cover. They are mostly managed grasslands dominated by grasses such as *Cynodon dactylon, Paspalum notatum*, and *Lolium perenne*.
- Columbia Bottomlands Herbaceous Wetlands (4717) (Elliott 2011) Finer. Wetlands dominated by herbaceous species such as *Carex crus-corvi*, other *Carex* spp., *Eleocharis quadrangulata, Rhynchospora* spp., *Juncus* spp., *Sagittaria* spp., *Saururus cernuus, Echinodorus cordifolius, Typha* spp., and/or *Polygonum* spp.
- Columbia Bottomlands Live Oak Forest and Woodland (4702) (Elliott 2011) Finer. This type typically occupies slightly drier sites on levees and ridges and is dominated by *Quercus virginiana*.
- Columbia Bottomlands Mixed Evergreen-Deciduous Forest and Woodland (4703) (Elliott 2011) Finer. Forest and woodland with the canopy shared between *Quercus virginiana* and hardwood species described for the system.
- Columbia Bottomlands Riparian Deciduous Forest and Woodland (4714) (Elliott 2011) Finer. Forests and woodlands with a deciduous canopy that occupy sites along drainages but outside of bottomland soils.
- Columbia Bottomlands Riparian Deciduous Shrubland (4716) (Elliott 2011) Finer. Shrublands dominated by deciduous species along drainages that are outside of bottomland soils and are often the result of disturbance. Species such as *Sapindus saponaria var. drummondii, Cephalanthus occidentalis, Cornus drummondii*, or *Sesbania drummondii* may be dominant. Disturbed sites may be dominated by *Prosopis glandulosa, Acacia farnesiana,* or *Triadica sebifera*.
- Columbia Bottomlands Riparian Evergreen Shrubland (4715) (Elliott 2011) Finer. Evergreen shrublands, often resulting from disturbance, that occupy sites along drainages but outside of bottomland soils. Species such as *Baccharis* spp., *Rosa bracteata, Ilex vomitoria,* or small *Quercus virginiana* sometimes dominate this type.
- Columbia Bottomlands Riparian Herbaceous Vegetation (4727) (Elliott 2011) Finer. These are typically managed grasslands on upland drainages. Most are dominated by non-native species such as *Bothriochloa ischaemum var. songarica, Cynodon dactylon, Paspalum notatum,* and *Lolium perenne.*
- Columbia Bottomlands Riparian Herbaceous Wetland (4737) (Elliott 2011) Finer. Herbaceous wetlands along upland drainages outside of bottomland soils. These wetlands are often dominated by sedges, rushes, and forbs such as *Polygonum* spp.
- Columbia Bottomlands Riparian Live Oak Forest and Woodland (4712) (Elliott 2011) Finer. Forests or woodlands along drainages outside of bottomland soils, but within the Columbia Bottomlands landscape, where the canopy is dominated by *Quercus virginiana*.
- Columbia Bottomlands Riparian Mixed Evergreen-Deciduous Forest and Woodland (4713) (Elliott 2011) Finer. Forests or woodlands along drainages outside of bottomland soils, but within the Columbia Bottomlands landscape, where the canopy is codominated by *Quercus virginiana* and deciduous species.

DESCRIPTION

Environment: This system occurs on Quaternary alluvium and adjacent Pleistocene terraces (Beaumont and Lissie formations) along

the Brazos, San Bernard, and Colorado rivers (as they pass through these Pleistocene formations), and adjacent streams such as Oyster Creek, Caney Creek, and Linnville Bayou. It occupies a generally level landscape, punctuated by a series of swales, depressions, and natural levees. Much of the flooding experienced by this system results from seasonal precipitation and tropical storms. Overbank flooding is infrequent, occurring about every 15 to 25 years. Soils are frequently clayey bottomlands (such as Pledger or Brazoria clays) or loamy bottomlands (such as those of the Asa or Norwood series), but also found on blackland and claypan soils within the basin.

Vegetation: Herbaceous communities and open water typically characterize the wettest sites in this system, with species such as *Eleocharis quadrangulata, Sagittaria graminea, Sagittaria platyphylla, Ludwigia* spp., *Saururus cernuus, Azolla caroliniana,* and *Lemna obscura*. Such very wet sites may have *Taxodium distichum* and *Salix nigra* in the overstory, or may be shrub swamps dominated by *Cephalanthus occidentalis* and/or *Forestiera acuminata*. Sites inundated somewhat less frequently, such as meander scars, abandoned oxbows, and channels, are often dominated in the overstory by species including *Fraxinus pennsylvanica, Ulmus americana,* and *Carya aquatica*, while the woody understory of these sites are typically open and may be dominated by *Cephalanthus occidentalis* and/or *Forestiera acuminata*. Rarely, *Leitneria floridana* may be a conspicuous component of the shrub layer. Herbaceous cover is often patchy and can include species such as *Phanopyrum gymnocarpon, Echinodorus cordifolius, Carex* spp., *Rhynchospora corniculata, Saururus cernuus, Polygonum punctatum, Hygrophila lacustris, Boehmeria cylindrica, Mikania scandens,* and *Lemna obscura*. Flats and ridges that are only occasionally flooded are often dominated by *Celtis laevigata, Ulmus crassifolia, Quercus nigra,* and *Quercus shumardii*. Shrubs on these sites include *Ilex vomitoria, Sapindus saponaria var. drummondii, Malvaviscus arboreus var. drummondii, Symphoricarpos orbiculatus,* and *Callicarpa americana*. *Sabal minor* and *Carex cherokeensis* are more abundant on these sites, and other species such as *Toxicodendron radicans, Chasmanthium sessiliflorum, Chasmanthium latifolium, Calyptocarpus vialis, Oplismenus hirtellus ssp. setarius,* and *Polygonum virginianum* may be present. Clay backflats in this landscape may be dominated by *Quercus virginiana* and *Carya illinoinensis,* and *Quercus virginiana* may also share dominance with other canopy species on natural levees of these river systems. Blackland soils on the Pleistocene surface (such as those of the Lake Charles series) are often occupied by a forest dominated or codominated by *Quercus nigra, Celtis laevigata, Ulmus crassifolia, Fraxinus pennsylvanica,* and less frequently *Quercus virginiana*. The shrub layer on these sites is often well-developed and typically dominated by *Ilex vomitoria,* sometimes with *Sabal minor, Cornus drummondii,* and *Prunus caroliniana* also present. Vines are commonly encountered, including species such as *Vitis mustangensis, Toxicodendron radicans, Ampelopsis arborea,* and *Berchemia scandens*. *Chasmanthium sessiliflorum, Carex cherokeensis, Carex crus-corvi, Urochloa platyphylla, Juncus* spp., and numerous other species are commonly found in the herbaceous layer. It is unclear whether these typically prairie-dominated surfaces are now occupied by woodland and forest due to a disruption in natural fire cycle and disturbance, or whether the unique hydrology or other environmental factors of the Columbia Bottomlands leads to this incongruity. *Tillandsia usneoides* is a frequently encountered epiphyte in these forests. Riverside woodlands, along major rivers, have *Platanus occidentalis* and *Populus deltoides* in the canopy. The non-native tree *Triadica sebifera* may often be encountered, sometimes as a significant or dominant component of the canopy.

Component Associations:
- *Cephalanthus occidentalis / Carex* spp. - *Lemna* spp. Southern Shrubland (CEGL002191, G4)
- *Fraxinus pennsylvanica - (Carya aquatica) / Forestiera acuminata / Phanopyrum gymnocarpon* Depression Forest (CEGL007926, G2?)
- *Platanus occidentalis - Salix nigra / Conyza canadensis* Forest (CEGL004612, G4?)
- *Quercus virginiana - Quercus nigra / Chasmanthium latifolium* Forest (CEGL002107, G2G3)
- *Quercus virginiana / Ilex vomitoria - Sabal minor / Carex cherokeensis - Malvaviscus arboreus var. drummondii* Forest (CEGL007830, G2G3)
- *Salix nigra - (Fraxinus pennsylvanica, Acacia farnesiana)* Forest (CEGL008481, G4?)
- *Taxodium distichum - Fraxinus pennsylvanica* Gallery Forest (CEGL007928, G2Q)
- *Ulmus crassifolia - Carya illinoinensis - Celtis laevigata / Chasmanthium sessiliflorum - Carex cherokeensis* Forest (CEGL002388, G2G3)

Spatial Characteristics

Adjacent Ecological Systems:
- Central Texas Coastal Prairie River Floodplain (CES203.713)

Distribution

Range: This system occupies a large area encompassing the historic floodplains of the Brazos, Colorado, and San Bernard rivers in the Coastal Prairie region of the Texas Gulf Coast. Chocolate Bayou represents the eastern extent of this system as the forest grades into systems more closely resembling West Gulf Coastal Plain Small Stream and River Forest (CES203.487) to the northeast. Tres Palacios Creek represents the southwestern limit of this system, as floodplains further south and west share closer affinity to coastal rivers such as the Mission and Aransas.

Divisions: 203:C
Nations: US
Subnations: TX
Map Zones: 36:C
USFS Ecomap Regions: 255Da:CCC, 255Db:CCC, 255Dd:CCC
TNC Ecoregions: 31:C

Sources

References: Elliott 2011, Rosen and Miller 2005, Rosen et al. 2008, Southeastern Ecology Working Group n.d.

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.859583#references

Description Author: L. Elliott, mod. J. Teague

Version: 25 Feb 2011

Concept Author: L. Elliott, D. Diamond, A. Treuer-kuehn, D. German, J. Teague

Stakeholders: Southeast

ClassifResp: Southeast

EAST GULF COASTAL PLAIN DUNE AND COASTAL GRASSLAND (CES203.500)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Non-Diagnostic Classifiers: Herbaceous; Depressional; Isolated Wetland [Partially Isolated]
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2435; ESLF 7148; ESP 1435

CONCEPT

Summary: This system includes vegetation of coastal dunes along the northern Gulf of Mexico, including the northwestern panhandle of Florida, southern Alabama, and southeastern Mississippi. The vegetation consists largely of herbaceous and embedded shrublands on barrier islands and other near-coastal areas where salt spray, saltwater overwash, and sand movement are important ecological forces. This vegetation differs from that of other regions of the Gulf, and this region forms a natural unit with similar climate and substrate. There are a number of diagnostic and endemic plant species which characterize this system, including *Ceratiola ericoides*, *Chrysoma pauciflosculosa*, *Schizachyrium maritimum*, *Paronychia erecta*, and *Helianthemum arenicola*.

Similar Ecological Systems:
- East Gulf Coastal Plain Maritime Forest (CES203.503)

Related Concepts:
- Beach Dune (FNAI 1990) Intersecting
- Coastal Grassland (FNAI 1990) Intersecting
- Southern Scrub Oak: 72 (Eyre 1980) Finer

DESCRIPTION

Environment: The vegetation consists largely of herbaceous vegetation and patches of shrublands on barrier islands and other near-coastal areas where salt spray, saltwater overwash, and sand movement are important ecological forces. This vegetation differs from that of other regions of the Gulf, and this region forms a natural unit with similar climate and substrate (Johnson 1997).

Vegetation: There are a number of diagnostic and endemic plant species which characterize this system, including *Ceratiola ericoides*, *Chrysoma pauciflosculosa*, *Schizachyrium maritimum*, *Paronychia erecta*, and *Helianthemum arenicola* (Johnson and Barbour 1990).

Dynamics: The natural coastal dynamics include the movement of sand from wind, tides, and storm surge. This includes transport of sand along the coast (primarily from east to west), and movement of sand by wind or water between the dunes, beach and subtidal areas, and the movement of sand from the foredunes to the interior. If not restricted by infrastructure or engineered hard structures, beaches and dunes can migrate as coastlines change over time in response to the action of wind and water. The Gulf of Mexico coast is affected by one tide per day. Coastal grassland develops as a barrier island builds seaward, developing new dune ridges along the shore which protect the inland ridges from sand burial and salt spray, or as a beach recovers after storm overwash and a new foredune ridge builds up along the shore, protecting the overwashed area behind it from sand burial and salt spray (FNAI 2010a). Wrack and seaweed deposited along the shore is an important source of nutrients for the coastal ecosystem, and helps promote revegetation in newly disturbed areas (Defeo et al. 2009). Fire is rare and local to small areas.

Component Associations:
- *(Iva imbricata) / Sporobolus virginicus - Spartina patens - (Paspalum distichum, Sesuvium portulacastrum)* Herbaceous Vegetation (CEGL007839, G3?)
- *Ceratiola ericoides - (Chrysoma pauciflosculosa) / Polygonella polygama / Cladonia leporina* Shrubland (CEGL003864, G2?)
- *Chrysoma pauciflosculosa - Paronychia erecta* Dwarf-shrubland (CEGL003947, G1G2)
- *Fuirena scirpoidea - Panicum tenerum - Dichanthelium wrightianum - Andropogon capillipes* Herbaceous Vegetation (CEGL004953, G2?)
- *Ilex vomitoria - Quercus (geminata, virginiana) - Morella cerifera - Serenoa repens* Shrubland (CEGL003813, G2G3)
- *Quercus myrtifolia - Quercus geminata - Ceratiola ericoides - Conradina canescens* Shrubland (CEGL003824, G2)
- *Schizachyrium maritimum - (Heterotheca subaxillaris)* Herbaceous Vegetation (CEGL004057, G2)
- *Spartina patens - Schizachyrium maritimum - Solidago sempervirens* Herbaceous Vegetation (CEGL008445, G3?)
- *Spartina patens - Setaria parviflora - Hydrocotyle bonariensis* Herbaceous Vegetation (CEGL004257, G3)

DISTRIBUTION

Range: Coastal dunes along the northern Gulf of Mexico, including the northwestern panhandle of Florida, southern Alabama, and southeastern Mississippi.
Divisions: 203:C
Nations: US
Subnations: AL, FL, MS

Map Zones: 55:C, 99:C
USFS Ecomap Regions: 232L:CC
TNC Ecoregions: 53:C

SOURCES

References: Comer et al. 2003, Defeo et al. 2009, FNAI 2010a, Johnson 1997, Johnson and Barbour 1990, Johnson and Muller 1993a
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723088#references
Description Author: R. Evans, mod. C. Nordman
Version: 14 Jan 2014
Concept Author: R. Evans
Stakeholders: Southeast
ClassifResp: Southeast

EAST GULF COASTAL PLAIN NEAR-COAST PINE FLATWOODS (CES203.375)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Forest and Woodland (Treed); Extensive Wet Flat; Short Disturbance Interval; Needle-Leaved Tree
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2454; ESLF 9123; ESP 1454

CONCEPT

Summary: This system of open forests or woodlands occupies broad, sandy flatlands in a relatively narrow band along the northern Gulf of Mexico coast east of the Mississippi River. This range corresponds roughly to the Gulf Coast Flatwoods (EPA Ecoregion 75a). These areas predominantly occur on poorly drained acidic Spodosol soils, which are subject to seasonal inundation as well as droughty conditions. Often called "flatwoods" or "flatlands," they are subject to short fire-return intervals and seasonally high water tables. Overstory vegetation is characterized by *Pinus palustris* and, to a lesser degree, by *Pinus elliottii*. Understory structure ranges from densely shrubby to open and herbaceous-dominated, with variation in soils and drainage. The variation includes Scrubby Flatwoods, Mesic Flatwoods, Wet Flatwoods, and Maritime Flatwoods. Fire is naturally frequent; many sites have a fire-return time of from one to four years.
Classification Comments: There was some consideration of splitting out the slash pine flatwoods from this system due to presumed differences in both moisture status and fire history when compared with typical longleaf. There is considerable variation between wet and "non-wet" flatwoods implied in this system.
Similar Ecological Systems:
- Central Florida Pine Flatwoods (CES203.382)
- East Gulf Coastal Plain Interior Upland Longleaf Pine Woodland (CES203.496)
- Southern Atlantic Coastal Plain Wet Pine Savanna and Flatwoods (CES203.536)

Related Concepts:
- Longleaf Pine - Slash Pine: 83 (Eyre 1980) Finer
- Longleaf Pine: 70 (Eyre 1980) Finer
- Mesic Flatwoods (FNAI 1990) Intersecting
- Pond Pine: 98 (Eyre 1980) Finer
- Pondcypress: 100 (Eyre 1980) Finer
- Scrubby Flatwoods (FNAI 1990) Intersecting
- Slash Pine: 84 (Eyre 1980) Finer
- Wet Flatwoods (FNAI 1990) Intersecting

DESCRIPTION

Environment: This system occupies broad, sandy flatlands which are subject to short fire-return intervals even though they are subject to seasonally high water tables. Spodosols encourage seasonal saturation, acidity, and high soil iron and aluminum concentrations. These areas are often called "flatwoods" or "flatlands."
Vegetation: Overstory vegetation is characterized by *Pinus palustris* and to a lesser degree by *Pinus elliottii*. Some stands include *Pinus serotina*. Shrubs include *Quercus geminata, Quercus minima, Quercus pumila, Serenoa repens, Cyrilla racemiflora, Ilex coriacea, Ilex glabra, Ilex vomitoria*, and *Lyonia lucida*. Herbaceous species may include *Aristida beyrichiana, Ctenium aromaticum, Muhlenbergia expansa, Schizachyrium scoparium, Sporobolus floridanus, Carphephorus pseudoliatris, Sarracenia alata, Agalinis filicaulis, Polygala cymosa, Rhynchospora* spp., and *Helianthus radula*.
Dynamics: Fire is naturally frequent, with a fire-return time of from one to four years. Disturbances are an important part of the natural functions of wet pine savanna and flatwoods. In order for these habitats to burn frequently (every 2-3 years), there needs to be enough fine fuel, such as needles from *Pinus palustris* trees, healthy populations of native warm-season grasses, and evergreen shrubs with volatile oils in their leaves, such as *Gaylussacia frondosa, Ilex coriacea, Ilex glabra, Lyonia* spp., *Serenoa repens*, and *Vaccinium* spp. The frequent fires promote flowering, seed production, and seed germination of many plants and provide open areas in patches (Van Lear et al. 2005).

Component Associations:
- *Pinus (palustris, elliottii var. elliottii) / (Quercus geminata) / Serenoa repens / Aristida beyrichiana* Woodland (CEGL007714, G3?)
- *Pinus elliottii var. elliottii - (Pinus palustris) / Ilex vomitoria - Serenoa repens - Morella cerifera* Woodland (CEGL004658, G2G3)
- *Pinus elliottii var. elliottii - (Pinus serotina) / Aristida beyrichiana - Rhynchospora oligantha - Sarracenia (flava, minor, psittacina)* Woodland (CEGL003673, G2?)
- *Pinus elliottii var. elliottii - Taxodium ascendens / Polygala cymosa - Rhynchospora* spp. Woodland (CEGL004556, G2?)

- *Pinus elliottii var. elliottii / Serenoa repens - Ilex glabra* Woodland (CEGL003643, G4?)
- *Pinus palustris - (Pinus elliottii var. elliottii) / Ctenium aromaticum - Carphephorus pseudoliatris - (Sarracenia alata)* Woodland (CEGL003645, G3?)
- *Pinus palustris - (Pinus elliottii var. elliottii) / Ilex coriacea - Cyrilla racemiflora* Woodland (CEGL003656, G3G4)
- *Pinus palustris - (Pinus elliottii var. elliottii) / Ilex vomitoria / Muhlenbergia expansa - Agalinis filicaulis* Woodland (CEGL004792, G1?)
- *Pinus palustris - Pinus serotina / Ilex glabra - Lyonia lucida - (Serenoa repens)* Woodland (CEGL004791, G3G4)
- *Pinus palustris / Quercus minima - Quercus pumila / Aristida beyrichiana* Woodland (CEGL003808, G3?)
- *Pinus palustris / Schizachyrium scoparium - Muhlenbergia expansa - Helianthus radula* Woodland (CEGL004956, G2?)
- *Pinus palustris / Serenoa repens - Ilex glabra* Woodland (CEGL003653, G2G3)
- *Pinus serotina / Sporobolus floridanus - Aristida beyrichiana* Woodland (CEGL003797, G2)

DISTRIBUTION

Range: This system is conceived of as including wet and dry pine flatwoods of the near-coastal zone of the East Gulf Coastal Plain, mainly south of the Cody Scarp (Peet and Allard 1993). It corresponds roughly to the Gulf Coast Flatwoods, Ecoregion 75a (EPA 2004).
Divisions: 203:C
Nations: US
Subnations: AL, FL, GA, LA, MS
Map Zones: 55:C, 99:C
USFS Ecomap Regions: 232D:CC, 232L:CC
TNC Ecoregions: 53:C

SOURCES

References: Brewer 2008, Carr et al. 2010, Comer et al. 2003, EPA 2004, Eyre 1980, FNAI 1990, FNAI 2010a, Griffith et al. 2001, NatureServe 2011, Oswalt et al. 2012, Peet 2006, Peet and Allard 1993, Van Lear et al. 2005, Wahlenberg 1946
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723141#references
Description Author: R. Evans, mod. M. Pyne and C. Nordman
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: R. Evans **ClassifResp:** Southeast

EASTERN BOREAL FLOODPLAIN (CES103.588)

CLASSIFIERS

Classification Status: Standard

Primary Division: Boreal (103)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Short (<5 yrs) Flooding Interval [Short interval, Spring Flooding]; Forest and Woodland (Treed); Riverine / Alluvial; Flood Scouring; Picea (glauca, mariana, rubens) - Abies
Non-Diagnostic Classifiers: Mesotrophic Water; Circumneutral Water; Acidic Water; Lowland; Shrubland (Shrub-dominated); Toeslope/Valley Bottom; Glaciated; Mesotrophic Soil; Oligotrophic Soil; Circumneutral Soil; Acidic Soil; Deep Soil; Mineral: W/ A-Horizon >10 cm; Silt Soil Texture; Very Short Disturbance Interval
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Mixed evergreen-deciduous open tree canopy
National Mapping Codes: EVT 2444; ESLF 9113; ESP 1444

CONCEPT

Summary: These southern boreal floodplains are found in the extreme northern portions of the eastern U.S., and believed to be more widespread in Canada. They consist of floodplains along medium-sized northern rivers, in areas not strongly influenced by ice-scour (i.e., depositional), where topography and process have resulted in a complex of upland and wetland alluvial vegetation. This complex includes floodplain forests dominated by northern trees such as *Populus balsamifera* and *Fraxinus nigra*, as well as herbaceous sloughs and shrub wetlands. (*Acer saccharinum* is uncommon or absent.) Most areas are underwater each spring; microtopography determines how long the various habitats are inundated. The distribution in Division 201 appears to be primarily Canadian, with incursions into northern Maine and northern Minnesota.
Classification Comments: Where this system transitions to Western Canadian Boreal Mixed Hardwood-Conifer Swamp and Floodplain (CES103.523) is not clear, and perhaps they should be combined. As written, this system does have some different floristics than the western boreal one.
Related Concepts:
- Alder Floodplain (Gawler and Cutko 2010) Finer
- Balsam Poplar Floodplain Forest (Gawler and Cutko 2010) Finer
- Black Ash - American Elm - Red Maple: 39 (Eyre 1980) Finer

Component Associations:
- *Acer rubrum - Abies balsamea / Viburnum nudum var. cassinoides* Floodplain Forest (CEGL006501, GNR)
- *Calamagrostis canadensis - Carex* spp. Laurentian & Northeast Wet Meadow (CEGL005448, G4G5)
- *Cornus sericea - Salix* spp. - (*Rosa palustris*) Shrubland (CEGL002186, G5)
- *Fraxinus nigra* - Mixed Hardwoods - Conifers / *Cornus sericea / Carex* spp. Forest (CEGL002105, G4)
- *Populus balsamifera - Fraxinus nigra / Matteuccia struthiopteris* Forest (CEGL006432, GNR)
- River Mudflats Sparse Vegetation (CEGL002314, GNR)

DISTRIBUTION

Range: This system is found primarily in eastern Canada, with distribution extending into far-northern New England and the northern Great Lakes region.
Divisions: 103:C; 201:C
Nations: CA, US
Subnations: ME, MI, MN, NB, NH, NY, ON, QC, VT
Map Zones: 40:?, 41:P, 50:P, 51:P, 63:P, 64:P, 66:C
USFS Ecomap Regions: 212J:CP, 212L:CP, 212M:CP, 212N:CP, 212R:CP, 212S:CP, 212T:CP, 212X:CP, 212Y:CP
TNC Ecoregions: 47:P, 48:C, 63:C

SOURCES

References: Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723018#references
Description Author: S.C. Gawler
Version: 09 Jan 2003 **Stakeholders:** Canada, East, Midwest
Concept Author: S.C. Gawler **ClassifResp:** East

GREAT LAKES WET-MESIC LAKEPLAIN PRAIRIE (CES202.027)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Non-Diagnostic Classifiers: Herbaceous; Depressional [Lakeshore]; Isolated Wetland [Partially Isolated]
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2411; ESLF 7124; ESP 1411

CONCEPT

Summary: This system is found on the lakeplain near the southern central Great Lakes of the United States and Canada. Stands occur on level, sandy glacial outwash, sandy glacial lakeplains, and deposits of dune sand in silty/clayey glacial lakeplains. The soils are sands and sandy loams, loams with poor to moderate water-retaining capacity, typically occurring over less permeable silty clays . There is often temporary inundations after heavy rains or in the spring, followed by dry conditions throughout much of the remaining growing season. The vegetation of this system is dominated by graminoid species typically 1-2 m high. Trees and shrubs are very rare. There is very little bare ground. *Andropogon gerardii, Calamagrostis canadensis, Carex* spp. (*Carex aquatilis, Carex bicknellii, Carex buxbaumii, Carex pellita (= Carex lanuginosa)*), *Panicum virgatum, Spartina pectinata, Schizachyrium scoparium*, and *Sorghastrum nutans* are the most abundant graminoid species. Many of the sites that this system formerly occupied are now urban and/or agricultural. Areas around Chicago and Detroit were likely in this system but are heavily converted now and few sites remain. Remnant sites have been impacted by woody encroachment of native and non-native species.

DESCRIPTION

Environment: Stands occur on level, sandy glacial outwash, sandy glacial lakeplains, and deposits of dune sand in silty/clayey glacial lakeplains. The soils are sands, sandy loams, and loams with poor to moderate water-retaining capacity and typically occur over less permeable silty clays. The shallow, less permeable silty clays and the flat landscape combine to favor temporary inundations after heavy rains or in the spring. The coarser surface soils then dry out throughout much of the remaining growing season. These occurred in a patchy landscape of both drier oak woodland/savanna and more mesic beech-maple forest. Pin oak depressions were common in these prairies.
Dynamics: The cycle of soils being temporarily inundated and then drying out during the growing season is important for this system. Great Lakes water levels also affected this system with longer-term increases and decreases creating wetter and drier baseline conditions, respectively. Graminoids and forbs can thrive under these conditions but woody species are inhibited. The dry conditions and abundance of herbaceous vegetation creates conditions well-suited for burning and fires further reduced woody vegetation. Drier sites and those in a drier landscape burned more frequently. Fires were most likely in dry years after a productive year(s) when biomass was higher. Fire regime was probably related to the adjacent oak savannas but likely a little less frequent. Water levels were highly variable and boundaries of this system probably shifted across the landscape in response to fire, Great Lakes water levels, and wetter or drier climatic cycles.

Component Associations:
- *Andropogon gerardii - Calamagrostis canadensis - Pycnanthemum virginianum - Oligoneuron ohioense* Herbaceous Vegetation (CEGL005095, G2)
- *Andropogon gerardii - Sorghastrum nutans - Schizachyrium scoparium - Aletris farinosa* Herbaceous Vegetation (CEGL005096, G2)
- *Quercus alba - Quercus velutina - Quercus palustris / Carex pensylvanica* Woodland (CEGL005054, G2)
- *Spartina pectinata - Carex* spp. *- Calamagrostis canadensis* Lakeplain Herbaceous Vegetation (CEGL005109, G2G3)

DISTRIBUTION

Range: This system is found near the southern central Great Lakes of the United States and Canada, from southeastern Wisconsin and northeastern Illinois to southern Michigan and southwestern Ontario. This does not go farther east than northwestern Ohio (glacial Lake Maumee).
Divisions: 202:C
Nations: CA, US
Subnations: IL, IN, MI, OH, ON, WI
Map Zones: 41:?, 49:C, 50:C, 51:C, 52:C
USFS Ecomap Regions: 222Ja:CCC, 222K:CC, 222Ua:CCC, 222Ud:CCC, 222Ue:CCC
TNC Ecoregions: 48:C

SOURCES

References: Chapman 1984, Chapman et al. 1989, Comer et al. 1995b, Comer et al. 2003, Faber-Langendoen and Maycock 1987, Faber-Langendoen and Maycock 1994, Kost et al. 2007
Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722678#references
Description Author: K. Chapman, D. Faber-Langendoen, P. Comer, mod. S.C. Gawler and J. Drake
Version: 14 Jan 2014 **Stakeholders:** Canada, Midwest
Concept Author: K. Chapman, D. Faber-Langendoen, P. Comer **ClassifResp:** Midwest

GREAT LAKES WOODED DUNE AND SWALE (CES201.726)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Laurentian-Acadian (201)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: 30-180-day hydroperiod; Coastal Dune Mosaic; Forest and Woodland (Treed); Dune (Substrate); Glaciated; Sand Soil Texture
Non-Diagnostic Classifiers: Shallow (<15 cm) Water; Lowland [Lowland]; Shrubland (Shrub-dominated); Herbaceous; Temperate [Temperate Continental]; Depressional [Lakeshore]; Isolated Wetland [Partially Isolated]; Intermediate Disturbance Interval; W-Patch/High Intensity
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Mixed evergreen-deciduous open tree canopy
National Mapping Codes: EVT 2466; ESLF 9135; ESP 1466

CONCEPT

Summary: This system is found in nearly 100 occurrences throughout the Great Lakes shorelines of the United States and Canada. It consists of a foredune, followed by a series of low to high dunes (uplands) and swales (wetlands). The system is often best developed where post-glacial streams entered an embayment and provide a dependable sand source. The combination of along-shore currents, waves, and winds form foredunes along the shoreline. The foredunes of most dune-and-swale complexes are commonly 1-2 m high, with *Ammophila breviligulata, Calamovilfa longifolia, Salix serissima, Salix cordata,* and *Populus balsamifera* most common. The swale immediately behind the foredune is influenced by short-term variation in lake levels and can be partially or occasionally completely filled by dune sands following major storm events. Species common to this first swale include *Juncus balticus, Juncus pelocarpus, Juncus nodosus, Eleocharis acicularis,* and *Schoenoplectus americanus (= Scirpus americanus)*. Occasionally, such swales may contain lake-influenced, calcareous sands and may contain moderately alkaline indicators.

A low dune field with more advanced plant succession often follows the first open dunes and swales. *Pinus banksiana, Pinus strobus,* and *Pinus resinosa* often form a scattered overstory canopy, while *Juniperus communis, Juniperus horizontalis, Arctostaphylos uva-ursi,* and *Koeleria macrantha* form a scattered ground layer. Following the dune-field zone, both dunes and swales are typically forested. Moist swales are often forested, and soil organic material has often begun to accumulate. *Thuja occidentalis, Alnus incana, Salix* spp., and *Acer rubrum* dominate the partial overstory canopy and understory. In contrast to the dry or moist swales, wetter swales (where standing water is present through most of the year) may be dominated by Carices, such as *Carex aquatilis* and *Carex stricta*. Forested beach ridges, with soils of medium to course sand, tend to be dominated by species common to dry-mesic and mesic northern forest. Complexes located in embayments protected from prevailing winds tend to be formed entirely of low, water-lain beach ridges. As a result, even the beach ridges within these complexes support wetland vegetation.

Six major subtypes of Great Lakes Dune and Swale were described for Michigan, including the Lake Superior high dune type, the Lake Superior low dune type, the North Lake Michigan high dune type, Northern Lake Huron-Lake Michigan low dune type, the Southern Lake Huron type, and the Northern Great Lakes low dune type. These subtypes represent patterns of floristic variation resulting from latitude and sand dune/beach ridge characteristics that constrain floristic and structural attributes. High dune types may support predominantly upland vegetation, while low dune types may support predominantly wetland vegetation.
Classification Comments: Six major subtypes of Great Lakes Dune and Swale were described for Michigan, including the Lake Superior high dune type, the Lake Superior low dune type, the North Lake Michigan high dune type, Northern Lake Huron-Lake Michigan low dune type, the Southern Lake Huron type, and the Northern Great Lakes low dune type. These subtypes represent patterns of floristic variation resulting from latitude and sand dune/beach ridge characteristics that constrain floristic and structural attributes.

This system has rather strong variation between northern and southern Great Lakes examples (north and south of Bailey's 210-220 division line). Those occurring along the southern Lake Michigan shoreline of Indiana and Illinois have been altered significantly, but likely reflect a distinct ecological system type with oak woodland and savanna on beach ridges and wet prairie in swales.
Similar Ecological Systems:
- Great Lakes Dune (CES201.026)
- Great Lakes Sand Beach (CES201.149)
- Northern Great Lakes Interdunal Wetland (CES201.034)--may not be a distinct system.

Related Concepts:
- Jack Pine: 1 (Eyre 1980) Finer
- Northern White-Cedar: 37 (Eyre 1980) Finer

DESCRIPTION

Environment: The system consists of a foredune, followed by a series of low to high dunes (uplands) and swales (wetlands). The system is often best developed where post-glacial streams entered an embayment and provide a dependable sand source. The combination of along-shore currents, waves, and winds form foredunes along the shoreline. With gradual long-term drops in water

level, combined with post-glacial uplifting of the earth's crust, these low dunes gradually rise above the direct influence of the lakes, and new foredunes replace them. Over several thousand years, a series of ridges and swales is created. For most complexes, the flow of surface streams and groundwater maintain the wet conditions in the swales. With time, plant succession has proceeded to the point where the beach ridges are now forested while the wet swales are either forested or open wetlands. Along the Lake Superior shoreline, where post-glacial uplift is greatest, many of the complexes consist primarily of dry, forested swales. The dunes and swales differs depending on fetch and the amount of sediment available. The influence of Great Lakes water-level fluctuations is probably limited to the first few swales inland from the shoreline. For most of the complexes, the water occupying the swales comes from streams flowing from the adjacent uplands or from groundwater seepage.

Vegetation: The foredunes of most dune-and-swale complexes are commonly 1-2 m high, with *Ammophila breviligulata, Calamovilfa longifolia, Salix serissima, Salix cordata*, and *Populus balsamifera* most common. The swale immediately behind the foredune is influenced by short-term variation in lake levels and can be partially or occasionally completely filled by dune sands following major storm events. Species common to this first swale include *Juncus balticus, Juncus pelocarpus, Juncus nodosus, Eleocharis acicularis*, and *Schoenoplectus americanus (= Scirpus americanus)*. Occasionally, such swales may contain lake-influenced, calcareous sands, and the shallow swale may contain moderately alkaline indicators, such as *Cladium mariscoides, Myrica gale, Dasiphora fruticosa ssp. floribunda (= Pentaphylloides floribunda)*, and others.

A low dune field with more advanced plant succession often follows the first open dunes and swales. *Pinus banksiana, Pinus strobus*, and *Pinus resinosa* often form a scattered overstory canopy, while *Juniperus communis, Juniperus horizontalis, Arctostaphylos uva-ursi*, and *Koeleria macrantha* form a scattered ground layer.

Following the dune-field zone, both dunes and swales are typically forested. Moist swales are often forested, and soil organic material has often begun to accumulate. *Thuja occidentalis*, *Alnus incana*, *Salix* spp., and *Acer rubrum* dominate the partial overstory canopy and understory. In contrast to the dry or moist swales, wetter swales (where standing water is present through most of the year) may be dominated by Carices, such as *Carex aquatilis* and *Carex stricta*.

Forested beach ridges, with soils of medium to course sand, tend to be dominated by species common to dry-mesic and mesic northern forest. Soil moisture conditions appear to change dramatically with slight elevational changes and are reflected in the development of soil organic material and changing plant species. On higher, drier ridges, soils often have less than 3 cm of organic material. *Pinus resinosa, Pinus strobus*, and *Quercus rubra* are often codominant, while *Betula papyrifera, Populus grandidentata, Abies balsamea*, and *Acer rubrum* are subdominant or understory species. *Pteridium aquilinum, Gaylussacia baccata, Vaccinium myrtilloides, Cornus canadensis*, and *Gaultheria procumbens* occur in the shrub and ground layers.

Complexes located in embayments protected from prevailing winds tend to be formed entirely of low, water-lain beach ridges. As a result, even the beach ridges within these complexes support wetland vegetation.

Dynamics: Foredune and immediate back dune areas are influenced by active dune processes of wind-caused "blowouts" and subsequent restabilization. Forested beach ridges may support fire regimes characteristic of similar upland forest systems outside of these complexes. Due to lakeshore proximity, heavy winds and resultant windthrow are common in forested ridges. Great Lakes water-level fluctuations likely influence water levels in swales closest to the shoreline, if at all. The hydrology of interdunal swales is driven largely by lateral flow through the porous beach ridges. Older swales (farthest from current lakeshores) in larger complexes support peat-forming bogs.

Component Associations:

- *Ammophila breviligulata - (Schizachyrium scoparium)* Herbaceous Vegetation (CEGL005098, G3G5)
- *Chamaedaphne calyculata - Myrica gale / Carex lasiocarpa* Dwarf-shrubland (CEGL005228, G4G5)
- *Dasiphora fruticosa ssp. floribunda / Cladium mariscoides - Juncus balticus - (Rhynchospora capillacea)* Herbaceous Vegetation (CEGL005105, G3?)
- *Hudsonia tomentosa* Dune Dwarf-shrubland (CEGL004024, GNR)
- *Juniperus horizontalis - Arctostaphylos uva-ursi - Juniperus communis* Dune Dwarf-shrubland (CEGL005064, G3G4)
- *Pinus banksiana - (Pinus resinosa) - Pinus strobus / Juniperus horizontalis* Wooded Herbaceous Vegetation (CEGL005125, G2)
- *Pinus banksiana - Pinus resinosa - Pinus strobus* Dune Forest (CEGL002589, G3Q)
- *Populus deltoides - (Juniperus virginiana)* Dune Woodland (CEGL005119, G1G2)
- *Prunus pumila - (Ptelea trifoliata)* Dune Shrubland (CEGL005075, G2Q)
- *Thuja occidentalis - (Picea mariana, Abies balsamea) / Alnus incana* Forest (CEGL002456, G4)
- *Thuja occidentalis - Fraxinus nigra* Forest (CEGL005165, GNR)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:

- Great Lakes Sand Beach (CES201.149)

DISTRIBUTION

Range: This system occurs throughout the Great Lakes shorelines of the United States and Canada. In Pennsylvania, this is only on Presque Isle.

Divisions: 201:C; 202:C

Nations: CA, US

Subnations: IL, IN, MI, MN, NY, OH?, ON, PA, WI

Map Zones: 41:C, 49:C, 50:C, 51:C, 52:C, 62:C, 63:C, 64:C

USFS Ecomap Regions: 211Ee:PPP, 212Ha:CCC, 212Hf:CCC, 212Hl:CCC, 212J:CC, 212L:CC, 212Ra:CCC, 212Rc:CCC, 212Re:CCC, 212Sb:CCC, 212Sc:CCC, 212Sn:CCC, 212Sq:CCC, 212Te:CCC, 212Ya:CCC, 212Z:CC, 222Ib:CCP, 222Ie:CCC, 222Ud:CCC, 222Ue:CCC
TNC Ecoregions: 48:C

SOURCES

References: Comer and Albert 1993, Comer et al. 2003, Lichter 1998, MNFI 1999
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722946#references
Description Author: P. Comer and D. Albert
Version: 11 Apr 2007 **Stakeholders:** Canada, East, Midwest
Concept Author: P. Comer and D. Albert **ClassifResp:** Midwest

GREAT PLAINS PRAIRIE POTHOLE (CES303.661)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Western Great Plains (303)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Non-Diagnostic Classifiers: Lowland [Lowland]; Pothole; Herbaceous; Temperate [Temperate Continental]; Depressional; Isolated Wetland [Partially Isolated]
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2482; ESLF 9203; ESP 1482

CONCEPT

Summary: The prairie pothole system is found primarily in the glaciated northern Great Plains of the United States and Canada, and is characterized by depressional wetlands formed by glaciers scraping the landscape during the Pleistocene era. This system is typified by several classes of wetlands distinguished by changes in topography, soils and hydrology. Many of the basins within this system are closed basins and receive irregular inputs of water from their surroundings (groundwater and precipitation), and some export water as groundwater. Hydrology of the potholes is complex. Precipitation and runoff from snowmelt are the principal water sources, with groundwater inflow secondary. Evapotranspiration is the major water loss, with seepage loss secondary. Most of the wetlands and lakes contain water that is alkaline (pH >7.4). The concentration of dissolved solids result in water that ranges from fresh to extremely saline. The flora and vegetation of this system are a function of the topography, water regime, and salinity. In addition, because of periodic droughts and wet periods, many wetlands within this system undergo vegetation cycles. This system includes elements of aquatic vegetation, emergent marshes, and wet meadows that develop into a pattern of concentric rings. This system is responsible for a significant percentage of the annual production of many economically important waterfowl in North America and houses more than 50% of North American's migratory waterfowl, with several species reliant on this system for breeding and feeding. Much of the original extent of this system has been converted to agriculture, and only approximately 40-50% of the system remains undrained.
Classification Comments: More data from Canada is needed to really define this system completely.

DESCRIPTION

Environment: This system is characterized by closed basins, potholes, that receive irregular inputs of water from the surroundings and may export water as groundwater. The climate for the range of this system is characterized by mid-continental temperature and precipitation extremes. Across the range of this system, precipitation triples from 30 cm to 90 cm (west to east) and average annual temperature increases from 1 to 10 degrees C (north to south). Snowmelt and spring rains typically fill many of the potholes in examples of this system. The region in the range of this system is distinguished by a thin mantle of glacial drift overlying stratified sedimentary rocks of the Mesozoic and Cenozoic ages; these form a glacial landscape of end moraines, stagnation moraines, outwash plains and lakeplains. The glacial drift ranges 30 to 120 m thick and forms steep to slight local relief with fine-grained, silty to clayey soils. Soils in outwash plains are coarser. Limestone, sandstone, and shales predominate as bedrock, and highly mineralized water can discharge from these rocks. The hydrology of this system is complex with salinity ranging from fresh to saline, and chemical characteristics varying seasonally and annually. Sites with substantial surface or groundwater outlet are typically fresh while sites with little or no outlet tend to accumulate salts. Rain and snowmelt are the primary water sources with evapotranspiration being the source of major water loss. Some potholes are connected to groundwater sources and can serve as groundwater recharge sources, some receive groundwater outflow, and some have both. Water depth in most potholes is shallow. Many have a maximum depth of <2 m and most are <1 m deep (Sloan 1970). Seasonal water level fluctuations mean that the depth during much of the growing season is less than these maximums.
Vegetation: The vegetation within this system is highly influenced by hydrology, salinity and dynamics. Potholes found within this system can vary in depth and duration, which will determine the local gradient of species. Likewise, plant species found within individual potholes of this system will be strongly influenced by periodic drought and wet periods. Deeper potholes with standing water throughout most of the year have a central zone of submersed aquatic vegetation. Potholes that dry during droughty times can have central zones dominated by either tall emergents or mid-height emergents depending on the depth of the marsh. Wet meadow species such as grasses, forbs and sedges can be found in potholes that are only flooded briefly in the spring. All of these types of potholes can be found within an example of this system. Grazing, draining, and mowing of this system can influence the distribution of these types of potholes and plant species within this system.
Dynamics: A cycle of flooding and drying is the primary natural dynamic influencing this system. Snowmelt contributes substantially to the seasonal water input. In addition to runoff from snow melting within the watershed, snow tends to accumulate within the pothole due to the slightly more sheltered landscape position and the typically heavier and taller vegetation cover present in at least parts of the pothole. Spring rains contribute additional water, and potholes consistently have their yearly maximum water depth in late spring. Heavy rains in the summer can fill potholes, but the tendency is for water levels to fall as the growing season progresses. This fluctuation of water level during the year results in very different flooding regimes for different parts of the pothole. At the driest edge, the ground may be flooded or saturated for only a few weeks during the growing season, while the wettest parts of some potholes are flooded year-round. These different flooding regimes create environments favoring different types of plants and

many potholes have strong zonation of vegetation (Johnson et al. 1987). From driest to wettest, these zones are wet meadow, shallow marsh, deep marsh, aquatic, and deep water. Many potholes do not have enough water to support the wetter vegetation zones so individual potholes may have shallow marsh at the center with a ring of wet meadow or deep marsh surrounded by shallow marsh which in turn is surrounded by wet meadow. The changes in water volume in a given pothole are also reflected in the salinity of the water. Prairie potholes are least saline in the spring when snowmelt and spring rains fill the wetland, and possibly flush water out of the basin through seasonal overflow, but salinity increases as evapotranspiration reduces the volume of water in the basin throughout the growing season (Stewart and Kantrud 1972).

In addition to seasonal water level fluctuations, there are longer-term changes in water levels that affect prairie potholes (Kantrud et al. 1989a). Multi-year patterns of above or below average precipitation result in shifting vegetation zones within a single site. A multi-year dry period will cause a pothole to shrink, and the environments suitable for each vegetation zone will move towards the center, possibly eliminating the wettest zones altogether. A multi-year wet period will fill potholes, moving the environments conducive to each vegetation zone away from the center and possibly creating habitats for new, wetter zones in the middle. Changes in water depth of several feet are possible over a few to several years (Stewart and Kantrud 1972). These multi-year changes in the location of vegetation zones promote floristic diversity by creating shifting environments at any one place on the landscape. During the wetter seasonal or multi-year periods, temporary connections may be formed among otherwise discontinuous wetlands, allowing the spread of species and possibly affecting water chemistry through flushing of salts or other dissolved chemicals into or out of basins (Leibowitz and Vining 2003).

Component Associations:
- *Carex lasiocarpa - Carex oligosperma / Sphagnum* spp. Herbaceous Vegetation (CEGL002265, G3G4)
- *Schoenoplectus acutus - (Schoenoplectus fluviatilis)* Freshwater Herbaceous Vegetation (CEGL002225, G4G5)
- *Schoenoplectus maritimus - Schoenoplectus acutus - (Triglochin maritima)* Herbaceous Vegetation (CEGL002227, G3G5)
- *Schoenoplectus maritimus* Herbaceous Vegetation (CEGL001843, G4)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Northwestern Great Plains Mixedgrass Prairie (CES303.674)

DISTRIBUTION

Range: This system can be found throughout the northern Great Plains ranging from central Iowa northwest to southern Saskatchewan and Alberta, and extending west into north-central Montana. It encompasses approximately 870,000 square km with approximately 80% of its range in southern Canada. It is also prevalent in North Dakota, South Dakota, and northern Minnesota.
Divisions: 205:C; 303:C
Nations: CA, US
Subnations: AB, IA, MB, MN, MT, ND, SD, SK
Map Zones: 20:C, 29:C, 38:?, 39:C, 40:C, 41:C, 42:P
USFS Ecomap Regions: 251A:CC, 251B:CC, 331D:CC, 331E:CC, 331K:CC, 331L:CC, 331M:CC
TNC Ecoregions: 26:C, 34:C, 35:C, 66:C, 67:C

SOURCES

References: Adamus and Hairston 1996, Comer et al. 2003, Johnson et al. 1987, Johnson et al. 2005, Kantrud et al. 1989a, Kantrud et al. 1989b, Leibowitz and Vining 2003, Lesica 1989, Millet et al. 2009, Preston et al. 2013, Sloan 1970, Stewart and Kantrud 1972
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722997#references
Description Author: S. Menard, mod. J. Drake
Version: 14 Jan 2014 **Stakeholders:** Canada, Midwest, West
Concept Author: S. Menard **ClassifResp:** Midwest

GREAT PLAINS WOODED DRAW AND RAVINE (CES303.680)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Western Great Plains (303)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Non-Diagnostic Classifiers: Forest and Woodland (Treed); Ravine; G-Patch/Medium Intensity; Draw
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Mixed evergreen-deciduous open tree canopy
National Mapping Codes: EVT 2385; ESLF 4328; ESP 1385

CONCEPT

Summary: This ecological system is typically found associated with permanent or ephemeral streams though it may occur on steep northern slopes or within canyon bottoms that do not experience periodic flooding. Soil moisture and topography allow greater moisture conditions compared to the surrounding areas. Occurrences can be either tree-dominated or predominantly shrubland. *Fraxinus pennsylvanica* with *Ulmus rubra* or *Ulmus americana* typically dominate this system, although *Juniperus scopulorum* can dominate the canopy in the western Great Plains and *Juniperus virginiana* in the east. *Populus tremuloides, Betula papyrifera,* or *Acer negundo* are commonly present in portions of the northwestern Great Plains, for example in areas of central and eastern Montana. In south-central and east-central portions of the Great Plains, *Quercus macrocarpa* can also be present. Wetter areas within this system can have significant amounts of *Populus deltoides*. Component shrubs can include *Cornus sericea, Crataegus douglasii, Crataegus chrysocarpa, Crataegus succulenta, Elaeagnus commutata, Prunus virginiana, Rhus* spp., *Rosa woodsii, Shepherdia argentea, Symphoricarpos occidentalis,* or *Viburnum lentago*. Common grasses can include *Calamagrostis stricta, Carex* spp., *Pascopyrum smithii, Piptatherum micranthum, Pseudoroegneria spicata,* or *Schizachyrium scoparium*. This system was often subjected to heavy grazing and trampling by both domestic animals and wildlife and can be heavily degraded in some areas. In addition, exotic species such as *Ulmus pumila* and *Elaeagnus angustifolia* can invade these systems.
Classification Comments: More information from the broader division and from the Rocky Mountain division will be needed to determine if those areas dominated by ash and elm should be separated from areas dominated by *Juniperus scopulorum*. Those areas dominated by *Juniperus* are typically found in the Badlands and the western portions of North Dakota and Nebraska, and should probably be described based on data from the Great Plains Steppe or Rocky Mountain division. However, *Juniperus* can occur in stands with elm and ash in Nebraska and North Dakota. Expanded range into the central Great Plains (parts of Provinces 332 and 251). Possibly consider splitting the western Great Plains stands from the central Great Plains stands but there are currently not enough floristic and environmental differences known between stands in the two areas to justify that.
Related Concepts:
- Bur Oak: 236 (Eyre 1980) Intersecting
- Bur Oak: 42 (Eyre 1980) Finer
- Cottonwood: 63 (Eyre 1980) Finer
- Great Plains Wooded Draw, Ravine and Canyon (Rolfsmeier and Steinauer 2010) Broader
- Paper Birch: 18 (Eyre 1980) Finer
- Rocky Mountain Juniper: 220 (Eyre 1980) Intersecting

DESCRIPTION

Environment: This system is associated with permanent or ephemeral streams. It also can occur on steep northern slopes or within canyon bottoms that do not experience periodic flooding. Soils are primarily wet to mesic, and the more sheltered and lower landscape position allows for greater moisture conditions compared to the surrounding areas.
Vegetation: Species composition can vary across the range of this system. *Fraxinus pennsylvanica* and *Ulmus* spp. typically dominate this system. In some western areas of the Great Plains Division, *Juniperus* spp. can dominate, and in the south-central and east-central portions of the Great Plains, *Quercus macrocarpa* can also be important. *Tilia americana* and *Ostrya virginiana* are also common associates in the eastern portion of this system's range. Exotic species, such as *Ulmus pumila* and *Elaeagnus angustifolia*, can be present in degraded examples. Wetter areas within this system can have significant amounts of *Populus deltoides*.
Dynamics: Fire can influence this system; however, grazing is the most prevalent dynamic process influencing this system. Overgrazing can heavily degrade this system, particularly the understory, and allow for the invasion of exotic species.

Component Associations:
- *Betula papyrifera / Corylus cornuta* Forest (CEGL002079, G2G3)
- *Carex nebrascensis* Herbaceous Vegetation (CEGL001813, G4)
- *Cornus drummondii - Amorpha fruticosa - Cornus sericea* Shrubland (CEGL005220, G4?)
- *Cornus sericea - Salix (bebbiana, discolor, petiolaris) / Calamagrostis stricta* Shrubland (CEGL002187, G3G4)
- *Cornus sericea* Rocky Mountain Shrubland (CEGL001165, G4Q)
- *Crataegus douglasii - (Crataegus chrysocarpa)* Shrubland (CEGL001093, G2Q)
- *Elaeagnus commutata / Pascopyrum smithii* Shrubland (CEGL001099, G3?)
- *Elaeagnus commutata* Shrubland (CEGL001098, G2Q)

- *Fraxinus pennsylvanica - (Ulmus americana) / Symphoricarpos occidentalis* Forest (CEGL002088, G4?)
- *Fraxinus pennsylvanica - Ulmus americana / Prunus virginiana* Woodland (CEGL000643, G2G3)
- *Fraxinus pennsylvanica - Ulmus americana / Symphoricarpos occidentalis* Forest (CEGL002082, G3G5)
- *Fraxinus pennsylvanica - Ulmus* spp. - *Celtis occidentalis* Forest (CEGL002014, G3G5)
- *Juniperus scopulorum / Cornus sericea* Woodland (CEGL000746, G4)
- *Juniperus scopulorum / Piptatherum micranthum* Woodland (CEGL000747, G3G4)
- *Juniperus scopulorum / Pseudoroegneria spicata* Woodland (CEGL000748, G4)
- *Juniperus scopulorum / Schizachyrium scoparium* Woodland (CEGL000750, G2)
- *Juniperus scopulorum* Woodland (CEGL003550, GNR)
- *Populus deltoides (ssp. wislizeni, ssp. monilifera) / Pascopyrum smithii* Woodland (CEGL002680, G3)
- *Populus deltoides - Fraxinus pennsylvanica* Forest (CEGL000658, G2G3)
- *Populus deltoides / Carex pellita* Woodland (CEGL002649, G2)
- *Populus deltoides / Symphoricarpos occidentalis* Woodland (CEGL000660, G2G3)
- *Prunus virginiana - (Prunus americana)* Shrubland (CEGL001108, G4Q)
- *Quercus macrocarpa / Prunus virginiana - Symphoricarpos occidentalis* Woodland (CEGL002138, G3G4)
- *Rosa woodsii* Shrubland (CEGL001126, G5)
- *Shepherdia argentea* Shrubland (CEGL001128, G3G4)
- *Symphoricarpos occidentalis* Shrubland (CEGL001131, G4G5)

DISTRIBUTION

Range: This system is found throughout the Western Great Plains Division and east into the western tallgrass prairie zone of the central United States. In Wyoming, it occurs in the northeastern foothills of the Bighorns and across far-northeastern Wyoming into the northern fringes of the Black Hills.
Divisions: 205:P; 303:C
Nations: US
Subnations: CO, IA, KS, MO, MT, ND, NE, OK, SD, WY
Map Zones: 20:C, 27:P, 28:P, 29:C, 30:C, 31:C, 33:C, 34:C, 35:?, 38:C, 39:C, 40:C, 43:C
USFS Ecomap Regions: 251C:CC, 251F:CC, 251H:CC, 331D:CP, 331E:CP, 331F:CC, 331G:CP, 331H:C?, 331K:CC, 331L:CC, 331M:CP, 331N:C?, 332C:CC, 332E:CC, M331B:??, M331I:??, M334A:PP
TNC Ecoregions: 26:C, 27:C, 33:C, 34:C, 36:C, 37:C

SOURCES

References: Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722979#references
Description Author: S. Menard and K. Kindscher, mod. M.S. Reid and J. Drake
Version: 06 Dec 2012 **Stakeholders:** Midwest, Southeast, West
Concept Author: S. Menard and K. Kindscher **ClassifResp:** Midwest

HAWAI'I 'IHI'IHILUAKEA VERNAL POOL (CES412.223)

CLASSIFIERS

Classification Status: Standard

Primary Division: Northern Polynesia (412)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Short (<5 yrs) Flooding Interval [Short interval, Winter Flooding]; Vernal Pool Mosaic; Herbaceous; Tropical/Subtropical; Depressional [Vernal Pool]; Isolated Wetland [Partially Isolated]; Clay Soil Texture; Basin; Marsilea villosa
Non-Diagnostic Classifiers: Lowland [Lowland]
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - forbland, Perennial forb grassland
National Mapping Codes: EVT 2805; ESLF 9439; ESP 1805

CONCEPT

Summary: This rare, intermittently wet fern wetland develops in lowland vernal pools and areas that get flooded periodically. It occurs in shallow depressions in clay soil, cinder craters, or lithified sand dunes overlain with alluvial clay common in dry areas of most islands where winter rains create seasonal pools at elevations between 424 and 1032 m (1391-3385 feet). Now restricted to O'ahu and Molokai'i, the wetland is characterized by the dominance of the federally endangered endemic fern *Marsilea villosa*. On Molokai'i, it occurs in rocky areas that never hold standing water but get flushed out annually or less often. On the seasonal floodplain in Lualualei Valley, O'ahu, scattered depressions support *Marsilea* mats under scattered *Prosopis pallida* and among *Sida fallax*. At 'Ihi'ihilauÃ¢kea Crater, O'ahu, the crater floor is thickly covered with *Marsilea* when seasonal rains saturate the soil, sometimes submerging the habitat. During dry periods the fern becomes a dormant rhizomatous mat, and the area appears to be a weedy dryland of grasses and forbs, including *Amaranthus spinosus*, *Xanthium strumarium*, *Setaria verticillata*, *Cynodon dactylon*, *Chloris barbata*, and *Merremia aegyptia*. Sexual reproduction of *Marsilea* may occur as infrequently as once every ten or more years, due to the infrequency of sufficiently heavy rains in lowland areas. Historic populations on O'ahu were destroyed by drainage of ponding areas, habitat degradation, competition from alien plants, off-road vehicle use, and development.

DISTRIBUTION

Range: This system occurs at elevations between 424 and 1032 m (1391-3385 feet) on O'ahu and Moloka'i. Historically it also occurred on Ni'ihau.
Divisions: 412:C
Nations: US
Subnations: HI
Map Zones: 79:C
USFS Ecomap Regions: M423:C
TNC Ecoregions: 65:C

SOURCES

References: Palmer 2003, USFWS 1996a, USFWS 2003, Wagner et al. 1999, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.770653#references
Description Author: M. Castillo
Version: 27 Jan 2009
Concept Author: M. Castillo and G. Kittel
Stakeholders: West
ClassifResp: West

HAWAI'I RIPARIAN FOREST AND SHRUBLAND (CES412.220)

CLASSIFIERS

Classification Status: Standard

Primary Division: Northern Polynesia (412)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Short (<5 yrs) Flooding Interval; Riparian Mosaic; Forest and Woodland (Treed); Shrubland (Shrub-dominated); Stream terrace (undifferentiated); Riverine / Alluvial
Non-Diagnostic Classifiers: Clay Subsoil Texture; Montane; Lowland; Sideslope; Toeslope/Valley Bottom; Tropical/Subtropical; Muck; Mineral: W/ A-Horizon >10 cm
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2802; ESLF 9336; ESP 1802

CONCEPT

Summary: This ecological system occurs as narrow bands of terrestrial vegetation bordering perennial streams from near sea level to 915 m (0-3000 feet) elevation on Kaua'i, O'ahu, Moloka'i, LGna'i, Maui, and Hawai'i. At montane elevations, there is little vegetation distinction between the plants in the riparian corridor and plants in wet gulch bottoms of surrounding montane rainforest. Vegetated forest corridors are generally broken by a series of waterfalls and may reach 48.3 km (30 miles) long. Soils are generally well-drained basaltic lava with varying depths of clay and organic horizons that usually contain rock and organic sediments carried down from steep adjacent slopes. Riparian corridors are vegetated by native species that occur in surrounding native communities, the majority of which are *Metrosideros*-dominated forest communities with an assortment of endemic ferns, shrubs and trees. Distinct riparian corridors dominated by *Pipturus albidus* form linear patches in montane and upper lowland areas, sometimes sharing dominance with other urticaceous shrub species such as *Touchardia latifolia, Boehmeria grandis*, and *Urera glabra*. Other areas possess a diverse understory of ferns and bryophytes. The lower reaches of a few lowland gulches remain overtopped by a native association of *Pisonia / Charpentiera* surrounded by dry and mesic forest. Windward riparian corridors are colonized by patches of *Hedychium* spp. (ginger). In the pre-European setting, riparian forests may be invaded by and ultimately dominated by *Aleurites moluccana*, and include the Polynesian introduced tree *Syzygium malaccense*.

DESCRIPTION

Environment: This ecological system occurs as narrow bands of terrestrial vegetation bordering perennial streams from near sea level to 915 m (0-3000 feet) elevation. At montane elevations, there is little vegetation distinction between the plants in the riparian corridor and plants in wet gulch bottoms of surrounding montane rainforest. Climate is variable depending on where the stand occurs, ranging from arid to very wet (Zones 1-7) of the 7 Moisture Zones developed for the Hawaiian Islands by Price et al. (2007). Annual precipitation may vary from less than 500 mm to over 4500 mm. Vegetated forest corridors are generally broken by a series of waterfalls and may reach 48.3 km (30 miles) long. Soils are generally well-drained basaltic lava with varying depths of clay and organic horizons that usually contain rock and organic sediments carried down from steep adjacent slopes.

Component Associations:
- *Pipturus albidus* Lowland Wet Shrubland (CEGL008051, G3)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Hawai'i Freshwater Aquatic Bed (CES412.225)

Adjacent Ecological System Comments: Hawaiian aquatic freshwater biota is unique and includes fish, shrimp and mollusks descended from marine forms and native damselflies, which colonized from continental freshwater habitats. Damselfly (*Megalagrion*) and dragonfly (*Anax, Pantala*) naids utilize stream sediments as habitats, while adults utilize emergent vegetation. Shore bugs (*Saldula* spp.), freshwater snails (*Nertera* spp.), freshwater shrimp (*Halocaridina, Atyoida, Machrobrachium, Metabetaeus, Caligus, Hyalella, Penaeus*, and *Calappa*), and five endemic amphidromous freshwater fishes (*Awaous, Lentipes, Sicyopterus, Stenogobius*, and *Eleotris*) are part of the aquatic stream system. Plunge pools along the steeper gradient sections of Hawaiian streams serve as important habitat to the federally endangered Hawaiian duck (*Anas wyvilliana*).

DISTRIBUTION

Range: This system occurs from near sea level to 915 m (3000 feet) elevation on Kaua'i, O'ahu, Moloka'i, LÃ¢na'i, Maui, and Hawai'i.
Divisions: 412:C
Nations: US
Subnations: HI
Map Zones: 79:C
USFS Ecomap Regions: M423:C
TNC Ecoregions: 65:C

SOURCES

References: Gagne and Cuddihy 1990, Loope 1998, Mueller-Dombois and Fosberg 1998, Price et al. 2007, Wagner et al. 1999, Western Ecology Working Group n.d.

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.770644#references

Description Author: M. Castillo, mod. K.A. Schulz

Version: 05 Mar 2009 **Stakeholders:** West

Concept Author: M. Castillo and G. Kittel **ClassifResp:** West

INTER-MOUNTAIN BASINS GREASEWOOD FLAT (CES304.780)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Lowland [Lowland]; Shrubland (Shrub-dominated); Toeslope/Valley Bottom; Alkaline Soil; Deep Soil; Xeromorphic Shrub
Non-Diagnostic Classifiers: Deep (>15 cm) Water; Alluvial flat; Alluvial plain; Alluvial terrace; Temperate [Temperate Continental]; Depressional; Isolated Wetland [Partially Isolated]; Saline Substrate Chemistry; Sarcobatus vermiculatus
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Evergreen shrubland
National Mapping Codes: EVT 2153; ESLF 9103; ESP 1153

CONCEPT

Summary: This ecological system occurs throughout much of the western U.S. in Intermountain basins and extends onto the western Great Plains and into central Montana. It typically occurs near drainages on stream terraces and flats or may form rings around more sparsely vegetated playas. Sites typically have saline soils, a shallow water table and flood intermittently, but remain dry for most growing seasons. The water table remains high enough to maintain vegetation, despite salt accumulations. This system usually occurs as a mosaic of multiple communities, with open to moderately dense shrublands dominated or codominated by *Sarcobatus vermiculatus*. Other shrubs that may be present to codominant in some occurrences include *Atriplex canescens, Atriplex confertifolia, Atriplex gardneri, Artemisia tridentata ssp. wyomingensis, Artemisia tridentata ssp. tridentata, Artemisia cana ssp. cana*, or *Krascheninnikovia lanata*. Occurrences are often surrounded by mixed salt desert scrub or big sagebrush shrublands. The herbaceous layer, if present, is usually dominated by graminoids. There may be inclusions of *Sporobolus airoides, Pascopyrum smithii, Distichlis spicata* (where water remains ponded the longest), *Calamovilfa longifolia, Poa pratensis, Puccinellia nuttalliana*, or *Eleocharis palustris* herbaceous types.

Similar Ecological Systems:
- Inter-Mountain Basins Wash (CES304.781)

Related Concepts:
- Salt Desert Shrub (414) (Shiflet 1994) Broader
- Saltbush - Greasewood (501) (Shiflet 1994) Intersecting

Component Associations:
- *Atriplex confertifolia - Sarcobatus vermiculatus* Shrubland (CEGL001313, G5)
- *Distichlis spicata - (Scirpus nevadensis)* Herbaceous Vegetation (CEGL001773, G4)
- *Distichlis spicata* - Mixed Herb Herbaceous Vegetation (CEGL001771, G3G5)
- *Distichlis spicata* Herbaceous Vegetation (CEGL001770, G5)
- *Eleocharis palustris* Herbaceous Vegetation (CEGL001833, G5)
- *Ericameria nauseosa / Sporobolus airoides* Shrubland (CEGL002918, G3Q)
- *Leymus cinereus - Distichlis spicata* Herbaceous Vegetation (CEGL001481, G3)
- *Leymus cinereus* Bottomland Herbaceous Vegetation (CEGL001480, G1)
- *Leymus cinereus* Herbaceous Vegetation (CEGL001479, G2G3Q)
- *Puccinellia nuttalliana* Herbaceous Vegetation (CEGL001799, G3?)
- *Salicornia rubra* Herbaceous Vegetation (CEGL001999, G2G3)
- *Sarcobatus vermiculatus - Atriplex parryi / Distichlis spicata* Shrubland (CEGL002764, GNR)
- *Sarcobatus vermiculatus - Psorothamnus polydenius* Shrubland (CEGL002763, GNR)
- *Sarcobatus vermiculatus / Achnatherum hymenoides* Shrubland (CEGL001373, G4)
- *Sarcobatus vermiculatus / Artemisia tridentata* Shrubland (CEGL001359, G4)
- *Sarcobatus vermiculatus / Atriplex confertifolia - (Picrothamnus desertorum, Suaeda moquinii)* Shrubland (CEGL001371, G5?)
- *Sarcobatus vermiculatus / Atriplex gardneri* Shrubland (CEGL001360, G4?)
- *Sarcobatus vermiculatus / Bouteloua gracilis* Shrubland (CEGL001361, G1Q)
- *Sarcobatus vermiculatus / Distichlis spicata* Shrubland (CEGL001363, G4)
- *Sarcobatus vermiculatus / Elymus elymoides - Pascopyrum smithii* Shrubland (CEGL001365, G2?)
- *Sarcobatus vermiculatus / Elymus elymoides* Shrubland (CEGL001372, G4)
- *Sarcobatus vermiculatus / Juncus balticus* Sparse Vegetation (CEGL002919, G3?)
- *Sarcobatus vermiculatus / Leymus cinereus* Shrubland (CEGL001366, G3)
- *Sarcobatus vermiculatus / Nitrophila occidentalis - Suaeda moquinii* Shrubland (CEGL001369, G5?)
- *Sarcobatus vermiculatus / Pascopyrum smithii - (Elymus lanceolatus)* Shrub Herbaceous Vegetation (CEGL001508, G4)
- *Sarcobatus vermiculatus / Pseudoroegneria spicata* Shrubland (CEGL001367, G3)
- *Sarcobatus vermiculatus / Sporobolus airoides* Shrubland (CEGL001368, G3?)

- *Sarcobatus vermiculatus / Suaeda moquinii* Shrubland (CEGL001370, GUQ)
- *Sarcobatus vermiculatus* Disturbed Shrubland (CEGL001357, G5)
- *Sporobolus airoides - Distichlis spicata* Herbaceous Vegetation (CEGL001687, G4?)
- *Sporobolus airoides* Southern Plains Herbaceous Vegetation (CEGL001685, G3Q)

DISTRIBUTION

Range: This system occurs throughout much of the western U.S. in Intermountain basins and extends onto the western Great Plains.
Divisions: 303:C; 304:C
Nations: US
Subnations: AZ, CA, CO, ID, MT, NM, NV, OR, UT, WA, WY
Map Zones: 6:P, 7:C, 8:C, 9:C, 10:?, 12:C, 13:C, 15:?, 16:C, 17:C, 18:C, 19:C, 20:C, 21:C, 22:C, 23:C, 24:C, 25:C, 27:C, 28:C, 29:C, 30:P, 33:?
USFS Ecomap Regions: 313A:CC, 313B:CC, 313D:CC, 315A:CC, 315H:CC, 321A:??, 322A:CC, 331B:CC, 331C:CP, 331D:CP, 331F:CC, 331G:CC, 331H:CC, 331I:CC, 331J:CC, 331K:CP, 331L:C?, 341A:CC, 341B:CC, 341C:CC, 341D:CC, 341E:CC, 341F:CC, 341G:CC, 342A:CC, 342B:CC, 342C:CC, 342D:CC, 342F:CC, 342G:CC, 342H:CC, 342I:C?, 342J:CC, M242C:??, M261D:CC, M261E:CP, M261G:CC, M313A:CC, M313B:CC, M331A:C?, M331B:CP, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CP, M331J:C?, M332A:C?, M332D:CP, M332E:C?, M332G:CC, M341A:CC, M341B:CC, M341C:CC, M341D:CC
TNC Ecoregions: 4:C, 6:C, 8:C, 9:C, 10:C, 11:C, 19:C, 20:C, 26:C

SOURCES

References: Comer et al. 2003, Knight 1994, West 1983b
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722892#references
Description Author: NatureServe Western Ecology Team
Version: 29 Jan 2007 **Stakeholders:** Midwest, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

LAURENTIAN-ACADIAN FLOODPLAIN FOREST (CES201.587)

CLASSIFIERS

Classification Status: Standard

Primary Division: Laurentian-Acadian (201)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Short (<5 yrs) Flooding Interval [Short interval, Spring Flooding]; Forest and Woodland (Treed); Shrubland (Shrub-dominated); Woody-Herbaceous; Herbaceous; Riverine / Alluvial; Flood Scouring
Non-Diagnostic Classifiers: Mesotrophic Water; Moderate (100-500 yrs) Persistence; Lowland; Toeslope/Valley Bottom; Glaciated; Eutrophic Soil; Mesotrophic Soil; Circumneutral Soil; Acidic Soil; Deep Soil; Mineral: W/ A-Horizon >10 cm; Silt Soil Texture; Udic; Unconsolidated; Very Short Disturbance Interval; Broad-Leaved Deciduous Tree; Broad-Leaved Shrub; Graminoid
National Mapping Codes: ESLF 9328

CONCEPT

Summary: This system encompasses north-temperate floodplains in the northeastern and north-central U.S. and adjacent Canada at the northern end of the range of silver maple. They occur along medium to large rivers where topography and process have resulted in the development of a complex of upland and wetland temperate alluvial vegetation on generally flat topography. This complex includes floodplain forests, with *Acer saccharinum* characteristic, as well as herbaceous sloughs and shrub wetlands. In areas subject to more scour, sparse non-wetland vegetation may develop on sandbars or exposed rock. Most areas are underwater each spring; microtopography determines how long the various habitats are inundated. Associated trees include *Acer rubrum* and *Carpinus caroliniana*, the latter frequent but never abundant. On terraces or in more calcareous areas, *Acer saccharum* or *Quercus rubra* may be locally prominent, with *Betula alleghaniensis* and *Fraxinus* spp. *Salix nigra* is characteristic of the levees adjacent to the channel. Common shrubs include *Cornus amomum* and *Viburnum* spp. The herb layer in the forested portions often features abundant spring ephemerals, giving way to a fern-dominated understory in many areas by mid-summer. Non-forested wetlands associated with these systems include shrub-dominated and graminoid-herbaceous vegetation.
Classification Comments: These floodplains are similar to those to the south in the Central Interior, North-Central Interior Floodplain (CES202.694) and Appalachian Division, Central Appalachian River Floodplain (CES202.608) in having *Acer saccharinum* as a characteristic species; however, they are generally more depauperate and lack certain tree species that characterize central Appalachian floodplains such as *Platanus occidentalis*, *Betula nigra*, and *Quercus palustris*. This system can include areas of scour along sandbars or rivershore rock outcrops as well as the more typical floodplain vegetation.
Similar Ecological Systems:
- Central Appalachian River Floodplain (CES202.608)
- North-Central Interior Floodplain (CES202.694)

Related Concepts:
- Bluebell - Balsam Ragwort Shoreline Outcrop (Gawler and Cutko 2010) Finer
- Hardwood River Terrace Forest (Gawler and Cutko 2010) Finer
- Hudsonia River Beach (Gawler and Cutko 2010) Finer
- Northern Red Oak: 55 (Eyre 1980) Finer
- Silver Maple - American Elm: 62 (Eyre 1980) Finer
- Silver Maple Floodplain Forest (Gawler and Cutko 2010) Finer
- Sugar Maple: 27 (Eyre 1980) Finer

Component Associations:
- *Acer (rubrum, saccharinum) - Fraxinus pennsylvanica / Ilex verticillata / Osmunda regalis* Forest (CEGL006630, GNR)
- *Acer rubrum - Abies balsamea / Viburnum nudum var. cassinoides* Floodplain Forest (CEGL006501, GNR)
- *Acer rubrum - Prunus serotina / Cornus amomum* Forest (CEGL006503, GNR)
- *Acer saccharinum - (Populus deltoides) / Matteuccia struthiopteris - Laportea canadensis* Forest (CEGL006147, G4G5)
- *Acer saccharinum - Fraxinus pennsylvanica - Ulmus americana* Forest (CEGL002586, G4?)
- *Acer saccharinum / Onoclea sensibilis - Boehmeria cylindrica* Forest (CEGL006176, GNR)
- *Acer saccharum - Fraxinus* spp. *- Tilia americana / Matteuccia struthiopteris - Ageratina altissima* Forest (CEGL006114, GNR)
- *Acer saccharum / Ostrya virginiana / Brachyelytrum erectum* Forest (CEGL006504, GNR)
- *Alnus incana - Cornus (amomum, sericea) / Clematis virginiana* Shrubland (CEGL006062, G4G5)
- *Andropogon gerardii - Campanula rotundifolia - Solidago simplex* Sparse Vegetation (CEGL006284, G2)
- Bedrock - Boulder Rivershore Vegetation (CEGL002302, GNR)
- *Calamagrostis canadensis - Scirpus* spp. *- Dulichium arundinaceum* Herbaceous Vegetation (CEGL006519, GNR)
- *Cephalanthus occidentalis - Decodon verticillatus* Shrubland (CEGL006069, G4G5)
- *Hudsonia tomentosa - Paronychia argyrocoma* Dwarf-shrubland (CEGL006232, G1)
- Igneous - Metamorphic Cobble - Gravel River Shore Sparse Vegetation (CEGL002304, G4G5)
- *Prunus pumila var. depressa / Deschampsia caespitosa* Herbaceous Vegetation (CEGL006437, GNR)

- River Mudflats Sparse Vegetation (CEGL002314, GNR)
- *Spartina pectinata - Muhlenbergia richardsonis - Sporobolus heterolepis - Oligoneuron album - Euthamia graminifolia* Sparse Vegetation (CEGL005233, G1)
- *Vaccinium* spp. / *Danthonia spicata - Solidago puberula* Sparse Vegetation (CEGL006531, GNR)

DISTRIBUTION

Range: Central and northern New England and adjacent Canada west to the Great Lakes.
Divisions: 103:C; 201:C
Nations: CA, US
Subnations: MA?, ME, MI, MN, NB, NH, NY, VT, WI
Map Zones: 41:C, 50:C, 51:C, 63:C, 64:C, 65:C, 66:C
USFS Ecomap Regions: 211A:CC, 211B:CC, 211C:CC, 211D:CC, 211E:CC, 212H:CC, 212J:CC, 212K:CC, 212L:CC, 212M:CC, 212N:CC, 212Q:CC, 212Ra:CCC, 212Rb:CCP, 212Rc:CCC, 212Rd:CCC, 212Re:CCC, 212Sb:CCP, 212Sc:CCP, 212Sn:CCC, 212Sq:CCP, 212Tb:CCP, 212Tc:CCC, 212Te:CCC, 212Xb:CCP, 212Xc:CCP, 212Xq:CCC, 212Ya:CCC, 212Z:CC, 222N:CC, 251A:CC, M211A:CC, M211B:CC, M211C:CC, M211D:CC
TNC Ecoregions: 47:C, 48:C, 61:C, 63:C, 64:C

SOURCES

References: Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723019#references
Description Author: S.C. Gawler
Version: 05 Jun 2008 **Stakeholders:** Canada, East, Midwest, Southeast
Concept Author: S.C. Gawler **ClassifResp:** East

MEDITERRANEAN CALIFORNIA FOOTHILL AND LOWER MONTANE RIPARIAN WOODLAND AND SHRUBLAND (CES206.944)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Riparian Mosaic; Forest and Woodland (Treed); Mediterranean [Mediterranean Xeric-Oceanic]; Riverine / Alluvial; Very Short Disturbance Interval; Flood Scouring
Non-Diagnostic Classifiers: Short (<5 yrs) Flooding Interval; Montane [Lower Montane]; Lowland [Foothill]; Lowland [Lowland]; Shrubland (Shrub-dominated); Shallow Soil; Aquic; Udic; Broad-Leaved Deciduous Tree
National Mapping Codes: ESLF 9330

CONCEPT

Summary: This system is found throughout Mediterranean California within a broad elevation range from near sea level up to 300 m (900 feet) in the Coast Ranges and inland to 1500 m (4545 feet). This system often occurs as a mosaic of multiple communities that are tree-dominated with a diverse shrub component and open shrublands. This system includes open channels and bare alluvial bars as well. The variety of plant associations connected to this system reflects elevation, stream gradient, floodplain width, and flooding events. Dominant trees may include *Alnus rhombifolia*, *Acer negundo*, *Alnus rubra* (in Coast Ranges), *Populus fremontii*, *Salix laevigata*, *Salix gooddingii*, *Pseudotsuga menziesii*, *Platanus racemosa*, *Quercus agrifolia*, and *Acer macrophyllum* (in central and south coast). Dominant shrubs include *Salix exigua* and *Salix lasiolepis*. Exotic trees *Ailanthus altissima*, *Eucalyptus* spp., and herbs such as *Arundo donax* occur. These are disturbance-driven systems that require flooding, scour and deposition for germination and maintenance.
Classification Comments: It is unclear if riparian woodlands and shrublands occur in the upper montane and subalpine regions of the Sierras and possibly the Transverse Ranges, and if they do, if they are significantly different in composition to be distinguished as an ecological system. Some literature indicates that, if they do occur, the woodlands at least are not at all common. For now, there is no "subalpine-upper montane Sierran riparian" system described. Lower elevation (low montane and foothill) riparian systems on the east side of the Sierras are treated in Great Basin Foothill and Lower Montane Riparian Woodland and Shrubland (CES304.045).
Related Concepts:
- Riparian Woodland (203) (Shiflet 1994) Broader

DISTRIBUTION

Range: This system is found throughout Mediterranean California within a broad elevation range from near sea level up to 300 m (900 feet) in the Coast Ranges and inland to 1500 m (4545 feet).
Divisions: 206:C
Nations: MX, US
Subnations: CA, MXBC(MX), OR
Map Zones: 2:C, 3:C, 4:C, 5:C, 6:C, 7:C
USFS Ecomap Regions: 322A:PP, M261B:CC, M261C:CC, M261D:CC, M261E:CC, M261F:CC, M261G:CC
TNC Ecoregions: 5:C, 12:C, 13:C, 14:C, 16:C

SOURCES

References: Barbour and Major 1988, Comer et al. 2003, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722737#references
Description Author: P. Comer, T. Keeler-Wolf, mod. G. Kittel
Version: 13 Jan 2012 **Stakeholders:** Latin America, West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

MEDITERRANEAN CALIFORNIA SERPENTINE FOOTHILL AND LOWER MONTANE RIPARIAN WOODLAND AND SEEP (CES206.945)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Intermittent Flooding; Short (<5 yrs) Flooding Interval; Serpentine; Mediterranean [Mediterranean Xeric-Oceanic]; Seepage-Fed Sloping; Riverine / Alluvial; Cupressus sargentii
Non-Diagnostic Classifiers: Montane [Lower Montane]; Lowland [Foothill]; Forest and Woodland (Treed); Shrubland (Shrub-dominated); Toeslope/Valley Bottom; Aquic; Very Short Disturbance Interval; Flood Scouring
National Mapping Codes: ESLF 9325

CONCEPT

Summary: This ecological system is found mostly in the central and inner northern Coast Ranges of California and Sierra Nevada foothills. It includes springs, seeps, and perennial and intermittent streams in serpentine substrates (true serpentinite but also other related substrates). Characteristic species include *Salix breweri, Cupressus sargentii, Frangula californica ssp. tomentella (= Rhamnus tomentella), Umbellularia californica, Cirsium fontinale, Stachys albens, Solidago* spp., *Packera clevelandii (= Senecio clevelandii), Mimulus glaucescens, Mimulus guttatus, Aquilegia eximia*, and *Carex serratodens*. Riparian portions of this system are disturbance-driven and require limited flooding, scour and deposition for germination and maintenance.
Related Concepts:
- Port Orford-Cedar: 231 (Eyre 1980) Intersecting
- Riparian Woodland (203) (Shiflet 1994) Broader. Serpentine substrates are not specifically mentioned in Shiflet (1994) for this type, but they are likely included in SRM concept.

DESCRIPTION

Environment: This system is found in creek bottoms and stream terraces with serpentine-derived alluvium. Elevations range from 300-3000 m. Soils are saturated to moist throughout the growing season (Sawyer et al. 2009).
Dynamics: Steady groundwater flow and fire primarily disturb stands of this ecosystem. Plants resprout after flooding disturbance. Most serpentine riparian areas have moderate rather than large flooding events, and most serpentine riparian has low perennial flows not subject to vacillating events as non-serpentine areas. Serpentine riparian are less likely to be susceptible to drought and drying since the serpentine geology tends to release water slowly over time (T. Keeler-Wolf pers. comm. 2013). *Frangula californica* resprouts vigorously after fire (Sawyer et al. 2009). However, it is not known how often fires historically occurred in *Frangula californica*-dominated systems. Fire is less of a disturbance issue in willow-dominated systems, but fire does occur, and *Salix* generally resprouts after fires (Stromberg and Rychener 2010). Fires probably occur relatively frequently even though serpentine chaparral surrounding the riparian has lower fuels than typical non-serpentine chaparral (T. Keeler-Wolf pers. comm. 2013).

Component Associations:
- *Chamaecyparis lawsoniana / Rhododendron occidentale / Carex* spp. Temporarily Flooded Forest (CEGL000047, G2)

DISTRIBUTION

Range: This system occurs in the central and inner northern Coast Ranges of California and Oregon and Sierra Nevada foothills.
Divisions: 206:C
Nations: US
Subnations: CA, OR
Map Zones: 2:C, 3:C, 4:C, 6:C
USFS Ecomap Regions: M261A:CC, M261B:CP, M261C:CP, M261D:C?, M261F:C?
TNC Ecoregions: 5:C, 12:P, 14:C, 15:P

SOURCES

References: Barbour and Major 1988, Batten et al. 2006, Brooks and Minnich 2006, CNPS and CDFG 2006, Coffman 2007, Comer et al. 2003, Eyre 1980, Holland and Keil 1995, Keeler-Wolf pers. comm., PRBO Conservation Science 2011, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Shiflet 1994, Stromberg and Rychener 2010
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722736#references
Description Author: P. Comer and T. Keeler-Wolf, mod. G. Kittel
Version: 14 Jan 2014 **Stakeholders:** West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

NORTH-CENTRAL INTERIOR FLOODPLAIN (CES202.694)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Non-Diagnostic Classifiers: Floodplain; Forest and Woodland (Treed); Herbaceous; Glaciated; Clay Soil Texture; Sand Soil Texture; Udic
National Mapping Codes: ESLF 9338

CONCEPT

Summary: This system is found along rivers across the glaciated Midwest. It occurs from river's edge across the floodplain or to where it meets a wet meadow system. It can have a variety of soil types found within the floodplain from very well-drained sandy substrates to very dense clays. It is this variety of substrates and flooding that creates the mix of vegetation that includes *Acer saccharinum, Populus deltoides*, willows, especially *Salix nigra* in the wettest areas, and *Fraxinus pennsylvanica, Ulmus americana*, and *Quercus macrocarpa* in more well-drained areas. Within this system are oxbows that may support *Nelumbo lutea* and *Typha latifolia*. Understory species are mixed, but include shrubs, such as *Cornus drummondii* and *Asimina triloba* (in Kansas), sedges and grasses, which sometimes help form savanna vegetation. Flooding is the primary dynamic process, but drought, grazing, and fire have all had historical influence on this system. Federal reservoirs have had a serious and negative effect on this system, along with agriculture that has converted much of this system to drained agricultural land.
Classification Comments: The distribution limit northward is considered to be the Laurentian region boundary. This system is distinguished from floodplain systems northeastward, Laurentian-Acadian Floodplain Forest (CES201.587), and eastward, Central Appalachian River Floodplain (CES202.608). *Celtis* and *Populus deltoides* are absent (or essentially so) from the Laurentian-Acadian type.
Similar Ecological Systems:
- Central Appalachian River Floodplain (CES202.608)
- Laurentian-Acadian Floodplain Forest (CES201.587)

Related Concepts:
- Black Willow: 95 (Eyre 1980) Finer
- Bur Oak: 42 (Eyre 1980) Finer
- Cottonwood: 63 (Eyre 1980) Finer
- Eastern Floodplain Wetland (Rolfsmeier and Steinauer 2010) Equivalent
- River Birch - Sycamore: 61 (Eyre 1980) Finer
- Silver Maple - American Elm: 62 (Eyre 1980) Finer
- Sugarberry - American Elm - Green Ash: 93 (Eyre 1980) Finer
- Sycamore - Sweetgum - American Elm: 94 (Eyre 1980) Finer

DESCRIPTION

Environment: This ecological system occurs in floodplains of medium to large rivers. It is found on alluvial soils ranging from sandy to very dense clays. Soil texture reflects the upstream substrate through which the river and its tributaries flow and water velocity. Sandy sediments can be carried by faster-flowing water, while slow-moving rivers can only carry fine-textured sediment. Water velocity and volume change greatly during the year as rains and snowmelt deliver pulses of water and seasonal droughts (typically including winter in the northern portion of this system's range when most precipitation is frozen) result in low water. Within a short distance on a river floodplain, different soil textures can be found. Coarser-textured soils are typically adjacent to the main channel where they are deposited first by rising or falling floodwaters. Finer-textured soils are further away from the main channel, deposited when floodwaters have spread out and slowed down. Within the space of a few years, floods of differing magnitude can deposit sand over silt or vice versa, resulting in complex soil topology.
Vegetation: The variety of soil properties associated with this system can create a mixture of vegetation. *Acer saccharinum* occurs on the wetter soils of floodplains in the eastern portion of this system, with *Populus deltoides* and willows, especially *Salix nigra*, occurring more in the western range of this system. *Fraxinus pennsylvanica, Ulmus americana*, and *Quercus macrocarpa* occur in more well-drained areas. Understory species can vary across the range of this system but can include shrubs such as *Cornus drummondii* and *Asimina triloba*, and sedge and grass species. Oxbows within this system may have species such as *Nelumbo lutea* and *Typha latifolia*.
Dynamics: This system is primarily controlled by moderate to frequent flooding. Flood frequency depends on precipitation patterns within the watershed and proximity to the main channel. Areas adjacent to the main channel or low islands within the channel can be flooded every year or even more than once per year. Those areas further from the channel on terraces or behind natural levees may only be flooded once every several years. Free-flowing rivers migrate across their floodplain, cutting new channels or eroding the bank on one side while building up the bank on the other, so the flooding regime of any one point in the floodplain will change over time. Flooding redeposits alluvium, eroding some areas and aggrading others, can bury or wash away small plants, and redistributes

nutrients, especially in less frequently flooded zones where silt and clay tend to be deposited. These processes open up new areas for colonization. Where trees can grow (i.e., not in permanent or semi-permanent backwater wetlands), there is a common succession sequence of annual herbaceous species followed by shrub *Salix* spp., followed by *Populus deltoides, Salix nigra*, and *Acer saccharinum*, followed by a number of trees, including *Acer negundo, Carya illinoinensis, Celtis laevigata, Celtis occidentalis, Fraxinus pennsylvanica, Quercus macrocarpa*, and *Ulmus americana*. This sequence can be reset by major floods and erosion/deposition. Frequent minor to moderate flooding holds the system at the intermediate forest stage, and large areas of this floodplain system are dominated by *Populus deltoides, Salix nigra*, and *Acer saccharinum*.

Fire could impact parts of this system. Most of the forests in this system were not fire-prone due to the lack of litter, frequent flooding, and relatively protected landscape position in the river valley with wetlands often near, but forests on higher, coarser soils or wet-mesic prairies on the margins of the floodplain could become dry in late summer and burn, if an ignition source was present (Weaver 1960).

Component Associations:
- *Acer saccharinum - Celtis laevigata - Carya illinoinensis* Forest (CEGL002431, G3G4)
- *Acer saccharinum - Fraxinus pennsylvanica - Ulmus americana* Forest (CEGL002586, G4?)
- *Acer saccharum - Carya cordiformis / Asimina triloba* Floodplain Forest (CEGL005035, G2)
- *Betula nigra - Platanus occidentalis* Forest (CEGL002086, G5)
- *Brasenia schreberi* Eastern Herbaceous Vegetation (CEGL004527, G4?)
- *Calamagrostis stricta - Carex sartwellii - Carex praegracilis - Plantago eriopoda* Saline Herbaceous Vegetation (CEGL002255, G2G3)
- *Carex pellita - Carex* spp. - *Schoenoplectus tabernaemontani* Fen Herbaceous Vegetation (CEGL002041, G1)
- *Carex* spp. - *(Carex pellita, Carex vulpinoidea)* Herbaceous Vegetation (CEGL005272, GNR)
- *Carex utriculata - Carex lacustris - (Carex vesicaria, Carex stricta)* Herbaceous Vegetation (CEGL002257, G4G5)
- *Carya illinoinensis - Celtis laevigata* Forest (CEGL002087, G4?)
- *Cephalanthus occidentalis / Carex* spp. - *Lemna* spp. Southern Shrubland (CEGL002191, G4)
- *Cephalanthus occidentalis / Carex* spp. Northern Shrubland (CEGL002190, G4)
- *Fagus grandifolia - Quercus* spp. - *Acer rubrum - Juglans nigra* Forest (CEGL005014, G2G3)
- *Fraxinus pennsylvanica - (Ulmus americana) / Symphoricarpos occidentalis* Forest (CEGL002088, G4?)
- *Fraxinus pennsylvanica - Celtis occidentalis - Tilia americana - (Quercus macrocarpa)* Forest (CEGL002081, G4?)
- *Fraxinus pennsylvanica - Celtis* spp. - *Quercus* spp. - *Platanus occidentalis* Bottomland Forest (CEGL002410, G3G4)
- *Fraxinus pennsylvanica - Ulmus* spp. - *Celtis occidentalis* Forest (CEGL002014, G3G5)
- *Nelumbo lutea* Herbaceous Vegetation (CEGL004323, G4?)
- *Nuphar advena - Nymphaea odorata* Herbaceous Vegetation (CEGL002386, G4G5)
- *Populus deltoides - (Salix nigra) / Spartina pectinata - Carex* spp. Woodland (CEGL002017, G1)
- *Populus deltoides - Fraxinus pennsylvanica* Forest (CEGL000658, G2G3)
- *Populus deltoides - Platanus occidentalis* Forest (CEGL002095, G1G2)
- *Populus deltoides - Salix nigra - Acer saccharinum* Forest (CEGL002018, G3G4)
- *Potamogeton* spp. - *Ceratophyllum* spp. Midwest Herbaceous Vegetation (CEGL002282, G5)
- *Quercus macrocarpa - Quercus bicolor - Carya laciniosa / Leersia* spp. - *Cinna* spp. Forest (CEGL002098, G2G3)
- River Mudflats Sparse Vegetation (CEGL002314, GNR)
- Riverine Sand Flats - Bars Sparse Vegetation (CEGL002049, G4G5)
- *Sagittaria latifolia - Leersia oryzoides* Herbaceous Vegetation (CEGL005240, GNR)
- *Salix interior* Temporarily Flooded Shrubland (CEGL008562, G4G5)
- *Salix nigra* Forest (CEGL002103, G4)
- *Salix* spp. / *Andropogon gerardii - Sorghastrum nutans* Gravel Wash Herbaceous Vegetation (CEGL005175, G2Q)
- *Schoenoplectus fluviatilis - Schoenoplectus* spp. Herbaceous Vegetation (CEGL002221, G3G4)
- *Schoenoplectus tabernaemontani - Typha* spp. - (*Sparganium* spp., *Juncus* spp.) Herbaceous Vegetation (CEGL002026, G4G5)
- *Typha* spp. Midwest Herbaceous Vegetation (CEGL002233, G5)

DISTRIBUTION

Range: This system is found along medium and large river floodplains throughout the glaciated Midwest ranging from eastern Kansas and western Missouri to western Ohio and north along the Red River basin in Minnesota and the eastern Dakotas. This system is essentially restricted to USFS Provinces 251 and 222, though it may go further west in larger rivers in the Great Plains, notably the Missouri and Platte rivers.
Divisions: 202:C; 205:C
Nations: US
Subnations: IA, IL, IN, KS, MI, MN, MO, ND, NE, OH, SD, WI
Map Zones: 38:C, 39:C, 40:C, 42:C, 43:C, 44:P, 47:C, 49:C, 50:C, 51:C, 52:C
USFS Ecomap Regions: 222H:CC, 222I:CC, 222Ja:CCC, 222Jb:CCC, 222Jc:CCC, 222Je:CCC, 222Jg:CCC, 222Jh:CCC, 222Ji:CCC, 222K:CC, 222L:CC, 222M:CC, 222Ua:CCC, 222Ud:CCC, 222Ue:CCC, 223A:CC, 251B:CC, 251E:CC, 251F:CC, 251G:CC, 251H:CC, 255A:CC, 332B:CC, 332C:CC, 332D:CC, 332E:CC
TNC Ecoregions: 35:C, 36:C, 45:C, 46:C, 47:?, 48:?

SOURCES

References: Bragg and Tatschi 1977, Comer et al. 2003, DeSantis et al. 2012, Eyre 1980, Herms et al. 2010, Johnson 1992, Rolfsmeier and Steinauer 2010, Weaver 1960, Yin and Nelson 1996

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722965#references

Description Author: S. Menard and K. Kindscher, mod. J. Drake

Version: 14 Jan 2014 **Stakeholders:** Canada, Midwest, Southeast

Concept Author: S. Menard and K. Kindscher **ClassifResp:** Midwest

NORTHERN ATLANTIC COASTAL PLAIN CALCAREOUS RAVINE (CES203.069)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Ravine; Slope; Seepage-Fed Sloping; Calcareous
Non-Diagnostic Classifiers: Forest and Woodland (Treed)
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: ESLF 4156

CONCEPT

Summary: This system occurs on dry to mesic slopes and saturated bottoms of dissected ravine systems in the northern Atlantic Coastal Plain where erosion has exposed Tertiary-aged shell deposits, limesands, or aboriginal shell middens. These calcium-bearing sediments produce soils that range from slightly acidic to circumneutral and moderately to very strongly calcareous. The fertile soils support a rich diversity of plant species that distinguishes this system from the more widespread dry-mesic, acidic (poor) ravines. This system includes mostly deciduous upland forests and woodlands on slopes and low interfluves and forested seepage wetlands found in saturated stream valley bottoms. Species composition varies with the environmental setting , but all habitats are characterized by species indicative of high base status soils. The communities of this system often contain species that are disjunct from their primary ranges in the mountains or Piedmont, such as Erigeron pulchellus, *Actaea pachypoda, Caltha palustris, Pedicularis lanceolata, Solidago flexicaulis, Quercus muehlenbergii, Verbesina virginica var. virginica, Hexalectris spicata, Corallorhiza wisteriana, Campanulastrum americanum, Celastrus scandens, Muhlenbergia sobolifera, Muhlenbergia tenuiflora, Sanicula marilandica*, and *Thalictrum revolutum*.

Related Concepts:
- Beech - Sugar Maple: 60 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs on dry to mesic slopes and saturated bottoms of dissected ravine systems in the northern Atlantic Coastal Plain where erosion has exposed Tertiary-aged shell deposits, limesands or aboriginal shell middens that have been exposed by downcutting streams or on river fronting bluffs along the northern Atlantic Coastal Plain of Virginia, Maryland, Delaware and New Jersey. It includes mesic and dry uplands and groundwater-saturated wetlands associated with these fertile, base-rich soils. Occurrences are typically linear or small patch and uncommon.

Vegetation: Forests of mesic slopes and low interfluves are characterized by *Fagus grandifolia, Liriodendron tulipifera, Quercus alba, Carya cordiformis*, and *Quercus rubra* in the overstory. Other canopy dominants and associates may include *Quercus muehlenbergii, Fraxinus americana, Tilia americana*, and *Acer barbatum*. The understory is often dense and may include *Asimina triloba, Lindera benzoin, Viburnum prunifolium, Ulmus rubra, Ilex opaca, Magnolia tripetala*, and *Cercis canadensis var. canadensis*. The ground cover is lush though sometimes patchy and may include *Podophyllum peltatum, Arisaema triphyllum, Sanguinaria canadensis, Circaea lutetiana ssp. canadensis, Maianthemum racemosum ssp. racemosum, Cardamine concatenata*, and *Polystichum acrostichoides*. More locally abundant herbs include *Cystopteris protrusa, Deparia acrostichoides, Diplazium pycnocarpon, Actaea racemosa (= Cimicifuga racemosa), Phegopteris hexagonoptera, Nemophila aphylla*, and *Actaea pachypoda*.

Drier, more southerly facing convex slopes are characterized by a more open canopy of *Quercus muehlenbergii*; common associates may include *Acer barbatum, Carya cordiformis, Fagus grandifolia, Fraxinus americana, Quercus alba, Quercus rubra*, and *Quercus prinus*. The understory may include *Juniperus virginiana var. virginiana, Cercis canadensis var. canadensis, Dirca palustris, Ilex opaca var. opaca, Sideroxylon lycioides*, and *Viburnum rufidulum*. The herb layer is usually patchy but contains a diversity of species, including *Aquilegia canadensis, Erigeron pulchellus var. pulchellus, Bromus pubescens, Dichanthelium boscii, Verbesina virginica var. virginica, Campanulastrum americanum, Smallanthus uvedalius, Silphium trifoliatum var. trifoliatum, Desmodium pauciflorum, Hexalectris spicata*, and *Piptochaetium avenaceum*.

Forested seepage wetlands are often found along stream bottoms and at the base of slopes. Braided streams and hummock-and-hollow microtopography are characteristic of the environmental setting. The tree canopy is characterized by *Fraxinus pennsylvanica, Acer rubrum, Liquidambar styraciflua, Nyssa biflora*, and others. The shrub layer is comprised of *Lindera benzoin, Morella cerifera (= Myrica cerifera)*, and *Cornus foemina*. Vines are abundant, especially *Decumaria barbara*. The herbaceous layer is characterized by *Caltha palustris, Carex bromoides, Packera aurea (= Senecio aureus), Scirpus lineatus, Thelypteris palustris, Pedicularis lanceolata, Carex tetanica, Liparis loeselii*, and *Carex granularis* on drier hummocks, and *Saururus cernuus, Bidens laevis, Pilea fontana, Glyceria striata*, and *Impatiens capensis* in wetter hollows and seepage rivulets.

Dynamics: Natural erosion of steep bluffs exposed by downcutting streams.

Component Associations:
- *Acer rubrum - Fraxinus pennsylvanica / Packera aurea - Carex bromoides - Pilea fontana - Bidens laevis* Forest (CEGL006413, G2)

- *Fagus grandifolia - Acer barbatum - Quercus muehlenbergii / Sanguinaria canadensis* Forest (CEGL007181, G2?)
- *Fagus grandifolia - Liriodendron tulipifera - Carya cordiformis / Lindera benzoin / Podophyllum peltatum* Forest (CEGL006055, G4?)
- *Quercus muehlenbergii / Cercis canadensis / Dichanthelium boscii - Bromus pubescens - Erigeron pulchellus var. pulchellus - Aquilegia canadensis* Forest (CEGL007748, G1)

SPATIAL CHARACTERISTICS

Spatial Summary: Small, linear patch.

DISTRIBUTION

Range: This system is known from the northern Atlantic Coastal Plain of Virginia and Maryland, possibly ranging north into Delaware and New Jersey.
Divisions: 203:C
Nations: US
Subnations: DE?, MD, NJ?, VA
Map Zones: 60:C
TNC Ecoregions: 57:C, 58:C

SOURCES

References: Eastern Ecology Working Group n.d., Fleming 2002b, McAvoy and Harrison 2012, Patterson 2008c, Ware and Ware 1992
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.798077#references
Description Author: G. Fleming and J. Teague, mod. L.A. Sneddon
Version: 14 Jan 2014 **Stakeholders:** East, Southeast
Concept Author: NCR Review Team **ClassifResp:** East

NORTHERN ATLANTIC COASTAL PLAIN DUNE AND SWALE (CES203.264)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Large patch, Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: North Atlantic Coastal Plain; Beach (Substrate); Graminoid; Coast
Non-Diagnostic Classifiers: Herbaceous; Depressional; Isolated Wetland [Partially Isolated]
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2436; ESLF 7149; ESP 1436

CONCEPT

Summary: This system consists of vegetation of barrier islands and other coastal areas, ranging from northernmost North Carolina northward to southern Maine (where extensive sandy coastlines are replaced by rocky coasts). A range of plant communities may be present, but natural vegetation is predominately herbaceous, with *Ammophila breviligulata* diagnostic. Shrublands resulting from succession from grasslands may occur in limited areas. Both dune uplands and non-flooded wetland vegetation of interdunal swales are included in this system. In the northern portion of the range, these swales are often characterized by *Vaccinium macrocarpon*, while south of New Jersey, swales are characterized by a variety of graminoids and forbs, usually including *Schoenoplectus pungens*, *Fimbristylis castanea*, *Fimbristylis caroliniana*, *Juncus* spp. and others. Small patches of natural woodland may also be present in limited areas, especially in the northern range of this system. Dominant ecological processes are those associated with the maritime environment, including frequent salt spray, saltwater overwash, and sand movement.
Classification Comments: This system was separated from Southern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.273) to parallel broad-scale biogeographic and climatic differences believed to be important in this environment. This system occupies the northern part of this broad transition which was labeled by Cowardin et al. (1979) as the Virginian Province, although the demarcated boundary differs somewhat from that used here. A useful vegetation indicator of this transition is the shift in herbaceous dominance on the dunes from *Uniola paniculata* in the south to *Ammophila breviligulata* in the north. Although the location of this shift itself is somewhat imprecise because of widespread planting of both species on artificially enhanced dunes, this boundary appears to be well approximated by Omernik Ecoregion 63g vs. 63d (EPA 2004). There is extensive south-to-north turnover of associations in TNC Ecoregion 58 with very little overlap southward. *Quercus virginiana* is only occasional in this system at its extreme southern end (southern Virginia) and should not be thought of as characteristic.

This system is distinguished from Northern Atlantic Coastal Plain Maritime Forest (CES203.302) by the lack of dominant woody vegetation. This distinction becomes blurred where dunes have been artificially enhanced and an unnatural succession to woody vegetation is occurring. The boundary at the northern end is the end of extensive sandy coastlines and the beginning of rocky coasts.

Southeastern Coastal Plain Interdunal Wetland (CES203.258) may occur with this system in northern North Carolina and southern Virginia. Where the ranges overlap, Southeastern Coastal Plain Interdunal Wetland (CES203.258) is distinguished from this system by the presence of standing water for a significant part of the growing season. This corresponds to a break between open-water and tall-graminoid marsh vegetation in the ponds and low-graminoid- or forb-dominated vegetation in the grasslands. North of Virginia, interdunal wetlands are smaller and more integrated into the dune systems and are included in this system.
Similar Ecological Systems:
- Northern Atlantic Coastal Plain Heathland and Grassland (CES203.895)
- Northern Atlantic Coastal Plain Maritime Forest (CES203.302)
- Northern Atlantic Coastal Plain Sandy Beach (CES203.301)--occurs between this system and the high tide line.
- Southeastern Coastal Plain Interdunal Wetland (CES203.258)
- Southern Atlantic Coastal Plain Dune and Maritime Grassland (CES203.273)--occurs to the south.

Related Concepts:
- Dune Grassland (Gawler and Cutko 2010) Finer
- Eastern Redcedar: 46 (Eyre 1980) Finer
- Loblolly Pine: 81 (Eyre 1980) Finer
- Pitch Pine Dune Woodland (Gawler and Cutko 2010) Finer
- Pitch Pine: 45 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs on coastal strands and barrier islands, on sand dunes and sand flats. Strong salt spray is an important influence on vegetation in many parts. Overwash by sea water during storms is important on sand flats not protected by continuous dunes. On dunes, present or recent sand movement is an important factor. The combination of these factors prevents the dominance of woody vegetation. Sites may be either dry or saturated by freshwater from rainfall and the local water table. Areas connected to tidal influence are placed in other systems. Soils are sandy, with little organic matter and little or no horizon development. Soils may be excessively drained on the higher dunes. Soils are low in nutrient-holding capacity, but aerosol input of sea salt provides a continuous source of nutrients.

Vegetation: Vegetation consists of a set of grassland and herbaceous to shrubby associations. *Ammophila breviligulata* is the characteristic dominant on the youngest dunes and those most exposed to salt spray. Shrublands resulting from succession from grasslands may occur in limited areas, but they are generally not natural components of this system in the southern part of its range (M. Schafale pers. comm.). These communities tend to be low in plant species richness but have a characteristic set of forbs and occasional low shrubs associated with them. Wetter sand flats and dune swales may be dominated by a variety of herbs and sometimes have fairly high species richness.
Dynamics: The environment of this system is one of the most dynamic in existence for terrestrial vegetation. Reworking of sand by storms or by slower eolian processes may completely change the local environment in a short time, changing one association to another. Many of these sites are fairly early in the process of primary succession on recent surfaces. Chronic salt spray is an ongoing stress. Overwash and extreme salt spray in storms are frequent disturbances. Vegetation interacts strongly with geologic processes; the presence of grass is an important factor in the development of new dunes. Alteration of dynamic processes, such as artificial enhancement of dunes by planting or sand fencing, can have drastic effects on this system, causing large areas to succeed to woody vegetation. Fire is probably not a major natural factor in this system, but may have been important locally. Most vegetation is too sparse to carry fire well.

Component Associations:
- (*Morella cerifera*) / *Panicum virgatum - Spartina patens* Herbaceous Vegetation (CEGL004129, G2G4)
- *(Morella pensylvanica) / Schizachyrium littorale - Aristida tuberculosa* Shrub Herbaceous Vegetation (CEGL006161, GNR)
- *Ammophila breviligulata - Lathyrus japonicus* Herbaceous Vegetation (CEGL006274, G4?)
- *Ammophila breviligulata - Panicum amarum var. amarum* Herbaceous Vegetation (CEGL004043, G2)
- *Bacopa monnieri - Eleocharis albida* Herbaceous Vegetation (CEGL006350, G1Q)
- *Cladium mariscoides / Vaccinium macrocarpon - Morella pensylvanica* Dwarf-shrubland (CEGL006141, G2G3)
- *Deschampsia flexuosa* Herbaceous Vegetation (CEGL006621, GNR)
- *Hudsonia tomentosa - Arctostaphylos uva-ursi* Dwarf-shrubland (CEGL006143, G2G3)
- *Hudsonia tomentosa / Panicum amarum var. amarulum* Dwarf-shrubland (CEGL003950, G2G3)
- *Juncus (dichotomus, scirpoides) - Drosera intermedia* Herbaceous Vegetation (CEGL004111, G2G3)
- *Juniperus virginiana var. virginiana / Morella pensylvanica* Woodland (CEGL006212, G2)
- *Morella (pensylvanica, cerifera) / Schizachyrium littorale - Eupatorium hyssopifolium* Shrub Herbaceous Vegetation (CEGL004240, G2)
- *Morella cerifera - Vaccinium corymbosum* Shrubland (CEGL003906, G2G4)
- *Morella cerifera / Hydrocotyle verticillata* Shrubland (CEGL003840, G2G3)
- *Morella cerifera / Spartina patens* Shrubland (CEGL003839, G3G4)
- *Morella pensylvanica - Prunus maritima* Shrubland (CEGL006295, G4)
- *Morella pensylvanica - Toxicodendron radicans / Typha latifolia* Shrubland (CEGL006444, GNR)
- *Morella pensylvanica / Diodia teres* Shrubland (CEGL003881, G2)
- *Morella pensylvanica / Schizachyrium littorale - Danthonia spicata* Shrub Herbaceous Vegetation (CEGL006067, G2)
- *Myrica gale - Morella pensylvanica* Saturated Shrubland (CEGL006339, GNR)
- *Pinus rigida / Hudsonia tomentosa* Woodland (CEGL006117, G2G3)
- *Pinus rigida / Vaccinium macrocarpon* Woodland (CEGL006127, GNR)
- *Pinus taeda / Hudsonia tomentosa* Woodland (CEGL006052, G1G2)
- *Prunus serotina / Morella cerifera / Smilax rotundifolia* Scrub Forest (CEGL006319, G1G2)
- *Salix nigra* Seasonally Flooded Forest (CEGL006348, G2G3)
- *Schoenoplectus pungens - Fimbristylis (castanea, caroliniana)* Herbaceous Vegetation (CEGL004117, G1G2)
- *Schoenoplectus pungens var. pungens - Juncus canadensis* Herbaceous Vegetation (CEGL006935, GNR)
- *Smilax glauca - Toxicodendron radicans* Vine-Shrubland (CEGL003886, G1G2)
- *Spartina patens - Eleocharis parvula* Herbaceous Vegetation (CEGL006342, G2G4)
- *Spartina patens - Schoenoplectus pungens - Solidago sempervirens* Herbaceous Vegetation (CEGL004097, G2G3)
- *Spartina patens - Thinopyrum pycnanthum* Herbaceous Vegetation (CEGL006149, GNR)
- *Vaccinium corymbosum - Rhododendron viscosum - Clethra alnifolia* Shrubland (CEGL006371, G3)
- *Vitis rotundifolia / Triplasis purpurea - Panicum amarum - Schizachyrium littorale* Mid-Atlantic Coastal MedaÃ±o Sparse Vegetation (CEGL004397, G1)

SPATIAL CHARACTERISTICS

Spatial Summary: Occurs as a large-patch or linear system.
Size: Occurs in narrow to broad bands, extending along the length of coastal shores and barrier islands. Individual patches may cover a thousand or more acres. However, some of the best remnants are naturally small.
Adjacent Ecological Systems:
- Northern Atlantic Coastal Plain Heathland and Grassland (CES203.895)
- Northern Atlantic Coastal Plain Maritime Forest (CES203.302)
- Northern Atlantic Coastal Plain Sandy Beach (CES203.301)

DISTRIBUTION

Range: This system ranges from northernmost North Carolina (EPA ecoregion 63d) and southeastern Virginia to southern Maine. The southern portion is a transition zone from around Kitty Hawk, North Carolina, to the Virginia-North Carolina border. The

northern limit is Merrymeeting Bay, Maine.
Divisions: 203:C
Nations: US
Subnations: CT, DE, MA, MD, ME, NC, NH, NJ, NY, RI, VA
Map Zones: 60:C, 65:C, 66:C
USFS Ecomap Regions: 211Db:CCC, 221Aa:CCC, 221Ab:CCC, 221Ac:CCC, 221Ad:CCC, 221Ak:CCC, 221An:CCC, 232Ab:CCC, 232Hc:CCC, 232I:CC
TNC Ecoregions: 57:C, 58:C, 62:C, 63:C

SOURCES

References: Comer et al. 2003, Cowardin et al. 1979, Eastern Ecology Working Group n.d., EPA 2004, Massachusetts Barrier Beach Task Force 1994, NYNHP 2013e, Schafale pers. comm.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723222#references
Description Author: R. Evans, mod. M. Pyne, S.C. Gawler, L.A. Sneddon
Version: 14 Jan 2014 **Stakeholders:** East, Southeast
Concept Author: R. Evans **ClassifResp:** East

NORTHERN ATLANTIC COASTAL PLAIN RIVERINE PEAT SWAMP (CES203.070)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Riverine / Alluvial
Non-Diagnostic Classifiers: Forest and Woodland (Treed); Stream terrace (undifferentiated)
FGDC Crosswalk: Vegetated, Tree-dominated, Closed tree canopy, Deciduous closed tree canopy
National Mapping Codes: ESLF 4157

CONCEPT

Summary: This ecological system is found throughout the northern Atlantic Coastal Plain, ranging from Virginia to New Jersey. Examples occur along low-gradient streams and rivers. Floodplain development varies from little to moderate according to stream size. This system is influenced by overbank flooding, groundwater seepage and occasional beaver impoundments. The vegetation is a mosaic of forests, woodlands, shrublands, and herbaceous communities. Canopy composition and cover can vary within and among examples of this system, but typical tree species may include *Quercus palustris, Quercus phellos, Chamaecyparis thyoides, Acer rubrum, Fraxinus pennsylvanica, Nyssa sylvatica, Betula nigra, Liquidambar styraciflua*, and *Platanus occidentalis*. Shrubs and herbaceous layers can vary in richness and cover. Some characteristic shrubs may include *Alnus maritima, Carpinus caroliniana, Lindera benzoin*, and *Viburnum nudum*. Seepage forests dominated by *Acer rubrum* and *Magnolia virginiana* can often be found within this system, especially at the headwaters and terraces of streams.
Classification Comments: New Jersey's Pine Barrens riverside savannas, not covered in other ecological systems, fit this concept and are explicitly included, pending further review.
Similar Ecological Systems:
- Atlantic Coastal Plain Blackwater Stream Floodplain Forest (CES203.247)
- Atlantic Coastal Plain Brownwater Stream Floodplain Forest (CES203.248)
- Atlantic Coastal Plain Small Blackwater River Floodplain Forest (CES203.249)
- Atlantic Coastal Plain Small Brownwater River Floodplain Forest (CES203.250)
- Southern Atlantic Coastal Plain Large River Floodplain Forest (CES203.066)

Related Concepts:
- Atlantic White-Cedar: 97 (Eyre 1980) Finer
- River Birch - Sycamore: 61 (Eyre 1980) Finer
- Sycamore - Sweetgum - American Elm: 94 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs on Coastal Plain flood terraces of streams and rivers, and is also influenced by groundwater seepage. In New Jersey, this system occurs in the Pine Barrens matrix.
Dynamics: This system is hydrologically influenced primarily by groundwater seepage, but is also subjected to periodic overbank flooding. The system is maintained by a natural disturbance regime of flooding and periodic fires of varied intensity. High-intensity fires may consume peat and limit re-establishment of Atlantic white-cedar.

Component Associations:
- *Acer negundo* Forest (CEGL005033, G4G5)
- *Acer rubrum - Fraxinus (pennsylvanica, americana) / Lindera benzoin / Symplocarpus foetidus* Forest (CEGL006406, G4G5)
- *Acer rubrum - Fraxinus pennsylvanica / Saururus cernuus* Forest (CEGL006606, G3G4)
- *Acer rubrum - Nyssa sylvatica - Magnolia virginiana / Viburnum nudum var. nudum / Osmunda cinnamomea - Woodwardia areolata* Forest (CEGL006238, G3?)
- *Betula nigra - Platanus occidentalis / Impatiens capensis* Forest (CEGL006184, G3Q)
- *Chamaecyparis thyoides - Acer rubrum - Magnolia virginiana* Forest (CEGL006078, GNR)
- *Chamaecyparis thyoides / Alnus maritima ssp. maritima* Woodland (CEGL006307, GNR)
- *Chamaecyparis thyoides / Gaylussacia dumosa / Andropogon glomeratus var. glomeratus* Woodland (CEGL006262, G2G3)
- *Chamaecyparis thyoides / Ilex glabra - Rhododendron viscosum* Forest (CEGL006188, G3)
- *Chamaecyparis thyoides / Narthecium americanum - Sarracenia purpurea - Drosera filiformis / Sphagnum pulchrum* Woodland (CEGL006263, G2)
- *Cladium mariscoides - Panicum rigidulum var. pubescens* Herbaceous Vegetation (CEGL006270, G3)
- *Cornus amomum - Alnus serrulata* Shrubland (CEGL006414, GNR)
- *Decodon verticillatus* Semipermanently Flooded Shrubland (CEGL005089, GNR)
- *Eriocaulon aquaticum - Juncus pelocarpus - Drosera intermedia* Herbaceous Vegetation (CEGL006265, G3G4)
- *Liquidambar styraciflua - Acer rubrum - Quercus phellos / Leucothoe racemosa* Forest (CEGL006110, G3)
- *Liquidambar styraciflua - Liriodendron tulipifera / Lindera benzoin / Arisaema triphyllum* Forest (CEGL004418, G4)

- *Muhlenbergia torreyana - Lobelia canbyi - Rhynchospora alba* Herbaceous Vegetation (CEGL006291, G2)
- *Platanus occidentalis - (Liquidambar styraciflua, Liriodendron tulipifera) / Asimina triloba* Forest (CEGL006603, G3G4)
- *Quercus (phellos, palustris, michauxii) - Liquidambar styraciflua / Cinna arundinacea* Forest (CEGL006605, G3G4)
- *Rhynchospora (alba, cephalantha) - Muhlenbergia uniflora - Lophiola aurea* Herbaceous Vegetation (CEGL006285, G2)

SPATIAL CHARACTERISTICS

Spatial Summary: Small, linear patch.
Size: Can be quite long but never very wide.
Adjacent Ecological Systems:
- Northern Atlantic Coastal Plain Pitch Pine Barrens (CES203.269)

Adjacent Ecological System Comments: This list is incomplete; other systems are adjacent in different parts of the range.

DISTRIBUTION

Range: This system occurs on the mid-Atlantic Coastal Plain from Virginia to New Jersey.
Divisions: 203:C
Nations: US
Subnations: DE, MD, NJ, VA
Map Zones: 60:C
USFS Ecomap Regions: 232A:CC, 232H:CC
TNC Ecoregions: 57:C, 58:C, 62:C

SOURCES

References: Eastern Ecology Working Group n.d., Faber-Langendoen et al. 2011, Laderman 1989, Smith 2012, Strakosch Walz 2004, Wacker 1979, Walz et al. 2006c
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.798071#references
Description Author: J. Teague, mod. S.C. Gawler and L.A. Sneddon
Version: 14 Jan 2014 **Stakeholders:** East, Southeast
Concept Author: NCR Review Team **ClassifResp:** East

NORTHERN ROCKY MOUNTAIN AVALANCHE CHUTE SHRUBLAND (CES306.801)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Shrubland (Shrub-dominated); Avalanche chute; Very Short Disturbance Interval [Periodicity/Nonrandom Disturbance]; Avalanche
Non-Diagnostic Classifiers: Montane [Upper Montane]; Montane [Montane]; Temperate [Temperate Continental]; Seepage-Fed Sloping [Mineral]; Forb
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Deciduous shrubland
National Mapping Codes: EVT 2168; ESLF 5327; ESP 1168

CONCEPT

Summary: This ecological system occurs in the mountains throughout the northern Rockies, from Wyoming north and west into British Columbia and Alberta. It is composed of a diverse mix of deciduous shrubs or trees, and conifers found on steep, frequently disturbed slopes in the mountains. Occurrences are found on the lower portions and runout zones of avalanche tracks, and slopes are generally steep, ranging from 15-60%. Aspects vary, but are more common where unstable or heavy snowpack conditions frequently occur. Sites are often mesic to wet because avalanche paths are often in stream gullies, and snow deposition can be heavy in the run-out zones. The vegetation consists of moderately dense, woody canopy characterized by dwarfed and damaged conifers and small, deciduous trees/shrubs. Characteristic species include *Abies lasiocarpa*, *Acer glabrum*, *Alnus viridis ssp. sinuata* or *Alnus incana*, *Populus balsamifera ssp. trichocarpa*, *Populus tremuloides*, or *Cornus sericea*. Other common woody plants include *Paxistima myrsinites*, *Sorbus scopulina*, and *Sorbus sitchensis*. The ground cover is moderately dense to dense forb-rich, with *Senecio triangularis*, *Castilleja* spp., *Athyrium filix-femina*, *Thalictrum occidentale*, *Urtica dioica*, *Erythronium grandiflorum*, *Myosotis asiatica (= Myosotis alpestris)*, *Veratrum viride*, *Heracleum maximum (= Heracleum lanatum)*, and *Xerophyllum tenax*. Mosses and ferns are often present.

Component Associations:
- *Abies lasiocarpa* - *Acer glabrum* Avalanche Chute Shrubland (CEGL000984, G5)
- *Acer glabrum* Avalanche Chute Shrubland (CEGL001061, G5)
- *Alnus* spp. Avalanche Chute Shrubland (CEGL001158, G5)
- *Alnus viridis ssp. sinuata / Athyrium filix-femina* - *Cinna latifolia* Shrubland (CEGL001156, G4)
- *Alnus viridis ssp. sinuata* / Mesic Forbs Shrubland (CEGL002633, G3G4)
- *Populus balsamifera ssp. trichocarpa / Cornus sericea* Forest (CEGL000672, G3G4)
- *Populus tremuloides / Amelanchier alnifolia* Avalanche Chute Shrubland (CEGL005886, G3?)
- *Populus tremuloides / Cornus sericea* Forest (CEGL000582, G4)

DISTRIBUTION

Range: This ecological system occurs in the mountains throughout the northern Rockies, from Wyoming north and west into British Columbia and Alberta. It is likely to occur in the Colorado Rockies, but no association from that area have been classified as "avalanche chute" communities.
Divisions: 306:C
Nations: CA, US
Subnations: AB, BC, CO, MT, OR, WA, WY
Map Zones: 9:C, 10:C, 12:?, 19:C, 21:P, 28:P
USFS Ecomap Regions: M242D:PP, M331A:CC, M331D:CC, M331E:CP, M331J:CC, M332B:PP, M332E:PP, M332F:PP, M333A:CC, M333B:CC, M333C:CC, M333D:CC
TNC Ecoregions: 7:C, 8:C, 9:C

SOURCES

References: Butler 1979, Butler 1985, Comer et al. 2003, Malanson and Butler 1984, NCC 2002
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722872#references
Description Author: NatureServe Western Ecology Team
Version: 20 Feb 2003 **Stakeholders:** Canada, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

NORTHWESTERN GREAT PLAINS ASPEN FOREST AND PARKLAND (CES303.681)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Western Great Plains (303)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Non-Diagnostic Classifiers: Forest and Woodland (Treed); Woody-Herbaceous; Boreal; Glaciated
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Deciduous open tree canopy
National Mapping Codes: EVT 2009; ESLF 4146; ESP 1009

CONCEPT

Summary: This system ranges from the North Dakota/Manitoba border west to central Alberta and is considered part of the boreal-mixedgrass prairie grassland transition region. The climate in this region is mostly subhumid low boreal with short, warm summers and cold, long winters. Much of this region is covered with undulating to kettled glacial till. *Populus tremuloides* dominates this system. Common associates are *Betula papyrifera* and *Populus balsamifera* with an understory of mixedgrass species and tall shrubs. More poorly drained sites may contain willow (*Salix* spp.) and sedges (*Carex* spp.). Fire constitutes the most important dynamic in this system and prevents boreal conifer species such as *Picea glauca* and *Abies balsamea* from becoming too established in this system.
Classification Comments: This system can grade into Eastern Great Plains Tallgrass Aspen Parkland (CES205.688) to the east, which has a predominance of tallgrass species in the understory compared to the more mixedgrass species in this system. More data from Canada are needed to fully describe this system. In spring 2006, it was determined by Steve Cooper, Marion Reid and Gwen Kittel that this system does not occur in north-central Montana, mapzone 20. However, it does occur along the lower-elevation slopes of the Montana Front Range, in mapzone 19.
Similar Ecological Systems:
- Eastern Great Plains Tallgrass Aspen Parkland (CES205.688)
- Rocky Mountain Aspen Forest and Woodland (CES306.813)

Related Concepts:
- Aspen: 16 (Eyre 1980) Finer
- Aspen: 217 (Eyre 1980) Broader
- Fescue Grassland (613) (Shiflet 1994) Intersecting. *Festuca campestris* grasslands occur as small inclusions in this ecological system.
- Paper Birch: 18 (Eyre 1980) Finer

DESCRIPTION

Environment: Climate in the range of this system is mostly subhumid low boreal with short, warm summers and long, cold winters. Undulating to kettled glacial till predominates this region.
Vegetation: *Populus tremuloides* dominates this system. Common associates are *Populus balsamifera* and *Betula papyrifera* along with an understory of mixedgrass and tall-shrub species.
Dynamics: Fire is likely the most important natural dynamic allowing for a more open structure and preventing this system from containing more conifer species.

Component Associations:
- *Betula papyrifera / Corylus cornuta* Forest (CEGL002079, G2G3)
- *Betula papyrifera / Corylus cornuta* Woodland (CEGL002128, G2G3)
- *Festuca altaica - (Hesperostipa* spp., *Achnatherum* spp.) Herbaceous Vegetation (CEGL002436, GNR)
- *Festuca campestris - Pseudoroegneria spicata* Herbaceous Vegetation (CEGL001629, G4)
- *Populus tremuloides - Populus balsamifera / Calamagrostis canadensis - Spartina pectinata* Forest (CEGL002097, G3G4)
- *Populus tremuloides / Calamagrostis rubescens* Forest (CEGL000575, G5?)
- *Populus tremuloides / Prunus virginiana* Woodland (CEGL002130, G4G5)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Eastern Great Plains Tallgrass Aspen Parkland (CES205.688)

Adjacent Ecological System Comments: This system can grade into Eastern Great Plains Tallgrass Aspen Parkland (CES205.688) to the east.

DISTRIBUTION

Range: This system is found in the boreal-grassland transition region from the North Dakota/Manitoba border west to central Alberta. and south along the eastern slopes of the Front Range of Montana, where it occurs below lower treeline.
Divisions: 205:C; 303:C
Nations: CA, US

Subnations: AB, MB, MT, ND, SK
Map Zones: 19:C, 30:?, 40:P
USFS Ecomap Regions: 331D:CC, M333C:CC
TNC Ecoregions: 34:?, 66:C, 67:C

SOURCES

References: Barbour and Billings 1988, Comer et al. 2003, Greenall 1995, Ricketts et al. 1999
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722978#references
Description Author: S. Menard
Version: 20 Apr 2006 **Stakeholders:** Canada, Midwest, West
Concept Author: S. Menard **ClassifResp:** Midwest

NORTHWESTERN GREAT PLAINS RIPARIAN (CES303.677)

CLASSIFIERS

Conf.: 3 - Weak
Classification Status: Standard
Primary Division: Western Great Plains (303)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Non-Diagnostic Classifiers: Forest and Woodland (Treed)
National Mapping Codes: ESLF 9326

CONCEPT

Summary: This system is found in the riparian areas of medium and small rivers and streams throughout the northwestern Great Plains. It is likely most common in the Northern Great Plains Steppe. This system occurs in the Upper Missouri and tributaries starting at the Niobrara, White, Cheyenne, Belle Fourche, Moreau, Grand, Heart, Little Missouri, Yellowstone, Powder, Tongue, Bighorn, Wind, Milk, Musselshell, Marias, and Teton rivers; and in Canada, the Southern Saskatchewan, Red Deer and Old Man rivers to where they extend into Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821) or Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland (CES306.804). These are found on alluvial soils in highly variable landscape settings, from deep cut ravines to wide, braided streambeds. Hydrologically, these tend to be more flashy with less developed floodplain than on larger rivers, and typically dry down completely for some portion of the year. Dominant vegetation shares much with generally drier portions of larger floodplain systems downstream, but overall abundance of vegetation is generally lower. Communities within this system range from riparian forests and shrublands to gravel/sand flats. Dominant species include *Populus deltoides*, *Populus balsamifera ssp. trichocarpa*, *Salix* spp., *Artemisia cana ssp. cana*, and *Pascopyrum smithii*. These areas are often subjected to heavy grazing and/or agriculture and can be heavily degraded. Another factor is that groundwater depletion and lack of fire have created additional species changes.
Classification Comments: This system needs to be more clearly delineated from Northwestern Great Plains Floodplain (CES303.676). The component plant association list is incomplete. All the riparian/floodplain/alluvial systems of the Great Plains region need to be revisited for naming conventions, along with better definitions of conceptual boundaries. There is much apparent overlap in their concepts and distribution, and the names add to the confusion. In particular, the difference between "riparian" and "floodplain" usage in the names needs revisiting and possible changing. These systems include Northwestern Great Plains Floodplain (CES303.676), Northwestern Great Plains Riparian (CES303.677), Western Great Plains Floodplain (CES303.678), and Western Great Plains Riparian (CES303.956).
Related Concepts:
- Northwestern Great Plains Riparian (Rolfsmeier and Steinauer 2010) Equivalent
- Sagebrush - Grass (612) (Shiflet 1994) Intersecting. Most *Artemisia cana ssp. cana* shrublands occur on stream terraces.

Component Associations:
- *Artemisia cana / Pascopyrum smithii* Shrubland (CEGL001072, G4)
- *Pascopyrum smithii - (Elymus trachycaulus)* Clay Pan Herbaceous Vegetation (CEGL002239, GNR)
- *Populus deltoides - Fraxinus pennsylvanica* Forest (CEGL000658, G2G3)
- *Populus deltoides / Cornus sericea* Forest (CEGL000657, G2G3)
- *Populus deltoides / Symphoricarpos occidentalis* Woodland (CEGL000660, G2G3)

DISTRIBUTION

Range: This system occurs throughout the northwestern Great Plains, north of the North Platte River basin in eastern Wyoming. It is found in eastern Wyoming and eastern Montana along the upper Missouri, Yellowstone, Powder, Tongue, Bighorn, Wind, Milk, Musselshell, Marias, and Teton rivers; in northern Nebraska and the Dakotas on the Niobrara, upper Missouri, White, Cheyenne, Belle Fourche, Moreau, Grand, Heart, Little Missouri rivers; and in Canada the Southern Saskatchewan, Red Deer and Old Man rivers.
Divisions: 205:P; 303:C
Nations: CA, US
Subnations: AB, MB, MT, ND, NE, SD, SK, WY
Map Zones: 20:C, 22:P, 29:C, 30:C, 31:C, 39:C, 40:C
USFS Ecomap Regions: 331D:CC, 331F:CP, 331G:CC, 331K:CC, 331L:CC, 331M:C?, 331N:CC, 342A:CC, 342F:CC, M334A:CC
TNC Ecoregions: 10:C, 26:C, 34:C, 66:P, 67:P

SOURCES

References: Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722981#references
Description Author: NatureServe Western Ecology Team
Version: 01 Oct 2007
Stakeholders: Canada, Midwest, West
Concept Author: NatureServe Western Ecology Team
ClassifResp: West

OZARK-OUACHITA RIPARIAN (CES202.703)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Ozark/Ouachita
Non-Diagnostic Classifiers: Forest and Woodland (Treed); Stream terrace (undifferentiated)
National Mapping Codes: ESLF 9337

CONCEPT

Summary: This system is found along streams and small rivers within the Ozark and Ouachita regions. In contrast to larger floodplain systems, this system has little to no floodplain development and often contains cobble bars and steep banks. It is higher gradient than larger floodplains and experiences periodic, strong flooding. It is often characterized by a cobble bar with forest immediately adjacent with little to no marsh development. Canopy cover can vary within examples of this system, but typical tree species include *Liquidambar styraciflua, Platanus occidentalis, Betula nigra, Acer* spp., and *Quercus* spp. The richness of the herbaceous layer can vary significantly, ranging from species-rich to species-poor. Likewise, the shrub layer can vary considerably, but typical species may include *Lindera benzoin, Alnus serrulata*, and *Hamamelis vernalis*. Small seeps and fens can often be found within this system, especially at the headwaters and terraces of streams. These areas are typically dominated by primarily wetland obligate species of sedges (*Carex* spp.), ferns (*Osmunda* spp.), and other herbaceous species such as *Impatiens capensis*. Flooding and scouring strongly influence this system and prevent the floodplain development found on larger rivers.
Classification Comments: A separate Ozark-Ouachita fen/seep system (CES202.052) has also been developed.
Similar Ecological Systems:
- South-Central Interior Small Stream and Riparian (CES202.706)

Related Concepts:
- River Birch - Sycamore: 61 (Eyre 1980) Finer
- Sugar Maple: 27 (Eyre 1980) Finer

DESCRIPTION

Environment: This system has little to no floodplain development and often contains cobble bars and steep banks. It is often characterized by a cobble bar with forest immediately adjacent with little to no marsh development. Because these habitats are moister than adjacent uplands, the streamside zones have much higher plant and animal diversity. Orchids and many other species of mesic habitats can be found here. At the larger end of the size continuum, these streams can have gravel and even sand bottoms that support a range of species, including *Salix* spp., *Justicia americana*, and others. Pools provide refugia for invertebrate and vertebrate species that can then rapidly recolonize the stream during high water.
Vegetation: Typical tree species in examples of this system include *Liquidambar styraciflua, Platanus occidentalis, Betula nigra*, maples (*Acer* spp.), and oaks (*Quercus* spp.). The richness of the herbaceous layer can vary significantly, ranging from species-rich to species-poor. Likewise, the shrub layer can vary considerably, but typical species may include *Lindera benzoin, Alnus serrulata*, and *Hamamelis vernalis*.
Dynamics: Flooding and scouring strongly influence this system and prevent the floodplain development found on larger rivers. It is traditionally higher gradient than larger floodplains and experiences periodic strong flooding. The distinctive dynamics of stream flooding are presumably the primary reason for the distinctive vegetation of this system, though not all of the factors are well known. Small rivers and streams, with small watersheds, have more variable flooding regimes that larger rivers. Floods tend to be of short duration and unpredictably variable as to season and depth. In addition to disturbance, floods bring nutrient input, deposit sediment, and disperse plant seeds. Fire does not appear to be a dominant factor, and most floodplain vegetation is not very flammable. Historical references to canebrakes dominated by *Arundinaria gigantea* suggest that fire may have once been more possible and more important in at least some portions.

Flooding is the major process affecting the vegetation, with the substrate more rapidly drained than in flat floodplain areas. The higher gradients of most of these streams and rivers limit floods to fairly short duration. Flooding is most common in the winter, but may occur in other seasons particularly in association with hurricanes, tornados, or microbursts from thunderstorms. Flood waters may have significant energy in higher gradient systems, but scouring and reworking of sediment are important in maintaining the small non-forested patches of the bar and bank communities. Flooding can act as a replacement disturbance in areas where beavers impounded a channel or in rare years with severe prolonged flood events. There are two general types of floods: occasional catastrophic, prolonged floods (due to beaver activity or other severe event); and more frequent repeated minor flooding (i.e., several minor floods within a 10-year period).

The wind disturbance associated with flooding is very significant along small streams because of wet and less dense soils and shallow-rooted trees. Canopy tree mortality from more common windstorms would have resulted in tree-by-tree or small group replacement. Windthrow is the primary cause of mortality in bottomlands. Major storms or hurricanes occurring at approximately 20 year intervals would have impacted whole stands.

In this system, the fire-return interval varies greatly. Except in canebrakes, most fires were very light surface fires, creeping in hardwood or pine litter with some thin, patchy cover of bottomland grasses. Flame lengths were mostly 15-30 cm (6-12 inches). Fire-scarred trees can be found in most small stream sites except in the wettest microsites. Stand-replacement fires are almost unknown in this type. Except where Native American burning was involved, fires likely occurred primarily during drought conditions and then often only when fire spread into bottomlands from more pyrophytic uplands. Trees may be partially girdled by fire in duff, followed by bark sloughing. While fire rarely killed the tree, this allowed entry of rot, which, in the moist environment, often resulted in hollow trees, providing nesting and denning habitat for many species of birds and animals. Surface fires occurred on a frequency ranging from about 3-8 years in streamside canebrake, streamside hardwood/canebrake, or pine, to 25 years or more in hardwood litter. Low areas having a long hydroperiod, islands, and areas protected from fire by back swamps and oxbows were virtually fire-free. Fire effects were largely limited to top-kill of shrubs and tree saplings less than 5 cm (2 inches) diameter, and formation of hollow trees.

Component Associations:
- *(Carex interior, Carex lurida) - Carex leptalea - Parnassia grandifolia - Rhynchospora capillacea* Herbaceous Vegetation (CEGL002404, G2G3)
- *Acer (saccharum, barbatum) - Quercus rubra - Carya cordiformis / Asimina triloba* Forest (CEGL002060, G3)
- *Acer negundo - (Platanus occidentalis, Populus deltoides)* Forest (CEGL004690, G4)
- *Alnus serrulata - Amorpha fruticosa* Shrubland (CEGL007807, G3?)
- *Alnus serrulata* Interior Shrubland (CEGL003894, G4?)
- *Betula nigra - Platanus occidentalis* Forest (CEGL002086, G5)
- *Carex crinita - Osmunda* spp. / *Physocarpus opulifolius* Seep Herbaceous Vegetation (CEGL002392, G2)
- *Carex crinita - Osmunda* spp. / *Sphagnum* spp. Herbaceous Vegetation (CEGL002263, G2G3)
- *Carex interior - Carex lurida - Andropogon gerardii - Parnassia grandifolia* Herbaceous Vegetation (CEGL002416, G1G2)
- *Carex joorii - Eleocharis tenuis var. verrucosa - Juncus* spp. - *Panicum rigidulum* Interior Highlands Channel Scar Depression Wooded Herbaceous Vegetation (CEGL007116, G2?)
- *Hamamelis vernalis - Cornus obliqua - Hypericum prolificum* Shrubland (CEGL003898, G3)
- *Juncus effusus* Seasonally Flooded Herbaceous Vegetation (CEGL004112, G5)
- *Juniperus virginiana var. virginiana - Leptopus phyllanthoides - (Quercus nigra, Ilex vomitoria)* Shrubland (CEGL003942, G2Q)
- *Justicia americana* Herbaceous Vegetation (CEGL004286, G4G5)
- *Liquidambar styraciflua - (Quercus alba, Acer saccharum) / Carpinus caroliniana / Lindera benzoin* Forest (CEGL007826, G3G4)
- Ozark Riverine Cobble - Gravel Flats Sparse Vegetation (CEGL007012, GNR)
- *Panicum virgatum - Calamovilfa arcuata* Herbaceous Vegetation (CEGL007838, G2?)
- *Podostemum ceratophyllum* Herbaceous Vegetation (CEGL004331, G3G5)
- *Salix caroliniana* Temporarily Flooded Ozark Shrubland (CEGL007064, G4?)
- *Salix nigra* Temporarily Flooded Shrubland (CEGL003901, G4?)
- *Scirpus cyperinus* Seasonally Flooded Southern Herbaceous Vegetation (CEGL003866, G4)
- *Taxodium distichum - Platanus occidentalis* Ouachita Foothills Forest (CEGL007377, G2Q)
- *Zizaniopsis miliacea* Rocky Riverbed Herbaceous Vegetation (CEGL004140, G2?)

DISTRIBUTION

Range: This system is found within the Ozarks and the Ouachita Mountains of Missouri, Arkansas and Oklahoma.
Divisions: 202:C
Nations: US
Subnations: AR, MO, OK
Map Zones: 32:C, 44:C
USFS Ecomap Regions: M223A:CC, M231A:CC
TNC Ecoregions: 38:C, 39:C

SOURCES

References: Arkansas Forestry Commission 2010, Comer et al. 2003, Eyre 1980, Nelson 1985
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722957#references
Description Author: S. Menard, mod. M. Pyne
Version: 14 Jan 2014
Concept Author: S. Menard
Stakeholders: Midwest, Southeast
ClassifResp: Midwest

RIO GRANDE DELTA THORN WOODLAND (CES301.716)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Madrean Semidesert (301)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Lowland [Lowland]; Forest and Woodland (Treed); Tropical/Subtropical; Riverine / Alluvial
Non-Diagnostic Classifiers: Broad-Leaved Evergreen Tree
National Mapping Codes: ESLF 4164

CONCEPT

Summary: This diverse, usually broad-leaved evergreen woodland is found on resaca banks and old natural levees on the Rio Grande delta in southern Texas. Sites are well-watered, somewhat elevated relative to the surrounding landscape, and tend to occupy loamy or clayey bottomland soils. This system includes evergreen, mixed and deciduous woodlands and shrublands with a typically open upper canopy of broadleaf evergreen species such as *Ebenopsis ebano* and *Ehretia anacua* and a dense shrub layer of numerous species present. Mature occurrences will often support epiphytes such as *Tillandsia recurvata, Tillandsia usneoides*, and rarely *Tillandsia baileyi*.

Classification Comments: Younger occurrences, especially those occupying drier sites, tend to present as shrublands, often dominated by similar, though shorter, canopy species. These occurrences also tend to be less diverse, lack the layered structure, and usually support fewer epiphytes.

Similar Ecological Systems:

- Tamaulipan Floodplain (CES301.990)

Related Concepts:

- Rio Grande Delta Deciduous Thorn Woodland and Shrubland (7804) (Elliott 2011) Finer. Woodlands with increased dominance of deciduous species such as *Celtis laevigata, Ulmus crassifolia*, and *Celtis pallida (= Celtis ehrenbergiana)*.
- Rio Grande Delta Dense Shrubland (7805) (Elliott 2011) Finer. Dense shrublands often representing younger occurrences and occurrences occupying slightly less well-watered sites. *Phaulothamnus spinescens, Guajacum angustifolium, Celtis pallida*, and *Diospyros texana* are often conspicuous components.
- Rio Grande Delta Evergreen Thorn Woodland and Shrubland (7802) (Elliott 2011) Finer. Much of this system (>90%) is mapped as this type with broadleaf evergreen species such as *Ebenopsis ebano* and *Ehretia anacua* making up a significant portion of the overstory canopy and a dense shrub layer of numerous species present.

DESCRIPTION

Environment: This system occurs in the historic floodplain of the Rio Grande delta on Quaternary-aged alluvium. It is found on slight rises such as old natural levees or resaca banks often on Clayey or Loamy Bottomland Ecological Sites, but occasionally on Clay Loam or Gray Sandy Loam types. Sites are well-watered, somewhat elevated relative to the surrounding landscape, and tend to occupy loamy or clayey bottomland soils. Occasionally occurrences can be found on clay loams (such as Raymondville or Racombes soils) or gray sandy loams (such as Hidalgo sandy clay loam).

Vegetation: The sometimes patchy canopy of these woodlands often contains species such as *Ebenopsis ebano, Ehretia anacua, Celtis laevigata, Ulmus crassifolia*, and *Celtis pallida (= Celtis ehrenbergiana)*, and may reach heights of 15 m. Species such as *Phaulothamnus spinescens, Amyris madrensis, Amyris texana, Diospyros texana, Leucaena pulverulenta, Guajacum angustifolium, Malpighia glabra, Adelia vaseyi, Bernardia myricifolia, Sideroxylon celastrinum, Condalia hookeri, Forestiera angustifolia, Havardia pallens, Iresine palmeri, Trixis inula, Xylosma flexuosa*, and *Randia rhagocarpa* may occur as shrubs or in the subcanopy, and some individuals of a few of these species may reach heights of 4 to 5 m. This shrub or understory layer can be extremely dense, almost impenetrable. Woody cover, including the patchier overstory canopy and the almost continuous shrub/understory layer, often reaches greater than 90%. This system is sometimes referred to as a tall shrubland, since shrubs are often the dominant lifeform, but frequently reach heights resembling the stature of woodland. *Prosopis glandulosa* may occasionally be absent or uncommon in the canopy, and is generally not dominant except in disturbed situations. The herbaceous layer is generally represented by a only a few species and is relatively sparse, with species such as *Rivina humilis, Plumbago scandens, Celosia nitida, Chromolaena odorata, Leersia monandra, Digitaria californica, Setaria* spp., *Salvia coccinea, Petiveria alliacea, Malvastrum americanum, Urtica chamaedryoides, Verbesina microptera, Calyptocarpus vialis*, and *Siphonoglossa pilosella (= Justicia pilosella)* sometimes present. Vines such as *Serjania brachycarpa, Urvillea ulmacea, Cocculus diversifolius, Mikania scandens, Cardiospermum* spp., *Chiococca alba, Cissus trifoliata*, and *Passiflora* spp. may also be commonly encountered. The rather rare epiphyte *Tillandsia baileyi* may be found in these woodlands, along with the more common *Tillandsia recurvata* and *Tillandsia usneoides*. Younger occurrences, especially those occupying drier sites, tend to present as shrublands, often dominated by similar, though shorter, canopy species. These occurrences also tend to be less diverse, lack the layered structure, and usually support fewer epiphytes.

Dynamics: The major processes in this system were flooding and drought (Diamond 1998). Freezes can have significant impacts on canopy species such as *Ebenopsis, Sabal* and *Leucaena pulverulenta* in the delta. Hurricanes may not significantly affect dense *Ebenopsis ebano - Ehretia anacua* forest, except through flood effects. Lengthy droughts (lasting 10 years) can influence this system

but most species are drought-tolerant. Infrequent fires may also occur.

This system was modeled as part of the Tamaulipan Riparian Systems group by Landfire (2007a) using three classes: early-, mid- and late-seral. Fire frequency is likely over-emphasized in this model for this system, as other ecologists suggest fire was historically infrequent in the Rio Grande delta (Diamond 1998).

Early-seral class (0-12 years): Herbaceous species dominant where there are high sunlight conditions. Woody species begin establishing in the understory. Duration of this stage is 12 years. Flooding at an interval of 500 years is modeled for this stage (Landfire 2007a).

Mid-seral class (13-33 years): Species composition would contain canopy species of an earlier successional type such as *Acacia farnesiana, Ehretia anacua, Leucaena pulverulenta, Celtis laevigata* and *Celtis pallida*. Shrub cover would be increased due to openness of the canopy. Duration of this stage is 20 years. Flooding at an interval of 500 years moves to early-seral class. Surface fires every 30 years maintain this mid-seral class (Landfire 2007a).

The late-seral class (34+ years): Canopy becomes more closed and includes *Ehretia anacua, Ebenopsis ebano, Ulmus crassifolia*, and *Celtis laevigata*. Gap succession does occur as individual tree mortality occurs (maintenance/ every 500 years) and moves class to mid-seral. Freezes will reduce canopy of ebony and other subtropical species. Freezes (every 50 years) and surface fires (every 30 years) occur but do not cause transitions to other structural or floristic states. Flooding at an interval of 500 years takes class to early-seral (Landfire 2007a).

Component Associations:
- *Celtis laevigata - Ulmus crassifolia - (Fraxinus berlandieriana) / Rivina humilis - Chromolaena odorata* Forest (CEGL007752, G1G2)
- *Ebenopsis ebano - Ehretia anacua / Condalia hookeri* Forest (CEGL002054, G1)
- *Ebenopsis ebano - Phaulothamnus spinescens* Scrub (CEGL002169, G2)

Spatial Characteristics

Spatial Summary: This system was apparently much wider spread historically, forming a matrix type in the Rio Grande delta of southern Texas. It is currently only known from smaller patches.
Size: Historically: Matrix. Currently: Small patch
Adjacent Ecological Systems:
- Tamaulipan Floodplain (CES301.990)

Distribution

Range: This system is currently on known from remnant occurrences in the historic delta of the Rio Grande in southern Texas. It may also occur in Mexico.
Divisions: 301:C
Nations: MX? , US
Subnations: MXNU?(MX), MXTM?(MX), TX
USFS Ecomap Regions: 255Dc:???, 315Ef:CCC, 315Eg:CCC
TNC Ecoregions: 30:C, 31:P

Sources

References: Correll and Johnston 1970, Diamond 1987, Diamond 1988, Diamond 1998, Elliott 2011, Eyre 1980, Jahrsdoerfer and Leslie 1988, Lonard and Judd 2002, McLendon 1991, Southeastern Ecology Working Group n.d., TNC 2013, Webster 2001
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.859592#references
Description Author: L. Elliott, mod. J. Teague and K.A. Schulz
Version: 14 Jan 2014 **Stakeholders:** Latin America, Southeast
Concept Author: L. Elliott, D. Diamond, A. Treuer-kuehn, D. German, J. Teague **ClassifResp:** Southeast

SONORAN FAN PALM OASIS (CES302.759)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: North American Warm Desert (302)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Forest and Woodland (Treed); Tropical/Subtropical [Tropical Xeric]; Temperate [Temperate Xeric]; Seepage-Fed Sloping; Palm or Sabal
Non-Diagnostic Classifiers: Lowland [Foothill]; Lowland [Lowland]; Isolated Wetland [Partially Isolated]; Udic
National Mapping Codes: ESLF 9327

CONCEPT

Summary: This ecological system occurs on highly localized, spring-fed depressions along canyon waterways and tectonic fault lines below 900 m in elevation in the Sonoran and Mojave deserts. Permanent subsurface water is required to maintain *Washingtonia filifera*, a relict species. Salinity is low in the root zone, but increases near the surface where evaporation leaves salt accumulations. These oases woodlands are distinctively dominated by *Washingtonia filifera* with variable understory conditions. Other trees that may be present include *Platanus racemosa*, *Quercus chrysolepis*, *Populus fremontii*, and *Fraxinus velutina*. A subcanopy of *Salix lasiolepis*, *Salix gooddingii*, *Salix exigua*, or *Prosopis glandulosa* is often present. Reproduction of *Washingtonia filifera* is limited by water supply, surface salinity, rainfall, and fire. Fan palms are fire-tolerant, while the understory species are not, and fires open up the understory allowing palm seedlings to establish. Removal of the understory also decreases competition for water. There are currently 80 known occurrences in California and probably 100 throughout its range including Arizona and Nevada.

DESCRIPTION

Environment: Desert springs in canyon waterways or along fault lines where underground water is continuously available. Salinity is low in the root zone, but increases near the surface where evaporation leaves salt accumulations.
Dynamics: Reproduction of *Washingtonia filifera* is limited by water supply, surface salinity, rainfall, and fire. Fan palms are fire-tolerant, while the understory species are not, and fires open up the understory allowing palm seedlings to establish. Removal of the understory also decreases competition for water. Fire is essential in the regeneration of *Washingtonia filifera* (Sawyer et al. 2009). Natural fires started by lighting as well as those set by Native Americans prior to 1900s created favorable germination sites and increased the flow of springs. Flash floods probably had similar effect (Sawyer et al. 2009).

Component Associations:
- *Washingtonia filifera* Woodland (CEGL000001, G3?)

DISTRIBUTION

Range: Below 900 m in elevation in the Sonoran and Mojave deserts.
Divisions: 302:C
Nations: MX, US
Subnations: AZ, CA, MXBC(MX), MXSO(MX), NV
Map Zones: 4:C, 13:C
USFS Ecomap Regions: 322A:CC, 322B:CC, 322C:CC
TNC Ecoregions: 17:C, 23:C

SOURCES

References: Barbour and Major 1988, Brown 1982a, Comer et al. 2003, Holland and Keil 1995, MacMahon 1988, PRBO Conservation Science 2011, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Szaro 1989, Thomas et al. 2004
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722913#references
Description Author: NatureServe Western Ecology Team, mod. G. Kittel
Version: 14 Jan 2014 **Stakeholders:** Latin America, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

SOUTH FLORIDA PINE FLATWOODS (CES411.381)

CLASSIFIERS

Classification Status: Standard

Primary Division: Caribbean (411)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Needle-Leaved Tree
Non-Diagnostic Classifiers: Woody-Herbaceous; Extensive Wet Flat
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Evergreen open tree canopy
National Mapping Codes: EVT 2446; ESLF 9115; ESP 1446

CONCEPT

Summary: This system is endemic to Florida, ranging from Lee, Desoto, Highlands, and Okeechobee counties southward. It was once an extensive system within its historic range. The vegetation is naturally dominated by *Pinus elliottii var. densa*, being largely outside the natural range of *Pinus serotina, Pinus elliottii var. elliottii*, and *Pinus palustris*. In natural condition, examples are generally open with a variety of low shrub and grass species forming a dense ground cover. Frequent, low-intensity fire was the dominant natural ecological force, but most areas have undergone long periods without fire, resulting in greater dominance of shrubs and saw palmetto, as well as denser canopies of slash pine.
Classification Comments: No associations have currently been described in the USNVC for this system. More information is needed. The floristic composition of this system overlaps Florida Dry Prairie (CES203.380); the primary difference lies in taller and denser shrub cover (especially of *Serenoa repens*) (Huffman and Judd 1998). There is considerable variation between wet and "non-wet" flatwoods implied in this system.
Similar Ecological Systems:
- Florida Dry Prairie (CES203.380)
- South Florida Pine Rockland (CES411.367)--is also dominated almost exclusively by *Pinus elliottii var. densa* in the canopy, but occurs on limestone and has a richer, diverse mix of tropical and temperate species in the understory.

Related Concepts:
- Mesic Flatwoods (FNAI 1990) Intersecting
- Pine Forest (Duever et al. 1986) Finer
- Scrubby Flatwoods (FNAI 1990) Intersecting
- Wet Flatwoods (FNAI 1990) Intersecting

DESCRIPTION

Environment: This system occurs on sandy soils, including Spodosols, which are prone to some saturation or short periods of flooding after summer rains. These flatwoods occur in areas which have some creeks, which provide some natural firebreaks. Similar areas which are very extensive without creeks tend to be Florida Dry Prairie (CES203.380), which naturally burns more frequently.
Vegetation: According to Huffman and Judd (1998), examples of this system have generally open canopies composed of *Pinus elliottii var. densa* and, more rarely, *Pinus palustris*. *Serenoa repens, Lyonia lucida, Lyonia fruticosa, Ilex glabra, Vaccinium darrowii, Vaccinium myrsinites*, and *Quercus minima* are common shrubs. Grasses are typically abundant, including *Aristida beyrichiana* and *Schizachyrium scoparium var. stoloniferum*; most other grass and herbaceous species found are in common with Florida Dry Prairie (CES203.380).
Dynamics: Frequent, low-intensity fire was the dominant natural ecological force, but most areas have undergone long periods without fire, resulting in greater dominance of shrubs and saw palmetto, as well as denser canopies of slash pine (Huffman and Judd 1998, Noel et al. 1998). Disturbances are an important part of the natural functions of pine flatwoods. In order for these habitats to burn frequently (every 2-3 years), there needs to be enough fine fuel, such as needles from *Pinus elliottii var. densa* or *Pinus palustris* trees, healthy populations of native warm-season grasses, and evergreen shrubs with volatile oils in their leaves, such as *Gaylussacia frondosa, Hypericum reductum, Ilex glabra, Lyonia ferruginea, Lyonia fruticosa, Serenoa repens*, and *Vaccinium myrsinites*. The frequent fires promote flowering, seed production, and seed germination of many plants and provide open areas in patches (Van Lear et al. 2005).

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- South Florida Depression Pondshore (CES411.054)

DISTRIBUTION

Range: This system is found in southern Florida, extending north to mid-peninsula (e.g., Lee, Desoto, Highlands, and Okeechobee counties).
Divisions: 203:C; 411:C
Nations: US
Subnations: FL

Map Zones: 56:C
USFS Ecomap Regions: 232D:CC, 232G:CC, 411A:CC
TNC Ecoregions: 54:C, 55:C

SOURCES

References: Brewer 2008, Comer et al. 2003, Duever et al. 1986, FNAI 1990, Huffman and Judd 1998, McPherson 1986, NatureServe 2011, Noel et al. 1998, Oswalt et al. 2012, Stout and Marion 1993, Van Lear et al. 2005, Wahlenberg 1946

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723135#references

Description Author: R. Evans and C. Nordman
Version: 14 Jan 2014
Concept Author: R. Evans and C. Nordman

Stakeholders: Southeast
ClassifResp: Southeast

SOUTH-CENTRAL INTERIOR LARGE FLOODPLAIN (CES202.705)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Non-Diagnostic Classifiers: Floodplain; Forest and Woodland (Treed); Herbaceous
National Mapping Codes: ESLF 9334

CONCEPT

Summary: This floodplain system is found in the Interior Highlands as far west as eastern Oklahoma, as well as throughout the Interior Low Plateau, Cumberlands, Southern Ridge and Valley, and Western Allegheny Plateau, and lower elevations of the Southern Blue Ridge. Examples occur along large rivers or streams where topography and alluvial processes have resulted in a well-developed floodplain. A single occurrence may extend from river's edge across the outermost extent of the floodplain or to where it meets a wet meadow or upland system. Many examples of this system will contain well-drained levees, terraces and stabilized bars, and some will include herbaceous sloughs and shrub wetlands resulting, in part, from beaver activity. A variety of soil types may be found within the floodplain from very well-drained sandy substrates to very dense clays. It is this variety of substrates in combination with different flooding regimes that creates the mix of vegetation. Most areas, except for the montane alluvial forests, are inundated at some point each spring; microtopography determines how long the various habitats are inundated. Although vegetation is quite variable in this broadly defined system, examples may include *Acer saccharinum*, *Platanus occidentalis*, *Liquidambar styraciflua*, and *Quercus* spp. Understory species are mixed, but include shrubs, such as *Cephalanthus occidentalis* and *Arundinaria gigantea ssp. gigantea*, and sedges (*Carex* spp.). This system likely floods at least once annually and can be altered by occasional severe floods. Impoundments and conversion to agriculture can also impact this system.

Classification Comments: Montane alluvial forests may be difficult to place within this system because they share traits with both this system and Southern and Central Appalachian Cove Forest (CES202.373), at least in the southern Appalachians. This split from Central Appalachian River Floodplain (CES202.608) may appear somewhat arbitrary but is based on the freshwater systems classification, using roughly the Mid-Continental Divide. This means that Ecoregions 50 and 51 are included in this system, whereas Ecoregions 52 and 59 are considered part of Central Appalachian River Floodplain (CES202.608) (except for a small part of southernmost Ecoregion 59 in West Virginia that drains to the Ohio River).This system grades into Western Great Plains Floodplain (CES303.678) in the Crosstimbers region of east-central Oklahoma as eastern cottonwood (*Populus deltoides*) and willows (*Salix* spp.) become more dominant.

Similar Ecological Systems:
- Central Appalachian River Floodplain (CES202.608)
- South-Central Interior Small Stream and Riparian (CES202.706)
- Southern Piedmont Large Floodplain Forest (CES202.324)
- Southern Piedmont Small Floodplain and Riparian Forest (CES202.323)
- Western Great Plains Floodplain (CES303.678)

Related Concepts:
- Black Willow: 95 (Eyre 1980) Finer
- Bottomland Hardwood Forest (Evans 1991) Intersecting
- Bottomland Hardwood Swamp (Evans 1991) Intersecting
- Bottomland Marsh (Evans 1991) Intersecting
- Bur Oak: 42 (Eyre 1980) Finer
- Coastal Plain Bottomland Hardwood Forest (Evans 1991) Intersecting
- Coastal Plain Slough (Evans 1991) Intersecting
- Cottonwood: 63 (Eyre 1980) Finer
- Cypress/Tupelo Swamp (Evans 1991) Intersecting
- Floodplain Ridge/Terrace Forest (Evans 1991) Intersecting
- Floodplain Slough (Evans 1991) Intersecting
- Pin Oak - Sweetgum: 65 (Eyre 1980) Finer
- Riparian Forest (Evans 1991) Intersecting
- River Birch - Sycamore: 61 (Eyre 1980) Finer
- Shrub Swamp (Evans 1991) Intersecting
- Silver Maple - American Elm: 62 (Eyre 1980) Finer
- Sugarberry - American Elm - Green Ash: 93 (Eyre 1980) Finer
- Swamp Chestnut Oak - Cherrybark Oak: 91 (Eyre 1980) Finer
- Sweetgum - Willow Oak: 92 (Eyre 1980) Finer
- Sycamore - Sweetgum - American Elm: 94 (Eyre 1980) Finer

DESCRIPTION

Environment: This system inhabits broad floodplains along large creeks and rivers that are usually inundated for at least part of each year. Flood frequency depends on precipitation patterns within the watershed and proximity to the main channel. Areas adjacent to the main channel or low islands within the channel can be flooded every year or even more than once per year. Those areas further from the channel on terraces or behind natural levees may only be flooded once every several years. Free-flowing rivers migrate across their floodplain, cutting new channels or eroding the bank on one side while building up the bank on the other, so the flooding regime of any one point in the floodplain will change over time. Flooding redeposits alluvium, eroding some areas and aggrading others, can bury or wash away small plants, and redistributes nutrients, especially in less frequently flooded zones where silt and clay tend to be deposited. These processes open up new areas for colonization.

Vegetation: Vegetation varies quite widely, encompassing shrubby and herbaceous communities, as well as forested communities with a wide array of canopy types. Examples may include *Acer saccharinum, Platanus occidentalis, Liquidambar styraciflua*, and *Quercus* spp. Understory species are mixed but include shrubs, such as *Cephalanthus occidentalis* and *Arundinaria gigantea ssp. gigantea*, and sedges (*Carex* spp.).

Dynamics: Flooding dynamics are an important factor in the development and maintenance of this system. Flood frequency depends on precipitation patterns within the watershed and proximity to the main channel. Areas adjacent to the main channel or low islands within the channel can be flooded every year or even more than once per year. Those areas further from the channel on terraces or behind natural levees may only be flooded once every several years. Free-flowing rivers migrate across their floodplain, cutting new channels or eroding the bank on one side while building up the bank on the other, so the flooding regime of any one point in the floodplain will change over time. Flooding redeposits alluvium, eroding some areas and aggrading others, can bury or wash away small plants, and redistributes nutrients, especially in less frequently flooded zones where silt and clay tend to be deposited. These processes open up new areas for colonization.

Component Associations:

- *Acer negundo* Forest (CEGL005033, G4G5)
- *Acer rubrum var. trilobum - Fraxinus pennsylvanica / Carex crinita - Peltandra virginica* Forest (CEGL004420, G1)
- *Acer saccharinum - Betula nigra / Cephalanthus occidentalis* Forest (CEGL007810, G3Q)
- *Acer saccharinum - Celtis laevigata - Carya illinoinensis* Forest (CEGL002431, G3G4)
- *Acer saccharinum - Fraxinus pennsylvanica - Ulmus americana* Forest (CEGL002586, G4?)
- *Acer saccharum - Carya cordiformis / Asimina triloba* Floodplain Forest (CEGL005035, G2)
- *Alnus serrulata - Xanthorhiza simplicissima* Shrubland (CEGL003895, G3G4)
- *Arundinaria gigantea ssp. gigantea* Shrubland (CEGL003836, G2?)
- *Betula nigra - Platanus occidentalis* Forest (CEGL002086, G5)
- *Carex torta* Herbaceous Vegetation (CEGL004103, G3G4)
- *Carya illinoinensis - Celtis laevigata* Forest (CEGL002087, G4?)
- *Cephalanthus occidentalis / Carex* spp. - *Lemna* spp. Southern Shrubland (CEGL002191, G4)
- *Fagus grandifolia - Quercus* spp. - *Acer rubrum - Juglans nigra* Forest (CEGL005014, G2G3)
- *Fraxinus pennsylvanica - Celtis* spp. - *Quercus* spp. - *Platanus occidentalis* Bottomland Forest (CEGL002410, G3G4)
- *Fraxinus pennsylvanica - Ulmus americana - Celtis laevigata / Ilex decidua* Forest (CEGL002427, G4G5)
- *Fraxinus pennsylvanica - Ulmus crassifolia - Celtis laevigata* Forest (CEGL004618, GNR)
- *Hypericum densiflorum - Alnus serrulata / Tripsacum dactyloides* Shrubland (CEGL008495, G1G2)
- *Justicia americana* Herbaceous Vegetation (CEGL004286, G4G5)
- *Lemna* spp. Eastern North American Aquatic Vegetation (CEGL005451, G5)
- *Liquidambar styraciflua - Liriodendron tulipifera - (Platanus occidentalis) / Carpinus caroliniana - Halesia tetraptera / Amphicarpaea bracteata* Forest (CEGL007880, G3G4)
- *Liquidambar styraciflua - Quercus michauxii - Carya laciniosa / Fagus grandifolia - (Aesculus flava)* Forest (CEGL007702, G2G3Q)
- *Nuphar advena - Nymphaea odorata* Herbaceous Vegetation (CEGL002386, G4G5)
- *Osmunda regalis var. spectabilis* Seepage Scour Herbaceous Vegetation (CEGL008404, G3?)
- *Platanus occidentalis - Acer saccharinum - Juglans nigra - Ulmus rubra* Forest (CEGL007334, G4)
- *Platanus occidentalis - Betula nigra - Celtis laevigata - Fraxinus pennsylvanica / Arundinaria gigantea* Temporarily Flooded Forest (CEGL007999, G3?)
- *Platanus occidentalis - Betula nigra / Cornus amomum / (Andropogon gerardii, Chasmanthium latifolium)* Woodland (CEGL003725, G3)
- *Platanus occidentalis - Fraxinus pennsylvanica - Quercus imbricaria* Forest (CEGL007339, G2Q)
- *Platanus occidentalis - Fraxinus pennsylvanica / Carpinus caroliniana / Verbesina alternifolia* Forest (CEGL006458, G3Q)
- *Platanus occidentalis - Liriodendron tulipifera - Betula (alleghaniensis, lenta) / Alnus serrulata - Leucothoe fontanesiana* Forest (CEGL004691, G2?)
- *Platanus occidentalis / Aesculus flava* Forest (CEGL006466, GNR)
- *Polygonum* spp. - Mixed Forbs Herbaceous Vegetation (CEGL002430, G4G5)
- *Populus deltoides - Salix nigra - Acer saccharinum* Forest (CEGL002018, G3G4)
- *Quercus (rubra, velutina, alba) / Carpinus caroliniana - (Halesia tetraptera) / Maianthemum racemosum* Forest (CEGL006462, G1)

- *Quercus macrocarpa - Quercus shumardii - Carya cordiformis / Chasmanthium latifolium* Forest (CEGL004544, G3?)
- *Quercus michauxii - Quercus shumardii - Liquidambar styraciflua / Arundinaria gigantea* Forest (CEGL002099, G3G4)
- *Quercus nigra - Quercus (alba, phellos)* Forest (CEGL004979, G3?)
- *Quercus palustris - (Fraxinus nigra) / Lindera benzoin / Carex bromoides* Forest (CEGL007399, GNR)
- *Quercus palustris - (Quercus stellata) - Quercus pagoda / Isoetes* spp. Forest (CEGL002101, G2G3)
- *Quercus phellos - (Quercus lyrata) / Carex* spp. - *Leersia* spp. Forest (CEGL002102, G3G4Q)
- *Quercus stellata - Quercus marilandica - Quercus falcata / Schizachyrium scoparium* Sand Woodland (CEGL002417, G2)
- *Quercus stellata / (Danthonia spicata, Croton willdenowii)* Woodland (CEGL005057, G1)
- River Mudflats Sparse Vegetation (CEGL002314, GNR)
- *Salix caroliniana* Temporarily Flooded Ozark Shrubland (CEGL007064, G4?)
- *Salix interior* Temporarily Flooded Shrubland (CEGL008562, G4G5)
- *Salix nigra* Forest (CEGL002103, G4)
- *Salix nigra* Large River Floodplain Forest (CEGL007410, G3G5)
- *Schoenoplectus tabernaemontani - Typha* spp. - (*Sparganium* spp., *Juncus* spp.) Herbaceous Vegetation (CEGL002026, G4G5)
- *Taxodium distichum / Lemna minor* Forest (CEGL002420, G4G5)
- *Tsuga canadensis - Quercus rubra - (Platanus occidentalis, Betula nigra) / Rhododendron maximum / Anemone quinquefolia* Forest (CEGL006620, GNR)
- *Verbesina alternifolia - Elymus riparius - Solidago gigantea - (Teucrium canadense)* Herbaceous Vegetation (CEGL006480, GNR)

Spatial Characteristics

Size: Examples can range in size from very small (<1 acre) to hundreds of acres in larger floodplain areas.

Distribution

Range: This system ranges from the Ozarks, Arkansas River Valley, and Interior Low Plateau to the Southern Blue Ridge and north into the Western Allegheny Plateau.
Divisions: 202:C; 205:C
Nations: US
Subnations: AL, AR, GA, IL, IN, KY, MO, NC, OH, OK, PA, SC?, TN, VA, WV
Map Zones: 32:P, 37:P, 38:?, 43:C, 44:C, 47:C, 48:C, 49:C, 53:C, 57:C, 61:C, 62:C
TNC Ecoregions: 32:P, 37:C, 38:C, 39:C, 44:C, 49:C, 50:C, 51:C, 59:C

Sources

References: Comer et al. 2003, DeSantis et al. 2012, Evans 1991, Eyre 1980, Herms et al. 2010, Johnson 1992, Woods et al. 2002
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722955#references
Description Author: S. Menard, M. Pyne, R. Evans, R. White, mod. J. Drake
Version: 14 Jan 2014 **Stakeholders:** East, Midwest, Southeast
Concept Author: S. Menard, M. Pyne, R. Evans, R. White **ClassifResp:** Midwest

SOUTH-CENTRAL INTERIOR SMALL STREAM AND RIPARIAN (CES202.706)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Non-Diagnostic Classifiers: Forest and Woodland (Treed); Stream terrace (undifferentiated)
National Mapping Codes: ESLF 9335

CONCEPT

Summary: This system is found throughout the Interior Low Plateau, Southern Ridge and Valley, Western Allegheny Plateau, lower elevations of the Southern Blue Ridge, and parts of the Cumberlands. Examples occur along small streams and floodplains with low to moderately high gradients. There may be little to moderate floodplain development. Flooding and scouring both influence this system, and the nature of the landscape prevents the kind of floodplain development found on larger rivers. This system may contain cobble bars with adjacent wooded vegetation and rarely have any marsh development, except through occasional beaver impoundments. The vegetation is a mosaic of forests, woodlands, shrublands, and herbaceous communities. Canopy cover can vary within examples of this system, but typical tree species may include *Platanus occidentalis, Acer rubrum var. trilobum, Betula nigra, Liquidambar styraciflua,* and *Quercus* spp. Shrubs and herbaceous layers can vary in richness and cover. Some characteristic shrubs may include *Hypericum densiflorum, Salix* spp., and *Alnus* spp. Small seeps dominated by sedges (*Carex* spp.), ferns (*Osmunda* spp.), and other herbaceous species can often be found within this system, especially at the headwaters and terraces of streams.
Classification Comments: This system is closely related to Central Appalachian Stream and Riparian (CES202.609) but has been distinguished based on the precepts of the Freshwater Systems classification. This system has been divided from Central Appalachian Riparian roughly by the Mid-Continental Divide. This means that Ecoregions 50 and 51 are included in this system, whereas Ecoregions 52 and 59 are considered part of Central Appalachian Riparian (except for a small part of southernmost Ecoregion 59 in West Virginia that drains to the Ohio River). In contrast to floodplain systems, this system has little to no floodplain development. In comparison with South-Central Interior Large Floodplain (CES202.705), this system typically has somewhat higher gradients, is sometimes rocky, and may experience flash floods. Stands from somewhat larger rivers have been placed here if the river lacks substantial floodplain development (e.g., the New River of West Virginia and the Ocoee Gorge of Tennessee).
Similar Ecological Systems:
- Central Appalachian Stream and Riparian (CES202.609)
- Cumberland Riverscour (CES202.036)--is essentially a more extreme and local variant of this broader concept, found in the major rivers of the Cumberland Plateau and related areas of Tennessee, Kentucky, and adjacent states.
- Ozark-Ouachita Riparian (CES202.703)--is the Ozark-Ouachita equivalent of this system.
- South-Central Interior Large Floodplain (CES202.705)

Related Concepts:
- Alluvial Forest (Evans 1991) Intersecting
- Black Willow: 95 (Eyre 1980) Finer
- Bottomland Hardwood Forest (Evans 1991) Intersecting
- Bottomland Hardwood Swamp (Evans 1991) Intersecting
- Bottomland Marsh (Evans 1991) Intersecting
- Coastal Plain Bottomland Hardwood Forest (Evans 1991) Intersecting
- Cypress/Tupelo Swamp (Evans 1991) Intersecting
- Floodplain Ridge/Terrace Forest (Evans 1991) Intersecting
- Floodplain Slough (Evans 1991) Intersecting
- Gravel/Cobble Bar (Evans 1991) Finer
- Riparian Forest (Evans 1991) Intersecting
- River Birch - Sycamore: 61 (Eyre 1980) Finer
- Shrub Swamp (Evans 1991) Intersecting
- Sycamore - Sweetgum - American Elm: 94 (Eyre 1980) Finer

DESCRIPTION

Environment: This system is found along fairly high-energy streams and rivers with steep banks, this system is subject to frequent flooding and can be subject to scouring depending upon the substrate. Some associations do not flood but instead are saturated zones or patches near the streams.
Vegetation: There is wide variation in vegetation depending upon the frequency of the flooding cycle (more frequent flooding creates a better environment for forbs and shrubs, less frequent may create a better environment for the establishment of trees). Typical tree species may include *Platanus occidentalis, Acer rubrum var. trilobum, Betula nigra, Liquidambar styraciflua,* and *Quercus* spp. Shrubs and herbaceous layers can vary in richness and cover. Some characteristic shrubs may include *Hypericum densiflorum, Salix* spp., and *Alnus* spp. Small seeps dominated by sedges (*Carex* spp.), ferns (*Osmunda* spp.), and other herbaceous species can often be

found within this system, especially at the headwaters and terraces of streams. These areas are not typically flooded or scoured but saturated.

Dynamics: Flooding and seed propagule dispersal caused by flooding events are the two most important processes affecting this system. The two processes vary widely depending upon size of stream, upstream land use and topography, presence or absence of invasive exotics that may displace native community types, etc.

Component Associations:

- (*Salix* spp.) / *Andropogon gerardii - Panicum virgatum - Salvia azurea* Cahaba Riverwash Herbaceous Vegetation (CEGL004149, G1)
- *Acer negundo - (Platanus occidentalis, Populus deltoides)* Forest (CEGL004690, G4)
- *Acer rubrum var. trilobum - Nyssa sylvatica / Osmunda cinnamomea - Chasmanthium laxum - Carex intumescens / Sphagnum lescurii* Forest (CEGL007443, G3?)
- *Acer rubrum var. trilobum - Nyssa sylvatica / Rhododendron canescens - Viburnum nudum var. nudum / Woodwardia areolata* Forest (CEGL004425, G2G3)
- *Alnus maritima ssp. georgiensis - (Decodon verticillatus) / Hibiscus moscheutos - Sparganium americanum* Spring-run Marsh Shrubland (CEGL004145, G1)
- *Alnus serrulata - Xanthorhiza simplicissima* Shrubland (CEGL003895, G3G4)
- *Alnus serrulata* Interior Shrubland (CEGL003894, G4?)
- *Alnus serrulata* Saturated Southern Interior Shrubland (CEGL007059, G3)
- *Alnus serrulata* Southeastern Seasonally Flooded Shrubland (CEGL008474, G4)
- *Andropogon gerardii - Panicum virgatum - Baptisia australis* Herbaceous Vegetation (CEGL006283, G3)
- *Arundinaria gigantea ssp. gigantea* Shrubland (CEGL003836, G2?)
- *Betula nigra - Platanus occidentalis / Alnus serrulata / Boehmeria cylindrica* Forest (CEGL007312, G4G5)
- *Betula nigra - Platanus occidentalis* Forest (CEGL002086, G5)
- *Carex crinita - Osmunda* spp. / *Physocarpus opulifolius* Seep Herbaceous Vegetation (CEGL002392, G2)
- *Carex crinita - Osmunda* spp. / *Sphagnum* spp. Herbaceous Vegetation (CEGL002263, G2G3)
- *Carex torta* Herbaceous Vegetation (CEGL004103, G3G4)
- *Eragrostis hypnoides - Ludwigia palustris - Lindernia dubia - Cyperus squarrosus* Herbaceous Vegetation (CEGL006483, G3)
- *Fagus grandifolia - Quercus alba / Kalmia latifolia - Rhododendron canescens - Symplocos tinctoria* Forest (CEGL008551, G3?)
- *Fagus grandifolia - Quercus* spp. - *Acer rubrum - Juglans nigra* Forest (CEGL005014, G2G3)
- *Hymenocallis coronaria - Justicia americana* Herbaceous Vegetation (CEGL004285, G1)
- *Juncus effusus - Chelone glabra - Scirpus* spp. Southern Blue Ridge Beaver Pond Herbaceous Vegetation (CEGL008433, G4?)
- *Juncus effusus* Seasonally Flooded Herbaceous Vegetation (CEGL004112, G5)
- *Justicia americana* Herbaceous Vegetation (CEGL004286, G4G5)
- *Liquidambar styraciflua - Liriodendron tulipifera - (Platanus occidentalis) / Carpinus caroliniana - Halesia tetraptera / Amphicarpaea bracteata* Forest (CEGL007880, G3G4)
- *Nuphar advena - Nymphaea odorata* Herbaceous Vegetation (CEGL002386, G4G5)
- *Orontium aquaticum* Permanently Flooded Herbaceous Vegetation (CEGL008480, G3G4)
- *Osmunda regalis var. spectabilis* Seepage Scour Herbaceous Vegetation (CEGL008404, G3?)
- *Peltandra virginica - Saururus cernuus - Boehmeria cylindrica / Climacium americanum* Herbaceous Vegetation (CEGL007696, G3)
- *Pinus virginiana - Juniperus virginiana var. virginiana - Quercus stellata / Amelanchier stolonifera / Danthonia spicata / Leucobryum glaucum* Woodland (CEGL008449, G1)
- *Platanus occidentalis - Betula nigra - Salix (caroliniana, nigra)* Woodland (CEGL003896, G4G5)
- *Platanus occidentalis - Betula nigra / Cornus amomum / (Andropogon gerardii, Chasmanthium latifolium)* Woodland (CEGL003725, G3)
- *Platanus occidentalis - Celtis laevigata - Liriodendron tulipifera / Lindera benzoin - Arundinaria gigantea / Amphicarpaea bracteata* Forest (CEGL008429, G4?)
- *Platanus occidentalis - Liquidambar styraciflua / Carpinus caroliniana - Asimina triloba* Forest (CEGL007340, G5)
- *Platanus occidentalis - Liriodendron tulipifera - Betula (alleghaniensis, lenta) / Alnus serrulata - Leucothoe fontanesiana* Forest (CEGL004691, G2?)
- *Platanus occidentalis / Dichanthelium clandestinum - Festuca subverticillata* Woodland (CEGL004031, G4)
- *Podostemum ceratophyllum* Herbaceous Vegetation (CEGL004331, G3G5)
- *Polygonum (hydropiperoides, punctatum) - Leersia* spp. Herbaceous Vegetation (CEGL004290, G4?)
- *Potamogeton* spp. - *Ceratophyllum* spp. - *Elodea* spp. Permanently Flooded Herbaceous Vegetation (CEGL004725, G4?)
- *Quercus (alba, coccinea, falcata, velutina) / Kalmia latifolia* Temporarily Flooded Forest (CEGL004098, G4?)
- *Quercus alba - (Liriodendron tulipifera, Liquidambar styraciflua) / Calycanthus floridus / Athyrium filix-femina* Forest (CEGL008428, G3G4)
- *Quercus alba - Carya (alba, ovata) - Liriodendron tulipifera - (Quercus phellos) / Cornus florida* Forest (CEGL007709, G4)
- *Salix caroliniana* Temporarily Flooded Forest (CEGL007373, G4)
- *Salix nigra - Betula nigra / Schoenoplectus pungens* Wooded Herbaceous Vegetation (CEGL006463, G1?)
- *Salix nigra - Platanus occidentalis* Forest (CEGL004626, G5)
- *Schizachyrium scoparium - Andropogon ternarius - Liatris microcephala - (Pityopsis ruthii)* Herbaceous Vegetation

(CEGL008455, G2)
- *Schizachyrium scoparium - Schoenoplectus americanus - Juncus marginatus - Eupatorium serotinum* Herbaceous Vegetation (CEGL008496, G2)
- *Sparganium americanum - (Sparganium erectum ssp. stoloniferum) - Epilobium leptophyllum* Herbaceous Vegetation (CEGL004510, G3?)
- *Tsuga canadensis - Liriodendron tulipifera - Platanus occidentalis / Rhododendron maximum - Xanthorhiza simplicissima* Temporarily Flooded Forest (CEGL007143, G3)
- *Verbesina alternifolia - Elymus riparius - Solidago gigantea - (Teucrium canadense)* Herbaceous Vegetation (CEGL006480, GNR)

Spatial Characteristics

Spatial Summary: Small, linear patch.
Size: Can be quite long but never very wide.

Distribution

Range: This system ranges from the Interior Low Plateau to the Southern Blue Ridge and north into the Western Allegheny Plateau and portions of the Cumberlands. There would be limited and peripheral presence in the Upper East Gulf Coastal Plain. It also is present on Crowley's Ridge, an anomalous and distinct upland topographic feature that is embedded within the Mississippi River Alluvial Plain.
Divisions: 202:C; 203:C
Nations: US
Subnations: AL, AR, GA, IL, IN, KY, NC, OH, PA, SC, TN, VA, WV
Map Zones: 45:C, 46:P, 47:C, 48:C, 49:C, 53:C, 57:C, 61:C, 62:C
USFS Ecomap Regions: 234D:CC
TNC Ecoregions: 42:C, 43:C, 44:C, 49:C, 50:C, 51:C, 59:C

Sources

References: Comer et al. 2003, Evans 1991, Eyre 1980, Stevens and Cummins 1999
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722954#references
Description Author: S. Menard, M. Pyne, R. Evans, R. White, D. Faber-Langendoen, mod. S.C. Gawler and J. Drake
Version: 14 Jan 2014 **Stakeholders:** East, Midwest, Southeast
Concept Author: S. Menard, M. Pyne, R. Evans, R. White, D. Faber-Langendoen **ClassifResp:** Midwest

TEXAS COAST DUNE AND COASTAL GRASSLAND (CES203.465)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Non-Diagnostic Classifiers: Herbaceous; Depressional; Isolated Wetland [Partially Isolated]
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2437; ESLF 7150; ESP 1437

CONCEPT

Summary: This ecological system consists of wetland and upland herbaceous and shrubland vegetation of barrier islands, near-coastal areas, and the Coastal Sand Plain along the Texas coast in the northern Gulf of Mexico. Plant communities of primary and secondary dunes, interdunal swales, barrier flats, and adjacent mainland are included. Salt spray, saltwater overwash, and sand movement are important ecological forces. Some examples of this system naturally occurred as an open matrix of midgrass species within native mesquite - acacia shrublands dominated by *Prosopis glandulosa, Acacia farnesiana,* and *Acacia rigidula* but have become shrub-dominated due to the lack of fire.

Similar Ecological Systems:
- Central and South Texas Coastal Fringe Forest and Woodland (CES203.464)--shares many taxa, but each seems to have a suite of unique species not found in the other.

Related Concepts:
- Active Sand Dune (6200) [CES203.465.1] (Elliott 2011) Finer
- Coastal and Sandsheet: Deep Sand Shrubland (6306) [CES203.465.6] (Elliott 2011) Finer
- Coastal and Sandsheet: Dune and Coastal Grassland (6307) [CES203.465.7] (Elliott 2011) Finer

DESCRIPTION

Environment: This system occupies deep eolian sands and Pleistocene barrier island and beach deposits that sit on top of underlying geologic formations, especially the Beaumont Formation. This includes deep sands well inland on the South Texas Sand Sheet, which represents by far the largest continuous patch of this type. It is found on primary and secondary dunes, as well as relatively level areas such as barrier flats, and on the mainland on deep sands of stranded beach ridges. Significant local topography, in the form of swales and pothole wetlands, may be present. Significant surface drainages are generally scarce. Soils are deep or coastal sands (Elliott 2011).
Vegetation: This system includes upland, grass-dominated vegetation on deep sands. Dunes are often dominated by *Uniola paniculata*, with other species such as *Croton punctatus, Panicum amarum, Ipomoea pes-caprae, Ipomoea imperati, Tidestromia lanuginosa, Cakile* spp., and *Sesuvium portulacastrum* also present. Upland grasslands are often dominated by *Schizachyrium littorale* and *Paspalum monostachyum*. Numerous other species, such as *Sorghastrum nutans, Paspalum plicatulum, Muhlenbergia capillaris, Cenchrus spinifex, Elionurus tripsacoides, Eragrostis secundiflora, Bothriochloa laguroides ssp. torreyana, Heteropogon contortus, Andropogon glomeratus, Spartina patens,* and *Dichanthelium* spp., may also be common. Numerous forbs, including such species as *Heterotheca subaxillaris, Croton* spp., *Chamaecrista fasciculata, Rayjacksonia phyllocephala, Physalis* spp., *Helianthus argophyllus, Gaillardia pulchella, Solidago sempervirens, Baptisia* spp., *Indigofera miniata, Eriogonum multiflorum, Conoclinium betonicifolium,* and *Rudbeckia hirta*, are also commonly encountered. Some woody species are found in the system but typically make up very little cover. Cover of woody species is limited but may include *Baccharis* spp., *Opuntia engelmannii var. lindheimeri, Morella cerifera, Quercus fusiformis, Quercus virginiana*, and stunted *Prosopis glandulosa*. Non-native woody species such as *Tamarix* spp., *Schinus terebinthifolius*, and *Triadica sebifera* may be present to dominant. Small areas may have sufficient woody cover to be mapped as a shrubland (Elliott 2011).
Dynamics: Substrate, hydrology, drought, coastal processes (including tropical storms) and fire play a role in maintaining this ecological system (Lonard et al. 2004, Morton et al. 2004, Britton et al. 2010). Composition and structure vary depending on these processes.

Component Associations:
- *Acacia rigidula* Shrubland (CEGL003874, G4G5)
- *Panicum amarum - Paspalum monostachyum* Herbaceous Vegetation (CEGL004970, G3?)
- *Schizachyrium littorale - Paspalum monostachyum* Herbaceous Vegetation (CEGL002207, G3?)
- *Spartina patens - Fimbristylis (caroliniana, castanea) - (Panicum virgatum)* Herbaceous Vegetation (CEGL007836, G2G3)
- *Spartina patens - Panicum amarum - Hydrocotyle bonariensis* Herbaceous Vegetation (CEGL004971, G2?)
- *Uniola paniculata - (Panicum amarum) - Croton punctatus* Herbaceous Vegetation (CEGL002218, G3?)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Central and South Texas Coastal Fringe Forest and Woodland (CES203.464)

DISTRIBUTION

Range: This system is found in the northern Gulf of Mexico along the Texas coast.
Divisions: 203:C; 301:C
Nations: US
Subnations: TX
Map Zones: 36:C, 37:?
USFS Ecomap Regions: 232E:CC, 255D:CC, 315E:??
TNC Ecoregions: 31:C

SOURCES

References: Bielfelt 2013, Britton et al. 2010, Comer et al. 2003, Defeo et al. 2009, Elliott 2011, Lonard et al. 2004, Morton et al. 2004

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723121#references

Description Author: R. Evans and J. Teague, mod. M. Pyne and L. Elliott
Version: 14 Jan 2014
Concept Author: R. Evans and J. Teague
Stakeholders: Southeast
ClassifResp: Southeast

TEXAS-LOUISIANA COASTAL PRAIRIE (CES203.550)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Herbaceous; Deep Soil; Graminoid
Non-Diagnostic Classifiers: Extensive Wet Flat; Isolated Wetland [Partially Isolated]
FGDC Crosswalk: Vegetated, Herbaceous / Nonvascular-dominated, Herbaceous - grassland, Perennial graminoid grassland
National Mapping Codes: EVT 2434; ESLF 7147; ESP 1434

CONCEPT

Summary: This system encompasses non-saline tallgrass prairie vegetation that developed over Pleistocene terraces flanking the Gulf Coast of Louisiana and Texas. It is sometimes characterized by a ridge-and-swale or mound-and-intermound microtopography and encompasses both upland and wetland plant communities. Upland dominants typically include *Schizachyrium scoparium, Paspalum plicatulum*, and *Sorghastrum nutans*. Wetland dominants in undisturbed occurrences include *Panicum virgatum* and *Tripsacum dactyloides*. Fire is an important ecological process in this system.
Classification Comments: The concept of this system includes the Kleberg prairie of Johnston (1963) and the clay prairie concept of McClendon (1991) (in part) that were formerly included in Tamaulipan Clay Grassland (CES301.987).
Similar Ecological Systems:
- Central Texas Coast River Terrace Sandyland Grassland (CES203.712)
- Texas-Louisiana Coastal Prairie Pondshore (CES203.541)

Related Concepts:
- Gulf Coast: Coastal Prairie (5207) [CES203.550] (Elliott 2011) Equivalent

DESCRIPTION

Environment: This mid- to tallgrass prairie occupies Pleistocene surfaces of the Texas and Louisiana coast, on non-saline soils. The occurrence of this system is generally coincident with the distribution of the Pleistocene Beaumont and Lissie formations in Texas (Prairie and Intermediate allogroups in Louisiana). It is usually found on level to gently rolling landscapes, with slopes generally less than 5%. Microtopography plays an important role in local variation in the system, with ridges, swales, mounds, depressions, mima (or pimple) mounds, and gilgai leading to a mosaic of drier and wetter plant communities. Typical soils are non-saline Vertisols, Alfisols, and (less extensively) Mollisols (Diamond and Smeins 1984, Smeins et al. 1992). Vertisols are often characterized by gilgai, resulting from shrink-swell attributes of the montmorillonitic clays of which they are composed. Historically, rivers and streams dissected this vegetation type, breaking it into large compartments with species composition shifting across the range. A moisture gradient occurs from northeast (average 120 cm/year) to southwest (average 100 cm/year) across the range of this system (Diamond and Smeins 1984).
Vegetation: Stands are dominated by graminoid species, such as *Andropogon gerardii, Andropogon glomeratus, Bouteloua curtipendula, Cyperus entrerianus, Dichanthelium oligosanthes, Fimbristylis puberula, Muhlenbergia capillaris, Panicum virgatum, Paspalum floridanum, Paspalum plicatulum, Paspalum setaceum, Rhynchospora* spp., *Schizachyrium scoparium, Sorghastrum nutans, Sporobolus compositus, Tridens strictus*, and *Tripsacum dactyloides*. *Axonopus* spp., *Andropogon virginicus, Bothriochloa laguroides ssp. torreyana, Nassella leucotricha*, and *Sporobolus indicus* may be particularly noticeable on overgrazed sites; disturbed occurrences may be dominated by *Andropogon glomeratus*. Non-native graminoids that may be conspicuous to dominant components include *Cynodon dactylon, Bothriochloa ischaemum var. songarica, Dichanthium* spp., *Lolium perenne, Lolium arundinaceum (= Schedonorus phoenix), Paspalum notatum*, and *Paspalum dilatatum*. Forbs that may often be encountered include *Liatris* spp., *Sabatia campestris, Ambrosia psilostachya, Euphorbia bicolor, Solidago* spp., *Rudbeckia hirta, Ruellia humilis, Asclepias viridis, Chamaecrista fasciculata, Helianthus angustifolius, Euthamia* spp., *Ratibida columnifera, Symphyotrichum ericoides, Silphium laciniatum, Baptisia* spp., *Iva angustifolia, Eryngium yuccifolium, Boltonia diffusa*, and *Neptunia lutea*. Woody species may invade this typically herbaceous vegetation, including *Rosa bracteata, Acacia farnesiana, Triadica sebifera, Baccharis halimifolia, Celtis laevigata*, and *Prosopis glandulosa* (Elliott 2011).
Dynamics: The impacts and interaction of fire, drought, competition, and possibly grazing constitute the major natural dynamics influencing this system (Smeins et al. 1992, USGS 2013). Frequent fires every 2-5 years of both lightning and anthropogenic origins prevent woody species from establishing and favor grassland species adapted to fire for reproduction and vigor. Microtopographic and moisture variability interacted with fire to produce variable fire effects influencing the distribution of flora and fauna. Grazing by bison and other ungulates also played an important role in maintaining the vegetation composition and structure of this system. This system is important for a suite of wildlife, many of which are declining, that are dependent on native grasslands (TPWD 2012a).

Component Associations:
- *Andropogon gerardii - Panicum virgatum - Schizachyrium scoparium - Schizachyrium tenerum - Helianthus mollis* Herbaceous Vegetation (CEGL007938, G1)
- *Euthamia leptocephala - Helianthus angustifolius - Boltonia asteroides - Spartina patens* Herbaceous Vegetation (CEGL007936,

G1)
- *Muhlenbergia capillaris* Herbaceous Vegetation (CEGL004607, G1G2)
- *Panicum virgatum - Tripsacum dactyloides - (Panicum hemitomon)* Herbaceous Vegetation (CEGL007937, G1)
- *Schizachyrium scoparium - Paspalum plicatulum - Sorghastrum nutans - Dichanthelium oligosanthes - Paspalum setaceum - Symphyotrichum pratense* Alfisol Herbaceous Vegetation (CEGL002208, G1)
- *Schizachyrium scoparium - Sorghastrum nutans - Paspalum plicatulum - Carex microdonta - Neptunia lutea* Vertisol Herbaceous Vegetation (CEGL004519, G1)
- *Schizachyrium scoparium - Triplasis purpurea - Eriogonum multiflorum - Liatris elegans var. carizzana* Herbaceous Vegetation (CEGL008483, G1)

Spatial Characteristics

Adjacent Ecological Systems:
- Central Texas Coastal Prairie Riparian (CES203.714)
- Central Texas Coastal Prairie River Floodplain (CES203.713)
- West Gulf Coastal Plain Wet Longleaf Pine Savanna and Flatwoods (CES203.191)

Adjacent Ecological System Comments: In Louisiana, this system grades coastward into marshes of the chenier plain and inland into West Gulf Coastal Plain Wet Longleaf Pine Savanna and Flatwoods (CES203.191). In Texas this system generally grades coastward into a saline prairie or salt marsh system and inland into West Gulf Coastal Plain Wet Longleaf Pine Savanna and Flatwoods (CES203.191), or oak woodland vegetation. Degraded examples are often dominated by the invasive exotic *Triadica sebifera*. Relatively undisturbed natural depressions (potholes) occurring within the upland matrix units of this system are included in Texas-Louisiana Coastal Prairie Pondshore (CES203.541).

Distribution

Range: This system occurs within 50 to 150 miles of the Gulf Coast from southwestern Louisiana to south-central Texas encompassing approximately 10 million acres.
Divisions: 203:C; 301:C
Nations: US
Subnations: LA, TX
Map Zones: 36:C, 37:C
USFS Ecomap Regions: 232E:CC, 255D:CC, 315E:CC
TNC Ecoregions: 30:C, 31:C

Sources

References: Bergan 1999, Comer et al. 2003, Diamond and Smeins 1984, Elliott 2011, Grace et al. 2000, LDWF 2005, Smeins et al. 1992, TPDW 2012a, USFWS and USGS 1999, USGS 2013a
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723052#references
Description Author: J. Teague, mod. M. Pyne and L. Elliott
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: J. Teague **ClassifResp:** Southeast

WEST GULF COASTAL PLAIN PINE-HARDWOOD FLATWOODS (CES203.278)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Pimple mounds; Forest and Woodland (Treed); Extensive Wet Flat; Needle-Leaved Tree; Broad-Leaved Deciduous Tree
Non-Diagnostic Classifiers: Isolated Wetland [Partially Isolated]
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Mixed evergreen-deciduous open tree canopy
National Mapping Codes: EVT 2458; ESLF 9127; ESP 1458

CONCEPT

Summary: This ecological system represents predominantly mesic to dry flatwoods of limited areas of inland portions of the West Gulf Coastal Plain. These areas are usually found on Pleistocene high terraces that are located above current floodplains. The hydrology is controlled by local rainfall events and not by overbank flooding. Soils are fine-textured, and hardpans may be present in the subsurface. The limited permeability of these soils contributes to shallowly perched water tables during portions of the year when precipitation is greatest and evapotranspiration is lowest. Soil moisture fluctuates widely throughout the growing season, from saturated to very dry, a condition sometimes referred to elsewhere as xerohydric. Saturation occurs not from overbank flooding but typically whenever precipitation events occur. Local topography is a complex of ridges and swales, often in close proximity to one another. Ridges tend to be much drier than swales, which may hold water for varying periods of time. Within both ridges and swales, there is vegetation variability relating to soil texture and moisture and disturbance history. The driest ridges support *Pinus taeda* and *Quercus stellata*; more mesic ridges have *Pinus taeda* with *Quercus alba* and species such as *Symplocos tinctoria* and *Viburnum dentatum*. Fire may have been an important natural process in some examples of this system.
Classification Comments: Embedded swales tend to support hardwood forests or swamps, often heavily oak-dominated with species tolerant of some inundation, such as *Quercus phellos* and *Quercus laurifolia*, with sparse coverage of wetland herbs such as *Carex glaucescens*. Some swales support unusual pockets of *Fraxinus caroliniana* and *Crataegus* spp. These latter vegetation types are linked to West Gulf Coastal Plain Nonriverine Wet Hardwood Flatwoods (CES203.548). In Arkansas (at least), this system is most closely affiliated with these Soil Associations: "Adaton-Felker-Gore" (MUID=AR035); "Wrightsville-Acadia-Louin" (MUID=AR036); "Amy-Pheba-Savannah" (MUID=038); "Amy-Pheba-Guyton" (MUID=AR040); "Smithdale-Savannah-Sacul" (MUID= AR041); "Sacul-Savannah-Sawyer" (MUID= AR042); "Calloway-Henry-Grenada" (MUID=AR044); "Wrightsville-Kolin-Gore" (MUID=AR063); "Bussy-Tillou-Guyton" (MUID=AR069). Apparently, this system occurs within the historic range of longleaf pine [see USFS ecomap attributions]. Within this range, more information is needed to identify the toposequence between longleaf pine-dominated flatwoods/savannas/uplands and hardwood/loblolly-dominated flatwoods. The distribution of this system in the South Central Plains Flatwoods and Southern Tertiary Uplands (EPA 35e and f) needs to be better defined.
Similar Ecological Systems:
- West Gulf Coastal Plain Nonriverine Wet Hardwood Flatwoods (CES203.548)
- West Gulf Coastal Plain Wet Longleaf Pine Savanna and Flatwoods (CES203.191)

Related Concepts:
- Loblolly Pine - Hardwood: 82 (Eyre 1980) Finer
- Pineywoods: Hardwood Flatwoods (4004) [CES203.278.4] (Elliott 2011) Finer
- Pineywoods: Longleaf or Loblolly Pine / Hardwood Flatwoods or Plantation (4003) [CES203.278.3] (Elliott 2011) Finer
- Pineywoods: Longleaf or Loblolly Pine Flatwoods or Plantation (4001) [CES203.278.1] (Elliott 2011) Finer
- White Oak: 53 (Eyre 1980) Finer

DESCRIPTION

Environment: Areas occupied by this system are usually found on nonriverine, Pleistocene high terraces. These are mapped in the northern portion of East Texas as Quaternary Fluviatile Terrace (or Tile) Deposits. It is found on very gently undulating to flat surfaces, with local topographic relief provided by ridges and swales. Soils tend to be fine-textured and typically have a somewhat impermeable subsurface horizon, which leads to a perched water table. Saturation results from local rainfall run-on, and alternates with seasonal drying, leading to a xerohydric hydroperiod. The limited permeability of these soils contributes to shallowly perched water tables during portions of the year when precipitation is greatest and evapotranspiration is lowest. Soil moisture fluctuates widely throughout the growing season, from saturated to very dry, a condition sometimes referred to elsewhere as xerohydric. Saturation occurs not from overbank flooding but typically whenever precipitation events occur. Local topography is a complex of ridges and swales, often in close proximity to one another. Ridges tend to be much drier than swales, which may hold water for varying periods of time.
Vegetation: There is vegetation variability between and among ridges and swales, as well as within them, relating to soil texture and moisture and disturbance history. This woodland or forest system is often dominated by more mesic species on interior ridges,

including *Pinus taeda, Pinus echinata, Pinus elliottii, Quercus stellata, Quercus alba, Quercus falcata,* and *Carya texana* (Elliott 2011). Within the range of *Pinus palustris*, occurrences that represent West Gulf Coastal Plain Wet Longleaf Pine Savanna and Flatwoods (CES203.191) may be mapped as this system. The driest ridges support *Pinus taeda* and *Quercus stellata*; more mesic ridges have *Pinus taeda* with *Quercus alba* and understory species such as *Symplocos tinctoria* and *Viburnum dentatum*. On the somewhat wetter sites of the swales, species such as *Quercus nigra, Quercus phellos, Quercus laurifolia, Nyssa sylvatica, Liquidambar styraciflua,* and *Fraxinus pennsylvanica* may be dominant. Sites that are even wetter would likely be mapped as West Gulf Coastal Plain Nonriverine Wet Hardwood Flatwoods (CES203.548). Midstory species that may be encountered include *Acer rubrum, Ilex opaca, Ulmus alata,* and small members of the overstory. *Morella cerifera, Ilex decidua*, and *Ilex vomitoria* are commonly encountered shrubs. Herbaceous cover is generally sparse, with species such as *Chasmanthium* spp., *Andropogon glomeratus*, and *Gelsemium sempervirens*. Sites dominated by *Pinus taeda* or *Pinus elliottii* may often represent plantations or managed forests (Elliott 2011). *Triadica sebifera* may invade this system. Embedded swales (which are, in effect, smaller interfingered examples of West Gulf Coastal Plain Nonriverine Wet Hardwood Flatwoods (CES203.548)) tend to support hardwood forests or swamps, often heavily oak-dominated with species tolerant of some inundation, such as *Quercus phellos* and *Quercus laurifolia,* with sparse coverage of wetland herbs, such as *Carex glaucescens*. Some swales support unusual pockets of *Fraxinus caroliniana* and *Crataegus* spp.

Dynamics: The difference in the dynamics between this system and the "wet" hardwood flatwoods of the region, i.e., West Gulf Coastal Plain Nonriverine Wet Hardwood Flatwoods (CES203.548), is the different structure: the wetter type occurs as a closed forest, the dry/mesic (xero-hydric) one as a more open forest or woodland (with an open canopy, a full herbaceous expression, and few shrubs). The fire regime is different as well: the xero-hydric type is short-interval, low-intensity, low-severity versus medium- to long-interval, low-intensity, high-severity for the wet one (D. Zollner pers. comm. 2006).

Component Associations:
- *(Crataegus opaca) / Schizachyrium scoparium - Panicum virgatum - Croton capitatus* Seasonally Flooded Herbaceous Vegetation (CEGL003974, G2G3)
- *Panicum hemitomon - Ludwigia sphaerocarpa* Herbaceous Vegetation (CEGL008478, G1)
- *Pinus taeda - Quercus alba - (Fagus grandifolia) / Ilex opaca / Smilax pumila - Mitchella repens* Forest (CEGL007525, G3G4)
- *Pinus taeda - Quercus stellata / Crataegus* spp. Woodland (CEGL002112, G2G3)
- *Quercus alba - Carya alba / Symplocos tinctoria / Mitchella repens* Forest (CEGL007980, G3?)
- *Quercus stellata - Pinus taeda* Flatwoods Depression Forest (CEGL008587, G2G3)

Spatial Characteristics

Spatial Summary: This system forms a matrix in the Arkansas Coastal Plain in terraces along the lower Ouachita River (D. Zollner pers. comm. 2006). This dry (to mesic) pine-hardwood system is a matrix one, the wetter type (CES203.548) is a small- to large-patch system (D. Zollner pers. comm. 2006).

Adjacent Ecological Systems:
- Red River Large Floodplain Forest (CES203.065)
- West Gulf Coastal Plain Nonriverine Wet Hardwood Flatwoods (CES203.548)

Distribution

Range: This system is found in the inland portions of the West Gulf Coastal Plain, on nonriverine, Pleistocene high terraces.
Divisions: 203:C
Nations: US
Subnations: AR, LA, OK, TX
Map Zones: 36:C, 37:C, 44:C
USFS Ecomap Regions: 231E:CC, 232Fb:CCC, 234E:??, 255Da:CCC
TNC Ecoregions: 32:C, 40:C, 41:C

Sources

References: Comer et al. 2003, Elliott 2011, EPA 2004, Eyre 1980, Foti pers. comm., Hoagland pers. comm., Singhurst pers. comm., Zollner pers. comm.

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723208#references

Description Author: R. Evans, mod. M. Pyne, J. Teague, L. Elliott
Version: 18 Feb 2011 **Stakeholders:** Midwest, Southeast
Concept Author: R. Evans **ClassifResp:** Southeast

WESTERN CANADIAN BOREAL ASPEN PARKLAND (CES103.517)

CLASSIFIERS

Classification Status: Standard

Primary Division: Boreal (103)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
National Mapping Codes: ESLF 9395

CONCEPT

Summary: This ecological system ranges from the Peace River Parkland region of west-central Alberta, west into British Columbia along lower elevation river valleys. It occurs well within the boreal forest region of Alberta, and while it has some structural and floristic similarities to Northwestern Great Plains Aspen Forest and Parkland (CES303.681), the environmental setting and climate regime are distinctly different. The climate in this region is mostly subhumid low boreal with short, warm summers and cold, long winters. It is apparently slightly drier in this region than in the surrounding Dry Mixedwood region of Alberta. Much of this region is covered with undulating to kettled glacial till. In Alberta, this parkland is characterized by gently rolling glacio-lacustrine plains, and steep south-facing grassy and forested slopes along the Peace River. Elevations range from 300 m along the Peace River near Peace River townsite, to 800 m in the Grande Prairie area; they are probably a bit higher in eastern British Columbia. *Populus tremuloides* is the predominant tree in this system, although *Picea glauca* also occurs. Common associates are *Betula papyrifera* and *Populus balsamifera* with an understory of mixedgrass species and tall shrubs. More poorly drained sites may contain *Salix* spp., *Calamagrostis canadensis*, and *Carex* spp. Some of the common shrubs include *Amelanchier alnifolia, Symphoricarpos albus, Symphoricarpos occidentalis, Prunus virginiana, Salix bebbiana*, and *Rosa acicularis*. Prairie communities can occur in and around the patches of forest, with species composition of *Koeleria macrantha, Danthonia californica, Hesperostipa comata* (drier sites), *Hesperostipa curtiseta, Hesperostipa spartea*, and *Artemisia frigida*. Much of the area where this system once occurred has been converted to agricultural lands. Fire may have constituted an important dynamic in this system and prevents boreal conifer species such as *Picea glauca* and *Abies balsamea* from becoming too established in this system.
Classification Comments: This system can grade into Eastern Great Plains Tallgrass Aspen Parkland (CES205.688) to the east, which has a predominance of tallgrass species in the understory compared to the more mixedgrass species in this system.

DESCRIPTION

Environment: Climate in the range of this system is mostly subhumid low boreal with short, warm summers and long, cold winters. It is apparently slightly drier in this region than in the surrounding Dry Mixedwood region of Alberta. Undulating to kettled glacial till predominates this region.
Vegetation: *Populus tremuloides* dominates this system. Common associates are *Populus balsamifera* and *Betula papyrifera* along with an understory of mixedgrass and tall-shrub species.
Dynamics: Fire is likely the most important natural dynamic allowing for a more open structure and preventing this system from containing more conifer species. However, much of the area where this system once occurred has been converted to agricultural lands. Some small patches of the aspen parkland remain along the edges of the agricultural areas above the Peace River, but much of the prairies have been completely eliminated.

DISTRIBUTION

Range: This system is found in the boreal-grassland transition region of the Peace River Parkland in west-central Alberta, extending west into British Columbia along the river and its major tributaries. Its distribution elsewhere in Canada needs to be explored and clarified.
Divisions: 103:C
Nations: CA
Subnations: AB, BC
TNC Ecoregions: 140:C

SOURCES

References: Greenall 1995, Natural Regions Committee 2006, Ricketts et al. 1999, Stone et al. 2007, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.837923#references
Description Author: M.S. Reid
Version: 30 Mar 2010
Concept Author: Western Ecology Group
Stakeholders: Canada, West
ClassifResp: West

WESTERN GREAT PLAINS RIPARIAN (CES303.956)

CLASSIFIERS

Classification Status: Standard

Primary Division: Western Great Plains (303)
Land Cover Class: Mixed Upland and Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Riparian Mosaic; Woody-Herbaceous; Riverine / Alluvial; Very Short Disturbance Interval; Flood Scouring
Non-Diagnostic Classifiers: Intermittent Flooding; Short (<5 yrs) Flooding Interval; Floodplain; Fluvial; Lowland [Lowland]; Forest and Woodland (Treed); Shrubland (Shrub-dominated); Alluvial fan; Toeslope/Valley Bottom; Arroyo; Temperate [Temperate Xeric]; Broad-Leaved Deciduous Tree; Broad-Leaved Deciduous Shrub; Evergreen Sclerophyllous Shrub; Graminoid
National Mapping Codes: ESLF 9329

CONCEPT

Summary: This ecological system is found in the riparian areas of medium and small rivers and streams throughout the western Great Plains. It is most common in the Shortgrass Prairie and extends west as far as the Rio Grande in New Mexico, north into the Wyoming Basins and east into southwestern Nebraska, western Kansas and panhandles of Oklahoma and Texas. It includes primarily small, often narrow feeder streams that originate on the plains. However, it also includes reaches of major rivers, including the North and South Platte, portions of the Arkansas, Cimarron, Canadian and upper Pecos rivers, that have relatively narrow floodplains when compared to the Platte, for example. This system is found on alluvial soils in highly variable landscape settings, from deep cut ravines to wide, braided streambeds. The smaller streams hydrologically tend to be flashy and may dry down completely for some portion of the year. Main-stem larger rivers have a less well-developed floodplain than their downstream counterparts (e.g., the Platte and Missouri rivers), that are classified as floodplain systems. Water sources for this riparian system include snowmelt runoff, springs and summer rains. This system includes numerous smaller prairie rivers and streams that are often groundwater-fed, such as the Arikaree River and the Republican River. Dominant vegetation shares much with generally drier portions of larger floodplain systems downstream, but overall abundance of vegetation is generally lower. Communities within this system range from riparian forests and shrublands to herbaceous vegetation and gravel/sand bars. Dominant species include *Artemisia cana ssp. cana, Forestiera pubescens, Panicum obtusum, Panicum virgatum, Pascopyrum smithii, Populus deltoides, Salix amygdaloides, Salix exigua, Schizachyrium scoparium*, and *Sporobolus cryptandrus*. On the North Platte in southeastern Wyoming, *Fraxinus pennsylvanica* may be present to dominant. These areas are often subjected to heavy grazing and/or agriculture and can be heavily degraded. *Tamarix* spp., *Elaeagnus angustifolia*, and less desirable grasses and forbs can invade degraded examples up through central Colorado. Groundwater depletion and reduction in overbank flooding has resulted in additional species changes. In Texas, several cover types are represented within this system, including forest, woodland, shrubland, and herbaceous vegetation. Forests and woodlands may have species such *Populus deltoides, Salix nigra, Celtis laevigata, Juniperus ashei*, and *Juniperus pinchotii*. *Quercus fusiformis* occurs here at the western edge of its range but may be locally dominant. Shrubland portions are frequently dominated by *Prosopis glandulosa* but may also contain species such as *Salix nigra* and *Sapindus saponaria var. drummondii*. Herbaceous vegetation may be represented by marshes associated with small drainages and dominated by *Schoenoplectus* spp., *Eleocharis* spp., and other sedges.
Classification Comments: All the riparian/floodplain/alluvial systems of the Great Plains region need to be revisited for naming conventions, along with better definitions of conceptual boundaries. There is much apparent overlap in their concepts and distribution, and the names add to the confusion. In particular, the difference between "riparian" and "floodplain" usage in the names needs revisiting and possible changing. These systems include Northwestern Great Plains Floodplain (CES303.676), Northwestern Great Plains Riparian (CES303.677), Western Great Plains Floodplain (CES303.678), and Western Great Plains Riparian (CES303.956).
Similar Ecological Systems:
- Edwards Plateau Riparian (CES303.652)
- Southeastern Great Plains Riparian Forest (CES205.709)

Related Concepts:
- Cottonwood - Willow: 235 (Eyre 1980) Broader
- High Plains: Riparian Deciduous Shrubland (2706) [CES303.678.8] (Elliott 2011) Finer
- High Plains: Riparian Hardwood / Juniper Forest (2703) [CES303.678.4] (Elliott 2011) Finer
- High Plains: Riparian Hardwood Forest (2704) [CES303.678.6] (Elliott 2011) Finer
- High Plains: Riparian Herbaceous Vegetation (2707) [CES303.678.9] (Elliott 2011) Finer
- High Plains: Riparian Juniper Forest (2701) [CES303.678.1] (Elliott 2011) Finer
- High Plains: Riparian Juniper Shrubland (2705) [CES303.678.7] (Elliott 2011) Finer
- High Plains: Riparian Live Oak Forest (2702) [CES303.678.3] (Elliott 2011) Finer

DESCRIPTION

Environment: This riparian system lacks a broad, well-developed floodplain. It includes primarily small, often narrow feeder streams that originate on the plains. However, it also includes reaches of major prairie rivers, including the North and South Platte, portions of the Arkansas, Cimarron, Canadian and upper Pecos rivers, that have relatively narrow, less well-developed floodplain when compared to their downstream counterparts (e.g., the Platte and Missouri rivers) that are classified as floodplain systems. Water sources for this

riparian system include snowmelt runoff, springs and summer rains. The substrates are highly variable depending on landscape settings that range from deep-cut ravines to wide, braided streambeds, but tend to occur on relatively young alluvial substrates. In Texas this system occurs along headwater streams and generally occurs over upland soils that have developed in place over a variety of bedrock types, often limestone in parts of Texas (TPWD Phase 1). This system occurs along drainages that may be intermittent and tend to be dominated by erosional processes (as opposed to depositional processes) for example within the drainage of the Clear Fork of the Middle Brazos River of Texas (Elliott 2011). As this system is mapped by TPWD (Elliott 2011), it by definition occurs outside of areas mapped as bottomland soils. Soils are therefore mapped with soils of the surrounding uplands.

Vegetation: In Texas, the TPWD Phase 1 mapping represents the southeasternmost part of the range of the system and shares some similarity with Edwards Plateau Riparian (CES303.652) and Southeastern Great Plains Riparian Forest (CES205.709) to which it is adjacent. In the Phase 1 mapping project, this system is restricted to the drainages of the Clear Fork of the Middle Brazos River (Elliott 2011). Several cover types are represented within this system, including forest, woodland, shrubland, and herbaceous vegetation. Forests and woodlands may have species such *Populus deltoides, Salix nigra, Celtis laevigata, Juniperus ashei*, and *Juniperus pinchotii*. *Quercus fusiformis* occurs here at the western edge of its range but may be locally dominant (Elliott 2011). Shrubland portions are frequently dominated by *Prosopis glandulosa* but may also contain species such as *Salix nigra* and *Sapindus saponaria var. drummondii*. Herbaceous vegetation may be represented by marshes associated with small drainages and dominated by *Schoenoplectus* spp., *Eleocharis* spp., and other sedges. Grasslands associated with riparian corridors may also be present and will generally be somewhat more mesic than grasslands of the surrounding landscape (Elliott 2011).

Dynamics: Hydrologically, these sites tend to have a more flashy flood regime hydrology and narrow, less well-developed floodplains than those found on larger rivers, which are classified as floodplain systems. These streams may dry down completely for some portion of the year. Water sources for this riparian system are largely snowmelt runoff, springs and summer rains. This system includes numerous smaller prairie rivers and streams that are often also groundwater-fed, such as the Arikaree River and the Republican River.

From CNHP (2010b): Fluvial processes such as channel narrowing, meandering, and flood deposition play a key role in the dynamics of Western Great Plains streams (Friedman et al. 1996, Scott et al. 1996). Various combinations of these three factors may be acting at any particular site, depending on geologic and climate factors, including flow variability, sediment load, and gradient. Channel narrowing results when the stream abandons a portion of the former channel bed or when flow ceases in a channel. Narrowing happens when a period low flow prevents the reworking of the entire channel bed, and allows vegetation to establish. Newly established vegetation reduces erosion and promotes the deposition of fine sediment. On meandering streams, cutbanks on the outside bends gradually erode and the sediments are deposited downstream as point bars on the insides of bends. Vegetation is able to establish on these newly created moist surfaces. Flood deposition can produce bare, moist surfaces for tree establishment that are above the normal channel bed, and protected from normal flow-related disturbance.

Streamflows are highly variable in Western Great Plains streams. It is not known how much flows have changed since settlement, but a certain amount of intra- and inter-annual variation appears to be normal (Matthews 1988). Nearly all prairie steams are susceptible to lack of water during some years, if not annually. Although most streams receive groundwater inflow, recharge to groundwater is low due to limited precipitation, and water loss to evapotranspiration can be significant. The minimal to moderate groundwater inflow and the large loss of both groundwater and surface water to evapotranspiration resulted in many high plains streams having little to no flow under presettlement conditions, except during spring floods (Covich et al. 1997). Since settlement, variation in water flow is regulated by dams and diversions, groundwater levels have been reduced, agricultural activities have increased siltation rates and introduced both non-native species and chemical changes, and native grazers have been largely replaced by domestic cattle. Possible effects of altered fire regime in uplands are not known.

Additional factors affecting the dynamics of this system include drought and grazing. Riparian vegetation is affected by climatic drought that reduces soil moisture in the unsaturated zone and decreases streamflows, which reduces recharge and lowers the alluvial water table (Friedman et al. 1997). The elimination of beavers from most of the plains watersheds probably decreased water storage and increased variability in plains streams, although some of these changes were later reversed by dam construction (Friedman et al. 1997). The replacement of native grazers, especially bison, with fenced cattle has changed the regeneration patterns of cottonwood since settlement.

Component Associations:

- *Artemisia cana / Pascopyrum smithii* Shrubland (CEGL001072, G4)
- Great Plains Riverine Gravel Flats Sparse Vegetation (CEGL005223, GNR)
- *Populus deltoides (ssp. wislizeni, ssp. monilifera) / Salix exigua* Woodland (CEGL002685, G3)
- *Populus deltoides / Panicum virgatum - Schizachyrium scoparium* Woodland (CEGL001454, G2)
- *Symphoricarpos occidentalis* Shrubland (CEGL001131, G4G5)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:

- Northwestern Great Plains Canyon (CES303.658)
- Southeastern Great Plains Riparian Forest (CES205.709)

DISTRIBUTION

Range: This system is found in riparian areas of medium and small rivers and streams throughout the western Great Plains. It is most common in the Central Shortgrass Prairie and Southern Shortgrass Prairie, but extends west as far as the Rio Grande in New Mexico and into the Wyoming Basins. This system occurs on the North Platte, South Platte, Cache La Poudre, Arkansas, Purgatoire, middle

Rio Grande, the upper reaches of the Cimarron, Canadian, and Pecos rivers, and smaller prairie rivers and streams, such as the Arikaree and Republican rivers. Its occurrence is confirmed for Texas (Elliott 2011).
Divisions: 303:C; 304:P
Nations: US
Subnations: CO, KS, NE, NM, OK, TX, WY
Map Zones: 24:P, 25:C, 26:P, 27:C, 28:C, 32:C, 33:C, 34:C, 35:C
USFS Ecomap Regions: 313B:PP, 315A:CC, 315B:CC, 315H:CC, 321A:CC, 331B:CC, 331C:CC, 331E:CP, 331H:CC, 331I:CC, 331J:CC, 342A:PP, 342F:PP, M313A:C?, M313B:CC, M331B:CC, M331F:CC, M331G:CP, M331I:CC
TNC Ecoregions: 10:P, 26:C, 27:C, 28:C

SOURCES

References: Carsey et al. 2003a, CNHP 2010b, Comer et al. 2003, Covich et al. 1997, Elliott 2011, Eyre 1980, Friedman et al. 1996, Friedman et al. 1997, Kittel et al. 1999b, Manci 1989, Matthews 1988, Muldavin et al. 2000a, Scott et al. 1996, Stromberg and Tellman 2009, TNC 2013
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722725#references
Description Author: P. Comer, G. Kittel, K.A. Schulz, mod. L. Elliott
Version: 14 Jan 2014 **Stakeholders:** Canada, Midwest, Southeast, West
Concept Author: P. Comer, G. Kittel **ClassifResp:** West

SPARSELY VEGETATED

ACADIAN-NORTH ATLANTIC ROCKY COAST (CES201.573)

CLASSIFIERS

Classification Status: Standard

Primary Division: Laurentian-Acadian (201)
Land Cover Class: Barren
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Shrubland (Shrub-dominated); Moss/Lichen (Nonvascular); Rocks and Derived Substrates of the Immediate Coast
Non-Diagnostic Classifiers: Moderate (100-500 yrs) Persistence; Long (>500 yrs) Persistence; Lowland; Glaciated; Very Shallow Soil; Mineral: W/ A-Horizon <10 cm; Consolidated; Unconsolidated; W-Landscape/Medium Intensity
National Mapping Codes: ESLF 3189

CONCEPT

Summary: This system encompasses non-forested uplands along the immediate Atlantic Coast, from north of Cape Cod to the Canadian Maritimes. It is often a narrow zone between the high tide line and the upland forest; this zone becomes wider with increasing maritime influence. The substrate is rock, sometimes with a shallow soil layer, and tree growth is prevented by extreme exposure to wind, salt spray, and fog. Slope varies from flat rock to cliffs. Cover is patchy shrubs, dwarf-shrubs and sparse vascular vegetation, sometimes with a few stunted trees. Many coastal islands have graminoid-shrub areas that were maintained by sheep grazing and now persist even after grazing has ceased.

Related Concepts:
- Crowberry - Bayberry Headland (Gawler and Cutko 2010) Finer
- Rose - Bayberry Maritime Shrubland (Gawler and Cutko 2010) Finer
- Seaside Goldenrod - Goosetongue Open Headland (Gawler and Cutko 2010) Finer

Component Associations:
- *Cakile edentula ssp. edentula - Mertensia maritima* Sparse Vegetation (CEGL006106, GNR)
- *Morella pensylvanica - Empetrum nigrum* Dwarf-shrubland (CEGL006510, GNR)
- *Prunus serotina - Rhus typhina* Scrub Forest (CEGL006399, GNR)
- *Solidago sempervirens - (Rhodiola rosea) - Juniperus horizontalis* Sparse Vegetation (CEGL006529, GNR)

DISTRIBUTION

Range: Primary range is Maine eastward into the Canadian Maritimes, with peripheral occurrences southward along the New England rocky coast.
Divisions: 201:C; 202:C
Nations: CA, US
Subnations: CT?, MA, ME, NB, NH
Map Zones: 65:C, 66:C
TNC Ecoregions: 62:C, 63:C

SOURCES

References: Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723032#references
Description Author: S.C. Gawler
Version: 05 Oct 2004
Concept Author: S.C. Gawler
Stakeholders: Canada, East
ClassifResp: East

ALASKA ARCTIC ACTIVE INLAND DUNE (CES102.212)

CLASSIFIERS

Conf.: 1 - Strong
Classification Status: Standard
Primary Division: Arctic (102)
Land Cover Class: Barren
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Diagnostic Classifiers: Dune (Substrate); Polar [Polar Continental]; W-Patch/High Intensity
Non-Diagnostic Classifiers: Sand Soil Texture; Unconsolidated
FGDC Crosswalk: Vegetated, No dominant lifeform, Sparsely vegetated, Unconsolidated material
National Mapping Codes: EVT 2713; ESLF 3195; ESP 1713

CONCEPT

Summary: Inland active dunes are a minor but widespread system across the Alaskan arctic. The dunes or blowouts are dry to mesic sand deposits, and the slacks may be wet silts and sands. This system's patch size is small. Some common vegetation types include those dominated by low and tall willows, mesic herbaceous meadows, and wet sedge meadows. Low- and tall-willow communities are dominated by *Salix glauca, Salix alaxensis*, and *Salix niphoclada (= Salix brachycarpa ssp. niphoclada)*, along with *Bromus inermis var. pumpellianus (= Bromus pumpellianus)*. The mesic herbaceous meadows include *Leymus mollis, Bromus inermis var. pumpellianus*, and *Chamerion latifolium (= Epilobium latifolium)*. Additional herbaceous species include *Carex obtusata, Carex lachenalii, Festuca rubra, Festuca brachyphylla, Astragalus alpinus*, and others. Ponds and wet depressions may occur in the slacks and support wet herbaceous communities dominated by *Carex aquatilis* and *Arctophila fulva*.
Classification Comments: This system is known as Active Inland Dune by the Alaska Natural Heritage Program.
Related Concepts:
- II.B.1.a - Willow (closed) (Viereck et al. 1992) Intersecting
- II.B.2.a - Willow (open) (Viereck et al. 1992) Intersecting
- II.C.1.b - Low willow (Viereck et al. 1992) Intersecting
- II.C.2.g - Willow low (open) (Viereck et al. 1992) Intersecting
- III.A.1.a - Elymus (Viereck et al. 1992) Intersecting
- III.A.3.a - Wet sedge meadow tundra (Viereck et al. 1992) Intersecting
- III.B.1.a - Seral herbs (Viereck et al. 1992) Intersecting

DESCRIPTION

Dynamics: Active inland dunes occur as remnants of a larger system of dunes and sandsheets that developed under the climatic conditions of the late Pleistocene. Strong storm winds carried glacio-fluvial silts and sands across vast areas of northwestern North America. Most of these sand deposits have been stabilized by forest and tundra vegetation, but areas of active transport and deposition still exist. Some of the most noteworthy active areas are the Kobuk Dunes in western Alaska and the Carcross Dunes in southern Yukon. Dunes are also common where rivers have cut through sandsheets, and new dunes are still forming along rivers with high sediment loads and outwash deposits. These active dunes share many floristic elements and geomorphic processes (Parker and Mann 2000). The main disturbance process is the transport and deposition of sand. Common landforms include transverse and longitudinal dunes, sandsheets, desert pavements, blowouts, and interdune slacks. The dunes or blowouts are dry to mesic sand deposits, and the slacks may be wet silts and sands. Tundra vegetation has stabilized most of these sand deposits, but small blowouts and areas of active transport and deposition still exist.

DISTRIBUTION

Range: This system occurs throughout arctic Alaska, from the Bristol Bay lowlands in southwestern Alaska to the North Slope on the Arctic Ocean.
Divisions: 102:C; 104:C
Nations: US
Subnations: AK
Map Zones: 67:C, 68:C, 69:C, 72:C, 76:C
TNC Ecoregions: 73:C, 74:C, 75:C, 79:C

SOURCES

References: Komarkova and Webber 1980, Parker and Mann 2000, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818283#references
Description Author: K. Boggs
Version: 09 Dec 2008
Stakeholders: West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program
ClassifResp: West

ALASKA ARCTIC BEDROCK AND TALUS (CES102.228)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Arctic (102)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Cliff (Substrate); Talus (Substrate); Polar [Polar Continental]
Non-Diagnostic Classifiers: Lichen
FGDC Crosswalk: Vegetated, No dominant lifeform, Sparsely vegetated, Boulder, gravel, cobble, or talus
National Mapping Codes: EVT 2717; ESLF 3196; ESP 1717

CONCEPT

Classification Comments: This system is known as Bedrock, Non-Vegetated by the Alaska Natural Heritage Program.

DISTRIBUTION

Range: This system occurs throughout arctic Alaska, from the Bristol Bay lowlands in southwestern Alaska to the North Slope on the Arctic Ocean.
Divisions: 102:C; 104:C
Nations: CA, US
Subnations: AK
Map Zones: 67:C, 68:C, 69:C, 72:C, 76:C
TNC Ecoregions: 73:C, 74:C, 75:C, 79:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818292#references
Version: 09 Oct 2008 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKA ARCTIC TIDAL FLAT (CES102.208)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Arctic (102)
Land Cover Class: Barren
Spatial Scale & Pattern: Linear, Small patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Wetland
Diagnostic Classifiers: Tidal flat; Polar [Polar Hyperoceanic]; Tidal / Estuarine; Alga
FGDC Crosswalk: Vegetated, No dominant lifeform, Sparsely vegetated, Alga
National Mapping Codes: EVT 2710; ESLF 3197; ESP 1710

CONCEPT

Summary: Tidal flats are subject to regular tidal inundation, have <10% vascular species cover, and are dominated by bare ground or algae. This system often forms a narrow band along oceanic inlets, deltas, and tidal marshes. Algae are the dominant vegetation.
Classification Comments: This system is known as Tidal Flat by the Alaska Natural Heritage Program, and also includes Aleutian Tidal Flat.
Similar Ecological Systems:
- Temperate Pacific Intertidal Flat (CES204.879)

Related Concepts:
- III.B.3.d - Halophytic herb wet meadow (Viereck et al. 1992) Intersecting
- III.D.2.a - Four-leaf marestail (Viereck et al. 1992) Intersecting

DESCRIPTION

Dynamics: The dominant processes are tectonic uplift or subsidence and sediment deposition.

DISTRIBUTION

Range: This system occurs along Alaska's Aleutian and arctic coastlines, from the Alaska Peninsula and Bristol Bay lowlands in southwestern Alaska to the North Slope on the Arctic Ocean.
Divisions: 102:C; 104:C; 105:C
Nations: US
Subnations: AK
Map Zones: 67:C, 68:C, 72:C, 76:C
TNC Ecoregions: 72:C, 73:C, 74:C, 75:C, 79:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818271#references
Description Author: K. Boggs
Version: 09 Oct 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALASKAN PACIFIC MARITIME ALPINE FLOODPLAIN (CES204.161)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Barren
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Alpine/AltiAndino; Riparian Mosaic [Trees, shrublands, meadows]; Temperate [Temperate Oceanic]; Riverine / Alluvial
Non-Diagnostic Classifiers: Shrubland (Shrub-dominated); Alluvial terrace; Braided channel or stream
FGDC Crosswalk: Vegetated, No dominant lifeform, Sparsely vegetated, Unconsolidated material
National Mapping Codes: EVT 2676; ESLF 3198; ESP 1676

CONCEPT

Summary: This system includes active alpine and subalpine floodplains and consists of a complex of riparian vegetation, including gravel bars, herbaceous vegetation, and dwarf-, low, or tall shrub. Riparian zones are characterized by frequent flooding, shifting channels, and transport and deposition of alluvium. Tall and low shrubs reach their maximum elevation in riparian zones. This may be due to protection of the valley bottom and deeper winter snowpack or the favorable growing conditions of the riparian zone. Flooding regime and soil moisture control the pattern of vegetation cover. Common species occurring in frequently flooded areas include *Chamerion latifolium*, *Chamerion angustifolium*, *Lupinus nootkatensis*, *Salix* spp., and *Alnus viridis ssp. sinuata*. Species occurring in more stabilized areas of the floodplain may include *Salix reticulata*, *Salix arctica*(?), *Phyllodoce aleutica*, *Harrimanella stelleriana*, *Luetkea pectinata*, and *Sanguisorba canadensis*.
Classification Comments: This system is known as Alpine Floodplain by the Alaska Natural Heritage Program.
Related Concepts:
- II.B.1.a - Willow (closed) (Viereck et al. 1992) Intersecting
- II.B.1.d - Alder-willow (closed) (Viereck et al. 1992) Intersecting
- II.B.2.a - Willow (open) (Viereck et al. 1992) Intersecting
- II.B.2.d - Alder-willow (open) (Viereck et al. 1992) Intersecting
- II.C.1.b - Low willow (Viereck et al. 1992) Intersecting
- II.C.2.g - Willow low (open) (Viereck et al. 1992) Intersecting
- II.D.2.d - Mountain-heath tundra (Viereck et al. 1992) Intersecting
- II.D.2.e - Cassiope tundra (Viereck et al. 1992) Intersecting
- II.D.3.a - Willow tundra (Viereck et al. 1992) Intersecting
- III.B.1.a - Seral herbs (Viereck et al. 1992) Intersecting

DISTRIBUTION

Range: This system occurs from Kodiak Island through southeastern Alaska.
Divisions: 204:C
Nations: US
Subnations: AK
Map Zones: 77:C, 78:C
TNC Ecoregions: 69:C, 70:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817725#references
Description Author: T. Boucher
Version: 02 Sep 2008
Concept Author: Western Ecology Group and Alaska Natural Heritage Program
Stakeholders: West
ClassifResp: West

ALASKAN PACIFIC MARITIME ROCKY COASTLINE (CES204.167)

CLASSIFIERS

Classification Status: Standard

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Barren
Spatial Scale & Pattern: Linear, Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Herbaceous; Rocks and Derived Substrates of the Immediate Coast; Temperate [Temperate Oceanic]; Salt Spray; Beach (Landform); Coast
Non-Diagnostic Classifiers: Sea cliff; Shoreline; Cliff (Landform)
FGDC Crosswalk: Vegetated, No dominant lifeform, Sparsely vegetated, Unconsolidated material
National Mapping Codes: EVT 2667; ESLF 3199; ESP 1667

CONCEPT

Summary: Sea cliffs, rocky headlands, and cobble beaches occur commonly along the North Pacific coastline. Cobble beaches are associated with cliff and bluff systems or coarse-textured glacial deposits (i.e., coastal moraines). Beaches are often steep and feature distinct storm berms. These are typically high-energy environments exposed to wave action and storm swell. Cobble beaches may have a mixture of silts and sands below the surface (particularly in outwash plains), but the fine material is buried and not subjected to wind and water transport. Beach meadows may occupy well-drained stable portions of the upper beach. Vegetation typically includes herbaceous species with varying degrees of tolerance for salt spray and wind abrasion. Common species found on beach meadows on cobble substrates include *Leymus mollis, Lathyrus japonicus var. maritimus, Honckenya peploides, Mertensia maritima, Ligusticum scoticum, Potentilla villosa,* and *Lupinus nootkatensis.*

Sea cliffs and rocky headlands are sparsely vegetated or barren landscapes that are usually exposed to wind and salt spray. Forbs, grasses, shrubs, and stunted trees establish on ledges and in cracks. A variety of species may occur depending on level of salt exposure, steepness, aspect, and available microsites. Shrubs such as *Alnus viridis ssp. sinuata* or *Rubus spectabilis* may be present but usually account for less than 5% of the total vascular plant cover. Herbaceous cover is diverse and may include many of the following species: *Aruncus dioicus var. acuminatus, Heuchera glabra, Potentilla villosa, Phegopteris connectilis, Carex macrochaeta, Deschampsia* spp., *Lupinus nootkatensis, Campanula* spp., *Prenanthes alata, Rhodiola rosea,* and *Chamerion latifolium*. *Picea sitchensis* may also occupy these rocky headlands and often does. They are characterized by somewhat stunted growth, usually with branches from top to bottom of bole. Epiphytic lichens are abundant in this system.
Classification Comments: This system is known as Rocky Coastline by the Alaska Natural Heritage Program. It is distinguished from sandy beach systems by the absence of sand deposition and transport.
Related Concepts:
- III.B.2.a - Mixed herbs (Viereck et al. 1992) Broader. not a good match

DESCRIPTION

Environment: Sea cliffs, rocky headlands, and cobble beaches occur commonly along the North Pacific coastline. Cobble beaches are associated with cliff and bluff systems or coarse-textured glacial deposits (i.e., coastal moraines). Beaches are often steep and feature distinct storm berms. These are typically high-energy environments exposed to wave action and storm swell. Cobble beaches may have a mixture of silts and sands below the surface (particularly in outwash plains), but the fine material is buried and not subjected to wind and water transport. Beach meadows may occupy well-drained stable portions of the upper beach.
Vegetation: Vegetation typically includes herbaceous species with varying degrees of tolerance for salt spray and wind abrasion. Common species found on beach meadows on cobble substrates include *Leymus mollis, Lathyrus japonicus var. maritimus, Honckenya peploides, Mertensia maritima, Ligusticum scoticum, Potentilla villosa,* and *Lupinus nootkatensis*. Sea cliffs and rocky headlands are sparsely vegetated or barren landscapes that are usually exposed to wind and salt spray. Forbs, grasses, shrubs, and stunted trees establish on ledges and in cracks. A variety of species may occur depending on level of salt exposure, steepness, aspect, and available microsites. Shrubs such as *Alnus viridis ssp. sinuata* or *Rubus spectabilis* may be present but usually account for less than 5% of the total vascular plant cover. Herbaceous cover is diverse and may include many of the following species: *Aruncus dioicus var. acuminatus, Heuchera glabra, Potentilla villosa, Phegopteris connectilis, Carex macrochaeta, Deschampsia* spp., *Lupinus nootkatensis, Campanula* spp., *Prenanthes alata, Rhodiola rosea,* and *Chamerion latifolium* (Boggs et al. 2008b). *Picea sitchensis* may also occupy these rocky headlands and often does. They are characterized by somewhat stunted growth, usually with branches from top to bottom of bole. Epiphytic lichens are abundant in this system.
Dynamics: The primary disturbance is exposure to high wind and salt spray.

DISTRIBUTION

Range: This system occurs from the Cook Inlet Basin, on Kodiak Island, and through southeastern Alaska.
Divisions: 204:C
Nations: US
Subnations: AK
Map Zones: 75:C, 76:C, 77:C, 78:C
TNC Ecoregions: 69:C, 70:C, 71:C, 72:?

SOURCES

References: Boggs et al. 2008b, Western Ecology Working Group n.d.

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817799#references

Description Author: T. Boucher

Version: 10 Dec 2008

Concept Author: Western Ecology Group and Alaska Natural Heritage Program

Stakeholders: West

ClassifResp: West

ALEUTIAN ROCKY HEADLAND AND SEA CLIFF (CES105.305)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Boreal [Boreal Oceanic]; Salt Spray
Non-Diagnostic Classifiers: Headland; Sea cliff
FGDC Crosswalk: Vegetated, No dominant lifeform, Sparsely vegetated, Boulder, gravel, cobble, or talus
National Mapping Codes: EVT 2716; ESLF 3200; ESP 1716

CONCEPT

Summary: This ecological system includes rocky headlands and sea cliffs. Sea cliffs typically occur below 50 m elevation; however, on some extremely exposed cliffs, such as those on outer headlands, salt spray from winter storms may affect cliffs at 100-200 m elevation. Vegetation cover is typically sparse to absent. Frequent exposure to salt spray distinguishes this system from inland and alpine rock outcrops and cliffs. In addition to salt spray, wind and wave erosion, desiccation, and slope failures create a harsh growing environment. Forbs, grasses and shrubs establish on ledges and in cracks. On Amchitka Island, Shacklette et al. (1969) described several sea cliff communities, including *Eurhynchium-Puccinellia-Caloplaca*, *Potentiea-Draba-Saxifraga, Xanthoria-Ramalina*, and (on less steep cliffs) *Leymus-Ligusticum-Anemone*. On the Alaska Peninsula, dominance may shift to *Alnus viridis ssp. sinuata, Rubus spectabilis, Aruncus dioicus var. acuminatus, Heuchera glabra, Potentilla villosa, Phegopteris connectilis, Carex macrochaeta, Deschampsia* spp., *Lupinus nootkatensis, Campanula* spp., and *Chamerion latifolium*.
Classification Comments: This system is known as Rocky Headland and Sea Cliff by the Alaska Natural Heritage Program.
Related Concepts:
- *Eurhynchium-Puccinellia-Caloplaca* (Shacklette et al. 1969) Finer
- *Leymus-Ligusticum-Anemone* (Shacklette et al. 1969) Finer
- *Potentiea-Draba-Saxifraga* (Shacklette et al. 1969) Finer
- *Xanthoria-Ramalina* (Shacklette et al. 1969) Finer

DISTRIBUTION

Range: This system occurs on the Alaska Peninsula and Aleutian Islands.
Divisions: 102:C; 105:C
Nations: US
Subnations: AK
Map Zones: 76:C
TNC Ecoregions: 72:C, 73:C

SOURCES

References: Shacklette et al. 1969, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818606#references
Description Author: K. Boggs
Version: 16 Oct 2008 **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

ALEUTIAN VOLCANIC ROCK AND TALUS (CES105.308)

CLASSIFIERS

Classification Status: Standard

Primary Division: Montane Boreal (105)
Land Cover Class: Barren
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Talus (Landform); Boreal [Boreal Oceanic]
FGDC Crosswalk: Vegetated, No dominant lifeform, Sparsely vegetated, Boulder, gravel, cobble, or talus
National Mapping Codes: EVT 2732; ESLF 3201; ESP 1732

CONCEPT

Classification Comments: This system is known as Bedrock by the Alaska Natural Heritage Program.
Similar Ecological Systems:
- North Pacific Active Volcanic Rock and Cinder Land (CES204.092)

DISTRIBUTION

Range: This system occurs on the Alaska Peninsula and Aleutian Islands.
Divisions: 102:C; 105:C
Nations: US
Subnations: AK
Map Zones: 76:C
TNC Ecoregions: 72:C, 73:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.818612#references
Version: **Stakeholders:** West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

CENTRAL ATLANTIC COASTAL PLAIN SANDY BEACH (CES203.064)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Barren
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Herbaceous; Beach (Substrate); Coast
National Mapping Codes: ESLF 3162

CONCEPT

Summary: This system includes ocean beaches along the Mid-Atlantic coast ranging from approximately Bodie Island, North Carolina, to approximately Myrtle Beach, South Carolina, a range which is largely represented by Omernik Level IV Ecoregion 63g (EPA 2004). Examples of this system generally include the outermost zone of coastal vegetation extending seaward from foredunes on barrier islands and also limited wash-over flats behind breached foredunes. Substrates consist of unconsolidated sand and shell sediments that are constantly shifting. Although these habitats are situated just above the mean high tide limit, they are constantly impacted by waves and are prone to major impact from storm surges and hurricane events. Under normal conditions constant salt spray and rainwater maintain generally moist conditions. Dynamic disturbance regimes largely limit vegetation to pioneering, salt-tolerant, succulent annuals.
Classification Comments: To the north this system is replaced by Northern Atlantic Coastal Plain Sandy Beach (CES203.301) and to the south by Southern Atlantic Coastal Plain Sea Island Beach (CES203.383). This system provides habitat for the threatened plant seabeach amaranth (*Amaranthus pumilus*).
Similar Ecological Systems:
- Northern Atlantic Coastal Plain Sandy Beach (CES203.301)

DESCRIPTION

Environment: The beach includes the sand intertidal shore, and the low-gradient sand above the daily high tide line, which is between the foredune and the Atlantic Ocean. This area of upper beach is affected by wind and salt spray, seasonal high tides, and storm surge. Examples of this system generally extend seaward from foredunes on barrier islands and also limited overwash flats behind breached foredunes. Substrates consist of unconsolidated sand and shell sediments that are constantly shifting.
Dynamics: The process of sand movement due to the forces of wind and water are part of the natural dynamics of beach ecosystems. This includes transport of sand along the coast, and movement of sand by wind or water between the dunes, beach and subtidal areas. If not restricted by infrastructure or engineered hard structures, beaches and dunes can migrate as coastlines change over time in response to the action of wind and water. The beaches of the coast of the Carolinas are affected by two tides per day. Extensive construction of high, artificial dunes along the Atlantic Coast has reduced the extent of these habitats by increasing oceanside beach erosion and eliminating the disturbance regime that creates and maintains overwash flats.

Component Associations:
- *Cakile edentula ssp. edentula - Chamaesyce polygonifolia* Sparse Vegetation (CEGL004400, G4G5)
- *Sesuvium portulacastrum - Atriplex* spp. - *Suaeda* spp. Sparse Vegetation (CEGL004406, G3)

DISTRIBUTION

Range: This system ranges along the Mid-Atlantic coast ranging from approximately Bodie Island, North Carolina, to approximately Myrtle Beach, South Carolina, a range which is largely represented by Omernik Level IV Ecoregion 63g, Carolinian Barrier Islands and Coastal Marshes (EPA 2004), but extends southward into the coastal portion of 63h, Carolina Flatwoods (EPA 2004) in Horry County, South Carolina.
Divisions: 203:C
Nations: US
Subnations: NC, SC
Map Zones: 58:C
USFS Ecomap Regions: 232I:CC
TNC Ecoregions: 57:C

SOURCES

References: Defeo et al. 2009, EPA 2004, Southeastern Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.730725#references
Description Author: R.E. Evans, mod. M. Pyne
Version: 06 Feb 2014
Concept Author: R. Evans
Stakeholders: Southeast
ClassifResp: Southeast

CENTRAL CALIFORNIA COAST RANGES CLIFF AND CANYON (CES206.903)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Canyon Mosaic; Cliff (Substrate); Talus (Substrate); Mediterranean [Mediterranean Xeric-Oceanic]; Canyon
Non-Diagnostic Classifiers: Montane [Lower Montane]; Lowland [Foothill]; Lowland [Lowland]; Forest and Woodland (Treed); Shrubland (Shrub-dominated); Moss/Lichen (Nonvascular); Xeric; Landslide; Cliff (Landform)
National Mapping Codes: ESLF 3169

CONCEPT

Summary: Found from foothill and montane elevations of California's Coast Ranges, these are barren and sparsely vegetated areas (<10% plant cover) of steep cliff faces, narrow canyons, and smaller rock outcrops of various igneous, sedimentary, and metamorphic bedrock. This system also includes unstable scree and talus slopes typically occurring below cliff faces. Scattered vegetation may include *Pseudotsuga menziesii*, *Pinus contorta var. murrayana*, *Pinus ponderosa*, and *Pinus jeffreyi*. There may be shrubs including species of *Arctostaphylos* or *Ceanothus*. Soil development is limited as is herbaceous cover.

DISTRIBUTION

Range: Found from foothill and montane elevations of California's Coast Ranges.
Divisions: 206:C
Nations: US
Subnations: CA
Map Zones: 3:C, 4:C
USFS Ecomap Regions: 262A:PP, M261B:CC, M261C:CC
TNC Ecoregions: 14:C, 15:C

SOURCES

References: Barbour and Major 1988, Comer et al. 2003, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722778#references
Description Author: P. Comer, T. Keeler-Wolf
Version: 17 Mar 2003
Stakeholders: West
Concept Author: P. Comer, T. Keeler-Wolf
ClassifResp: West

CENTRAL INTERIOR ACIDIC CLIFF AND TALUS (CES202.689)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Barren
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Non-Diagnostic Classifiers: Talus (Landform); Acidic Soil; Cliff (Landform)
National Mapping Codes: ESLF 3149

CONCEPT

Summary: This system is found primarily in the Interior Highlands, including the Ozarks, Ouachita, and Interior Low Plateau ecoregions, extending marginally north and west along the Missouri and Mississippi rivers. Sandstone outcrops and talus ranging from moist to dry typify this system. It is typically sparsely vegetated; however, on moister sites with more soil development, several fern species and sedges (*Carex* spp.) can establish. Wind and water erosion are the major dynamic processes influencing this system.
Classification Comments: In Kentucky, this system covers the sandstone cliffs of the Shawnee Hills (Interior Low Plateau). In Illinois, one exemplary example is the "Garden of the Gods" in the Shawnee National Forest.
Similar Ecological Systems:
- North-Central Appalachian Acidic Cliff and Talus (CES202.601)

Related Concepts:
- Dry Sandstone Cliff (Evans 1991) Intersecting
- Moist Sandstone Cliff (Evans 1991) Intersecting

DESCRIPTION

Environment: Sandstone outcrops and talus ranging from moist to dry typify this system. Examples range from sparsely to moderately well-vegetated. Soil development is limited to cracks and ledges. Slope aspect and angle are strongly related to the amount of available moisture on a site. Steep, south- or west-facing slopes are drier than less steep east- or north-facing slopes. Some sites have seepage along the cliff face. Shading by adjacent forests can impact cliffs below the height of nearby trees.
Vegetation: This system is typically sparsely vegetated; however, on moister sites with more soil development, several fern species and sedges (*Carex* spp.) can establish. Some taxa that could be present include *Ribes cynosbati, Deschampsia flexuosa, Dryopteris marginalis*, and *Dennstaedtia punctilobula*, as well as *Carex interior, Carex lurida, Carex leptalea, Parnassia grandifolia, Rhynchospora capillacea, Osmunda cinnamomea, Rhynchospora capitellata, Heuchera parviflora var. puberula*, and *Xyris jupicai* on wetter sites.
Dynamics: Wind and water erosion are the major dynamic processes influencing this system.

Component Associations:
- *(Carex interior, Carex lurida) - Carex leptalea - Parnassia grandifolia - Rhynchospora capillacea* Herbaceous Vegetation (CEGL002404, G2G3)
- *(Hydrangea arborescens, Ribes cynosbati) / Deschampsia flexuosa - Dryopteris marginalis - Dennstaedtia punctilobula* Shrubland (CEGL007820, G2?)
- Chert Ozark Dry Cliff Sparse Vegetation (CEGL002285, G3?)
- Chert Ozark Moist Cliff Sparse Vegetation (CEGL002288, G2G3)
- Igneous Ozark Dry Cliff Sparse Vegetation (CEGL002286, G4)
- Igneous Ozark Moist Cliff Sparse Vegetation (CEGL002289, G4Q)
- Igneous Ozark Talus Sparse Vegetation (CEGL005203, G4)
- *Osmunda cinnamomea - Rhynchospora capitellata - Heuchera parviflora var. puberula - Xyris jupicai* Herbaceous Vegetation (CEGL007837, G1Q)
- Sandstone Interior Highlands Talus Sparse Vegetation (CEGL002309, G4G5)
- Sandstone Midwest Dry Cliff Sparse Vegetation (CEGL002045, G4G5)
- Sandstone Midwest Moist Cliff Vegetation (CEGL002287, G4G5)

DISTRIBUTION

Range: This system is found primarily in the Interior Highlands, including the Ozark, Ouachita, and Interior Low Plateau ecoregions. It extends marginally into the Central Tallgrass Prairie Ecoregion along the Missouri and Mississippi rivers.
Divisions: 202:C
Nations: US
Subnations: AR, IA?, IL, IN, KY, MO, TN
Map Zones: 43:P, 44:C, 47:C, 48:C, 49:C, 53:C
TNC Ecoregions: 36:C, 38:C, 39:C, 44:C

SOURCES

References: Comer et al. 2003, Evans 1991, Kost et al. 2007, WNHI 2012

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722970#references
Description Author: S. Menard, T. Foti, R. Evans, mod. M. Pyne and J. Drake
Version: 14 Jan 2014 **Stakeholders:** East, Midwest, Southeast
Concept Author: S. Menard, T. Foti, R. Evans **ClassifResp:** Midwest

CENTRAL INTERIOR CALCAREOUS CLIFF AND TALUS (CES202.690)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Barren
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
National Mapping Codes: ESLF 3148

CONCEPT

Summary: This system is found primarily in non-Appalachian portions of the Central Interior Division. It ranges from the Ouachitas east to the Cumberlands and north into the Western Allegheny Plateau and Lake states. Limestone and dolomite outcrops and talus distinguish this system. Examples range from moist to dry and from sparsely to moderately well-vegetated. Woodland species such as *Thuja occidentalis* can establish along the ridgetops, on ledges, and talus. Understory species can range from grassland species, such as *Andropogon gerardii* on drier slopes, to more mesic species in areas with higher moisture and more soil development. Wind and water erosion along with fire are the primary natural dynamics influencing this system. Some associations included here are rocky openings in forest stands, sometimes with moisture present from groundwater seepage. Also included are wet and dry cliffs. The flora of these wetter examples may include (across the broad range of the system) *Aconitum noveboracense, Adiantum capillus-veneris, Adoxa moschatellina, Aquilegia canadensis, Asplenium rhizophyllum, Boehmeria cylindrica, Chrysosplenium iowense, Cystopteris bulbifera, Cystopteris bulbifera, Dichanthelium depauperatum, Heuchera americana, Heuchera americana var. hirsuticaulis, Heuchera villosa var. arkansana, Hydrangea arborescens, Impatiens pallida, Lobelia siphilitica, Toxicodendron radicans*, and *Woodsia obtusa*.
Classification Comments: Similar examples in the driftless region of Minnesota, Wisconsin, Iowa and Illinois should be considered part of Paleozoic Plateau Bluff and Talus (CES202.704).
Similar Ecological Systems:
- North-Central Appalachian Circumneutral Cliff and Talus (CES202.603)
- Paleozoic Plateau Bluff and Talus (CES202.704)
- Southern Interior Calcareous Cliff (CES202.356)--includes circumneutral cliff and talus communities from southern Virginia south.
- Southern Interior Sinkhole Wall (CES202.357)

Related Concepts:
- Dry Limestone Cliff (Evans 1991) Finer
- Eastern Redcedar: 46 (Eyre 1980) Finer
- Moist Limestone Cliff (Evans 1991) Finer
- Northern White-Cedar: 37 (Eyre 1980) Finer

DESCRIPTION

Environment: Limestone and dolomite outcrops and talus distinguish this system. Examples range from moist to dry and from sparsely to moderately well-vegetated. Soil development is limited to cracks and ledges. Slope aspect and angle are strongly related to the amount of available moisture on a site. Steep, south- or west-facing slopes are drier than less steep east- or north-facing slopes. Some sites have seepage along the cliff face. Shading by adjacent forests can impact cliffs below the height of nearby trees.
Vegetation: Examples range from moist to dry and from sparsely to moderately well-vegetated. Woodland species such as *Thuja occidentalis* can establish along the ridgetops. Understory species can range from grassland species, such as *Andropogon gerardii* on drier slopes, to more mesic species in areas with higher moisture and more soil development. The flora of some moister examples (e.g., rocky openings in forest stands, with moisture present from groundwater seepage as well as wet cliffs) includes (across the broad range of the system) *Aconitum noveboracense, Adiantum capillus-veneris, Adoxa moschatellina, Aquilegia canadensis, Asplenium rhizophyllum, Boehmeria cylindrica, Chrysosplenium iowense, Cystopteris bulbifera, Cystopteris bulbifera, Dichanthelium depauperatum, Heuchera americana, Heuchera americana var. hirsuticaulis, Heuchera villosa var. arkansana, Hydrangea arborescens, Impatiens pallida, Lobelia siphilitica, Toxicodendron radicans*, and *Woodsia obtusa*.
Dynamics: Wind and water erosion along with fire are the primary natural dynamics influencing this system. Fires could spread from more vegetated communities adjacent to calcareous cliffs and could burn vegetation on the edges of this community. A study in a similar cliff system in southern Ontario found no relationship between cliff patch size and diversity or richness (Haig et al. 2000).

Component Associations:
- *(Hydrangea arborescens, Toxicodendron radicans) / Heuchera americana - (Dichanthelium depauperatum, Woodsia obtusa)* Shrubland (CEGL004395, G3?)
- *Acer saccharum - Tilia americana - Fraxinus americana / Ostrya virginiana / Geranium robertianum* Woodland (CEGL005058, G3G5)
- *Adiantum capillus-veneris - Boehmeria cylindrica - Lobelia siphilitica* Herbaceous Vegetation (CEGL004728, G2G3)
- *Andropogon gerardii - Chasmanthium latifolium - Amsonia tabernaemontana var. salicifolia* Herbaceous Vegetation (CEGL004739, G2G3)

- *Hydrangea arborescens / Heuchera (americana var. hirsuticaulis, villosa var. arkansana) - Aquilegia canadensis* Shrubland (CEGL007819, G3?)
- *Hydrangea arborescens / Impatiens (capensis, pallida) - Heuchera villosa* Shrubland (CEGL004708, G3)
- *Impatiens pallida - Cystopteris bulbifera - Adoxa moschatellina - (Chrysosplenium iowense, Aconitum noveboracense)* Algific Talus Herb Vegetation (CEGL002387, G2)
- Limestone - Dolostone Midwest Dry Cliff Sparse Vegetation (CEGL002291, G4G5)
- Limestone - Dolostone Midwest Moist Cliff Vegetation (CEGL002292, G4G5)
- Limestone - Dolostone Midwest Talus Vegetation (CEGL002308, G4G5)
- *Quercus muehlenbergii - (Juniperus virginiana var. virginiana)* Unglaciated Bluff Woodland (CEGL004267, G2G3)
- *Rhus aromatica - Celtis tenuifolia / Carex eburnea* Shrubland (CEGL004393, G3)
- *Schizachyrium scoparium - Bouteloua curtipendula* Bedrock Bluff Herbaceous Vegetation (CEGL002245, G3G4)
- *Schizachyrium scoparium - Sporobolus compositus var. compositus - Rudbeckia fulgida var. fulgida* Wooded Herbaceous Vegetation (CEGL004078, G2)
- Small Eroding Bluffs Midwestern Sparse Vegetation (CEGL002315, GNR)
- *Thuja occidentalis / Carex eburnea - Pellaea atropurpurea* Woodland (CEGL002596, G2G3)
- *Thuja occidentalis* Cliff Woodland (CEGL002451, G3)

DISTRIBUTION

Range: This system is found primarily in non-Appalachian portions of the Central Interior Division.
Divisions: 201:?; 202:C; 205:P
Nations: US
Subnations: AR, IA, IL, IN, KY?, MI, MN, MO, NY, OH, OK, PA, TN, WI
Map Zones: 41:?, 42:P, 43:P, 44:C, 47:C, 48:C, 49:P, 50:C, 51:C, 52:C, 53:C, 61:C, 62:C, 63:C, 64:C
USFS Ecomap Regions: 222M:CC
TNC Ecoregions: 36:C, 38:C, 39:C, 44:C, 45:C, 46:C, 47:?, 48:C, 49:C

SOURCES

References: Comer et al. 2003, Evans 1991, Eyre 1980, Haig et al. 2000, Kost et al. 2007, Vanderhorst pers. comm., WNHI 2012
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722969#references
Description Author: S. Menard, mod. J. Drake and M. Pyne
Version: 14 Jan 2014 **Stakeholders:** East, Midwest, Southeast
Concept Author: S. Menard **ClassifResp:** Midwest

COLORADO PLATEAU MIXED BEDROCK CANYON AND TABLELAND (CES304.765)

CLASSIFIERS

Conf.: 3 - Weak **Classification Status:** Standard
Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Barren
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Montane [Lower Montane]; Lowland [Foothill]; Shrubland (Shrub-dominated); Ridge/Summit/Upper Slope; Sedimentary Rock; Temperate [Temperate Xeric]; Alkaline Soil; Aridic
Non-Diagnostic Classifiers: Moss/Lichen (Nonvascular); Cliff (Substrate); Talus (Substrate)
National Mapping Codes: ESLF 3183

CONCEPT

Summary: The distribution of this ecological system is centered on the Colorado Plateau where it is comprised of barren and sparsely vegetated landscapes (generally <10% plant cover) of steep cliff faces, narrow canyons, and open tablelands of predominantly sedimentary rocks, such as sandstone, shale, and limestone. Some eroding shale layers similar to Inter-Mountain Basins Shale Badland (CES304.789) may be interbedded between the harder rocks. The vegetation is characterized by very open tree canopy or scattered trees and shrubs with a sparse herbaceous layer. Common species includes *Pinus edulis, Pinus ponderosa, Juniperus* spp., *Cercocarpus intricatus,* and other short-shrub and herbaceous species, utilizing moisture from cracks and pockets where soil accumulates.
Classification Comments: Geographically restricted and distinct from the related, but broader Inter-Mountain Basins Cliff and Canyon (CES304.779). Shale areas are not as extensive as in shale badlands.
Similar Ecological Systems:
- Colorado Plateau Pinyon-Juniper Shrubland (CES304.766)
- Inter-Mountain Basins Cliff and Canyon (CES304.779)

Related Concepts:
- Littleleaf Mountain-Mahogany (417) (Shiflet 1994) Intersecting
- Pinyon - Juniper: 239 (Eyre 1980) Intersecting

DESCRIPTION

Environment: This system includes limestone escarpments and plateaus occurring in a relatively narrow band of unvegetated or sparsely vegetated badlands formed by the red beds of the Claron (Wasatch) Formation along the eastern edge of the Pausaugunt Plateau (Bryce Canyon) and the western edge of the Markagunt Plateau (Cedar Breaks National Monument) (Graybosch and Buchanan 1983). It includes areas of which often 90% of the exposed surface consists of barren rock. It forms, or includes, areas of fixed bedrock forming the vertical or near-vertical parts on the plateau faces. The rocks forming such areas are predominantly limestone-capped plateaus. These areas are highly erodible and form the basic scenic structure of Bryce Canyon and Cedar Breaks national parks. The area is generally too steep to allow any significant soil development. Scattered plants obtain a precarious foothold in the crevices of the rocks. Knolls may form at the base of the cliffs.

This ecological system also includes sandstone and shale escarpments, which form, or include, areas of fixed bedrock forming the vertical or near-vertical parts of canyon walls and plateau faces. The scenic cliffs of the East Tavaputs area, e.g., the Book Cliffs, are excellent examples of this. The rocks forming such areas are predominantly sandstone and shale with some limestone and marlstone. These areas are unstable and rocks are frequently rolling down onto the talus slopes below (often forming Inter-Mountain Basins Shale Badland (CES304.789)). The area is generally too steep to allow any significant soil development. Scattered plants obtain a precarious foothold in the crevices of the rocks. Knolls may form at the base of the cliffs. The larger drainages (e.g., East Fork Parachute Creek) plunge several hundred feet at this escarpment, which creates scenic and lush hanging gardens. Many of these escarpments are over 1000 feet in height and provide excellent habitat for cliff-nesting birds such as peregrine falcons and golden eagles.

The Claron limestone, a Tertiary deposit, is divisible into Red Eocene beds and White Oligocene beds, which differ somewhat in presence or absence of pigmentation in the form of iron and manganese oxides, and in amounts of sand and conglomerates in the limestone (Graybosch and Buchanan 1983). The Claron Formation is characterized by a rapid rate of erosion, largely a function of creep resulting from winter freeze-thaw activity and wash away by summer thunderstorm runoff (Graybosch and Buchanan 1983). Freeze-thaw cycles are most pronounced on south-facing slopes. Soil development is limited. Infiltration rates are low and runoff high.
Vegetation: For the most part, this system is sparsely vegetated. Small patches of scattered trees and shrubs may occur. These small vegetated patches are usually dominated by conifer trees and may include *Abies concolor, Juniperus scopulorum, Picea pungens, Pinus flexilis, Pinus longaeva, Pinus ponderosa,* and *Pseudotsuga menziesii*. If a shrub layer exists, it may include *Acer glabrum, Amelanchier utahensis, Arctostaphylos patula, Ceanothus martinii, Cercocarpus montanus, Cercocarpus intricatus, Juniperus communis, Mahonia repens, Purshia tridentata, Ribes cereum,* and *Gutierrezia sarothrae*. Grasses and forbs, if present, may include *Astragalus kentrophyta, Cirsium arizonicum, Clematis columbiana, Leymus salinus, Eriogonum panguicense, Achnatherum hymenoides,* and *Linum kingii*.

This ecological system is noted for its high rate of endemic species of forbs, especially in Bryce Canyon. Nine of the eleven endemic species occur in the *Pinus longaeva* community, three are found in the *Pinus ponderosa - Arctostaphylos patula* plant association, and two occur in the mixed conifer type. Species that occur only in the *Pinus longaeva* type have the narrowest geographic distributions, although *Eriogonum panguicense var. panguicense* is an exception (Graybosch and Buchanan 1983). Within Bryce Canyon, most of these endemics are restricted to the Claron Formation (Graybosch and Buchanan 1983). The majority of endemic species found in southern Utah are restricted to substrates derived from a specific geologic formation (Welsh 1979). Welsh notes that most of these taxa are found in areas of exposed parent material. The distribution of endemic species in Utah is not a random one; fine-textured substrates support more species than coarser ones, and desert and foothill vegetation is richer in endemic species than montane communities (Welsh 1979).
Dynamics: This ecological system has a naturally high rate of erosion. Fires are infrequent and not an important ecological process.

Component Associations:
- *Acer negundo / Rhus trilobata* Woodland (CEGL002750, GNR)
- *Artemisia bigelovii - Ephedra (viridis, torreyana)* Talus Shrubland (CEGL003755, GNR)
- *Atriplex canescens - (Ephedra viridis) / (Muhlenbergia porteri)* Sandstone Sparse Vegetation (CEGL002927, GNR)
- *Atriplex canescens - Ephedra viridis* Talus Shrubland (CEGL001287, G4)
- *Celtis laevigata var. reticulata* Slickrock Canyon Woodland (CEGL002359, GNR)
- *Cercocarpus intricatus* Montane Shrubland (CEGL002587, GNR)
- *Cercocarpus intricatus* Slickrock Sparse Vegetation (CEGL002977, GNR)
- *Cercocarpus montanus* Rock Pavement Sparse Vegetation (CEGL002978, GNR)
- *Chrysothamnus viscidiflorus* Talus Shrubland (CEGL002347, GNR)
- *Coleogyne ramosissima* Sparse Shrubland (CEGL003834, GNR)
- *Ephedra torreyana - (Atriplex canescens, Atriplex confertifolia)* Sparse Vegetation (CEGL005801, GNR)
- *Ephedra torreyana* - (*Atriplex* spp.) / Nonvascular Gypsum Sparse Vegetation (CEGL002349, GNR)
- *Ephedra torreyana - Artemisia bigelovii* Sparse Vegetation (CEGL002350, GNR)
- *Ephedra torreyana* Sparse Vegetation (CEGL002353, GNR)
- *Fendlera rupicola* Talus Shrubland (CEGL002765, GNR)
- *Fraxinus anomala - Rhus trilobata* Talus Shrubland (CEGL003963, GNR)
- *Juniperus osteosperma - (Pinus edulis) / Coleogyne ramosissima - Purshia stansburiana - Quercus havardii var. tuckeri* Wooded Shrubland (CEGL003774, GNR)
- *Juniperus osteosperma / Artemisia nova* / Rock Woodland (CEGL000729, G5)
- *Juniperus osteosperma / Cercocarpus intricatus* Woodland (CEGL000733, GNR)
- *Pinus edulis - Juniperus osteosperma / Cercocarpus intricatus* Woodland (CEGL000779, G3)
- *Pinus edulis - Juniperus osteosperma / Ephedra viridis* Woodland (CEGL002370, G3)
- *Pinus edulis - Juniperus osteosperma / Petradoria pumila* Woodland (CEGL002332, GNR)
- *Pinus ponderosa* / Sparse Understory Woodland (CEGL002384, GNR)
- *Pinus ponderosa* Slickrock Sparse Vegetation (CEGL002972, GNR)
- *Pseudoroegneria spicata* - Cushion Plants Herbaceous Vegetation (CEGL001666, G3?)
- *Rhus trilobata - Ephedra (viridis, torreyana)* Talus Shrubland (CEGL003776, GNR)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Inter-Mountain Basins Shale Badland (CES304.789)

Adjacent Ecological System Comments: Some eroding shale layers similar to Inter-Mountain Basins Shale Badland (CES304.789) may be interbedded between the harder rocks.

DISTRIBUTION

Range: Colorado Plateau.
Divisions: 304:C
Nations: US
Subnations: AZ, CO, NM, UT, WY
Map Zones: 13:C, 14:P, 15:C, 16:C, 17:C, 22:P, 23:C, 24:C, 25:P, 27:?, 28:P
USFS Ecomap Regions: 313A:CC, 313B:CC, 313C:CC, 313D:CC, 315H:CC, 321A:CC, 322A:CC, 341A:CC, 341B:CC, 341C:CC, 341F:CP, M313A:CC, M313B:CC, M331D:CC, M331E:CC, M331G:CC, M331H:CC, M341B:CC, M341C:CC
TNC Ecoregions: 18:C, 19:C, 20:?

SOURCES

References: Comer et al. 2003, Graybosch and Buchanan 1983, LaMarche and Mooney 1972, Shute and West 1978, Thorne Ecological Institute 1973a, Welsh 1979, Welsh and Chatterly 1985
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722907#references
Description Author: NatureServe Western Ecology Team
Version: 20 Feb 2003 **Stakeholders:** West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

COLUMBIA PLATEAU ASH AND TUFF BADLAND (CES304.081)

CLASSIFIERS

Classification Status: Standard

Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Lowland [Lowland]; Badlands; Alkaline Soil; Silt Soil Texture; Clay Soil Texture
National Mapping Codes: ESLF 3174

CONCEPT

Summary: This ecological system of the Columbia Plateau region is composed of barren and sparsely vegetated substrates (<10% plant cover) typically derived from highly eroded volcanic ash and tuff. Landforms are typically rounded hills and plains that form a rolling topography. The harsh soil properties and high rate of erosion and deposition are driving environmental variables supporting sparse dwarf-shrubs and forbs. Characteristic species include *Grayia spinosa, Artemisia tridentata, Salvia dorrii, Achnatherum* sp., *Eriogonum* sp., *Sarcobatus vermiculatus, Purshia tridentata*, and *Atriplex confertifolia*. Characteristic forbs are short-lived annuals, including *Cleome, Mentzelia, Camissonia*, and *Mimulus* species, although these habitats often support endemic perennial forbs.
Classification Comments: Associations assigned to this system are not well-classified, but as many support G1 and G2 plant taxa, they are well sampled.
Similar Ecological Systems:
- Inter-Mountain Basins Shale Badland (CES304.789)

DESCRIPTION

Environment: This ecological system of the Columbia Plateau region is composed of barren and sparsely vegetated substrates (<10% plant cover) typically derived from highly eroded volcanic ash and tuff. Landforms are typically rounded hills and plains that form a rolling topography. The harsh soil properties and high rate of erosion and deposition are driving environmental variables supporting sparse dwarf-shrubs and forbs.
Vegetation: Characteristic species include *Grayia spinosa, Artemisia tridentata, Salvia dorrii, Achnatherum* sp., *Eriogonum* sp., *Sarcobatus vermiculatus, Purshia tridentata*, and *Atriplex confertifolia*. Characteristic forbs are short-lived annuals, including *Cleome, Mentzelia, Camissonia*, and *Mimulus* species, although these habitats often support endemic perennial forbs.

Component Associations:
- *Achnatherum hymenoides* Shale Barren Herbaceous Vegetation (CEGL001651, G2)
- *Artemisia tridentata ssp. wyomingensis - Atriplex confertifolia* Shrubland (CEGL001040, G3G5)
- *Salvia dorrii / Pseudoroegneria spicata* Dwarf-shrubland (CEGL001453, G4)

DISTRIBUTION

Range: This system is found on the Columbia Plateau of southern Idaho west into southern Oregon, northern Nevada, and extreme northeastern California.
Divisions: 304:C
Nations: US
Subnations: CA, ID, NV, OR, WA?
Map Zones: 7:P, 8:C, 9:C, 10:P, 12:P, 18:C
USFS Ecomap Regions: 342B:CC, 342C:CC, 342D:CC, M331A:??
TNC Ecoregions: 4:P, 6:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.740139#references
Description Author: J. Kagan
Version: 08 Sep 2004
Concept Author: J. Kagan
Stakeholders: West
ClassifResp: West

CUMBERLAND ACIDIC CLIFF AND ROCKHOUSE (CES202.309)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Barren
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Cliff (Substrate); Acidic Soil
National Mapping Codes: ESLF 3119

CONCEPT

Summary: This sandstone cliff ecological system is found in the Cumberland Plateau and Mountain regions of the southeastern United States. Examples are extremely steep or vertical rock faces exposed along bluffs often associated with rivers. The aspect is variable but best developed on south- and west-facing sites. Plants are infrequent due to the lack of crevices capable of accumulating soil, the highly acidic nature of the bedrock, and the frequent weathering and erosion of the substrate. Lichen cover may be extensive in places, especially on the more exposed portions. These cliffs are also prone to harsh climatic conditions; frequent disturbances include drought stress and wind and storm damage. As a result, examples are characterized by sparse herbaceous cover and few, if any, trees. Vegetation consists of scattered individuals of *Asplenium montanum*, *Silene rotundifolia*, and other species rooted in crevices and erosion pockets. In some parts of its range, this system is the primary or sole habitat for rare endemic species, such as *Minuartia cumberlandensis* and *Ageratina luciae-brauniae*. This system includes a mosaic of cavelike features (often called "rockhouses") and associated sandstone box canyons in the western Appalachian foothills regions of Kentucky, Alabama, West Virginia, and possibly southeastern Ohio. Where present, the rockhouses are a prominent and diagnostic feature of the system.
Classification Comments: It is unclear whether or not this system should range into the Interior Low Plateau. Also debatable is whether or not wet and dry cliffs should be included as well as the number of different physical settings possible. See also Southern Appalachian Montane Cliff and Talus (CES202.330).
Similar Ecological Systems:
- North-Central Appalachian Acidic Cliff and Talus (CES202.601)
- Southern Appalachian Montane Cliff and Talus (CES202.330)

Related Concepts:
- Dry Sandstone Cliff (Evans 1991) Intersecting
- Moist Sandstone Cliff (Evans 1991) Intersecting
- Virginia Pine: 79 (Eyre 1980) Finer

DESCRIPTION

Environment: The rockhouses are the most unique and diagnostic feature of the system. These unusual geologic features are created by spray and rock-cracking from seasonal flowing waterfalls at the heads of canyons amidst thick layers of sandstone from the Mississippian and Pennsylvanian geologic periods. The ceiling of the rockhouse may be 50 m tall, and they can be as much as 50 m deep (Walck et al. 1996, A. Weakley pers. comm. 2006). They require sufficient flowing water and freezing and thawing to weather the thick beds of sandstone. These conditions seem to be restricted to the western margin of the Appalachian Plateau.
Vegetation: Examples of this system usually include a vegetational mosaic that includes hemlock bluffs, sandstone cliffs, or overhangs near the base of a cliff (often with a sandy area beneath the overhang which is shaded and protected from direct rainfall, as well as gladelike vegetation at the horizontal portion of the cliffs). The rockhouses in the southern parts of the range are habitats for rare vascular plant species such as *Minuartia cumberlandensis* and *Ageratina luciae-brauniae* and sometimes support populations of rare nonvascular plants as well.
Dynamics: Within rockhouses, there are three distinct habitats: ceiling, backwall, and floor. The dripline defines the outer edge of the ceiling and floor. The ceiling generally slopes back from the dripline to the backwall, which is deeply shaded and generally stays moist. Shading in the rockhouse is greater in the summer when deciduous trees in front of the rockhouse are leafed out. Light levels vary from very low at the backwall (Farrar 1998) to relatively high, especially in winter, when leaves are down (Walck et al. 1996). The combination of shade and the stable and moderate microclimate of rockhouses has maintained a habitat suitable for unusual, disjunct and endemic plants (Walck et al. 1996), including tropical ferns and bryophytes (Farrar 1998) which may have persisted in these habitats since pre-Pleistocene times when there was a tropical or subtropical climate (Farrar 1998). Temperatures inside rockhouses are higher in the winter and lower in the summer than outside the rockhouses, and while rockhouse habitats are protected from rain, they tend to have higher humidities than the surrounding areas (Walck et al. 1996).

Component Associations:
- *Asplenium montanum - Heuchera parviflora var. parviflora - Silene rotundifolia* Sparse Vegetation (CEGL004392, G3G4)
- *Heuchera parviflora var. parviflora - Trichomanes boschianum - Thalictrum mirabile - (Ageratina luciae-brauniae, Solidago albopilosa)* Herbaceous Vegetation (CEGL004301, G2)
- *Osmunda cinnamomea - Rhynchospora capitellata - Thalictrum mirabile* Cumberland Seepage Cliff Herbaceous Vegetation (CEGL008432, G1G2Q)
- *Pinus virginiana - Pinus (rigida, echinata) - (Quercus prinus) / Vaccinium pallidum* Forest (CEGL007119, G3)

- *Schizachyrium scoparium - Danthonia sericea - Liatris microcephala - (Eurybia surculosa)* Wooded Herbaceous Vegetation (CEGL004061, G3)

DISTRIBUTION

Range: This ecological system occurs in a limited area of the Cumberland Plateau of northern Alabama, northwestern Georgia, eastern Kentucky, eastern Tennessee, West Virginia, and possibly southwestern Virginia. Rockhouses also occur in southeastern Ohio (Rockhouse 349) and in western Pennsylvania (Walck et al. 1996) along Laurel and Chestnut Ridges of the Laurel Highlands in the Central Appalachian Plateau ecoregion (E. Zimmerman pers. comm. 2013).
Divisions: 202:C
Nations: US
Subnations: AL, GA, KY, OH, PA, TN, VA?, WV
Map Zones: 46:C, 47:C, 48:C, 53:C, 57:C, 62:?
TNC Ecoregions: 50:C

SOURCES

References: Comer et al. 2003, Evans 1991, Eyre 1980, Farrar 1998, Walck et al. 1996, Weakley pers. comm.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723185#references
Description Author: R. Evans, mod. M. Pyne, S.C. Gawler, C. Nordman
Version: 14 Jan 2014 **Stakeholders:** East, Midwest, Southeast
Concept Author: R. Evans **ClassifResp:** Southeast

EAST GULF COASTAL PLAIN DRY CHALK BLUFF (CES203.492)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Barren
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Cliff (Substrate)
National Mapping Codes: ESLF 3117

CONCEPT

Summary: The ecological system is endemic to the Black Belt region of Alabama and Mississippi. Examples are relatively sheer surfaces of exposed chalk. Some are generally devoid of vegetation. In most cases these bluffs extend directly to the edge of rivers or streams.

DESCRIPTION

Vegetation: More information is needed. See Gunn (1985) and Morris et al. (1993).

Component Associations:
- *Adiantum capillus-veneris* Cahaba River Bluff Herbaceous Vegetation (CEGL007796, G2G3)

DISTRIBUTION

Range: This system is endemic to the Black Belt region of Alabama and Mississippi.
Divisions: 203:C
Nations: US
Subnations: AL, MS
Map Zones: 46:C
USFS Ecomap Regions: 231B:CC
TNC Ecoregions: 43:C

SOURCES

References: Comer et al. 2003, Gunn 1985, Morris et al. 1993
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723094#references
Description Author: A. Schotz and R. Evans
Version: 17 Mar 2009
Concept Author: A. Schotz and R. Evans
Stakeholders: Southeast
ClassifResp: Southeast

EASTERN GREAT PLAINS QUARTZITE ROCKY OUTCROP (CES205.697)

CLASSIFIERS

Classification Status: Standard

Primary Division: Eastern Great Plains (205)
Land Cover Class: Barren
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
National Mapping Codes: ESLF 3194

CONCEPT

Summary: This system is found along outcrops of Sioux quartzite in Minnesota and South Dakota. It is found on rocky, level or hilly areas within the Northern Tallgrass Prairie (TNC Ecoregion 35) of Minnesota and South Dakota. It is characterized by a mosaic of rocky outcrops that are sparsely vegetated with scattered succulents and other vegetation such as *Opuntia fragilis, Opuntia macrorhiza, Escobaria vivipara (= Coryphantha vivipara),* and *Lomatium orientale*, as well as *Selaginella rupestris, Talinum parviflorum, Woodsia ilvensis,* and a variety of spring- and summer-blooming annuals. Soil development is minimal and restricted to patches.
Classification Comments: This system may not hold together as a system separate from a larger, surrounding system. These rocky outcrops were split from quartzite glades found in the Baraboo Hills region of Wisconsin (CES202.699). Distribution into Manitoba needs further review.

DESCRIPTION

Environment: Soil development is minimal. Most vegetation present grows in shallow, dry soil that collects in small depressions on sloping rock faces. The outcrops are composed primarily of Sioux quartzite, granite and gneiss. Extreme drought and great fluctuations in the temperature of the ground surface occur within this system (MNNHP 1993).
Vegetation: This system contains a sparse vegetation layer, with scattered succulents and many annuals, including *Opuntia fragilis, Opuntia macrorhiza, Escobaria vivipara (= Coryphantha vivipara),* and *Lomatium orientale*, as well as *Selaginella rupestris, Talinum parviflorum, Woodsia ilvensis,* and a variety of spring- and summer-blooming annuals (MNNHP 1993).
Dynamics: Fire appears to be important in maintaining this system . Trees and shrubs invade in the absence of fire. *Juniperus virginiana* is an invader throughout the range of this type, displacing the herbs, lichens, and mosses that characterize the system (MNNHP 1993).

Component Associations:
- Boreal Glaciere Talus Sparse Vegetation (CEGL005243, G2G3)
- Quartzite - Granite Rock Outcrop Sparse Vegetation (CEGL002298, G3?)

DISTRIBUTION

Range: This system is found in a very restricted area within Minnesota and South Dakota along outcrops of Sioux quartzite.
Divisions: 205:C
Nations: CA? , US
Subnations: MB?, MN, ND, SD
Map Zones: 39:C, 40:?
USFS Ecomap Regions: 251Ba:CCC
TNC Ecoregions: 35:C

SOURCES

References: Midwestern Ecology Working Group n.d., MNNHP 1993
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.800696#references
Description Author: S.E. Menard
Version: 11 Apr 2007 **Stakeholders:** Canada, Midwest
Concept Author: S.E. Menard **ClassifResp:** Midwest

EDWARDS PLATEAU CLIFF (CES303.653)

CLASSIFIERS

Classification Status: Standard

Primary Division: Western Great Plains (303)
Land Cover Class: Barren
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland; Wetland
Diagnostic Classifiers: Herbaceous; Moss/Lichen (Nonvascular); Sedimentary Rock; Limestone; Cliff (Landform)
National Mapping Codes: ESLF 3127

CONCEPT

Summary: This ecological system occurs on limestone cliff faces and lower slopes of boxed canyons of the Edwards Plateau. It usually occurs as narrow, sometimes long bands in areas where moisture is consistently more available than on adjacent slopes. Conspicuous components of this system in seepage areas include *Adiantum capillus-veneris* along the seep and *Thelypteris ovata var. lindheimeri* on nearby moist habitats. More xeric communities dominated by *Buddleja racemosa, Ungnadia speciosa, Diospyros texana, Ageratina havanensis, Garrya ovata ssp. lindheimeri, Bernardia myricifolia, Philadelphus* spp., *Styrax* spp., and *Toxicodendron radicans ssp. eximium* occur on exposures of the Edwards Plateau Formation (or geologically similar formations) of the southern Edwards Plateau. Geology is clearly the controlling process of this system, along with moisture associated with the crevices in the underlying limestone bedrock. One factor controlling the composition of communities of this system is the amount of overstory shading at the sites. Herbaceous species that may be present include *Salvia roemeriana, Penstemon baccharifolius, Schoenus nigricans, Chaetopappa bellidifolia, Perityle* spp., and ferns in the genera *Asplenium, Astrolepis, Cheilanthes*, and *Pellaea*. Sparse grasses, including *Bouteloua hirsuta, Bouteloua rigidiseta*, and *Aristida oligantha*, may be present. This system occurs throughout the Edwards Plateau and west Texas. In the Lampasas Cutplain, this system is sparsely vegetated, and in the eastern plateau and Balcones Canyonlands, it is locally dominated by *Buddleja racemosa, Philadelphus* spp., *Styrax*, and *Perityle* spp. It is dominated in the western plateau by *Perityle* spp., *Penstemon baccharifolius*, and *Heterotheca* spp. and is associated with rivers and streams. These cliffs often serve as refugia from herbivores.
Classification Comments: Further field investigation is needed to better develop the association-level information for this system.
Similar Ecological Systems:
- Edwards Plateau Mesic Canyon (CES303.038)
- North American Warm Desert Bedrock Cliff and Outcrop (CES302.745)

Related Concepts:
- Edwards Plateau: Barren or Grassy Cliff / Bluff (807) [CES303.654.0] (Elliott 2011) Finer
- Edwards Plateau: Wooded Cliff / Bluff (806) [CES303.654] (Elliott 2011) Finer

DESCRIPTION

Environment: This system occurs on steep, vertical or near-vertical hard-bedded limestone cliff faces, sometimes alternating with slope-forming limestone members. There is little to no soil development. Some soil accumulates on ledges and in crevices. Some of these sites may be mesic, accumulating moisture from nearby slopes in crevices within the limestone substrate, and seeps may be present. They often occur as long narrow bands. Composition and cover on these cliff faces is a function of aspect, canopy cover provided by surrounding systems, local climate, and moisture available from the underlying geologic formation (Elliott 2011).
Vegetation: Seeps and mesic sites occupied by this system may have fairly dense cover of *Adiantum capillus-veneris* with patches of *Thelypteris ovata var. lindheimeri* present. More xeric sites often have significant shrub cover, with species such as *Buddleja racemosa, Ungnadia speciosa, Diospyros texana, Ageratina havanensis, Garrya ovata ssp. lindheimeri, Bernardia myricifolia, Philadelphus* spp., *Styrax* spp., and *Toxicodendron radicans ssp. eximium*. Herbaceous species that may be present include *Salvia roemeriana, Penstemon baccharifolius, Schoenus nigricans, Chaetopappa bellidifolia, Perityle* spp., and ferns in the genera *Asplenium, Astrolepis, Cheilanthes*, and *Pellaea*. Sparse grasses, including *Bouteloua hirsuta, Bouteloua rigidiseta*, and *Aristida oligantha*, may be present. These cliffs often serve as refugia from herbivores (Elliott 2011).

Component Associations:
- *Adiantum capillus-veneris - (Thelypteris ovata var. lindheimeri, Thelypteris kunthii)* Herbaceous Vegetation (CEGL004514, G2)
- *Buddleja racemosa - Ungnadia speciosa / Aquilegia canadensis - Aristolochia serpentaria* Shrubland (CEGL004531, G2?)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Edwards Plateau Carbonate Glade and Barrens (CES303.655)
- Edwards Plateau Dry-Mesic Slope Forest and Woodland (CES303.656)
- Edwards Plateau Floodplain Terrace (CES303.651)
- Edwards Plateau Limestone Savanna and Woodland (CES303.660)
- Edwards Plateau Limestone Shrubland (CES303.041)
- Edwards Plateau Mesic Canyon (CES303.038)
- Edwards Plateau Riparian (CES303.652)

- Edwards Plateau Upland Depression (CES303.654)

DISTRIBUTION

Range: This system occurs throughout the Edwards Plateau and west Texas.
Divisions: 302:C; 303:C
Nations: US
Subnations: TX
Map Zones: 35:C
USFS Ecomap Regions: 255E:CC, 315D:CC, 321B:CC
TNC Ecoregions: 24:C, 29:C

SOURCES

References: Southeastern Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.791388#references
Description Author: J. Teague, mod. L. Elliott
Version: 24 Feb 2011 **Stakeholders:** Midwest, Southeast, West
Concept Author: L. Elliott and J. Teague **ClassifResp:** Southeast

FLORIDA PANHANDLE BEACH VEGETATION (CES203.266)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland; Wetland
Diagnostic Classifiers: East Gulf Coastal Plain; Beach (Substrate); Graminoid; Coast
National Mapping Codes: ESLF 3147

CONCEPT

Summary: The panhandle beach system ranges from northwestern Florida (Ochlockonee River) to southeastern Mississippi. It includes the outermost zone of coastal vegetation extending seaward from foredunes. Within the northern Gulf of Mexico, the natural boundaries of this system are fairly distinct; the western boundary is mineralogical and the eastern is defined by a region of sunken, flooded coast line where beaches are absent. In addition, these beaches are distinguished by high cover of *Uniola paniculata* and *Schizachyrium maritimum*, along with local endemic species of *Chrysoma* and *Paronychia* (Barbour et al. 1987).

Similar Ecological Systems:
- Southwest Florida Dune and Coastal Grassland (CES203.539)

Related Concepts:
- Beach Dune (FNAI 1990) Intersecting
- Unconsolidated Substrate (FNAI 1990) Intersecting

DESCRIPTION

Environment: The beach includes the sand intertidal shore and the low-gradient sand above the daily high tide line, which is between the foredune and the Gulf of Mexico. This area of upper beach is affected by wind and salt spray, seasonal high tides, and storm surge. These beaches are rich in pyroxene, epidote, and garnet (Barbour et al. 1987). Within the northern Gulf of Mexico, the sandy substrate of this system is uniquely rich in medium, nutritionally poor sands. Especially low concentrations of potassium may be of great importance to plant growth and species distributions (Barbour et al. 1987).

Dynamics: The natural coastal dynamics include the movement of sand from wind, tides, and storm surge. This includes transport of sand along the coast (primarily from east to west), and movement of sand by wind or water between the dunes, beach and subtidal areas, and the movement of sand from the foredunes to the interior. If not restricted by infrastructure or engineered hard structures, beaches and dunes can migrate as coastlines change over time in response to the action of wind and water. The Gulf of Mexico coast is affected by one tide per day. Wrack and seaweed deposited along the shore is an important source of nutrients for the coastal ecosystem, and helps promote revegetation in newly disturbed areas (Defeo et al. 2009).

Component Associations:
- *Cakile constricta* Sparse Vegetation (CEGL004398, G2G3)
- *Sesuvium portulacastrum - Atriplex* spp. - *Suaeda* spp. Sparse Vegetation (CEGL004406, G3)
- *Uniola paniculata - Panicum amarum var. amarulum - Iva imbricata* Herbaceous Vegetation (CEGL004041, G2)

DISTRIBUTION

Range: Ranges from northwestern Florida (Ochlockonee River) to southeastern Mississippi.
Divisions: 203:C
Nations: US
Subnations: AL, FL, MS
Map Zones: 55:C, 99:C
USFS Ecomap Regions: 232L:CC
TNC Ecoregions: 53:C

SOURCES

References: Barbour et al. 1987, Comer et al. 2003, Defeo et al. 2009, FNAI 1990, FNAI 2010a
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723220#references
Description Author: R. Evans
Version: 06 Feb 2014
Concept Author: R. Evans
Stakeholders: Southeast
ClassifResp: Southeast

GREAT LAKES ACIDIC ROCKY SHORE AND CLIFF (CES201.025)

CLASSIFIERS

Conf.: 1 - Strong
Classification Status: Standard
Primary Division: Laurentian-Acadian (201)
Land Cover Class: Barren
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Igneous Rock; Coast
Non-Diagnostic Classifiers: Lowland [Lowland]; Moss/Lichen (Nonvascular); Cliff (Substrate); Rock Outcrops/Barrens/Glades; Sedimentary Rock; Metamorphic Rock
National Mapping Codes: ESLF 3146

CONCEPT

Summary: This system is found in the Great Lakes region of the U.S. and Canada where exposed bedrock dominates the shoreline. The bedrock may consist of acidic igneous, metamorphic, or sedimentary rock. Some bedrock shorelines are solid rock, others more cobbly or fragmented. The bedrock may be relatively horizontal or tilted, rounded or blocky, and sometimes cliff-like. The leading edge of the shoreline may be heavily impacted by wave action and winter ice movement, decreasing in effect with distance inland. Vegetation varies from sparse nonvascular vegetation to open-treed or shrubby communities along the same transect.

Component Associations:
- *Corylus cornuta - Amelanchier* spp. - *Prunus virginiana* Rocky Shrubland (CEGL005197, GNR)
- Granite - Metamorphic Bedrock Great Lakes Shore Sparse Vegetation (CEGL005216, GNR)
- Granite - Metamorphic Great Lakes Shore Cliff Sparse Vegetation (CEGL005244, GNR)
- Igneous - Metamorphic Bedrock Inland Lake Shore Sparse Vegetation (CEGL002301, G4G5)
- Non-alkaline Cobble - Gravel Great Lakes Shore Sparse Vegetation (CEGL002508, G2G3)
- *Picea glauca - Abies balsamea* Basalt - Conglomerate Woodland (CEGL005214, GNR)
- Sandstone Bedrock Great Lakes Shore Sparse Vegetation (CEGL002507, G3G4)
- Sandstone Great Lakes Shore Cliff Sparse Vegetation (CEGL002503, G4G5)

DISTRIBUTION

Range: Found in the Great Lakes region of the U.S. and Canada, where exposed bedrock dominates the shoreline.
Divisions: 201:C
Nations: CA, US
Subnations: MI, MN, ON, WI
Map Zones: 41:C, 50:C, 51:C
USFS Ecomap Regions: 212Lb:CCC, 212Ra:CCP, 212Rd:CCP, 212Sb:CCC, 212Sc:CCC, 212Sn:CCC, 212Sq:CCC, 212Ya:CCC, 222Ud:CCC
TNC Ecoregions: 48:C

SOURCES

References: Albert et al. 1995, Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722680#references
Description Author: D. Albert
Version: 25 Mar 2003
Stakeholders: Canada, East, Midwest
Concept Author: D. Albert
ClassifResp: Midwest

GREAT LAKES ALKALINE ROCKY SHORE AND CLIFF (CES201.995)

CLASSIFIERS

Conf.: 1 - Strong
Classification Status: Standard
Primary Division: Laurentian-Acadian (201)
Land Cover Class: Barren
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
National Mapping Codes: ESLF 3115

CONCEPT

Summary: This system is found in the Great Lakes region of the U.S. and Canada where exposed bedrock dominates the shoreline. The bedrock may consist of alkaline igneous, metamorphic, or sedimentary rocks. Some bedrock shorelines are solid rock, others more cobbly or fragmented. The bedrock may be relatively horizontal or tilted, rounded or blocky, and sometimes cliff-like. The leading edge of the shoreline may be heavily impacted by wave action and winter ice movement, decreasing in effect with distance inland. Alkaline rocky shores are predominantly dolostone when associated with the Niagaran Escarpment along the northern Lake Michigan and Lake Huron shorelines, perhaps best developed on Drummond Island and adjacent Ontario islands. Vegetation in these type is closely related to sparsely vegetated Great Lakes alvars. Alkaline basalts characterize these systems along portions of the Lake Superior shoreline, with a generally distinguishable flora from those on dolostone. Overall, vegetation varies from sparse nonvascular vegetation to open-treed or shrubby communities along the same transect.

Related Concepts:
- Limestone Pavement Lakeshore (Kost et al. 2007) Equivalent

Component Associations:
- Basalt - Conglomerate Bedrock Great Lakes Shore Sparse Vegetation (CEGL005215, G4G5)
- Basalt - Diabase Cobble - Gravel Great Lakes Shore Sparse Vegetation (CEGL005250, G4G5)
- Basalt - Diabase Great Lakes Shore Cliff Sparse Vegetation (CEGL005191, GNR)
- *Calamagrostis canadensis - Carex viridula - Cladium mariscoides - Lobelia kalmii* Herbaceous Vegetation (CEGL005115, G1G2)
- *Dasiphora fruticosa ssp. floribunda - Myrica gale* Rich Shore Fen Shrubland (CEGL005275, G1G2)
- *Dasiphora fruticosa ssp. floribunda / Clinopodium arkansanum - Argentina anserina - Primula mistassinica* Sparse Vegetation (CEGL002506, G3)
- Limestone - Dolostone Great Lakes Shore Cliff Sparse Vegetation (CEGL002504, G4G5)
- Limestone Cobble - Gravel Great Lakes Shore Sparse Vegetation (CEGL005169, G2G3)
- *Picea glauca - Abies balsamea* Basalt - Conglomerate Woodland (CEGL005214, GNR)

DISTRIBUTION

Range: Found in the Great Lakes region of the U.S. and Canada, where exposed bedrock dominates the shoreline.
Divisions: 201:C
Nations: CA, US
Subnations: MI, MN, ON, VT, WI
Map Zones: 41:C, 50:C, 51:C
USFS Ecomap Regions: 212Ha:CCP, 212Hf:CCC, 212Hl:CCC, 212Lb:CCC, 212Ra:CC?, 212Rc:CCC, 212Rd:CC?, 212Re:CCC, 212Sb:CCC, 212Sc:CC?, 212Sn:CCC, 212Te:CCC, 212Tf:CCC, 212Ya:C??
TNC Ecoregions: 48:C

SOURCES

References: Albert et al. 1995, Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722710#references
Description Author: D. Albert
Version: 24 Mar 2003
Stakeholders: Canada, East, Midwest
Concept Author: D. Albert
ClassifResp: Midwest

GREAT LAKES DUNE (CES201.026)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Laurentian-Acadian (201)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Non-Diagnostic Classifiers: Dune field; Foredune; Lowland [Lowland]; Interdune flat; Longshore bar; Herbaceous; Beach (Landform); Blowout
National Mapping Codes: ESLF 3137

CONCEPT

Summary: This system occurs along the Great Lakes shores region of the United States and Canada. Component plant communities vary from sparsely vegetated, active dunes to communities dominated by grasses, shrubs, and trees, depending on the degree of sand deposition, sand erosion, and distance from the lake. Many open dunes on Lake Michigan are considered "perched dunes" in that sands were deposited on top of glacial moraine located along the coast. In some instances, dunefields sit several hundred feet above current lake levels. Depositional areas, where Great Lakes beachgrass foredunes are found, are dominated by *Ammophila breviligulata* (or in the eastern part of the range *Ammophila champlainensis*); erosional areas, such as slacks in blowouts and dunefields, by *Calamovilfa longifolia*; and stabilized areas by *Schizachyrium scoparium*. In dunefields and on the most stable dune ridges, especially around northern Lake Michigan and Lake Huron, low evergreen shrubs (*Arctostaphylos uva-ursi, Juniperus communis, Juniperus horizontalis*) occupy dune crests and also the ground layer in the savanna edge of dunes; elsewhere, deciduous shrubs are dominant, including *Prunus pumila, Salix cordata*, and *Salix myricoides (= Salix glaucophylloides)*. Backdunes tend to succeed to forests and savanna indistinguishable from corresponding types found on sandy substrates further inland.
Classification Comments: The system, as described, includes the open grassland, shrubland, and woodland parts of the dune. The lee side of the dunes often contains forests on deep, moist to dry sands that resemble other forested systems. Such forests may include hemlock-hardwood and red oak forests.
Similar Ecological Systems:
- Great Lakes Sand Beach (CES201.149)
- Great Lakes Wooded Dune and Swale (CES201.726)

Related Concepts:
- Jack Pine: 1 (Eyre 1980) Finer

Component Associations:
- *Ammophila breviligulata - (Schizachyrium scoparium)* Herbaceous Vegetation (CEGL005098, G3G5)
- *Cakile edentula* Great Lakes Shore Sparse Vegetation (CEGL005162, G3?)
- *Cakile edentula var. lacustris - Argentina anserina* Sparse Vegetation (CEGL006235, GNR)
- *Juniperus horizontalis - Arctostaphylos uva-ursi - Juniperus communis* Dune Dwarf-shrubland (CEGL005064, G3G4)
- *Pinus banksiana - Pinus resinosa - Pinus strobus* Dune Forest (CEGL002589, G3Q)
- *Populus deltoides - (Juniperus virginiana)* Dune Woodland (CEGL005119, G1G2)
- *Prunus pumila - (Ptelea trifoliata)* Dune Shrubland (CEGL005075, G2Q)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Great Lakes Sand Beach (CES201.149)

DISTRIBUTION

Range: This system occurs along the Great Lakes shores of the United States and Canada on stabilized foredunes, ranging from Wisconsin to Ontario and New York in the Great Lakes, and in isolated occurrences along the shores of Lake Champlain, Vermont.
Divisions: 201:C; 202:C
Nations: CA, US
Subnations: IL, IN, MI, MN, NY, OH, ON, VT, WI
Map Zones: 41:C, 49:C, 50:C, 51:C, 52:C, 62:C, 63:C, 64:C, 65:C, 66:C
USFS Ecomap Regions: 211E:CC, 212Ha:CCC, 212Hf:CCC, 212Hl:CCC, 212Ra:CCC, 212Rd:CCC, 212Re:CCC, 212Sb:CCC, 212Sn:CCC, 212Te:CCC, 212Ya:CCC, 222Ja:CCC
TNC Ecoregions: 48:C, 64:C

SOURCES

References: Albert 1995b, Chapman et al. 1989, Comer et al. 1995a, Comer et al. 1998, Comer et al. 2003, Dorr and Eschman 1970, Dorroh 1971
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722679#references
Description Author: D. Faber-Langendoen

Version: 25 Mar 2003
Concept Author: D. Faber-Langendoen

Stakeholders: Canada, East, Midwest
ClassifResp: Midwest

GREAT LAKES SAND BEACH (CES201.149)

CLASSIFIERS

Classification Status: Standard

Primary Division: Laurentian-Acadian (201)
Land Cover Class: Barren
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
National Mapping Codes: ESLF 3210

CONCEPT

Summary: This ecological system is found along the shores of the Great Lakes, particularly along Lake Michigan. It is found on sandy substrates with little or no soil development within a few meters elevation of the water. The sandy substrate is not stabilized by significant vegetation and is easily moved. Stands of this system are subject to frequent disturbance by wind, waves, and ice-scour. Stands are typically narrow and linear but may extend for miles along the lakeshore. Vegetation is absent to sparse; that which is present is short and dominated by herbaceous species. *Ammophila breviligulata* and *Cakile edentula* are among the most common species. *Chamaesyce polygonifolia, Juncus balticus, Lathyrus japonicus*, and *Argentina anserina (= Potentilla anserina)* can be found, as well.
Classification Comments: There may be small dunes within this system, but areas where dunes are more extensive should be placed within Great Lakes Dune (CES201.026) or Great Lakes Wooded Dune and Swale (CES201.726). Cobble beaches are not included in this system but are in Great Lakes Acidic Rocky Shore and Cliff (CES201.025) or Great Lakes Alkaline Rocky Shore and Cliff (CES201.095), as appropriate.
Similar Ecological Systems:
- Great Lakes Dune (CES201.026)
- Great Lakes Wooded Dune and Swale (CES201.726)

DESCRIPTION

Environment: This system is found on sandy substrates with little or no soil development within a few meters elevation of the water. It rarely extends more than 30-50 m from the water. The sandy substrate is not stabilized by significant vegetation and is easily moved. Stands are subject to frequent disturbance by wind, waves, and ice-scour.
Vegetation: Vegetation is absent to sparse; that which is present is short and dominated by herbaceous species. *Ammophila breviligulata* and *Cakile edentula* are common. *Chamaesyce polygonifolia, Juncus balticus, Lathyrus japonicus*, and *Argentina anserina (= Potentilla anserina)* can be found, as well.
Dynamics: Stands are subject to frequent disturbance by wind, waves (with storm surges), and ice-scour. This leads to erosion or deposition of the sandy substrate by wind or water. The disturbances keep the beaches nearly free of vegetation.

Component Associations:
- *Ammophila breviligulata - (Schizachyrium scoparium)* Herbaceous Vegetation (CEGL005098, G3G5)
- *Cakile edentula* Great Lakes Shore Sparse Vegetation (CEGL005162, G3?)
- *Cakile edentula var. lacustris - Argentina anserina* Sparse Vegetation (CEGL006235, GNR)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Great Lakes Dune (CES201.026)
- Great Lakes Wooded Dune and Swale (CES201.726)
- Northern Great Lakes Interdunal Wetland (CES201.034)

Adjacent Ecological System Comments: Many beaches are not associated with dunes and are adjacent to a wide variety of uplands, typically forests.

DISTRIBUTION

Range: This system is found along the margins of the Great Lakes. It is most common along Lake Michigan but is also found on the south shore of Lake Superior and in places on Lake Huron, Lake Erie, and Lake Ontario.
Divisions: 201:C; 202:C
Nations: CA, US
Subnations: IN, MI, NY?, OH?, ON, PA?, WI
Map Zones: 41:C, 51:C, 59:P, 62:?
USFS Ecomap Regions: 212Ha:CCC, 212Hf:CCC, 212Hl:CCP, 212Ra:CCP, 212Rc:CCP, 212Ya:CCC, 212Zc:CPP, 222Ia:C??, 222Ja:CCC, 222Kg:CCC, 222Ua:CCP, 222Uc:CCP, 222Ud:CCP, 222Ue:CCP
TNC Ecoregions: 48:C

SOURCES

References: Midwestern Ecology Working Group n.d.
Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.884732#references
Description Author: J. Drake
Version: 19 Dec 2012 **Stakeholders:** Canada, East, Midwest
Concept Author: J. Drake **ClassifResp:** Midwest

GULF COAST CHENIER PLAIN BEACH (CES203.544)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Barren
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland; Wetland
National Mapping Codes: ESLF 3125

CONCEPT

Summary: This ecological system includes sparsely vegetated ocean beaches along the Gulf of Mexico from the mainland shores of the Chenier Plain of Louisiana and Texas north of Boliver peninsula. These beaches are generally eroding and narrow, and constitute the outermost zone of coastal vegetation in this area. Although these habitats are situated just above the mean high tide limit, they are constantly impacted by waves and flooded by storm surges. Dynamic disturbance regimes largely limit the vegetation to pioneering, salt-tolerant, succulent annuals or perennial vines (e.g. *Ipomoea* spp.). These beaches are generally unstable and highly impacted by attempts to limit the natural erosional processes. Sediment is carried by westerly-moving longshore currents from Louisiana to Texas, and these beaches have all been impacted by the reduction of sediment related to the altered deltaic processes of the Mississippi River.
Classification Comments: This system is distinguished more by the ecological processes that helped develop and maintain it than by its floristics. Based on floristics, it might warrant merger with other beaches of the northern Gulf of Mexico.
Related Concepts:
- Chenier: Beach (6000) [CES203.544] (Elliott 2011) Equivalent

DESCRIPTION

Environment: This ecological system includes the typically sparsely vegetated, sandy, back beach area of the mainland as it transitions into more stabilized communities. Examples are found on recent deposits of sand resulting from ongoing coastal sediment transport, as well as clays remaining on the Gulf margin after longshore transport of sand off of the sites. Sites are gently sloping towards the Gulf, with some development of foreshore dunes. This system occurs in the Chenier Plain region of Louisiana and Texas. Beaches along this part of the coast currently tend to be eroding and narrow, though historically these beaches were part of a system of alternating prograding barrier ridges and eroding tidal flats (Owen 2008). Soils are clays and sands. It is found on the narrow margin of mostly unvegetated sands receiving frequent inundation, erosion, or sediment deposition from eolian processes. The topography is low, and the substrate is dynamic, leading to reduced vegetation development. It is impacted by salt spray, tidal inundation, storm surge, and wind.
Vegetation: Dynamic disturbance regimes largely limit the vegetation to pioneering, salt-tolerant, succulent annuals or perennial vines (e.g., *Ipomoea* spp.). Other species that may be present include *Cakile geniculata, Spartina patens, Distichlis spicata, Panicum amarum*, and *Hydrocotyle bonariensis*. Other species that may be encountered include *Sesuvium* spp., *Ipomoea pes-caprae*, and *Ipomoea imperati*.
Dynamics: These beaches are generally eroding and narrow, and they are constantly impacted by waves and may be flooded by storm surges. They are generally unstable and highly impacted by attempts to limit the natural erosional processes. Sediment is carried by westerly-moving longshore currents from Louisiana to Texas, and these beaches have all been impacted by the reduction of sediment related to the altered deltaic processes of the Mississippi River. Historically, the Chenier Plain coast was place where headland ridges were either prograding or eroding based the proximity of sediment deposited by the Mississippi River as it meandered across its delta. Today, since new sediments are limited because of the control of the Mississippi River, existing headlands that comprise this ecological system are eroding (Morton et al. 2004).

Component Associations:
- *Ipomoea pes-caprae - Ipomoea imperati - (Cakile geniculata)* Herbaceous Vegetation (CEGL004402, G3?)
- *Spartina patens - Panicum amarum - Hydrocotyle bonariensis* Herbaceous Vegetation (CEGL004971, G2?)

DISTRIBUTION

Range: This system ranges from the mainland shores of the Chenier Plain of Louisiana and Texas.
Divisions: 203:C
Nations: US
Subnations: LA, TX
Map Zones: 37:C
USFS Ecomap Regions: 232E:CC
TNC Ecoregions: 31:C

SOURCES

References: Comer et al. 2003, Defeo et al. 2009, Elliott 2011, Morton et al. 2004, Owen 2008
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723058#references
Description Author: J. Teague, mod. M. Pyne and L. Elliott

Version: 14 Jan 2014
Concept Author: J. Teague

Stakeholders: Southeast
ClassifResp: Southeast

HAWAI'I ALPINE BEDROCK AND SCREE (CES412.400)

CLASSIFIERS

Conf.: 3 - Weak **Classification Status:** Standard
Primary Division: Northern Polynesia (412)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Alpine/AltiAndino [Alpine/AltiAndino]; Mountain(s); Lava; Cinder; Tropical/Subtropical [Tropical Xeric]
Non-Diagnostic Classifiers: Long (>500 yrs) Persistence; Ridge/Summit/Upper Slope; Basalt
FGDC Crosswalk: Vegetated, No dominant lifeform, Sparsely vegetated, Boulder, gravel, cobble, or talus
National Mapping Codes: EVT 2829; ESLF 3207; ESP 1829

CONCEPT

Summary: This barren to sparsely vegetated ecological system occurs on alpine slopes of higher mountains of Maui and Hawai'i at 3000-4590 m (9835-14,000 feet) elevation. Sites are generally very dry and cold. Precipitation occurs infrequently during the winter months of October-March. Snow is typically present on summits during winter months and can occur down to 3000 m. Snow can remain year-round on higher-elevation northerly slopes. Nightly frosts are common and can occur down to 3000 m. Sites are wind-exposed with high solar radiation. Substrates include cinder, volcanic ash, and basaltic lava, but can include glacial moraine. Ground surface is mostly gravel and barren rock. Vegetation, if present is sparse and may include scattered grasses (e.g., *Agrostis sandwicensis*, *Trisetum glomeratum*), ferns (e.g., *Pellaea ternifolia*, *Asplenium adiantum-nigrum*, *Asplenium trichomanes*), lichens (e.g., *Lecanora melaena*), and mosses (e.g., *Grimmia* spp., *Racomitrium* spp.).

Similar Ecological Systems:
- Hawai'i Alpine Dwarf-Shrubland (CES412.401)
- Hawai'i Dry-Site Lava Flow (CES412.416)

Related Concepts:
- Hawaiian Alpine Aeolian Desert (Gon 1999) Equivalent

DESCRIPTION

Environment: This alpine ecological system is restricted to the arid zone (Zone 1) of the 7 Moisture Zones developed for the Hawaiian Islands by Price et al. (2007). This barren to sparsely vegetated system occurs on alpine slopes of higher mountains of Maui and Hawai'i at 3000-4590 m (9835-14,000 feet) elevation. Sites are generally very dry and cold. Precipitation occurs infrequently during the winter months of October-March. Snow is typically present on summits during winter months and can occur down to 3000 m (Gagne and Cuddihy 1990). Snow can remain year-round on higher elevation northerly slopes. Nightly frosts are common and can occur down to 3000 m. Sites are wind exposed with high solar radiation. Substrates include cinder, volcanic ash, and basaltic lava, but can include glacial moraine. Ground surface is mostly gravel and barren rock.

Vegetation: Vegetation, if present is sparse and may include scattered grasses (e.g., *Agrostis sandwicensis, Trisetum glomeratum*), ferns (e.g., *Pellaea ternifolia, Asplenium adiantum-nigrum, Asplenium trichomanes*), lichens (e.g., *Lecanora melaena*), and mosses (e.g., *Grimmia* spp., *Racomitrium* spp.) (Mueller-Dombois and Fosberg 1998).

Dynamics: Annual precipitation is low as this system occurs above the inversion layer of warmer air that frequently forms below 3000 m and dramatically reduces precipitation at higher elevations (Gagne and Cuddihy 1990). The inversion layer largely prevents moisture from the wet trade winds from reaching the alpine zone.

Component Associations:
- Hawaiian Alpine Eolian Desert Sparse Vegetation (CEGL008106, G1)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Hawai'i Montane-Subalpine Dry Forest and Woodland (CES412.402)

Adjacent Ecological System Comments: This ecological system may co-occur with the alpine dwarf-shrubland ecological system with this system occurring on less exposed, less xeric sites. The dry-site lava flow ecological system is similar, but occurs at lower elevations.

DISTRIBUTION

Range: This ecological system occurs on alpine slopes of Mauna Loa and Mauna Kea on Hawai'i and Haleakala of Maui above 3000 m (9835 feet) elevation.
Divisions: 412:C
Nations: US
Subnations: HI
Map Zones: 79:C
USFS Ecomap Regions: M423:C
TNC Ecoregions: 65:C

SOURCES

References: Gagne and Cuddihy 1990, Gon 1999, Mueller-Dombois and Fosberg 1998, Price et al. 2007, Wagner et al. 1999, Western Ecology Working Group n.d.

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.821092#references

Description Author: K.A. Schulz

Version: 02 Feb 2009 **Stakeholders:** West

Concept Author: K.A. Schulz **ClassifResp:** West

HAWAI'I DRY-SITE LAVA FLOW (CES412.416)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Northern Polynesia (412)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Lava; Tropical/Subtropical [Tropical Xeric]
Non-Diagnostic Classifiers: Alpine/AltiAndino; Montane; Lowland; Basalt
FGDC Crosswalk: Vegetated, No dominant lifeform, Sparsely vegetated, Boulder, gravel, cobble, or talus
National Mapping Codes: EVT 2831; ESLF 3208; ESP 1831

CONCEPT

Summary: This ecological system is restricted to areas of geologically recent volcanic activity on drier portions of the islands of Hawai'i and Maui, from sea level to the summit of Mauna Loa, especially in the saddle region on the Big Island and higher elevations and leeward areas of Maui. Precipitation is typically <500 mm. The dry climate and slow soil development significantly retard the rate of primary succession on these sites, which remain barren or sparsely vegetated for at least 75-100 years. The initial plants to colonize include the lichen *Stereocaulon vulcani* and ferns such as *Pellaea ternifolia, Asplenium* spp., and *Psilotum nudum*. Next the tree *Metrosideros polymorpha* and shrubs such as *Dodonaea viscosa* and *Styphelia tameiameiae* establish in cracks on pÃ¢hoehoe or more sheltered microsites on 'a'Ã¢. Later, scattered *Agrostis sandwicensis, Coprosma montana, Myoporum sandwicense, Myrsine lanaiensis, Portulaca sclerocarpa, Tetramolopium humile, Vaccinium reticulatum, Verbena litoralis*, or *Wahlenbergia marginata (= Wahlenbergia gracilis)* may become established. PÃ¢hoehoe appears to support vegetation more rapidly than 'a'Ã¢. Exotic perennial bunchgrass *Pennisetum setaceum* is invading these sites and changing natural primary succession patterns.
Classification Comments: This system does not include wet lowland lava flows that succeed to other vegetation in less than 75-100 years.
Similar Ecological Systems:
- Hawai'i Alpine Bedrock and Scree (CES412.400)

Related Concepts:
- Barren Lava (Shaw and Castillo 1997) Equivalent

DESCRIPTION

Environment: This lowland to subalpine dry lava ecological system occurs within the arid, very dry, and moderately dry zones (Zones 1, 2 and 3) of the 7 Moisture Zones developed for the Hawaiian Islands by Price et al. (2007). This ecological system is restricted to areas of geologically recent volcanic activity on drier portions of the on the islands of Hawai'i and Maui from sea level to the summit of Mauna Loa, especially in the saddle region on the Big Island and higher elevation and leeward area of Maui. Precipitation is typically <500 mm. The dry climate and slow soil development significantly retard the rate of primary succession on these sites, which remain barren or sparsely vegetated for at least 75-100 years.
Vegetation: Vegetation of this ecological systems is characterized by the early stages of primary succession on barren lava. The initial plants to colonize include the lichen *Stereocaulon vulcani* and ferns such as *Pellaea ternifolia, Asplenium* spp., and *Psilotum nudum*. Next the tree *Metrosideros polymorpha* and shrubs such as *Dodonaea viscosa* and *Styphelia tameiameiae* establish in cracks on pÃ¢hoehoe or more sheltered microsites on 'a'Ã¢ (Shaw and Castillo 1997). Later, scattered *Agrostis sandwicensis, Coprosma montana, Myoporum sandwicense, Myrsine lanaiensis, Portulaca sclerocarpa, Tetramolopium humile, Vaccinium reticulatum, Verbena litoralis*, or *Wahlenbergia marginata (= Wahlenbergia gracilis)* may become established. PÃ¢hoehoe appears to support vegetation more rapidly than 'a'Ã¢. Exotic perennial bunchgrass *Pennisetum setaceum* is invading these sites and changing natural primary succession patterns.

DISTRIBUTION

Range: This ecological system is restricted to areas of geologically recent volcanic activity on drier portions of the islands of Hawai'i and Maui from sea level to the summits of larger mountains.
Divisions: 412:C
Nations: US
Subnations: HI
Map Zones: 79:C
USFS Ecomap Regions: M423:C
TNC Ecoregions: 65:C

SOURCES

References: Gagne and Cuddihy 1990, Loope 1998, Mueller-Dombois and Fosberg 1998, Price et al. 2007, Shaw and Castillo 1997, Wagner et al. 1999, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.821164#references

Description Author: K.A. Schulz
Version: 03 Feb 2009
Concept Author: K.A. Schulz

Stakeholders: West
ClassifResp: West

INTER-MOUNTAIN BASINS ACTIVE AND STABILIZED DUNE (CES304.775)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Dune (Landform); Dune field; Dune (Substrate); Temperate [Temperate Continental]; Sand Soil Texture; Aridic; W-Landscape/High Intensity
Non-Diagnostic Classifiers: Dune (undifferentiated); Lowland [Lowland]; Shrubland (Shrub-dominated); Woody-Herbaceous
National Mapping Codes: ESLF 3160

CONCEPT

Summary: This ecological system occurs in the Intermountain western U.S. on basins, valleys and plains. Often it is composed of a mosaic of migrating, bare dunes; anchored dunes with sparse to moderately dense vegetation (<10-30% canopy cover); and stabilized dunes. The system is defined by the presence of migrating dunes or, where the dunes are entirely anchored or stabilized, evidence that the substrate is eolian and not residual, that the vegetation is early- or mid-seral, and that the substrate is likely to become actively migrating again with disturbance or increased aridity. In the Colorado Plateau, there are many small active and partially vegetated dunes along some of the larger washes and playas (where sand is blown out of wash and forms dunes) and some larger dunes such as Coral Pink Dunes in southwestern Utah. Substrates are usually eolian sand, but small dunes composed of silt and clay downwind from playas in the Wyoming Basins (which usually support greasewood vegetation) also are included here. Species occupying these environments are often adapted to shifting, coarse-textured substrates (usually quartz sand) and form patchy or open grasslands, shrublands or steppe, and occasionally woodlands. Vegetation varies and may be composed of *Achnatherum hymenoides, Artemisia filifolia, Artemisia tridentata ssp. tridentata, Atriplex canescens, Ephedra* spp., *Chrysothamnus viscidiflorus, Coleogyne ramosissima, Ericameria nauseosa, Hesperostipa comata, Leymus flavescens, Muhlenbergia pungens, Psoralidium lanceolatum, Purshia tridentata, Redfieldia flexuosa, Sporobolus airoides, Sarcobatus vermiculatus, Tetradymia tetrameres*, or *Tiquilia* spp. Herbaceous species such as *Achnatherum hymenoides, Redfieldia flexuosa*, and *Psoralidium lanceolatum* are characteristic of early-seral vegetation through much of this system's range. Shrubs are commonly dominant on mid- to late-seral stands, and *Ericameria nauseosa* can be found at any stage.
Classification Comments: Rules should be devised for deciding whether shrub or shrub-steppe vegetation on completely stabilized dunes should be considered part of this active and stabilized dune system, or part of another system. The areas include Inter-Mountain Basins Mixed Salt Desert Scrub (CES304.784), Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777), and Inter-Mountain Basins Big Sagebrush Steppe (CES304.778) on sand, and Inter-Mountain Basins Greasewood Flat (CES304.780) on clay and silt.
Similar Ecological Systems:
- Inter-Mountain Basins Mixed Salt Desert Scrub (CES304.784)--some areas appear to be small stabilized dune fields or isolated dunes.
- Southern Colorado Plateau Sand Shrubland (CES304.793)

DESCRIPTION

Vegetation: Vegetation is absent or sparse on active dunes, but canopy cover may be as much as 30% on stable dunes and sandsheets. Species are often adapted to shifting, coarse-textured substrates (usually quartz sand) and form patchy or open grasslands, shrublands or steppe, and occasionally woodlands. Characteristic taxa include *Achnatherum hymenoides, Artemisia filifolia, Artemisia tridentata ssp. tridentata, Atriplex canescens, Ephedra* spp., *Chrysothamnus viscidiflorus, Coleogyne ramosissima, Ericameria nauseosa, Hesperostipa comata, Leymus flavescens, Muhlenbergia pungens, Psoralidium lanceolatum, Purshia tridentata, Redfieldia flexuosa, Sporobolus airoides, Sarcobatus vermiculatus, Tetradymia tetrameres*, or *Tiquilia* spp. Herbaceous species such as *Achnatherum hymenoides, Redfieldia flexuosa*, and *Psoralidium lanceolatum* are characteristic of early-seral vegetation throughout much of this system's range. In the Centennial Valley of southwestern Montana, where the dunes are more stable, *Artemisia tridentata ssp. tridentata* and *Artemisia tripartita ssp. tripartita* contribute a moderate amount of cover and are associated with *Hesperostipa comata* or *Festuca idahoensis* (in more mesic settings). Early- and mid-seral shrub communities in these dunes are dominated by *Ericameria nauseosa, Chrysothamnus viscidiflorus, Purshia tridentata*, and *Hesperostipa comata*. Several rare plant species occur in the Centennial Valley dunes and are associated with early-successional stages. These dunes are very similar to the St. Anthony dunes in Idaho. In the Killpecker Dunes in west-central Wyoming, *Artemisia tridentata ssp. tridentata* dominates late-seral vegetation and *Ericameria nauseosa* dominates mid-seral vegetation (Jones 2005). The Great Sand Dunes in southern Colorado consist of an active dunefield surrounded by a stabilized sandsheet dominated *Ericameria nauseosa, Sarcobatus vermiculatus*, or *Pinus ponderosa* (on a sand ramp). The stabilized areas are periodically disturbed by parabolic dunes tracking across them from blowouts caused by fire or drought (Marin et al. 2005).
Dynamics: Periodic drought influences dune migration rates by reducing vegetation cover that anchors dunes (Marin 2005, Forman et al. 2006). A typical primary successional sere on sands appears to be as follows: bare sand or sparse herbaceous vegetation on migrating sand, denser herbaceous vegetation or shrub stands of *Ericameria nauseosa* or *Ericameria nauseosa (= Chrysothamnus nauseosus)* on anchored or recently stabilized sand, and shrub vegetation of *Artemisia tridentata* on longer-stabilized sands.

Component Associations:
- *Achnatherum hymenoides - Psoralidium lanceolatum* Herbaceous Vegetation (CEGL001650, G3Q)
- *Achnatherum hymenoides - Sporobolus contractus* Herbaceous Vegetation (CEGL001652, G2G4)
- *Artemisia filifolia - Ephedra (torreyana, viridis)* Shrubland (CEGL002786, GNR)
- *Artemisia filifolia* Colorado Plateau Shrubland (CEGL002697, GNR)
- *Atriplex canescens - Ephedra viridis* Shrubland (CEGL003828, GNR)
- *Elymus lanceolatus - Phacelia hastata* Herbaceous Vegetation (CEGL001745, G2)
- *Ephedra torreyana - Achnatherum hymenoides* Hummock Shrubland (CEGL005802, GNR)
- *Ephedra torreyana / Achnatherum hymenoides - Pleuraphis jamesii* Shrubland (CEGL002352, GNR)
- *Ephedra viridis / (Achnatherum hymenoides, Hesperostipa comata)* Shrubland (CEGL002354, GNR)
- *Ephedra viridis / Pleuraphis jamesii* Shrubland (CEGL002356, GNR)
- *Ericameria nauseosa / Leymus flavescens / Psoralidium lanceolatum* Shrubland (CEGL001329, G1?)
- *Ericameria nauseosa* Sand Deposit Sparse Shrubland (CEGL002980, GNR)
- *Eriogonum leptocladon* Sparse Vegetation (CEGL002822, GNR)
- *Leymus flavescens* Herbaceous Vegetation (CEGL001563, G2)
- *Muhlenbergia pungens* Herbaceous Vegetation (CEGL002363, GNR)
- *Pinus ponderosa / (Ericameria nauseosa) / Achnatherum hymenoides* Woodland (CEGL001490, G1)
- *Pinus ponderosa / Artemisia tridentata ssp. wyomingensis / Hesperostipa comata* Woodland (CEGL000179, G1)
- *Poliomintha incana - Artemisia filifolia - Vanclevea stylosa* Shrubland (CEGL002418, GNR)
- *Populus angustifolia* Sand Dune Forest (CEGL002643, G1)
- *Psorothamnus polydenius var. polydenius / Achnatherum hymenoides* Shrubland (CEGL001353, G3G4)
- *Purshia tridentata - Artemisia tridentata ssp. tridentata* Shrubland (CEGL001054, G1)
- *Purshia tridentata - Ericameria nauseosa* Shrubland (CEGL001056, G1)
- *Purshia tridentata / Achnatherum hymenoides* Shrubland (CEGL001058, G1)
- *Purshia tridentata / Prunus virginiana* Shrubland (CEGL001060, G1?)
- *Quercus havardii var. tuckeri* Shrubland (CEGL002486, GNR)
- Redbeds (Siltstone, Sandstone, Gypsum) Sparse Vegetation (CEGL005261, GNR)
- *Redfieldia flexuosa - (Psoralidium lanceolatum)* Herbaceous Vegetation (CEGL002917, G1?)
- *Sarcobatus vermiculatus* Dune Shrubland (CEGL001364, G5?)
- *Tetradymia tetrameres* Dune Sparse Vegetation (CEGL002759, G3Q)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Inter-Mountain Basins Interdunal Swale Wetland (CES304.059)

DISTRIBUTION

Range: This system occurs in intermountain basins of the western U.S. including southwestern Montana in the Centennial Valley.
Divisions: 304:C; 306:C
Nations: US
Subnations: AZ, CO, ID, MT, NM, NV, OR, UT, WA, WY
Map Zones: 7:P, 8:P, 9:C, 12:P, 13:?, 15:?, 16:C, 17:C, 18:C, 19:C, 20:?, 21:C, 22:C, 23:C, 24:C, 25:C, 27:?, 28:C, 29:?, 33:P
USFS Ecomap Regions: 313A:CC, 313B:CC, 313D:CC, 315H:CC, 321A:PP, 322A:??, 331F:CC, 331G:CC, 331J:CC, 341A:CC, 341B:CC, 341D:C?, 341E:CC, 341F:CC, 342B:CC, 342C:CC, 342D:CC, 342F:CC, 342G:CC, 342H:CC, M242C:??, M261G:PP, M313A:CP, M313B:CC, M331A:CC, M331F:CC, M331G:CC, M331H:C?, M331I:CC, M332E:CC, M332G:CC, M341D:??
TNC Ecoregions: 6:C, 8:C, 10:C, 11:C, 19:C

SOURCES

References: Anderson 1999a, Bowers 1982, Caicco and Wellner 1983e, Chadwick and Dalke 1965, Comer et al. 2003, Forman et al. 2006, Fryberger et al. 1990, Hallock et al. 2007, Jones 2006, Knight 1994, Marin et al. 2005, Pineada et al. 1999
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722897#references
Description Author: K.A. Schulz, mod. M.S. Reid and G.P. Jones
Version: 01 Oct 2007 **Stakeholders:** West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

INTER-MOUNTAIN BASINS CLIFF AND CANYON (CES304.779)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Rock Outcrops/Barrens/Glades; Cliff (Landform)
Non-Diagnostic Classifiers: Montane [Upper Montane]; Montane [Montane]; Montane [Lower Montane]; Lowland [Foothill]; Lowland [Lowland]; Rockfall avalanche; Ridge/Summit/Upper Slope; Sideslope; Toeslope/Valley Bottom; Sedimentary Rock; Metamorphic Rock; Igneous Rock; Temperate [Temperate Continental]; Very Shallow Soil; Canyon
National Mapping Codes: ESLF 3173

CONCEPT

Summary: This ecological system ranges from Wyoming and Utah west to the Pacific states. It is found from foothill to subalpine elevations and includes barren and sparsely vegetated landscapes (generally <10% plant cover) of steep cliff faces, narrow canyons, and smaller rock outcrops of various igneous, sedimentary, and metamorphic bedrock types. Also included is vegetation of unstable scree and talus slopes that typically occurs below cliff faces. Widely scattered trees and shrubs may include *Abies concolor, Pinus edulis, Pinus flexilis, Pinus monophylla, Juniperus* spp., *Artemisia tridentata, Purshia tridentata, Cercocarpus ledifolius, Ephedra* spp., *Holodiscus discolor*, and other species often common in adjacent plant communities.
Similar Ecological Systems:
- Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765)

Component Associations:
- *Cercocarpus intricatus* Montane Shrubland (CEGL002587, GNR)
- *Cercocarpus intricatus* Slickrock Sparse Vegetation (CEGL002977, GNR)
- *Cercocarpus montanus* Rock Pavement Sparse Vegetation (CEGL002978, GNR)
- *Chrysothamnus viscidiflorus* Talus Shrubland (CEGL002347, GNR)
- *Crataegus rivularis* Shrubland (CEGL002889, G2Q)
- *Glossopetalon spinescens var. aridum / Pseudoroegneria spicata* Shrubland (CEGL001100, G4)
- *Juniperus osteosperma / Cercocarpus intricatus* Woodland (CEGL000733, GNR)
- *Leymus salinus* Shale Sparse Vegetation (CEGL002745, GNR)
- *Pinus monophylla - Juniperus osteosperma* / Sparse Understory Woodland (CEGL000829, G5)
- *Pinus ponderosa* Slickrock Sparse Vegetation (CEGL002972, GNR)

DISTRIBUTION

Range: This system ranges from Wyoming and Utah west to the Pacific states.
Divisions: 304:C
Nations: US
Subnations: CA, ID, NV, OR, UT, WA, WY
Map Zones: 1:C, 6:?, 7:P, 8:C, 9:C, 10:P, 12:C, 13:C, 16:C, 17:C, 18:P, 21:P, 22:C, 23:?, 24:?
USFS Ecomap Regions: 322A:CC, 331A:CC, 331G:CP, 341A:CC, 341C:C?, 341D:CC, 341E:CC, 341F:CC, 341G:CC, 342A:CC, 342B:CC, 342C:CC, 342D:CC, 342E:CC, 342F:CC, 342G:CC, 342H:CC, 342I:CC, 342J:CC, M242C:??, M331A:CC, M331B:CC, M331D:CC, M331E:CP, M331G:CC, M331H:CC, M331I:CC, M331J:CC, M332A:C?, M332G:CC, M333A:CC, M333D:C?, M341A:CC, M341B:C?, M341C:C?, M341D:CC
TNC Ecoregions: 4:?, 6:C, 11:C, 18:C

SOURCES

References: Comer et al. 2003, Knight 1994
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722893#references
Description Author: NatureServe Western Ecology Team
Version: 20 Feb 2003
Stakeholders: Midwest, West
Concept Author: NatureServe Western Ecology Team
ClassifResp: West

INTER-MOUNTAIN BASINS PLAYA (CES304.786)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland; Wetland
Diagnostic Classifiers: Alkaline Water; Saline Water Chemistry; Caliche Layer; Impermeable Layer; Intermittent Flooding; Lowland [Lowland]; Playa; Temperate [Temperate Xeric]; Depressional; Alkaline Soil; Saline Substrate Chemistry; Aridic
Non-Diagnostic Classifiers: Clay Subsoil Texture; Shrubland (Shrub-dominated); Herbaceous; Isolated Wetland [Partially Isolated]; Dwarf-Shrub; Forb; Graminoid
National Mapping Codes: ESLF 3179

CONCEPT

Summary: This ecological system is composed of barren and sparsely vegetated playas (generally <10% plant cover) found in the intermountain western U.S. Salt crusts are common throughout, with small saltgrass beds in depressions and sparse shrubs around the margins. These systems are intermittently flooded. The water is prevented from percolating through the soil by an impermeable soil subhorizon and is left to evaporate. Soil salinity varies greatly with soil moisture and greatly affects species composition. Characteristic species may include *Allenrolfea occidentalis*, *Sarcobatus vermiculatus*, *Grayia spinosa*, *Puccinellia lemmonii*, *Leymus cinereus*, *Distichlis spicata*, and/or *Atriplex* spp.
Classification Comments: Bjork (1997) refers to these as vernal lakes in Washington; his one example was ditched and may be artificial. There might have been these in Grand Coulee prior to Columbia Basin irrigation project.

DESCRIPTION

Dynamics: Playas are shallow, seasonal wetlands that lie in the lowest point of a closed watershed. Their basins are lined with clay soils, which collect and hold water from rainfall and runoff events. Water evaporates, leaving high salt concentrations in the soils. Some playas will only flood with water during years with high precipitation, sometimes only once or twice in a decade. Others will have standing water every spring, except in the driest of years. During flooded years, some salt-tolerant marsh plant species may grow, such as cattails (*Typha* spp.) or bulrush (*Scirpus* spp.).

Component Associations:
- *Allenrolfea occidentalis / Atriplex gardneri* Shrubland (CEGL000989, G4?)
- *Allenrolfea occidentalis* Shrubland (CEGL000988, G3)
- *Artemisia papposa / Danthonia californica - Festuca idahoensis* Shrubland (CEGL002991, GNR)
- *Artemisia tridentata ssp. tridentata / Leymus cinereus* Shrubland (CEGL001016, G2)
- *Chrysothamnus albidus / Puccinellia nuttalliana* Shrubland (CEGL001328, G3)
- *Distichlis spicata - (Scirpus nevadensis)* Herbaceous Vegetation (CEGL001773, G4)
- *Distichlis spicata* - Mixed Herb Herbaceous Vegetation (CEGL001771, G3G5)
- *Distichlis spicata* Herbaceous Vegetation (CEGL001770, G5)
- *Hordeum jubatum* Great Basin Herbaceous Vegetation (CEGL005285, G4)
- *Krascheninnikovia lanata / Poa secunda* Dwarf-shrubland (CEGL001326, G3)
- *Leymus cinereus - Distichlis spicata* Herbaceous Vegetation (CEGL001481, G3)
- *Leymus cinereus* Bottomland Herbaceous Vegetation (CEGL001480, G1)
- *Leymus triticoides - Poa secunda* Herbaceous Vegetation (CEGL001572, G2)
- *Leymus triticoides* Herbaceous Vegetation (CEGL001571, G4?)
- *Pluchea sericea* Seasonally Flooded Shrubland (CEGL003080, G3?)
- *Poa secunda - Muhlenbergia richardsonis* Herbaceous Vegetation (CEGL002755, GNR)
- *Puccinellia lemmonii - Poa secunda* Seasonally Flooded Herbaceous Vegetation (CEGL001658, G1)
- *Sarcobatus vermiculatus - Atriplex parryi / Distichlis spicata* Shrubland (CEGL002764, GNR)
- *Sarcobatus vermiculatus - Psorothamnus polydenius* Shrubland (CEGL002763, GNR)
- *Sarcobatus vermiculatus / Achnatherum hymenoides* Shrubland (CEGL001373, G4)
- *Sarcobatus vermiculatus / Artemisia tridentata* Shrubland (CEGL001359, G4)
- *Sarcobatus vermiculatus / Atriplex confertifolia - (Picrothamnus desertorum, Suaeda moquinii)* Shrubland (CEGL001371, G5?)
- *Sarcobatus vermiculatus / Atriplex gardneri* Shrubland (CEGL001360, G4?)
- *Sarcobatus vermiculatus / Distichlis spicata* Shrubland (CEGL001363, G4)
- *Sarcobatus vermiculatus / Elymus elymoides - Pascopyrum smithii* Shrubland (CEGL001365, G2?)
- *Sarcobatus vermiculatus / Elymus elymoides* Shrubland (CEGL001372, G4)
- *Sarcobatus vermiculatus / Ericameria nauseosa* Shrubland (CEGL001362, G5)
- *Sarcobatus vermiculatus / Leymus cinereus* Shrubland (CEGL001366, G3)
- *Sarcobatus vermiculatus / Nitrophila occidentalis - Suaeda moquinii* Shrubland (CEGL001369, G5?)
- *Sarcobatus vermiculatus / Pascopyrum smithii - (Elymus lanceolatus)* Shrub Herbaceous Vegetation (CEGL001508, G4)

- *Sarcobatus vermiculatus / Sporobolus airoides* Shrubland (CEGL001368, G3?)
- *Sarcobatus vermiculatus* Disturbed Shrubland (CEGL001357, G5)
- *Spartina gracilis* Herbaceous Vegetation (CEGL001588, GU)
- *Sporobolus airoides - Distichlis spicata* Herbaceous Vegetation (CEGL001687, G4?)
- *Suaeda moquinii* Shrubland (CEGL001991, G5)

DISTRIBUTION

Range: This system occurs throughout the Intermountain western U.S., extending east into the southwestern Great Plains.
Divisions: 304:C
Nations: US
Subnations: CA, CO, ID, NM, NV, OR, UT, WA?, WY
Map Zones: 6:?, 7:P, 8:P, 9:C, 12:C, 13:P, 15:?, 16:P, 17:C, 18:C, 19:?, 21:?, 22:P, 23:P, 24:C, 25:?, 28:P
USFS Ecomap Regions: 313A:CP, 313B:CP, 313D:CC, 322A:??, 331J:CC, 341A:CC, 341B:CC, 341C:CC, 341D:CC, 341E:CC, 341F:CC, 341G:CC, 342B:CC, 342C:CC, 342D:CC, 342E:CP, 342F:CC, 342G:CC, 342H:CC, 342I:C?, 342J:CC, M242C:CC, M261D:P?, M261G:PP, M313A:CC, M331D:??, M331E:??, M332G:CC, M341A:CC, M341B:C?, M341D:CC
TNC Ecoregions: 6:C, 10:C, 11:C, 19:C

SOURCES

References: Bjork 1997, Comer et al. 2003, Knight 1994, Nachlinger et al. 2001
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722886#references
Description Author: NatureServe Western Ecology Team
Version: 01 Oct 2007 **Stakeholders:** West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

INTER-MOUNTAIN BASINS SHALE BADLAND (CES304.789)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Lowland [Lowland]; Badland; Badlands; Alkaline Soil; Shale and Mudstone; Silt Soil Texture; Clay Soil Texture
Non-Diagnostic Classifiers: Shrubland (Shrub-dominated); Moss/Lichen (Nonvascular); Temperate [Temperate Continental]; Aridic; Very Short Disturbance Interval; Broad-Leaved Shrub; Dwarf-Shrub; Semi-Shrub
National Mapping Codes: ESLF 3139

CONCEPT

Summary: This widespread ecological system of the Intermountain western U.S. is composed of barren and sparsely vegetated substrates (<10% plant cover) typically derived from marine shales but also includes substrates derived from siltstones and mudstones (clay). In southern Wyoming , the shales are not marine in origin, but often have bentonite, derived from volcanic ash deposition that occurred during several eruptions of the Yellowstone volcanic fields. Landforms are typically rounded hills and plains that form a rolling topography. The harsh soil properties and high rate of erosion and deposition are driving environmental variables supporting sparse dwarf-shrubs, e.g., *Atriplex corrugata*, *Atriplex gardneri*, *Artemisia pedatifida*, and herbaceous vegetation.
Classification Comments: Exactly where this transitions to Western Great Plains Badlands (CES303.663) in central Wyoming needs to be clarified.
Similar Ecological Systems:
- Columbia Plateau Ash and Tuff Badland (CES304.081)

Component Associations:
- *Achnatherum hymenoides* Shale Barren Herbaceous Vegetation (CEGL001651, G2)
- *Artemisia arbuscula ssp. longiloba* / Cushion Plants Shrubland (CEGL005996, GNR)
- *Artemisia arbuscula ssp. longiloba / Elymus lanceolatus* Shrubland (CEGL002585, GNR)
- *Artemisia arbuscula ssp. longiloba / Poa fendleriana* Shrubland (CEGL005997, GNR)
- *Artemisia bigelovii / Achnatherum hymenoides* Shrubland (CEGL000990, G3Q)
- *Artemisia pygmaea / Elymus elymoides - Achnatherum hymenoides* Shrubland (CEGL001436, G3G4)
- *Atriplex confertifolia* Sparse Shrubland (CEGL003830, GNR)
- *Atriplex corrugata* Dwarf-shrubland (CEGL001437, G5)
- *Atriplex cuneata - Frankenia jamesii / Sporobolus airoides* Shrubland (CEGL001316, G1?)
- *Atriplex gardneri / Achnatherum hymenoides* Dwarf-shrubland (CEGL001444, G3)
- *Atriplex gardneri / Leymus salinus* Dwarf-shrubland (CEGL001442, G2?)
- *Atriplex gardneri / Pleuraphis jamesii* Dwarf-shrubland (CEGL001441, G3G5)
- *Atriplex gardneri / Xylorhiza venusta* Dwarf-shrubland (CEGL001446, G3G5)
- *Atriplex gardneri* Dwarf-shrubland (CEGL001438, G3G5)
- *Atriplex obovata* Badland Sparse Vegetation (CEGL002928, GNR)
- *Atriplex obovata* Talus Dwarf-shrubland (CEGL001789, GNR)
- *Atriplex* spp. Desert Pavement Sparse Vegetation (CEGL003767, GNR)
- *Ephedra torreyana* - (*Atriplex* spp.) / Nonvascular Gypsum Sparse Vegetation (CEGL002349, GNR)
- *Ephedra torreyana* Sparse Vegetation (CEGL002353, GNR)
- *Ericameria nauseosa* Sparse Shrubland (CEGL003961, GNR)
- *Eriogonum brevicaule* - Cushion Plants Sparse Vegetation (CEGL005319, GNR)
- *Eriogonum corymbosum / Leymus salinus* Dwarf-shrubland (CEGL001343, G2G4)
- *Eriogonum corymbosum* Badlands Sparse Vegetation (CEGL002979, GNR)
- *Eriogonum leptophyllum* Sparse Vegetation (CEGL004013, GNR)
- *Leymus salinus* Shale Sparse Vegetation (CEGL002745, GNR)
- *Pseudoroegneria spicata - Eriogonum brevicaule* Sparse Vegetation (CEGL001667, G3?)
- *Zuckia brandegeei* Sparse Vegetation (CEGL002493, GNR)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765)

DISTRIBUTION

Range: This system is found in the Intermountain western U.S., from Arizona and New Mexico north to Idaho and Montana. It is confirmed by Oregon and Washington reviewers to not occur in either of those states.

Divisions: 304:C; 306:C
Nations: US
Subnations: AZ, CA, CO, ID, MT, NM, NV, UT, WY
Map Zones: 8:?, 9:C, 12:?, 13:P, 15:?, 16:C, 17:P, 18:P, 21:?, 22:C, 23:C, 24:C, 25:P, 27:?, 28:C
USFS Ecomap Regions: 313A:CC, 313B:CC, 313D:CC, 315H:CC, 322A:??, 331F:CC, 331G:CC, 331I:C?, 331J:CP, 341A:CP, 341B:CC, 341C:CC, 342A:CC, 342B:C?, 342C:CP, 342D:CC, 342F:CC, 342G:CC, 342H:CC, 342I:C?, 342J:C?, M261D:??, M313A:PP, M313B:PP, M331B:C?, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M331J:CP, M334A:CC, M341B:CC, M341C:CC
TNC Ecoregions: 6:P, 9:C, 10:C, 11:C, 12:?, 18:C, 19:C, 20:C, 21:C

SOURCES

References: Comer et al. 2003, DeVelice and Lesica 1993, Knight 1994, Knight et al. 1987
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722883#references
Description Author: NatureServe Western Ecology Team
Version: 29 Jan 2007 **Stakeholders:** West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

INTER-MOUNTAIN BASINS VOLCANIC ROCK AND CINDER LAND (CES304.791)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Lava flow (undifferentiated); Lava; Cinder; Basalt; Temperate [Temperate Continental]; Cinder cone
Non-Diagnostic Classifiers: Montane; Lowland; Shrubland (Shrub-dominated); Herbaceous; Dune (Substrate); Igneous Rock; Very Shallow Soil; Sand Soil Texture; Aridic; W-Landscape/Medium Intensity
National Mapping Codes: ESLF 3128

CONCEPT

Summary: This ecological system occurs in the intermountain western U.S. and is limited to barren and sparsely vegetated volcanic substrates (generally <10% plant cover) such as basalt lava (malpais), basalt dikes with associated colluvium, basalt cliff faces and uplifted "backbones," tuff, cinder cones or cinder fields. It may occur as large-patch, small-patch and linear (dikes) spatial patterns. Vegetation is variable and includes a variety of species depending on local environmental conditions, e.g., elevation, age and type of substrate. At montane and foothill elevations scattered *Pinus ponderosa*, *Pinus flexilis*, or *Juniperus* spp. trees may be present. Shrubs such as *Ephedra* spp., *Atriplex canescens*, *Eriogonum corymbosum*, *Eriogonum ovalifolium*, and *Fallugia paradoxa* are often present on some lava flows and cinder fields. Species typical of sand dunes such as *Andropogon hallii* and *Artemisia filifolia* may be present on cinder substrates.

DESCRIPTION

Dynamics: This ecological system is relatively young (geologically speaking). Lichens are the primary erosion process in this system, and therefore, soil buildup is a slow process. Lichens are susceptible to changes in air quality (Brodo et. al. 2001) and are considered a good indicator of air quality.

Component Associations:
- *Andropogon hallii* Colorado Plateau Herbaceous Vegetation (CEGL002785, GNR)
- *Artemisia filifolia - Ephedra (torreyana, viridis)* Shrubland (CEGL002786, GNR)
- *Artemisia tridentata ssp. vaseyana / Poa secunda* Shrubland (CEGL001029, G3)
- *Eriogonum corymbosum* Cinder Sparse Vegetation (CEGL005803, GNR)
- *Eriogonum fasciculatum* Rock Outcrop Shrubland (CEGL001260, G5?)
- *Eriogonum ovalifolium var. depressum* Dwarf-shrubland (CEGL001401, G1)
- *Fallugia paradoxa - (Atriplex canescens, Ephedra torreyana)* Cinder Shrubland (CEGL005806, GNR)
- *Juniperus monosperma* Cinder Wooded Herbaceous Vegetation (CEGL005807, GNR)
- *Pinus flexilis / Purshia tridentata* Woodland (CEGL000814, G1?)
- *Pinus ponderosa - (Populus tremuloides) / Fallugia paradoxa - (Holodiscus dumosus)* Lava Bed Sparse Vegetation (CEGL002929, GNR)
- *Pinus ponderosa / Andropogon hallii* Woodland (CEGL005808, GNR)
- *Pinus ponderosa* / Cinder Woodland (CEGL002998, GNR)
- *Purshia tridentata / Pseudoroegneria spicata - Leymus cinereus* Shrub Herbaceous Vegetation (CEGL001497, G1?)
- *Tiquilia latior / Sporobolus airoides* Dwarf-shrubland (CEGL005809, GNR)

DISTRIBUTION

Range: This system occurs in the Intermountain western U.S. and is limited to barren and sparsely vegetated volcanic substrates. It occurs in Montana along the Rocky Mountain Front (east of the Continental Divide).
Divisions: 304:C
Nations: US
Subnations: AZ, ID, MT, NM, NV, OR, UT, WY
Map Zones: 7:?, 8:?, 9:C, 10:C, 12:P, 13:P, 15:P, 16:C, 17:C, 18:C, 19:C, 20:C, 23:C, 24:C, 25:P, 27:C
USFS Ecomap Regions: 313A:CC, 313B:CC, 313D:CC, 315H:CC, 322A:PP, 331B:CC, 331D:CP, 331J:CC, 341A:CC, 341B:CC, 342B:CC, 342C:CC, 342D:CC, 342H:CC, 342J:CP, M242C:PP, M313A:CC, M331A:C?, M331F:CC, M331G:C?, M332D:CC, M332F:CC, M332G:CC, M341C:CC
TNC Ecoregions: 4:C, 6:C, 8:C, 9:C, 11:C, 18:C, 19:C, 20:C, 21:C

SOURCES

References: Barbour and Billings 2000, Brodo et al. 2001, Comer et al. 2003, Day and Wright 1985, Hansen et al. 2004c, Tisdale et al. 1965
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722881#references
Description Author: NatureServe Western Ecology Team

Version: 23 Jan 2006
Concept Author: NatureServe Western Ecology Team

Stakeholders: West
ClassifResp: West

INTER-MOUNTAIN BASINS WASH (CES304.781)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Inter-Mountain Basins (304)
Land Cover Class: Barren
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland; Wetland
Diagnostic Classifiers: Lowland [Lowland]; Shrubland (Shrub-dominated); Wash; Toeslope/Valley Bottom; Riverine / Alluvial; Alkaline Soil; Xeromorphic Shrub; Sarcobatus vermiculatus
Non-Diagnostic Classifiers: Deep (>15 cm) Water; Temperate [Temperate Continental]; Saline Substrate Chemistry
National Mapping Codes: ESLF 3152

CONCEPT

Summary: This barren and sparsely vegetated (generally <10% plant cover) ecological system is restricted to intermittently flooded streambeds and banks that are often lined with shrubs such as *Sarcobatus vermiculatus, Ericameria nauseosa, Fallugia paradoxa, Artemisia tridentata ssp. tridentata,* and/or *Artemisia cana ssp. cana* (in more northern and mesic stands) that form relatively dense stringers in open dry uplands. *Grayia spinosa* may dominate in the Great Basin. Shrubs form a continuous or intermittent linear canopy in and along drainages but do not extend out into flats. Typically it includes patches of saltgrass meadow where water remains for the longest periods. In parts of Wyoming, stringers or patches of *Artemisia tridentata ssp. tridentata* are large and distinct enough from surrounding upland vegetation due to the influence of the wash that they can be classified separately. However, small intermittent washes may also be included with adjacent uplands if vegetation is not different enough floristically or structurally from uplands (e.g., just a little denser canopy). Soils are variable but are generally less alkaline than those found in the playa system. Desert scrub species (e.g., *Acacia greggii, Prosopis* spp.) that are common in the Mojave, Sonoran and Chihuahuan desert washes are not present. This type can occur in limited portions of the southwestern Great Plains.
Classification Comments: Where the stringers or patches of *Artemisia tridentata ssp. tridentata* are large enough to be mapped separately from both the wash and from the adjacent upland, then they should be mapped as Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777) or Inter-Mountain Basins Big Sagebrush Steppe (CES304.778) . Compare this wash system with Inter-Mountain Basins Greasewood Flat (CES304.780); the wash should be restricted to the periphery of the wash and distinct from adjacent vegetation. If not, consider including with greasewood flat. Invasive, exotic shrubs shrub as *Tamarix* spp. or *Chamaebatiaria millefolium* may be present to dominant in these washes where disturbed.
Similar Ecological Systems:
- Inter-Mountain Basins Greasewood Flat (CES304.780)

Related Concepts:
- Riparian (422) (Shiflet 1994) Broader

Component Associations:
- *Allenrolfea occidentalis* Shrubland (CEGL000988, G3)
- *Artemisia tridentata ssp. tridentata / Sporobolus cryptandrus* Shrubland (CEGL003826, GNR)
- *Atriplex canescens* Desert Wash Shrubland (CEGL003470, GNR)
- *Distichlis spicata - (Scirpus nevadensis)* Herbaceous Vegetation (CEGL001773, G4)
- *Distichlis spicata* - Mixed Herb Herbaceous Vegetation (CEGL001771, G3G5)
- *Distichlis spicata* Herbaceous Vegetation (CEGL001770, G5)
- *Ericameria nauseosa* Desert Wash Shrubland (CEGL002261, GNR)
- *Fallugia paradoxa* Colorado Plateau Desert Wash Shrubland (CEGL002357, GNR)
- *Fraxinus anomala* Woodland (CEGL002752, GUQ)
- *Grayia spinosa / Poa secunda* Shrubland (CEGL001351, G1)
- *Hordeum brachyantherum* Herbaceous Vegetation (CEGL003430, G2)
- *Sarcobatus vermiculatus - Atriplex parryi / Distichlis spicata* Shrubland (CEGL002764, GNR)
- *Sarcobatus vermiculatus - Psorothamnus polydenius* Shrubland (CEGL002763, GNR)
- *Sarcobatus vermiculatus / Achnatherum hymenoides* Shrubland (CEGL001373, G4)
- *Sarcobatus vermiculatus / Atriplex confertifolia - (Picrothamnus desertorum, Suaeda moquinii)* Shrubland (CEGL001371, G5?)
- *Sarcobatus vermiculatus / Atriplex gardneri* Shrubland (CEGL001360, G4?)
- *Sarcobatus vermiculatus / Distichlis spicata* Shrubland (CEGL001363, G4)
- *Sarcobatus vermiculatus / Elymus elymoides - Pascopyrum smithii* Shrubland (CEGL001365, G2?)
- *Sarcobatus vermiculatus / Elymus elymoides* Shrubland (CEGL001372, G4)
- *Sarcobatus vermiculatus / Ericameria nauseosa* Shrubland (CEGL001362, G5)
- *Sarcobatus vermiculatus / Leymus cinereus* Shrubland (CEGL001366, G3)
- *Sarcobatus vermiculatus / Nitrophila occidentalis - Suaeda moquinii* Shrubland (CEGL001369, G5?)
- *Sarcobatus vermiculatus / Pascopyrum smithii - (Elymus lanceolatus)* Shrub Herbaceous Vegetation (CEGL001508, G4)
- *Sarcobatus vermiculatus / Sporobolus airoides* Shrubland (CEGL001368, G3?)

- *Sarcobatus vermiculatus / Suaeda moquinii* Shrubland (CEGL001370, GUQ)
- *Sarcobatus vermiculatus* Disturbed Shrubland (CEGL001357, G5)
- *Sporobolus airoides* Southern Plains Herbaceous Vegetation (CEGL001685, G3Q)

DISTRIBUTION

Range: This system occurs throughout the Intermountain western U.S. extending east into the western Great Plains.
Divisions: 303:C; 304:C; 306:C
Nations: US
Subnations: AZ, CA, CO, ID, MT, NV, OR, UT, WA, WY
Map Zones: 8:?, 9:?, 12:C, 16:C, 17:C, 18:?, 22:?, 23:C, 24:C, 25:C, 27:P, 28:?, 29:?, 33:?
USFS Ecomap Regions: 313A:CC, 313B:CC, 313D:CC, 315H:PP, 331B:CC, 331H:C?, 331I:CC, 331J:CC, 341A:CC, 341B:CC, 341C:CC, 341D:CC, 341E:CC, 341F:CC, 341G:CC, 342A:CC, 342E:CC, 342F:CC, 342G:CC, M313A:CC, M313B:CP, M331I:??, M341A:CC, M341B:CC, M341C:CC, M341D:CC
TNC Ecoregions: 4:C, 6:C, 8:C, 9:C, 10:C, 11:C, 19:C, 20:C, 26:C

SOURCES

References: Comer et al. 2003, Knight 1994, West 1983b
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722891#references
Description Author: K.A. Schulz
Version: 01 Oct 2007 **Stakeholders:** Midwest, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

KLAMATH-SISKIYOU CLIFF AND OUTCROP (CES206.902)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Woody-Herbaceous; Moss/Lichen (Nonvascular); Cliff (Substrate); Talus (Substrate); Rock Outcrops/Barrens/Glades; Mediterranean [Mediterranean Xeric-Oceanic]
Non-Diagnostic Classifiers: Canyon Mosaic; Montane [Upper Montane]; Montane [Montane]; Montane [Lower Montane]; Lowland [Foothill]; Forest and Woodland (Treed); Canyon; Cliff (Landform)
National Mapping Codes: ESLF 3170

CONCEPT

Summary: Found from foothill to subalpine elevations of the Klamath Range, these are barren and sparsely vegetated landscapes (<10% plant cover) of steep cliff faces, bald ridgetops and shoulder outcrops, narrow canyons, and smaller rock outcrops of various igneous, sedimentary, and metamorphic bedrock. Vegetative cover is dominated by forbs, grasses, mosses, or lichens. This also includes unstable scree and talus slopes typically occurring below cliff faces. Scattered vegetation may include *Pseudotsuga menziesii* and *Acer macrophyllum* along with herbaceous and nonvascular species such as *Achnatherum lemmonii (= Stipa lemmonii)*, *Achnatherum occidentale (= Stipa occidentalis)*, *Elymus elymoides (= Sitanion hystrix)*, *Sedum oregonense*, and *Racomitrium ericoides (= Racomitrium canescens var. ericoides)*. Soil development is limited as is herbaceous cover.

DISTRIBUTION

Range: Found from foothill to subalpine elevations of the Klamath Range.
Divisions: 206:C
Nations: US
Subnations: CA, OR
Map Zones: 2:C, 3:C, 7:C
USFS Ecomap Regions: M242A:??, M261A:CC, M261B:CC
TNC Ecoregions: 5:C

SOURCES

References: Barbour and Major 1988, Comer et al. 2003, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722779#references
Description Author: P. Comer, T. Keeler-Wolf
Version: 17 Mar 2003 **Stakeholders:** West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

LAURENTIAN-ACADIAN ACIDIC CLIFF AND TALUS (CES201.569)

CLASSIFIERS

Classification Status: Standard

Primary Division: Laurentian-Acadian (201)
Land Cover Class: Barren
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Ridge/Summit/Upper Slope; Cliff (Substrate); Talus (Substrate); Acidic Soil; Landslide
Non-Diagnostic Classifiers: Moderate (100-500 yrs) Persistence; Montane; Lowland; Shrubland (Shrub-dominated); Moss/Lichen (Nonvascular); Glaciated; Very Shallow Soil; Mineral: W/ A-Horizon <10 cm; Intermediate Disturbance Interval [Periodicity/Polycyclic Disturbance]
National Mapping Codes: ESLF 3188

CONCEPT

Summary: This cliff system occurs at low to mid elevations, well below treeline, from New England west to the Great Lakes. It consists of vertical or near-vertical cliffs and the talus slopes below, formed on hills of granitic or otherwise acidic bedrock. Most of the substrate is dry and exposed, but small (occasionally large) areas of seepage are often present. Vegetation in seepage areas tends to be more well-developed and floristically different from the surrounding dry cliffs. The vegetation is patchy and often sparse, punctuated with patches of small trees (e.g., *Betula* and *Picea* spp.). Calciphilic species are absent. In north-facing or other sheltered settings where cold air accumulates at the bottom of slopes, a shrubland of heaths and reindeer lichens can develop. This system differs from the more southerly North-Central Appalachian Acidic Cliff and Talus (CES202.601) in the more boreal affinities of its flora, for example *Picea* spp. rather than *Juniperus virginiana*.

Similar Ecological Systems:
- North-Central Appalachian Acidic Cliff and Talus (CES202.601)

Related Concepts:
- Acidic Cliff - Gorge (Gawler and Cutko 2010) Finer
- Birch - Oak Talus Woodland (Gawler and Cutko 2010) Finer
- Labrador Tea Talus Dwarf-Shrubland (Gawler and Cutko 2010) Finer
- Northern Red Oak: 55 (Eyre 1980) Finer
- Paper Birch - Red Spruce - Balsam Fir: 35 (Eyre 1980) Finer
- Paper Birch:18 (Eyre 1980) Finer
- Red Spruce: 32 (Eyre 1980) Finer
- Spruce Talus Woodland (Gawler and Cutko 2010) Finer

Component Associations:
- *Acer spicatum - Thuja occidentalis - Betula papyrifera / Taxus canadensis* Alkaline Cliff Scrub (CEGL005251, GNR)
- *Betula alleghaniensis - Quercus rubra / Polypodium virginianum* Woodland (CEGL006320, G3G5)
- *Drosera rotundifolia - Viola* spp. Cliff Sparse Vegetation (CEGL006429, GNR)
- Eastern Boreal & Laurentian Basalt - Diabase Dry & Moist Acidic Talus Vegetation (CEGL005247, GNR)
- Eastern Boreal & Laurentian Dry Acidic Cliff Vegetation (CEGL002300, GNR)
- Eastern Boreal & Laurentian Granite - Metamorphic Talus Vegetation (CEGL002409, G4G5)
- *Picea mariana / Ledum groenlandicum - Empetrum nigrum / Cladina* spp. Dwarf-shrubland (CEGL006268, G3G5)
- *Picea rubens / Ribes glandulosum* Woodland (CEGL006250, G3G5)
- *Polypodium (virginianum, appalachianum)* / Lichens Nonvascular Vegetation (CEGL006534, GNR)
- *Polypodium (virginianum, appalachianum)* Cliff Sparse Vegetation (CEGL006528, GNR)
- Sandstone Midwest Dry Cliff Sparse Vegetation (CEGL002045, G4G5)
- Sandstone Midwest Moist Cliff Vegetation (CEGL002287, G4G5)

DISTRIBUTION

Range: This system is found in New England and adjacent Canada west to the Great Lakes.
Divisions: 201:C; 202:C
Nations: CA, US
Subnations: MA?, ME, MI, MN, NH, NY, VT, WI
Map Zones: 41:C, 50:C, 51:C, 63:C, 64:C, 65:C, 66:C
USFS Ecomap Regions: 212Jb:CCC, 212Jc:CCP, 212Jo:CCP, 212K:CC, 212Lb:CPP, 212M:CC, 212Q:CC, 212Ra:CCC, 212Sb:CCC, 212Sc:CCP, 212Sn:CCP, 212Sq:CCC, 212Tb:CCP, 212Tc:CCP, 212X:CP, 212Ya:CCC, 222Jc:CCC
TNC Ecoregions: 47:C, 48:C, 61:C, 63:C

SOURCES

References: Comer et al. 2003
Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723036#references
Description Author: S.C. Gawler
Version: 05 Oct 2004 **Stakeholders:** Canada, East, Midwest
Concept Author: S.C. Gawler **ClassifResp:** East

LAURENTIAN-ACADIAN CALCAREOUS CLIFF AND TALUS (CES201.570)

CLASSIFIERS

Classification Status: Standard

Primary Division: Laurentian-Acadian (201)
Land Cover Class: Barren
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Ridge/Summit/Upper Slope; Cliff (Substrate); Talus (Substrate); Alkaline Soil; Circumneutral Soil
Non-Diagnostic Classifiers: Moderate (100-500 yrs) Persistence; Montane; Lowland; Glaciated; Very Shallow Soil; Intermediate Disturbance Interval; Landslide
National Mapping Codes: ESLF 3144

CONCEPT

Summary: This cliff system occurs at low to mid elevations, well below treeline, from New England west to the Great Lakes. It consists of vertical or near-vertical cliffs and the talus slopes below, where weathering and/or bedrock chemistry produce circumneutral to calcareous pH and enriched nutrient availability. The vegetation is often sparse but may include patches of small trees. *Thuja occidentalis* may dominate on some cliffs (and reach very old ages, upwards of 1000 years). *Fraxinus* spp. and *Tilia americana* are woody indicators of the enriched setting.

Similar Ecological Systems:
- North-Central Appalachian Circumneutral Cliff and Talus (CES202.603)

Related Concepts:
- Northern White-Cedar: 37 (Eyre 1980) Finer
- White Cedar Woodland (Gawler and Cutko 2010) Finer

DESCRIPTION

Vegetation: *Thuja occidentalis* may dominate on some cliffs (and reach very old ages, upwards of 1000 years). *Fraxinus* spp. and *Tilia americana* are woody indicators of the enriched setting (Kelly and Larson 1997).

Component Associations:
- *Acer saccharum - Tilia americana - Fraxinus americana / Ostrya virginiana / Geranium robertianum* Woodland (CEGL005058, G3G5)
- *Carex scirpoidea* Alkaline Cliff Sparse Vegetation (CEGL006526, GNR)
- Limestone - Dolostone Midwest Dry Cliff Sparse Vegetation (CEGL002291, G4G5)
- Limestone - Dolostone Midwest Moist Cliff Vegetation (CEGL002292, G4G5)
- Limestone - Dolostone Midwest Talus Vegetation (CEGL002308, G4G5)
- *Thuja occidentalis* Carbonate Talus Woodland (CEGL005172, G3G4)
- *Thuja occidentalis* Cliff Woodland (CEGL002451, G3)

DISTRIBUTION

Range: This system is found in scattered locations from New England and adjacent Canada west to the Great Lakes and northern Minnesota
Divisions: 201:C
Nations: US
Subnations: ME, MI, MN, NH, NY, VT, WI
Map Zones: 41:C, 50:C, 51:C, 63:C, 64:C, 66:C
USFS Ecomap Regions: 212Hl:CCC, 212Jb:CCC, 212Jc:CCP, 212Jo:CCP, 212Lb:CPP, 212Q:CC, 212Ra:CCC, 212Rc:CCC, 212Re:CCC, 212Sb:CCC, 212Sc:CCC, 212Sn:CCP, 212Sq:CCC, 212Tb:CCC, 212Tc:CCP, 212Tf:CCC, 212X:CP, 212Ya:CCP, 212Z:CC, 222Jc:CCC
TNC Ecoregions: 47:C, 48:C, 63:C

SOURCES

References: Comer et al. 2003, Kelly and Larson 1997
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723035#references
Description Author: S.C. Gawler
Version: 09 Jan 2003 **Stakeholders:** East, Midwest
Concept Author: S.C. Gawler **ClassifResp:** East

LAURENTIAN-ACADIAN LAKESHORE BEACH (CES201.586)

CLASSIFIERS

Classification Status: Standard

Primary Division: Laurentian-Acadian (201)
Land Cover Class: Barren
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland; Wetland
Diagnostic Classifiers: Short (<5 yrs) Flooding Interval [Short interval, Irregular Flooding]; Depressional; Flood Scouring; Broad-Leaved Shrub; Dwarf-Shrub; Graminoid
Non-Diagnostic Classifiers: Lowland; Glaciated; Mesotrophic Soil; Oligotrophic Soil; Mineral: W/ A-Horizon <10 cm; Sand Soil Texture; Very Short Disturbance Interval
National Mapping Codes: ESLF 3182

CONCEPT

Summary: This system encompasses primarily upland vegetation along lakeshores or rivershores in the glaciated Northeast and upper Midwest (not including the Great Lakes). Some areas may be briefly inundated during high water periods. The substrate is sandy to gravelly, sometimes consolidated rock; there may be muddy patches. Ice-scour is not a major influence, although it may be locally important. These shores may be narrow zones of shrubs and/or sparse vegetation on rocks or sandy beaches. Descriptions of these beaches from Maine, New Hampshire, Vermont, and Minnesota suggests a variable structure and composition influenced by exposure, substrate, and how wet the substrate remains. The upper zone often features shrubs; these may include *Myrica gale, Gaylussacia baccata, Salix* spp., and *Photinia melanocarpa (= Aronia melanocarpa)*. Creeping shrubs such as *Hudsonia* spp., *Juniperus horizontalis*, and *Prunus pumila var. susquehanae* may be locally important. The herbaceous flora likewise varies; *Schizachyrium scoparium, Dichanthelium clandestinum, Cyperus* spp., *Dulichium arundinaceum*, and *Spartina pectinata* are representative graminoids; forbs may include *Argentina anserina, Lechea intermedia, Scutellaria lateriflora*, and *Mimulus ringens*, among others.
Classification Comments: Very little data on these. May not be defensible as a separate system, keep in for now as a placeholder. If it is combined with the surrounding uplands, the associations tagged to this system may become orphans.
Related Concepts:
- Lakeshore Sand/Cobble Beach (Gawler and Cutko 2010) Finer
- Pipewort - Water Lobelia Aquatic Bed (Gawler and Cutko 2010) Finer

Component Associations:
- *Dasiphora fruticosa ssp. floribunda / Rhynchospora capillacea - Scleria verticillata* Shrub Herbaceous Vegetation (CEGL006356, G1)
- Eroding Clay Bank Sparse Vegetation (CEGL002584, GNR)
- *Hudsonia tomentosa - Lupinus perennis* Dwarf-shrubland (CEGL006233, G1)
- Igneous - Metamorphic Cobble - Gravel Inland Lake Shore Sparse Vegetation (CEGL002303, G4G5)
- Inland Freshwater Strand Beach Sparse Vegetation (CEGL002310, G4G5)
- Lake Mudflats Sparse Vegetation (CEGL002313, GNR)
- *Spartina pectinata* North Atlantic Coast Herbaceous Vegetation (CEGL006095, GNR)

DISTRIBUTION

Range: Northern New England and northern New York west across the upper Great Lakes to northern Minnesota, and adjacent Canada; occasional southwards.
Divisions: 201:C
Nations: US
Subnations: MA, ME, MI, MN, NH, NY, RI, VT, WI
Map Zones: 41:C, 50:C, 51:C, 63:C, 64:C, 66:C
USFS Ecomap Regions: 211A:CP, 211B:CP, 211C:CP, 211D:CP, 211F:CC, 212Tb:CCC, 221:C
TNC Ecoregions: 47:C, 48:C, 60:C, 61:C, 63:C, 64:C

SOURCES

References: Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723020#references
Description Author: S.C. Gawler
Version: 25 Feb 2010
Concept Author: S.C. Gawler
Stakeholders: East, Midwest
ClassifResp: East

LOUISIANA BEACH (CES203.469)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Barren
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland; Wetland
Diagnostic Classifiers: Beach (Substrate); Graminoid; Coast
National Mapping Codes: ESLF 3131

CONCEPT

Summary: Louisiana beaches are predominantly found on remnant barrier islands associated with historic delta lobes of the Mississippi River. Since normal deltaic processes have been altered, the formation of new barrier islands has been halted and Louisiana barrier islands are undergoing deterioration. Within the northern Gulf region, these barrier islands are distinguished by dominance of *Spartina patens* instead of *Uniola paniculata*. Also characteristic are *Cenchrus spinifex (= Cenchrus incertus)* and *Sporobolus virginicus*.
Classification Comments: This system is distinguished more by its dependence on the deltaic processes of the Mississippi River than by its floristics. Based on floristics, it might warrant merger with other beaches of the northern Gulf of Mexico.

DESCRIPTION

Environment: This ecological system includes the usually sparsely vegetated, sandy, back beach area in a microtidal environment (< 0.5m) as it transitions into more stabilized dune or barrier flat communities.
Vegetation: These beaches are distinguished by dominance of *Spartina patens*. Also characteristic are *Cenchrus spinifex (= Cenchrus incertus)* and *Sporobolus virginicus* (Barbour et al. 1987).
Dynamics: The primary processes controlling this system are the natural deltaic process of the Mississippi River. The process of sand movement due to the forces of wind and water are part of its the natural dynamics. This includes transport of sand along the coast, and movement of sand by wind or water between the dunes, beach and subtidal areas. If the natural supply of sediment is maintained and not restricted by infrastructure or engineered hard structures, beaches and dunes will migrate and cause coastlines to change over time in response to the action of wind and water. Based on the dependence of this system on the natural processes of the Mississippi River, and the current alteration of those processes, this system has been severely degraded; no new beaches are forming and existing beaches are eroding (Morton et al. 2004). The loss of this system will impact the many wildlife that depend on it - terns, shorebirds, wading birds, brown pelican, and sea turtles.

Component Associations:
- *Ipomoea pes-caprae - Ipomoea imperati - (Cakile geniculata)* Herbaceous Vegetation (CEGL004402, G3?)
- *Spartina patens - Panicum amarum - Hydrocotyle bonariensis* Herbaceous Vegetation (CEGL004971, G2?)

DISTRIBUTION

Range: This system is found on remnant barrier islands associated with historic delta lobes of the Mississippi River. Very few examples remain intact.
Divisions: 203:C
Nations: US
Subnations: LA
Map Zones: 98:C
TNC Ecoregions: 31:C

SOURCES

References: Barbour et al. 1987, Comer et al. 2003, Defeo et al. 2009, LDWF 2005, Morton et al. 2004, Smith 1993
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723117#references
Description Author: J. Teague
Version: 14 Jan 2014
Concept Author: J. Teague
Stakeholders: Southeast
ClassifResp: Southeast

MEDITERRANEAN CALIFORNIA ALPINE BEDROCK AND SCREE (CES206.899)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Alpine/AltiAndino [Alpine/AltiAndino]; Alpine Mosaic; Ridge/Summit/Upper Slope; Temperate [Temperate Oceanic]; Nonvascular
Non-Diagnostic Classifiers: Hillslope bedrock outcrop; Peak; Periglacial boulderfield; Pinnacle; Ridgetop bedrock outcrop; Rockfall avalanche; Herbaceous; Summit; Moss/Lichen (Nonvascular); Talus (Landform); Glaciated; Periglacial; Very Shallow Soil; Landslide; Avalanche; W-Landscape/High Intensity; Cliff (Landform)
National Mapping Codes: ESLF 3172

CONCEPT

Summary: This system occurs in limited alpine environments mostly concentrated in the Sierra Nevada, but also on Mount Shasta and as far south as the Peninsular Ranges and White Mountains. Alpine elevations begin around 3500 m (10,600 feet) in the southern mountain ranges and 2700 m (8200 feet) in the southern Cascades. These are barren and sparsely vegetated alpine substrates, typically including both bedrock outcrops and scree slopes, with nonvascular (lichen)-dominated communities. This also encompasses a limited area of "alpine desert" with unstable sandy substrates and scattered individuals of *Astragalus* spp., *Arabis* spp., *Draba* spp., and *Oxytropis* spp., which mostly fall to the east of the Sierra Nevada crest. Exposure to desiccating winds, rocky and sometimes unstable substrates, and a short growing season limit plant growth.

DISTRIBUTION

Range: Concentrated in the Sierra Nevada, but also on Mount Shasta and as far south as the Peninsular Ranges and White Mountains. Alpine elevations begin around 3500 m (10,600 feet) in the southern mountain ranges and 2700 m (8200 feet) in the southern Cascades.
Divisions: 206:C
Nations: MX, US
Subnations: CA, MXBC(MX), NV, OR
Map Zones: 2:C, 3:?, 4:C, 6:C, 7:C, 12:P
USFS Ecomap Regions: 341D:CC, 342B:??, M261D:CP, M261E:CC
TNC Ecoregions: 5:C, 12:C, 16:P

SOURCES

References: Barbour and Major 1988, Comer et al. 2003, Hickman 1993, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722782#references
Description Author: P. Comer, T. Keeler-Wolf
Version: 17 Mar 2003 **Stakeholders:** Latin America, West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

MEDITERRANEAN CALIFORNIA COASTAL BLUFF (CES206.906)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Barren
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Headland; Sea cliff; Mediterranean [Mediterranean Xeric-Oceanic]; Salt Spray; Landslide; W-Landscape/High Intensity; Bluff; Succulent Shrub; Dwarf-Shrub
Non-Diagnostic Classifiers: Lowland [Lowland]; Herbaceous; Cliff (Substrate); Saline Substrate Chemistry; Xeric; Intermediate Disturbance Interval; Succulent Forb; Cliff (Landform); Coast
National Mapping Codes: ESLF 3166

CONCEPT

Summary: Areas of sea bluffs and rocky headlands occur just above the tidal zone throughout rugged portions of coastal Oregon, California, Baja Norte, and off-shore islands (e.g., Channel Islands). Plant communities along these often vertical slopes are typically sparse, with many succulents and prostrate shrubs, and species that readily withstand salt spray and saline soils, as well as seasonal drought. These may include *Baccharis pilularis, Dudleya* spp., *Carpobrotus chilensis, Carpobrotus edulis, Hazardia squarrosa (= Haplopappus squarrosus), Eriogonum parvifolium, Erigeron glaucus, Eriophyllum stoechadifolium*, and *Plantago maritima*. Slope instability and erosion result in severe climate, setting back succession in this system.

DISTRIBUTION

Range: Rugged portions of coastal Oregon, California, and off-shore islands (e.g., Channel Islands), and Baja Norte, Mexico.
Divisions: 206:C
Nations: MX, US
Subnations: CA, MXBC(MX), OR
Map Zones: 2:P, 3:C, 4:C
USFS Ecomap Regions: 261B:CC, 263A:CC
TNC Ecoregions: 14:C, 15:C, 16:C

SOURCES

References: Barbour and Major 1988, Comer et al. 2003, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722775#references
Description Author: P. Comer, T. Keeler-Wolf
Version: 17 Mar 2003 **Stakeholders:** Latin America, West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

MEDITERRANEAN CALIFORNIA NORTHERN COASTAL DUNE (CES206.907)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Dune field; Coastal Dune Mosaic; Dune (Substrate); Mediterranean [Mediterranean Xeric-Oceanic]; Sand Soil Texture; Very Short Disturbance Interval; W-Patch/High Intensity; Abronia latifolia
Non-Diagnostic Classifiers: Foredune; Lowland [Lowland]; Longshore bar; Sagpond; Woody-Herbaceous; Shoreline; Spit; Salt Spray; Unconsolidated; Beach (Landform); Blowout; Coast
National Mapping Codes: ESLF 3165

CONCEPT

Summary: This coastal system occurs in scattered locations from Point Conception, California, north to Coos Bay, Oregon. Coastal dunes include beaches, foredunes, sand spits, and active to stabilizing backdunes and sandsheets derived from quartz or gypsum sands. The mosaic of sparse to dense vegetation in dune systems is driven by sand deposition, erosion, and lateral movement. Coastal dunes often front portions of inlets and tidal marshes. They may also occur as extensive dune fields dominating large coastal bays. Dune vegetation typically includes herbaceous, succulent, and low-shrub species with varying degrees of tolerance for salt spray, wind and sand abrasion, and substrate stability. Dune succession is highly variable, so species composition can vary significantly between occurrences. Generally, these dune systems can be dominated by *Leymus mollis, Abronia latifolia, Ambrosia chamissonis, Baccharis pilularis, Calystegia soldanella, Artemisia pycnocephala, Ericameria ericoides, Eriogonum latifolium, Camissonia cheiranthifolia*, and *Carpobrotus chilensis (= Carpobrotus aequilateralus)*. Disturbance processes include dune blowouts caused by wind and occasional wave overwash during storm tidal surges.

DESCRIPTION

Environment: Coastal dunes include beaches, foredunes, sand spits, and active to stabilizing backdunes and sandsheets derived from quartz or gypsum sands. The mosaic of sparse to dense vegetation in dune systems is driven by sand deposition, erosion, and lateral movement. Coastal dunes often front portions of inlets and tidal marshes. They may also occur as extensive dune fields dominating large coastal bays. Climate is both Mediterranean and maritime; temperatures are moderate year-round. Most precipitation occurs in the winter months, followed by summer drought, and mild winter temperatures permit growing season throughout most of the year (Wiedemann 1984, Christy et al. 1998, Pickart and Barbour 2007). Clouds and fog are present throughout much of the year, with fog becoming increasingly common to the south (Wiedemann 1984). The dune localities are generally associated with nearby rivers, estuaries or bays; rivers deposit sediment which is carried by ocean currents and wind and deposited on flat coastline areas with onshore winds (Pickart and Barbour 2007). Dune sands are very poor soils, with no organic matter accumulation (Wiedemann 1984). pH is about neutral and the nutrient status is so low as to be almost unmeasurable. Dune sands have poor moisture-holding capacity. A salinity gradient appears to be important in California dunes, and germination or emergence stages are more vulnerable to soil salinity or washover of saltwater than established plants. Pickart and Barbour (2007) provide a summary of studies of the physiological ecology of dune plants.

Dynamics: Disturbance processes include dune blowouts caused by wind and occasional wave overwash during storm tidal surges. Cyclical dune activity is apparently triggered by cyclical changes in sea level associated with tectonic events (Wiedemann 1984, Christy et al. 1998, Pickart and Barbour 2007). Subsidence or uplift of 1.8 to 2.7 m (6-9 feet) associated with earthquakes would initiate new successional pathways after destruction of existing dune formations and vegetation (Thilenius 1995). Generally it appears that major earthquakes occur along this coastal region at 300- to 700-year intervals, and sometimes cause tsunamis (Carver et al. 1998, as cited in Pickart and Barbour 2007).

Wind is the other major disturbance process in this system. It drives seasonal movement of large dunes, in turn causing burial of forest vegetation along the eastern edge of the dune sheet and exhumation of previously buried vegetation in interdunal troughs. Storm winds lead to windthrow of many trees in exposed areas, and windfall is commonly seen in senescing stands of *Pinus contorta var. contorta*. Wind-driven sand and salt stunt and abrade plants, and can kill both buds and leaves of shrubs or conifers. Removal of vegetation exposes the sand to wind erosion, leading to the formation of blowouts or the complete destruction of stabilized dunes. Wind patterns are an important factor; in this system the northerly summer winds are associated with the North Pacific High and bring generally fair weather with occasional high-velocity land-sea breezes in the afternoon (Wiedemann 1984). In the winter, the low pressure systems commonly occurring further north are less important in this system. These wind patterns are modified by sheltering headlands and capes in places.

Fire, insects, and pathogens appear to have relatively minor roles in this system, although some *Pinus contorta var. contorta* stands are even-aged and result from stand-replacing fires; others result from primary succession (Christy et al. 1998). Pickart and Barbour (2007) provide a summary of recent work on plant-animal interactions and the roles of nitrogen-fixing plants in California dune ecosystems; they include topics such as rodent herbivory, the roles of ground-nesting bees in providing soil nutrients and pollination, cryptogamic soil crusts, obligate or facultative relationships between insects and plants, and others.

DISTRIBUTION

Range: Occurs in scattered locations from Point Conception, California, north to Coos Bay, Oregon.
Divisions: 204:P; 206:C
Nations: US
Subnations: CA, OR
Map Zones: 2:C, 3:C, 4:C
USFS Ecomap Regions: 263A:CC
TNC Ecoregions: 1:P, 14:C, 15:C

SOURCES

References: Barbour and Major 1988, Brown 1990, Christy et al. 1998, Comer et al. 2003, Holland and Keil 1995, Pickart 1987, Pickart and Barbour 2007, Pickart and Sawyer 1998, PRBO Conservation Science 2011, Sawyer and Keeler-Wolf 1995, Thilenius 1995, Wiedemann 1984, WNHP 2011

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722774#references

Description Author: P. Comer and T. Keeler-Wolf, mod. M. Reid
Version: 14 Jan 2014 **Stakeholders:** West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

MEDITERRANEAN CALIFORNIA SERPENTINE BARRENS (CES206.905)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Barren
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Non-Diagnostic Classifiers: Montane [Lower Montane]; Herbaceous; Moss/Lichen (Nonvascular); Serpentine; Mediterranean [Mediterranean Xeric-Oceanic]; Ultramafic with low Ca:Mg ratio; Very Shallow Soil; Xeric; Unconsolidated
National Mapping Codes: ESLF 3167

CONCEPT

Summary: This uncommon system is found in the central and southern Sierra Nevada, Central and Northern Coast Ranges, and Klamath Ranges at elevations between 150 to 1800 m (450-5500 feet), where serpentine outcrops and related soils are common. Not all serpentinite outcrops support distinct vegetation. Only those with very low Ca:Mg ratio impact biotic composition. This system is usually found on steep slopes with loosely consolidated soils and harsh soil chemical conditions (large rock outcrops and gravelly soil). There is typically a very low cover (<10%) of herbaceous species, including *Streptanthus* spp., *Hesperolinon* spp., *Allium falcifolium*, *Allium cratericola*, *Asclepias solanoana*, *Eriogonum ursinum*, and *Eriogonum nudum*.
Classification Comments: This system is very similar to North Pacific Serpentine Barren (CES204.095) of the East and West Cascades (Oregon and Washington) but tends to be more herbaceous in species composition, whereas North Pacific Serpentine Barren has a more developed woody component.
Similar Ecological Systems:
- North Pacific Serpentine Barren (CES204.095)

DESCRIPTION

Environment: This system is found in central and southern Sierra Nevada, central and northern Coast Ranges, and Klamath Mountains at elevations between 150 and 1800 m (450-5500 feet), where serpentine or ultramafic outcrops and related soils are common. Not all serpentinite outcrops support distinct vegetation. Only those with very low Ca:Mg ratio impact biotic composition. This system is usually found on steep slopes where loosely consolidated soils and harsh soil chemical conditions (large rock outcrops and gravelly soil) combine with xeric conditions (low rainfall or south- or west-facing, excessively-drained). Soils on ultramafics are usually shallow and skeletal, with little profile development. Ultramafic soils impose the following stresses on plants: imbalance of calcium and magnesium, magnesium toxicity, low availability of molybdenum, toxic levels of heavy metals, sometime high alkalinity, low concentrations of some essential nutrients, and low soil water storage capacity (Kruckeberg 1984, Sanchez-Mata 2007). In some cases, the steepness of the slopes and general sparseness of the vegetation result in continual erosion. Jimerson et al. (1995) found one plant community in this system to occur on convex, ridgetop or spur ridge positions where moisture conditions are extremely dry [often south- or west-facing]; exposed bare ground, gravel and rock have high cover. Occurrences are generally physiognomically distinct from the adjacent predominant forest or shrubland/chaparral vegetation; they can cover 100s of hectares.
Dynamics: The low cover of vascular plants combined with exposed sites leads to sheet erosion and soil loss being the major disturbance processes. Fine soil materials may be "captured" by micro-terraces leading to plant establishment and slow development of an organic soil horizon (Jimerson et al. 1995). Potential for alteration from fire is very low due to the high amount of soil and rock and low vegetation cover. Due the general lack of exotic species which tend to be intolerant of the ultramafic soils, this system is rich in native and endemic flora (Safford et al. 2005, Sanchez-Mata 2007). The interaction between serpentine soils and soil algae or fungi and small invertebrates is largely unstudied; Pegtel (1980) and Hopkins (1987) found that on barrens such as these the few tolerant plants are likely to be mycorrhizal. Harrison and Shapiro (1988) describe features of population biology of butterflies occurring on serpentines in northern California.

DISTRIBUTION

Range: This system is found in the central and southern Sierra Nevada, central and northern Coast Ranges, and Klamath Ranges at elevations between 150 and 1800 m (450-5500 feet).
Divisions: 206:C
Nations: US
Subnations: CA, OR
Map Zones: 2:C, 3:C, 6:C, 7:P
USFS Ecomap Regions: M261A:CC, M261B:CC, M261C:CC, M261D:CC, M261E:CC
TNC Ecoregions: 5:C, 12:C, 14:C, 15:C

SOURCES

References: Barbour and Major 1988, Barbour et al. 2007, Batten et al. 2006, Brooks and Minnich 2006, Comer et al. 2003, Harrison and Shapiro 1988, Holland and Keil 1995, Hopkins 1987, Jimerson et al. 1995, Kruckberg 1984, Pegtel 1980, PRBO Conservation Science 2011, Safford et al. 2005, Sanchez-Mata 2007, Sawyer and Keeler-Wolf 1995
Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722776#references
Description Author: P. Comer and T. Keeler-Wolf, mod. M.S. Reid
Version: 14 Jan 2014 **Stakeholders:** West
Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

MEDITERRANEAN CALIFORNIA SOUTHERN COASTAL DUNE (CES206.908)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Barren
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Dune field; Coastal Dune Mosaic; Foredune; Dune (Substrate); Mediterranean [Mediterranean Xeric-Oceanic]; Salt Spray; W-Patch/High Intensity; Blowout; Abronia maritima
Non-Diagnostic Classifiers: Lowland [Lowland]; Shrubland (Shrub-dominated); Sagpond; Woody-Herbaceous; Shoreline; Barrier beach; Sand Soil Texture; Xeric; Unconsolidated; Very Short Disturbance Interval; Beach (Landform)
National Mapping Codes: ESLF 3164

CONCEPT

Summary: This coastal system occurs in scattered locations from Point Conception, California, south to north-central Baja California. Coastal dunes include beaches, foredunes, sand spits, and active to stabilizing backdunes and sandsheets derived from quartz or gypsum sands. The mosaic of sparse to dense vegetation in dune systems is driven by sand deposition, erosion, and lateral movement. Coastal dunes often front portions of inlets and tidal marshes. They may also occur as extensive dune fields dominating large coastal bays. Dune vegetation typically includes herbaceous, succulent, and low-shrub species with varying degrees of tolerance for salt spray, wind and sand abrasion, and substrate stability. Dune succession is highly variable, so species composition can vary significantly between occurrences. Generally, this dune system includes fewer perennial grasses and more suffrutescent plants than more northern dune systems. This system can be dominated by *Abronia maritima, Abronia umbellata, Atriplex leucophylla, Isocoma menziesii (= Haplopappus venetus), Distichlis spicata, Croton californicus, Lupinus chamissonis,* and *Carpobrotus chilensis (= Carpobrotus aequilateralus)*. Disturbance processes include dune blowouts caused by wind and occasional wave overwash during storm tidal surges.

DESCRIPTION

Environment: Coastal dunes include beaches, foredunes, sand spits, and active to stabilizing backdunes and sandsheets derived from quartz or gypsum sands. The mosaic of sparse to dense vegetation in dune systems is driven by sand deposition, erosion, and lateral movement. Coastal dunes often front portions of inlets and tidal marshes. They may also occur as extensive dune fields dominating large coastal bays. The climate is both Mediterranean and maritime; temperatures are moderate year-round. Most precipitation occurs in the winter months, followed by summer drought, and mild winter temperatures permit growing season throughout most of the year. Clouds and fog are present throughout the year. The dune localities are generally associated with nearby rivers, estuaries or bays; rivers deposit sediment which is carried by ocean currents and wind and deposited on flat coastline areas with onshore winds (Pickart and Barbour 2007). Dune sands are very poor soils, with no organic matter accumulation (Wiedemann 1984), and poor moisture-holding capacity. pH is about neutral and the nutrient status is so low as to be almost unmeasurable. A salinity gradient appears to be important in California dunes, and germination or emergence stages are more vulnerable to soil salinity or washover of saltwater than established plants. Pickart and Barbour (2007) provide a summary of studies of the physiological ecology of dune plants.

Dynamics: Disturbance processes include dune blowouts caused by wind and occasional wave overwash during storm tidal surges. Wind is the major disturbance process in this system. It drives seasonal movement of large dunes, in turn causing burial of forest vegetation along the eastern edge of the dune sheet and exhumation of previously buried vegetation in interdunal troughs. Storm winds lead to windthrow of many trees in exposed areas. Wind-driven sand and salt stunt and abrade plants, and can kill both buds and leaves of shrubs or conifers. Removal of vegetation exposes the sand to wind erosion, leading to the formation of blowouts or the complete destruction of stabilized dunes. Wind patterns are an important factor; in this system the northerly summer winds are associated with the North Pacific High and bring generally fair weather with occasional high-velocity land-sea breezes in the afternoon (Wiedemann 1984). In the winter, the low pressure systems commonly occurring further north are less important in this system. These wind patterns are modified by sheltering headlands and capes in places.

Fire, insects, and pathogens appear to have relatively minor roles in this system. Pickart and Barbour (2007) provide a summary of recent work on plant-animal interactions and the roles of nitrogen-fixing plants in California dune ecosystems; they include topics such as rodent herbivory, the roles of ground-nesting bees in providing soil nutrients and pollination, cryptogamic soil crusts, obligate or facultative relationships between insects and plants, and others.

DISTRIBUTION

Range: Occurs in scattered locations from Point Conception, California, south to north-central Baja California.
Divisions: 206:C
Nations: MX, US
Subnations: CA, MXBC(MX)
Map Zones: 4:C
USFS Ecomap Regions: 261B:CC
TNC Ecoregions: NT1301:C, 16:C

SOURCES

References: Barbour and Major 1988, Brown 1990, Comer et al. 2003, Holland and Keil 1995, Pickart and Barbour 2007, PRBO Conservation Science 2011, Sawyer and Keeler-Wolf 1995, Wiedemann 1984, WNHP 2011

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722773#references

Description Author: P. Comer and T. Keeler-Wolf, mod. M. Reid

Version: 14 Jan 2014 **Stakeholders:** Latin America, West

Concept Author: P. Comer, T. Keeler-Wolf **ClassifResp:** West

NORTH AMERICAN GLACIER AND ICE FIELD (CES100.728)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Alpine Slopes; Alpine/AltiAndino [Alpine/AltiAndino]; Ice Fields / Glaciers; Glaciated
Non-Diagnostic Classifiers: Mediterranean [Mediterranean Xeric-Continental]; Temperate [Temperate Continental]
FGDC Crosswalk: Vegetated, No dominant lifeform, Sparsely vegetated
National Mapping Codes: EVT 2735; ESLF 3130; ESP 1735

CONCEPT

Summary: This widespread ecological system is composed of unvegetated landscapes of annual/perennial ice and snow in the North American arctic, and south into the highest elevations of the Rocky Mountains, Pacific coastal ranges, and the Sierra Madre of Mexico. They occur where snowfall accumulation exceeds melting. The primary ecological processes include snow/ice retention, wind desiccation, and permafrost. The snowpack/ice field never melts or, if so, then for only a few weeks. In places the ice fields are extensive, covering huge areas, while in the alpine, ice fields are part of the alpine mosaic consisting of alpine bedrock and scree, tundra dry meadow, wet meadow, fell-fields, and dwarf-shrubland. There are no vascular plants occurring in this system; biotic composition may include algal blooms, insect communities, and birds or mammals foraging on the insects.
Classification Comments: The barren rock and rubble within the glaciers is part of this system, not the alpine rock and scree systems.

DISTRIBUTION

Range: This ecological system is found throughout North America where high latitude or altitude results in permanent ice and snow fields, from the arctic and boreal regions south into the mountains of Alaska south and east through the cordillera of the Cascades and the Rocky Mountains. It also occurs in the alpine areas of the Sierra Madre in Mexico.
Divisions: 101:C; 102:C; 103:C; 104:C; 105:C; 204:C; 207:C; 305:C; 306:C
Nations: CA, MX, US
Subnations: AB, AK, BC, CO, ID, MB, MT, NT, ON, OR, QC, WA, WY, YT
Map Zones: 1:C, 2:?, 3:C, 7:C, 9:P, 10:C, 16:C, 19:C, 21:C, 28:C, 29:?, 67:C, 68:C, 69:C, 70:C, 71:C, 72:C, 73:C, 74:C, 75:C, 76:C, 77:C, 78:C
USFS Ecomap Regions: 331J:CC, 341G:CC, 342J:??, M242A:CC, M242B:CC, M242C:CP, M242D:CC, M261A:PP, M261E:PP, M331A:CC, M331B:CC, M331D:CC, M331E:CC, M331I:CC, M331J:CC, M332A:CC, M332B:CP, M332D:C?, M332E:CP, M332F:CP, M332G:CC, M333A:CC, M333B:CC, M333C:CC, M333D:CC
TNC Ecoregions: 3:C, 7:C, 9:C, 20:C, 69:C, 70:C, 71:P, 76:C, 77:P, 78:C, 79:C

SOURCES

References: Comer et al. 2003, Meidinger and Pojar 1991, Neely et al. 2001, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722944#references
Description Author: NatureServe Western Ecology Team, mod. M.S. Reid
Version: 22 Aug 2008 **Stakeholders:** Canada, Latin America, Midwest, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

NORTH AMERICAN WARM DESERT ACTIVE AND STABILIZED DUNE (CES302.744)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: North American Warm Desert (302)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Dune (Landform); Dune field; Dune (Substrate); Temperate [Temperate Xeric]; Sand Soil Texture; W-Landscape/High Intensity
Non-Diagnostic Classifiers: Dune (undifferentiated); Lowland [Lowland]; Shrubland (Shrub-dominated); Herbaceous; Tropical/Subtropical [Tropical Xeric]; Gypsiferous; Aridic
National Mapping Codes: ESLF 3121

CONCEPT

Summary: This ecological system occurs across the warm deserts of North America and is composed of unvegetated to sparsely vegetated (generally <10% plant cover) active dunes and sandsheets derived from quartz or gypsum sands. Common vegetation includes *Ambrosia dumosa, Abronia villosa, Artemisia filifolia, Atriplex canescens, Eriogonum deserticola, Larrea tridentata, Pleuraphis rigida, Poliomintha* spp., *Prosopis* spp., *Psorothamnus* spp., *Rhus microphylla,* and *Sporobolus flexuosus*. Dune "blowouts" and subsequent stabilization through succession are characteristic processes.
Similar Ecological Systems:
- Chihuahuan Gypsophilous Grassland and Steppe (CES302.732)

Component Associations:
- *Abronia villosa* Sparse Vegetation (CEGL003001, G2G3)
- *Artemisia filifolia - Psorothamnus scoparius - Dalea lanata* Gypsum Dune Shrubland (CEGL004561, G1G2)
- *Artemisia filifolia / Andropogon hallii - Achnatherum hymenoides* Gypsum Dune Shrubland (CEGL004559, G1G2)
- *Artemisia filifolia / Sporobolus flexuosus* Shrubland (CEGL001547, G5)
- *Artemisia filifolia / Sporobolus giganteus* Shrubland (CEGL001078, G5)
- *Cleome isomeris - Ephedra californica - Ericameria linearifolia* Shrubland (CEGL003056, G1G3)
- *Ephedra viridis / (Achnatherum hymenoides, Hesperostipa comata)* Shrubland (CEGL002354, GNR)
- *Ephedra viridis / Pleuraphis jamesii* Shrubland (CEGL002356, GNR)
- *Eriogonum deserticola* Sand Dune Sparse Vegetation (CEGL001962, G1)
- *Heliotropium convolvulaceum - Psoralidium lanceolatum - Polanisia jamesii* Sparse Vegetation (CEGL004581, G2?)
- *Heliotropium racemosum - Chamaesyce* sp. Sparse Vegetation (CEGL004582, G1?)
- *Poliomintha incana / Muhlenbergia pungens* Shrubland (CEGL002672, G3)
- *Prosopis glandulosa / Atriplex canescens* Shrubland (CEGL001382, G5)
- *Prosopis glandulosa / Sporobolus flexuosus* Shrubland (CEGL001386, G4)
- *Psorothamnus polydenius var. polydenius / Achnatherum hymenoides* Shrubland (CEGL001353, G3G4)
- *Sporobolus flexuosus - Dasyochloa pulchella* Herbaceous Vegetation (CEGL001693, G2?)
- *Sporobolus flexuosus - Paspalum setaceum* Herbaceous Vegetation (CEGL001694, G1G2)
- *Sporobolus flexuosus - Sporobolus contractus* Herbaceous Vegetation (CEGL001696, GNRQ)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- North American Warm Desert Interdunal Swale Wetland (CES302.039)

DISTRIBUTION

Range: This system occurs across the warm deserts of North America.
Divisions: 302:C
Nations: MX, US
Subnations: AZ, CA, MXBC(MX), MXBS(MX), MXCH(MX), MXSO(MX), NM, NV, TX
Map Zones: 13:C, 14:C, 15:?, 24:?, 25:C, 26:C, 27:C
USFS Ecomap Regions: 313B:??, 315A:CC, 315B:CC, 315H:CP, 321A:CC, 322A:CC, 322B:CC, 322C:CC, 331B:CC, M313A:CC, M313B:CC
TNC Ecoregions: 17:C, 22:C, 23:C, 24:C

SOURCES

References: Bowers 1982, Bowers 1984, Comer et al. 2003, Holland and Keil 1995, MacMahon 1988, Powell and Turner 1974, Thomas et al. 2004
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722928#references
Description Author: K.A. Schulz

Version: 21 Apr 2005
Concept Author: NatureServe Western Ecology Team

Stakeholders: Latin America, Southeast, West
ClassifResp: West

NORTH AMERICAN WARM DESERT BADLAND (CES302.743)

CLASSIFIERS

Conf.: 3 - Weak **Classification Status:** Standard
Primary Division: North American Warm Desert (302)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Badland; Badlands; Alkaline Soil; Shale and Mudstone; Silt Soil Texture; Clay Soil Texture
Non-Diagnostic Classifiers: Lowland [Lowland]; Shrubland (Shrub-dominated); Moss/Lichen (Nonvascular); Tropical/Subtropical [Tropical Xeric]; Temperate [Temperate Xeric]; Aridic; Very Short Disturbance Interval
National Mapping Codes: ESLF 3123

CONCEPT

Summary: This ecological system occurs from Arizona to Texas and adjacent Mexico. It is restricted to barren and sparsely vegetated (generally <10% plant cover) substrates typically derived from marine shale or mudstone (badlands and mudhills). The harsh soil properties and high rate of erosion and deposition are driving environmental variables supporting sparse shrubs and dwarf-shrubs e.g., *Atriplex hymenelytra*, and herbaceous vegetation.

Component Associations:
- *Atriplex hymenelytra* Shrubland (CEGL001317, G5)
- *Cleome isomeris - Ephedra californica - Ericameria linearifolia* Shrubland (CEGL003056, G1G3)

DISTRIBUTION

Range: This ecological system occurs from Arizona to Texas and adjacent Mexico.
Divisions: 302:C
Nations: MX, US
Subnations: AZ, MXCH(MX), MXSO(MX), NM, TX
Map Zones: 13:C, 14:?, 15:?, 25:P, 26:?
USFS Ecomap Regions: 322A:CC, 322B:C?, 322C:C?
TNC Ecoregions: 17:C, 22:P, 23:P, 24:C

SOURCES

References: Comer et al. 2003, Thomas et al. 2004
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722929#references
Description Author: NatureServe Western Ecology Team
Version: 20 Feb 2003 **Stakeholders:** Latin America, Southeast, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

NORTH AMERICAN WARM DESERT BEDROCK CLIFF AND OUTCROP (CES302.745)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: North American Warm Desert (302)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Rock Outcrops/Barrens/Glades; Temperate [Temperate Xeric]; Canyon; Cliff (Landform)
Non-Diagnostic Classifiers: Montane [Upper Montane]; Montane [Montane]; Montane [Lower Montane]; Lowland [Foothill]; Lowland [Lowland]; Rockfall avalanche; Ridge/Summit/Upper Slope; Sideslope; Toeslope/Valley Bottom; Granitic Rock; Sedimentary Rock; Metamorphic Rock; Igneous Rock; Tropical/Subtropical [Tropical Xeric]; Very Shallow Soil
National Mapping Codes: ESLF 3120

CONCEPT

Summary: This ecological system occurs from California to Texas and adjacent Mexico. It is found from subalpine to foothill elevations and includes barren and sparsely vegetated landscapes (generally <10% plant cover) of steep cliff faces, narrow canyons, and smaller rock outcrops of various igneous, sedimentary, and metamorphic bedrock types. Also included are unstable scree and talus slopes that typically occur bellow cliff faces. Species present are diverse and may include *Bursera microphylla*, *Fouquieria splendens*, *Nolina bigelovii*, *Opuntia bigelovii*, and other desert species, especially succulents. Lichens are predominant lifeforms in some areas. May include a variety of desert shrublands less than 2 ha (5 acres) in size from adjacent areas.
Similar Ecological Systems:
- Edwards Plateau Cliff (CES303.653)

Component Associations:
- *Fouquieria splendens / Bouteloua hirsuta* Shrubland (CEGL001377, G3?)
- *Fouquieria splendens* Shrubland (CEGL004452, GNR)
- *Larrea tridentata - Jatropha dioica var. graminea* Shrubland (CEGL004566, G3?)
- *Larrea tridentata - Opuntia schottii* Shrubland (CEGL004567, G4?)
- *Opuntia bigelovii* Shrubland (CEGL003065, G4?)

DISTRIBUTION

Range: This ecological system occurs from California to Texas and adjacent Mexico.
Divisions: 302:C
Nations: MX, US
Subnations: AZ, CA, MXBC(MX), MXBS(MX), MXCH(MX), MXSO(MX), NM, NV, TX
Map Zones: 12:?, 13:C, 14:C, 15:P, 16:?, 17:P, 23:?, 24:C, 25:C, 26:C, 27:P, 28:?
USFS Ecomap Regions: 313A:CC, 313B:CC, 313C:CC, 313D:CC, 315A:CC, 315B:CC, 315H:CC, 321A:CC, 322A:CC, 322B:CC, 322C:CC, 341F:CC, M313A:CC, M313B:CC
TNC Ecoregions: 17:C, 22:C, 23:C, 24:C

SOURCES

References: Barbour and Major 1988, Comer et al. 2003, Dick-Peddie 1993, MacMahon 1988, MacMahon and Wagner 1985, Shreve and Wiggins 1964, Thomas et al. 2004
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722927#references
Description Author: NatureServe Western Ecology Team
Version: 20 Feb 2003 **Stakeholders:** Latin America, Southeast, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

NORTH AMERICAN WARM DESERT PAVEMENT (CES302.750)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: North American Warm Desert (302)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Lowland [Lowland]; Playa; Desert Pavement; Tropical/Subtropical [Tropical Xeric]; Temperate [Temperate Xeric]; W-Landscape/High Intensity
Non-Diagnostic Classifiers: Shrubland (Shrub-dominated); Toeslope/Valley Bottom; Aridic
National Mapping Codes: ESLF 3143

CONCEPT

Summary: This ecological system occurs throughout much of the warm deserts of North America and is composed of unvegetated to very sparsely vegetated (<2% plant cover) landscapes, typically flat basins where extreme temperature and wind develop ground surfaces of fine to medium gravel coated with "desert varnish." This sparsely vegetated system may surround playas in valley bottoms or near washes and, less commonly, on dissected, eroding alluvial fans. Very low cover of desert scrub species such as *Larrea tridentata* or *Eriogonum fasciculatum* is usually present. However, ephemeral herbaceous species may have high cover in response to seasonal precipitation, including *Chorizanthe rigida*, *Eriogonum inflatum*, and *Geraea canescens*.

Component Associations:
- *Ambrosia deltoidea / Simmondsia chinensis* Shrubland (CEGL000953, G4)
- *Ambrosia dumosa - Larrea tridentata var. tridentata* Dwarf-shrubland (CEGL000956, G4)
- *Eriogonum fasciculatum - Purshia glandulosa* Shrubland (CEGL001259, G4)
- *Eriogonum fasciculatum* Shrubland (CEGL001258, G5)

DISTRIBUTION

Range: Occurs throughout much of the warm deserts of North America.
Divisions: 302:C
Nations: MX, US
Subnations: AZ, CA, MXCH(MX), MXSO(MX), NM, NV, TX
Map Zones: 13:C, 14:C, 15:?, 24:?, 25:C, 26:C
USFS Ecomap Regions: 321A:CC, 322A:CC, 322B:CC, 322C:CC, 341F:PP, M313A:CP, M313B:CC
TNC Ecoregions: 17:C, 23:C, 24:C

SOURCES

References: Barbour and Major 1988, Comer et al. 2003, MacMahon 1988, Thomas et al. 2004
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722922#references
Description Author: NatureServe Western Ecology Team
Version: 16 Jan 2009 **Stakeholders:** Latin America, Southeast, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

NORTH AMERICAN WARM DESERT PLAYA (CES302.751)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: North American Warm Desert (302)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland; Wetland
Diagnostic Classifiers: Alkaline Water; Saline Water Chemistry; Caliche Layer; Impermeable Layer; Intermittent Flooding; Lowland [Lowland]; Playa; Desert Pavement; Tropical/Subtropical [Tropical Xeric]; Temperate [Temperate Xeric]; Depressional; Alkaline Soil; Aridic
Non-Diagnostic Classifiers: Clay Subsoil Texture; Shrubland (Shrub-dominated); Woody-Herbaceous; Isolated Wetland [Partially Isolated]; Dwarf-Shrub; Forb; Graminoid
National Mapping Codes: ESLF 3161

CONCEPT

Summary: This ecological system is composed of barren and sparsely vegetated playas (generally <10% plant cover) found across the warm deserts of North America, extending into the extreme southern end of the San Joaquin Valley in California. Playas form with intermittent flooding, followed by evaporation, leaving behind a saline residue. Salt crusts are common throughout, with small saltgrass beds in depressions and sparse shrubs around the margins. Subsoils often include an impermeable layer of clay or caliche. Large desert playas tend to be defined by vegetation rings formed in response to salinity. Given their common location in windswept desert basins, dune fields often form downwind of large playas. In turn, playas associated with dunes often have a deeper water supply. Species may include *Allenrolfea occidentalis, Suaeda* spp., *Distichlis spicata, Eleocharis palustris, Oryzopsis* spp., *Sporobolus* spp., *Tiquilia* spp., or *Atriplex* spp. Ephemeral herbaceous species may have high cover periodically. Adjacent vegetation is typically Sonora-Mojave Mixed Salt Desert Scrub (CES302.749), Chihuahuan Mixed Salt Desert Scrub (CES302.017), Gulf of California Coastal Mixed Salt Desert Scrub (CES302.015), Baja California del Norte Gulf Coast Ocotillo-Limberbush-Creosotebush Desert Scrub (CES302.014), or Chihuahuan Creosotebush Desert Scrub (CES302.731).
Related Concepts:
- Saltbush - Greasewood (501) (Shiflet 1994) Intersecting. Desert playas can have salt desert scrub in low cover.

Component Associations:
- *Allenrolfea occidentalis* Shrubland (CEGL000988, G3)
- *Atriplex polycarpa / Pleuraphis mutica* Shrubland (CEGL001319, GU)
- *Atriplex polycarpa* Shrubland (CEGL001318, G5)
- *Bouteloua breviseta* Sparse Vegetation (CEGL004609, G3?)
- *Sesuvium verrucosum* Sparse Vegetation (CEGL004595, G3?)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Baja California del Norte Gulf Coast Ocotillo-Limberbush-Creosotebush Desert Scrub (CES302.014)
- Chihuahuan Creosotebush Desert Scrub (CES302.731)
- Chihuahuan Mixed Salt Desert Scrub (CES302.017)
- Gulf of California Coastal Mixed Salt Desert Scrub (CES302.015)
- Sonora-Mojave Mixed Salt Desert Scrub (CES302.749)

Adjacent Ecological System Comments: Adjacent vegetation is typically Sonora-Mojave Mixed Salt Desert Scrub (CES302.749), Chihuahuan Mixed Salt Desert Scrub (CES302.017), Gulf of California Coastal Mixed Salt Desert Scrub (CES302.015), Baja California del Norte Gulf Coast Ocotillo-Limberbush-Creosotebush Desert Scrub (CES302.014), or Chihuahuan Creosotebush Desert Scrub (CES302.731).

DISTRIBUTION

Range: Found across the warm deserts of North America, extending into the extreme southern end of the San Joaquin Valley in California.
Divisions: 302:C
Nations: MX, US
Subnations: AZ, CA, MXBC(MX), MXCH(MX), MXSO(MX), NM, NV, TX
Map Zones: 13:C, 14:C, 16:?, 17:?, 25:C, 26:C, 27:P, 28:?
USFS Ecomap Regions: 313A:CC, 315A:CC, 315B:CC, 315H:CP, 321A:CC, 322A:CC, 322B:CC, 322C:CP, 341F:CC, M313B:CC
TNC Ecoregions: 17:C, 22:C, 23:C, 24:C

SOURCES

References: Barbour and Major 1988, Brown 1982a, Comer et al. 2003, Dick-Peddie 1993, Holland and Keil 1995, Muldavin et al. 2000b, Thomas et al. 2004
Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722921#references
Description Author: NatureServe Western Ecology Team
Version: 14 Dec 2004 **Stakeholders:** Latin America, Southeast, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

NORTH AMERICAN WARM DESERT VOLCANIC ROCKLAND (CES302.754)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Primary Division: North American Warm Desert (302)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Lava; Cinder; Basalt; Tropical/Subtropical [Tropical Xeric]; Temperate [Temperate Xeric]
Non-Diagnostic Classifiers: Montane [Upper Montane]; Montane [Montane]; Montane [Lower Montane]; Lowland [Foothill]; Lowland [Lowland]; Shrubland (Shrub-dominated); Ridge/Summit/Upper Slope; Sideslope; Toeslope/Valley Bottom; Aridic
National Mapping Codes: ESLF 3180

CONCEPT

Summary: This ecological system occurs across the warm deserts of North America and is restricted to barren and sparsely vegetated (<10% plant cover) volcanic substrates such as basalt lava (malpais) and tuff. Vegetation is variable and includes a variety of species depending on local environmental conditions, e.g., elevation, age and type of substrate. Typically scattered *Larrea tridentata*, *Atriplex hymenelytra*, or other desert shrubs are present.

Component Associations:
- *Aloysia wrightii / Perityle staurophylla* Shrubland (CEGL001280, GNRQ)
- *Opuntia bigelovii* Shrubland (CEGL003065, G4?)

DISTRIBUTION

Range: Occurs across the warm deserts of North America.
Divisions: 302:C
Nations: MX, US
Subnations: AZ, CA, MXBC(MX), MXCH(MX), MXSO(MX), NM, NV, TX
Map Zones: 13:C, 14:C, 15:P, 17:?, 25:C, 26:C
USFS Ecomap Regions: 313A:CC, 313C:CP, 321A:CC, 322A:CC, 322B:CC, 322C:C?, 341F:CC, M313A:CP, M313B:CC
TNC Ecoregions: 17:C, 22:C, 23:C, 24:C

SOURCES

References: Barbour and Major 1988, Brown 1982a, Comer et al. 2003, Dick-Peddie 1993, Thomas et al. 2004
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722918#references
Description Author: NatureServe Western Ecology Team
Version: 20 Feb 2003
Stakeholders: Latin America, Southeast, West
Concept Author: NatureServe Western Ecology Team
ClassifResp: West

NORTH ATLANTIC COBBLE SHORE (CES201.051)

CLASSIFIERS

Classification Status: Standard

Primary Division: Laurentian-Acadian (201)
Land Cover Class: Barren
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland; Wetland
Non-Diagnostic Classifiers: <24-hour hydroperiod; Lowland [Lowland]; Boreal [Boreal Hyperoceanic]; Salt Spray; Beach (Landform)
National Mapping Codes: ESLF 3132

CONCEPT

Summary: This system encompasses areas of varying exposure that include boulder, cobble, and gravel shores, often adjacent to bedrock shoreline and rocky intertidal areas. Cobble shores may have >75% cobble bottom. Some occurrences are mixed sand and gravel beaches, others have different combinations of particle sizes. These areas have sufficient exposure to winnow out the fine sand-, silt- and clay-sized particles without removing the larger grain sizes. The bottom is usually comprised of cobble and gravel, although shell hash may also be present in various amounts. These areas have low diversity, probably due to insufficient nutrition for and high disturbance of infauna. Diagnostic species include species colonizing from nearby rocky areas if present, e.g., Irish moss (*Chondrus crispus*), rockweed (*Fucus vesiculosus*), knotted wrack (*Ascophyllum nodosum*), coralline algae (*Corallina officinalis*), and kelp (*Laminaria* spp.). Fauna is composed of the following: segmented worms (*Enchytraeus* spp.), collembola (mostly *Anurida maritima*), blue mussels (*Mytilus* spp.), periwinkles (*Littorina littorea*, *Littorina obtusata*, *Littorina saxatilis*), limpets (*Tectura testudinalis*), and barnacles (*Semibalanus balanoides*), among others.
Similar Ecological Systems:
- North Atlantic Rocky Intertidal (CES201.048)

DISTRIBUTION

Divisions: 103:P; 201:C; 202:P
Nations: CA, US
Subnations: LB, MA, ME, NB, NH, NS, QC
Map Zones: 66:C
TNC Ecoregions: 63:C

SOURCES

References: Brown 1993, Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722658#references
Description Author: S. Gawler, P. Comer
Version: 18 Apr 2003
Concept Author: S. Gawler, P. Comer
Stakeholders: Canada, East
ClassifResp: East

NORTH ATLANTIC INTERTIDAL MUDFLAT (CES201.050)

CLASSIFIERS

Classification Status: Standard

Primary Division: Laurentian-Acadian (201)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Wetland
Non-Diagnostic Classifiers: <24-hour hydroperiod; Lowland [Lowland]; Herbaceous
National Mapping Codes: ESLF 3133

CONCEPT

Summary: Mudflats are usually located in quiet pockets of bays and protected by headlands. Sand-sized particles are mixed with silt and clay. These flats can be highly productive of clams and other invertebrates, and are important habitats for many shorebird species, including the semipalmated sandpiper, semipalmated plover, short-billed dowitcher, black-bellied plover, and least sandpiper. In the summer, *Enteromorpha intestinalis* can cover these mudflats. Other characteristic species include *Enteromorpha prolifera, Ulva lactuca, Rhizoclonium riparium, Ruppia maritima*, and *Zostera marina*.
Classification Comments: This system currently extends from Cape Hatteras to the Canadian Maritimes. Compositional variation is known to exist across this range; it is left as one system pending finalization of NatureServe's marine/estuarine classification and determination of how the two classifications relate. For example, on the more local scale of the Gulf of Maine, it has been suggested that mudflats east of the Penobscot River contain somewhat different assemblages of organisms than do mudflats west of the Penobscot River (Brown 1993). Some factor (perhaps temperature) would be necessary to separate these communities.
Similar Ecological Systems:
- North Atlantic Tidal Sand Flat (CES201.049)

Component Associations:
- Intertidal Mudflats Sparse Vegetation (CEGL006614, G5)
- *Zostera marina* Herbaceous Vegetation (CEGL004336, G4G5)

DISTRIBUTION

Range: This system occurs along the mid- and north Atlantic coasts from North Carolina north into Canada.
Divisions: 103:P; 201:C; 202:C; 203:C
Nations: CA, US
Subnations: CT, DE, LB, MA, MD, ME, NB, NC, NH, NJ, NS, NY, QC?, RI, VA
Map Zones: 58:P, 60:C, 65:C, 66:C
TNC Ecoregions: 57:P, 58:C, 62:C, 63:C

SOURCES

References: Brown 1993, Comer et al. 2003, Nova Scotia Museum of Natural History 1996
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722659#references
Description Author: S. Gawler and P. Comer
Version: 05 Feb 2009 **Stakeholders:** Canada, East, Southeast
Concept Author: S. Gawler, P. Comer **ClassifResp:** East

NORTH ATLANTIC ROCKY INTERTIDAL (CES201.048)

CLASSIFIERS

Classification Status: Standard

Primary Division: Laurentian-Acadian (201)
Land Cover Class: Barren
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Saltwater (Polyhaline); <24-hour hydroperiod; Moss/Lichen (Nonvascular); Tidal flat; Lichen; Alga
Non-Diagnostic Classifiers: Lowland [Lowland]; Nonvascular
National Mapping Codes: ESLF 3190

CONCEPT

Summary: This ecological system represents the intertidal zone with solid rock substrates that can experience extremes of exposure to winds, waves, currents, and ice-scour. This encompasses both exposed and partially exposed habitats. Lichens (often *Xanthoria* spp., *Verrucaria* spp., and *Vaucheria* spp.) and blue-green algae (*Caliothrix* spp.) are present in the supralittoral and high littoral zones, respectively. Barnacles, usually *Semibalanus balanoides*, are found in the mid-intertidal zone, usually in crevices that offer some protection from the extreme elements. Mussels are found in the lower intertidal, also appearing mostly in crevices. Diagnostic species include Irish moss (*Chondrus crispus*), rockweed (*Fucus vesiculosus*, *Fucus evanescens*, and *Fucus spiralis*), knotted wrack (*Ascophyllum nodosum*), hollow-stemmed kelp (*Laminaria* spp.), blue mussels (*Mytilus edulis*), common periwinkles (*Littorina littorea*), dogwhelks (*Nucella lapillus*), and springtails (*Anurida maritima*). In the low-intertidal zone, small fronds of kelp may be present, but short, torn stipes are often all that remain. Rockweed and knotted wrack, which are typically found in less exposed rocky habitats, are small, restricted to crevices, or missing. Tidepools are frequently found in these habitats and are inhabited by both intertidal and subtidal species. Tidepools are nurseries for lumpfish, sea snails, and pollock. Many other fish have also been identified in tidepools. Many species of birds are found on these rocky shores. Purple sandpipers are found in the winter; ruddy turnstone and sanderlings are the main species in spring and fall migrations. Other shorebirds that also use rocky shores include black-bellied plovers, American oystercatchers, and pectoral sandpipers.
Classification Comments: This system currently extends from New York to the Canadian Maritimes. Compositional variation may exist across this range; it is left as one system pending finalization of NatureServe's marine/estuarine classification and determination of how the two classifications relate.
Similar Ecological Systems:
- North Atlantic Cobble Shore (CES201.051)--is similar but on a loose rock substrate.

Component Associations:
- *Ascophyllum nodosum - Fucus vesiculosus* Tidal Algal Nonvascular Vegetation (CEGL006341, GNR)

DISTRIBUTION

Range: This system is found throughout the Gulf of Maine and extending sporadically down to New York.
Divisions: 103:C; 201:C; 202:C
Nations: CA, US
Subnations: CT, LB, MA, ME, NB, NH, NS, NY, QC?, RI
Map Zones: 65:C, 66:C
TNC Ecoregions: 62:C, 63:C

SOURCES

References: Brown 1993, Comer et al. 2003, Olivero n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722661#references
Description Author: S. Gawler and P. Comer
Version: 04 Feb 2009
Concept Author: S. Gawler, P. Comer
Stakeholders: Canada, East
ClassifResp: East

NORTH ATLANTIC TIDAL SAND FLAT (CES201.049)

CLASSIFIERS

Classification Status: Standard

Primary Division: Laurentian-Acadian (201)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Wetland
Diagnostic Classifiers: Boreal [Boreal Hyperoceanic]; Unconsolidated; Alga
Non-Diagnostic Classifiers: Lowland [Lowland]
National Mapping Codes: ESLF 3134

CONCEPT

Summary: This system of intertidal sand flats occurs primarily in the embayed areas of the mid-Atlantic and north Atlantic coasts. Rocky or sandy barriers help create protected sounds and lagoons, providing areas for colonization of hydromorphic herbaceous vegetation. Local habitats range from small guts, shallow tributary creeks, and large saline pools to shallow estuarine bays, tidal creeks, and estuary pools. *Zostera marina* is the dominant plant species in saline habitats, but not all sand flats are vegetated. The invertebrate diversity in these sheltered habitats is higher than that of exposed and partially exposed sandy beaches. These habitats are frequently used by shorebirds, such as sanderlings, semipalmated sandpipers, black-bellied plovers, red knots, and semipalmated plovers.
Classification Comments: This system currently extends from Cape Hatteras to the Canadian Maritimes. Compositional variation is known to exist across this range; it is left as one system pending finalization of NatureServe's marine/estuarine classification and determination of how the two classifications relate.
Similar Ecological Systems:
- North Atlantic Intertidal Mudflat (CES201.050)
- Northern Atlantic Coastal Plain Seagrass Bed (CES203.246)

Component Associations:
- *Zostera marina* Herbaceous Vegetation (CEGL004336, G4G5)

DISTRIBUTION

Range: This system occurs primarily in the embayed regions of mid- and north Atlantic coast from North Carolina north into Canada.
Divisions: 103:C; 201:C; 202:C; 203:C
Nations: CA, US
Subnations: CT, DE, LB, MA, MD, ME, NB, NC, NF, NH, NJ, NS, NY, QC?, RI, VA
Map Zones: 58:P, 60:C, 65:C, 66:C
TNC Ecoregions: 57:P, 58:C, 62:C, 63:C

SOURCES

References: Brown 1993, Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722660#references
Description Author: S. Gawler and P. Comer
Version: 05 Feb 2009 **Stakeholders:** Canada, East, Southeast
Concept Author: S. Gawler, P. Comer **ClassifResp:** East

NORTH PACIFIC ACTIVE INLAND DUNE (CES204.861)

CLASSIFIERS

Conf.: 3 - Weak **Classification Status:** Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Herbaceous; Dune (Substrate); Very Short Disturbance Interval; Graminoid
Non-Diagnostic Classifiers: Lowland [Lowland]; Temperate [Temperate Continental]; Unconsolidated
National Mapping Codes: ESLF 3157

CONCEPT

Summary: Active inland dunes occur near the terminus of glaciers and on the edge of outwash plains, located mostly in south-central and southeastern Alaska; one rare remnant outlier example occurs in the western Columbia River Gorge of Oregon. Species composition is variable, ranging from *Leymus arenarius (= Elymus arenarius)* to *Betula papyrifera* to *Alnus* species. Disturbance is primarily from dune blowouts and the deposition of sand and loess. The Oregon occurrence is now mostly stabilized by vegetation because sand resupply from the Columbia River has been cut off by hydroelectric dams, but about 20 acres of open dunes remain active because of perennially strong winds. Dune creep continues to bury a bottomland forest of *Populus balsamifera ssp. trichocarpa*, *Fraxinus latifolia*, and *Cornus sericea*. This dune is 24-30.5 m (80-100 feet) tall, and a stabilized dune nearby is about 49 m (160 feet) tall.
Classification Comments: In Alaska, active inland dunes (as opposed to coastal dunes) have not been identified for the maritime region. It's now unclear whether this system occurs in Alaska, or only in one location in Oregon. Inland dunes apparently do not occur in the Cook Inlet Basin.

DISTRIBUTION

Range: This system is found from the Columbia River Gorge north. In Washington, only coastal dunes occur.
Divisions: 204:C
Nations: US
Subnations: AK?, OR
Map Zones: 1:P, 7:P
USFS Ecomap Regions: 331A:PP
TNC Ecoregions: 1:C

SOURCES

References: Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722814#references
Description Author: K. Boggs and J. Kagan, mod. C. Chappell and G. Kittel
Version: 07 Feb 2005 **Stakeholders:** West
Concept Author: K. Boggs and J. Kagan **ClassifResp:** West

NORTH PACIFIC ACTIVE VOLCANIC ROCK AND CINDER LAND (CES204.092)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Lava; Cinder; Basalt
National Mapping Codes: ESLF 3140

CONCEPT

Summary: This ecological system includes active volcanic landscapes dominated by ash, pyroclastic deposits, lava, landslides and other exposed bare mineral and rock. Periodic eruptions and earthquakes are the primary processes maintaining a primarily barren environment. Decades of inactivity slowly provide opportunity for development of other systems, such as North American Glacier and Ice Field (CES300.728) or North Pacific Wooded Volcanic Flowage (CES204.883), or primary successional stages of surrounding vegetated systems to develop.
Classification Comments: Mount St. Helens is the prototype. Barren volcanic landscapes on the Alaska Peninsula and Aleutian Islands have been placed into Aleutian Volcanic Rock and Talus (CES105.308).
Similar Ecological Systems:
- Aleutian Volcanic Rock and Talus (CES105.308)

DISTRIBUTION

Range: This system is found in the Cascade Range from northern California north to Washington and is limited to barren and sparsely vegetated volcanic substrates.
Divisions: 204:C
Nations: US
Subnations: CA?, OR, WA
Map Zones: 1:C, 2:P, 6:P, 7:C, 8:P, 9:P
USFS Ecomap Regions: M242B:C?, M242C:CC, M242D:CP
TNC Ecoregions: 3:C, 4:C, 5:C, 81:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.769600#references
Description Author: R. Crawford
Version: 16 Jan 2009
Stakeholders: West
Concept Author: R. Crawford
ClassifResp: West

NORTH PACIFIC ALPINE AND SUBALPINE BEDROCK AND SCREE (CES204.853)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Alpine Slopes; Alpine/AltiAndino; Talus (Substrate); Rock Outcrops/Barrens/Glades; Oligotrophic Soil; Very Shallow Soil
Non-Diagnostic Classifiers: Temperate [Temperate Continental]; Glaciated; Unconsolidated
FGDC Crosswalk: Vegetated, No dominant lifeform, Sparsely vegetated, Boulder, gravel, cobble, or talus
National Mapping Codes: EVT 2734; ESLF 3118; ESP 1734

CONCEPT

Summary: This ecological system includes all the exposed rock and rubble above the forest line (subalpine parkland and above) in the North Pacific mountain ranges and is restricted to the highest elevations in the Cascade Range, from southwestern British Columbia south into northern California, and also north into southeastern Alaska. It is composed of barren and sparsely vegetated alpine substrates, typically including both bedrock outcrops and scree slopes, upper mountain slopes, summits and nunataks. Nonvascular- (lichen-) dominated communities are common. Exposure to desiccating winds, rocky and sometimes unstable substrates, and a short growing season limit plant growth. In Alaska, this system usually occurs above alpine dwarf-shrub, herbaceous meadow, and dwarf-shrub-herbaceous systems typically at elevations higher than 915 m (3000 feet) (possibly higher in southeastern Alaska). There can be sparse cover of forbs, grasses, lichens, shrubs and small trees, but the total vascular plant cover is typically less than 25% due to the high cover of exposed rock. Species composition is variable and may include *Artemisia arctica, Astragalus alpinus, Carex microchaeta, Minuartia arctica, Salix rotundifolia, Saxifraga sibirica (= Saxifraga bracteata), Saxifraga bronchialis, Sibbaldia procumbens*, and *Silene acaulis*. Common nonvascular genera include *Racomitrium* and *Stereocaulon*.
Classification Comments: This system now includes the type known as Maritime High Alpine Herbaceous by the Alaska Natural Heritage Program.
Related Concepts:
- AN Alpine Sparsely Vegetated (Ecosystems Working Group 1998) Broader
- AU Alpine Unvegetated (Ecosystems Working Group 1998) Broader
- III.B.1.c - Alpine herbs (Viereck et al. 1992) Broader. sparse to unvegetated

DISTRIBUTION

Range: This ecological system is restricted to the highest elevations in the North Pacific ranges, from southeastern Alaska south into northern California.
Divisions: 204:C
Nations: CA, US
Subnations: AK, BC, CA, OR, WA
Map Zones: 1:C, 7:C, 77:C, 78:C
USFS Ecomap Regions: 342I:PP, M242A:CC, M242B:CC, M242C:CC, M242D:CC
TNC Ecoregions: 1:C, 2:C, 3:C, 4:P, 69:C, 70:C, 81:C

SOURCES

References: Ecosystems Working Group 1998, Meidinger and Pojar 1991, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.767930#references
Description Author: R. Crawford and M.S. Reid, mod. C. Chappell and T. Boucher
Version: 10 Dec 2008 **Stakeholders:** Canada, West
Concept Author: R. Crawford **ClassifResp:** West

NORTH PACIFIC COASTAL CLIFF AND BLUFF (CES204.094)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Barren
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Headland; Sea cliff; Talus (Substrate); Rock Outcrops/Barrens/Glades; Oligotrophic Soil; Salt Spray; Very Shallow Soil; Landslide; W-Landscape/High Intensity; Bluff
Non-Diagnostic Classifiers: Lowland [Lowland]; Cliff (Substrate); Temperate [Temperate Oceanic]; Saline Substrate Chemistry; Xeric; Cliff (Landform); Coast
National Mapping Codes: ESLF 3158

CONCEPT

Summary: This ecological system includes unvegetated or sparsely vegetated rock cliffs and very steep bluffs of glacial deposits along the Pacific Ocean and associated marine and estuarine inlets. It is restricted to degrading slopes from southwestern British Columbia south into central Oregon. It is composed of barren and sparsely vegetated substrates, typically including exposed sediments, bedrock, and scree slopes. Exposure to waves, eroding and desiccating winds, slope failures and sheet erosion create gravelly to rocky substrates that are often unstable. There can be sparse cover of forbs, grasses, lichens and low shrubs.
Classification Comments: Small areas of rock outcrop within a mosaic of vegetated systems are best considered part of an adjacent system, e.g., within herbaceous balds and bluffs. In Washington, North Pacific Hypermaritime Shrub and Herbaceous Headland (CES204.088) and this cliff system sometimes occur adjacent or in a mosaic together, but not always. It is quite frequent to get cliffs without the vegetated part. The shrub and herbaceous component is less common. In Mediterranean California these two types of systems are split from each other (coastal grassland from coastal bluff). As far as biodiversity goes, the vegetated versus the nonvegetated are very different. This system is distinguished from Mediterranean California Coastal Bluff (CES206.906) by being further north in areas where summers are typically cooler, and winters may include some snow.

DISTRIBUTION

Range: This system is found from central Oregon north along the immediate coast into British Columbia.
Divisions: 204:C
Nations: CA, US
Subnations: BC, OR, WA
Map Zones: 1:C, 2:C
USFS Ecomap Regions: 242A:CC, 263A:??, M242A:CC, M261A:??
TNC Ecoregions: 1:C, 69:C

SOURCES

References: Franklin and Dyrness 1973, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.769613#references
Description Author: R. Crawford and C. Chappell
Version: 30 Mar 2005
Stakeholders: Canada, West
Concept Author: R. Crawford and C. Chappell
ClassifResp: West

NORTH PACIFIC MARITIME COASTAL SAND DUNE AND STRAND (CES200.881)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Herbaceous; Dune (Substrate); Beach (Substrate); Temperate [Temperate Oceanic]; Salt Spray
Non-Diagnostic Classifiers: Lowland [Lowland]
National Mapping Codes: ESLF 3177

CONCEPT

Summary: Coastal sand dunes are found throughout the northern Pacific Coast, from south-central Alaska to the central Oregon coast (roughly Coos Bay). This system covers large areas of the southern Washington and central Oregon coasts, but coastal dunes in Alaska have been placed into a different system. Coastal dunes include beach strand (not the beach itself but sparsely or densely vegetated areas behind the beach), foredunes, sand spits, and active to stabile backdunes and sandsheets derived from quartz or gypsum sands. The mosaic of sparse to dense vegetation in dune systems is driven by sand deposition, erosion, and lateral movement. Disturbance processes include dune blowouts caused by wind and occasional wave overwash during storm tidal surges. Coastal dunes often front portions of inlets and tidal marshes. Dune vegetation typically includes herbaceous, succulent, shrub, and tree species with varying degrees of tolerance for salt spray, wind and sand abrasion, and substrate stability. Dune succession is highly variable, so species composition can vary significantly among occurrences. These dunes can be dominated by *Leymus arenarius (= Elymus arenarius)*, *Festuca rubra*, *Leymus mollis*, or various forbs adapted to salty dry conditions. *Gaultheria shallon* and *Vaccinium ovatum* are major shrub species. Forested portions of dunes are included within this system and are characterized (at least in the south) by *Pinus contorta var. contorta* early in succession, *Picea sitchensis* somewhat later in the sere, and in some cases *Tsuga heterophylla* later still. *Pseudotsuga menziesii* sometimes codominates in Oregon. In many cases, occurrences have thin, fragile layers of lichens and mosses covering the sand in between clumps of grasses or shrubs. Disturbance processes include dune blowouts caused by wind and occasional wave overwash during storm tidal surges. Late-sere forests, dominating stabilized dune systems where active dune processes are nearly absent and that compositionally represent the adjacent matrix system, are excluded from this dune system. Interdunal wetlands occur commonly within the matrix of this system and sometimes are extensive in deflation plains or old dune troughs, but are considered part of various separate wetland ecological systems depending on their hydrology, and are not part of this upland system.
Classification Comments: Concept has been revised with input from John Christy. We include forested dunes here and put wetlands in other wetland systems. Forested dunes eventually become very similar to the matrix forest, i.e., *Picea sitchensis* basically late-successional forest dunes. Mapping issues are expected as forested dunes lose the *Pinus contorta var. contorta* component and become completely dominated by *Picea sitchensis* and/or *Tsuga heterophylla* (old-growth or late-successional forest composition). As long as *Pinus contorta var. contorta* is a prominent component, the forested dune continues to be part of the dune system.
Similar Ecological Systems:
- Alaskan Pacific Maritime Coastal Dune, Beach and Beach Meadow (CES204.166)

Related Concepts:
- Lodgepole Pine: 218 (Eyre 1980) Intersecting
- Sitka Spruce: 223 (Eyre 1980) Intersecting

DESCRIPTION

Environment: These dunes are found in about 23 localities along the North American Pacific Northwest Coast, from just north of Coos Bay, Oregon, north into Washington near the Copalis River (Wiedemann 1984). Coastal dunes include beach strand (not the beach itself but sparsely or densely vegetated areas behind the beach), foredunes, sand spits, and active to stabile backdunes and sandsheets derived from quartz or gypsum sands. Climate is both Mediterranean and maritime; temperatures are moderate year-round. Most precipitation occurs in the winter months, followed by summer drought, and mild winter temperatures permit growing season throughout most of the year (Wiedemann 1984, Christy et al. 1998). Clouds and fog are present throughout the year, with fog becoming increasingly common to the south (Wiedemann 1984). The dune localities are generally associated with nearby rivers, estuaries or bays (Wiedemann 1984); rivers deposit sediment which is carried by ocean currents and wind and deposited on flat coastline areas with on-shore winds. Dune sands are very poor soils, with no organic matter accumulation (Wiedemann 1984). pH is about neutral and the nutrient status is so low as to be almost unmeasurable. In this system, the rainfall is so high that, combined with rapid drainage, salinity is not an important factor even in areas just above the beach (Wiedemann 1984). Dune sands have poor moisture-holding capacity; however, these dunes are underlain by groundwater aquifers that maintain a high water table (Christy et al. 1998).
Dynamics: The north Pacific coastal dunes are dynamic, transgressive, wind-controlled systems in their natural condition (citations in Zarnetske et al. 2010). These communities are dependent upon longshore drift and wind (WNHP 2011). Most occurrences are spits or berms behind sandy beaches. The mosaic of sparse to dense vegetation in dune systems is driven by sand deposition, erosion, and lateral movement. Disturbance processes include dune blowouts caused by wind and occasional wave overwash during storm tidal

surges. Cyclical dune activity is apparently triggered by cyclical changes in sea level associated with glaciation and tectonic events (Wiedemann 1984, Christy et al. 1998). Subsidence or uplift of 1.8 to 2.7 m (6-9 feet) associated with earthquakes would initiate new successional pathways after destruction of existing dune formations and vegetation (Thilenius 1995). Generally it appears that major earthquakes occur along this coastal region at 300- to 700-year intervals (Christy et al. 1998), and sometimes cause tsunamis.

Wind is the major disturbance process in this system. It drives seasonal movement of large dunes, in turn causing burial of forest vegetation along the eastern edge of the dune sheet and exhumation of previously buried vegetation in interdunal troughs. Storm winds lead to windthrow of many trees in exposed areas, and windfall is commonly seen in senescing stands of *Pinus contorta var. contorta*. Wind-driven sand and salt stunt and abrade plants, and can kill both buds and leaves of shrubs or conifers. Removal of vegetation exposes the sand to wind erosion, leading to the formation of blowouts or the complete destruction of stabilized dunes. Wind patterns are an important factor; in this system northerly summer winds are associated with the North Pacific High and bring generally fair weather with occasional high-velocity land-sea breezes in the afternoon (Wiedemann 1984). In the winter low pressure systems dominate the weather patterns, bringing heavy rains and strong southerly winds. These wind patterns are modified by sheltering headlands and capes in places.

Fire, insects, and pathogens appear to have relatively minor roles in this system, although some *Pinus contorta var. contorta* stands are even-aged and result from stand-replacing fires; others result from primary succession (Christy et al. 1998).

Component Associations:
- *Artemisia campestris - Festuca rubra / Racomitrium canescens* Herbaceous Vegetation (CEGL003370, G1)
- *Baccharis pilularis / Artemisia pycnocephala - Scrophularia californica* Shrubland (CEGL001426, G1G2)
- *Carex macrocephala* Herbaceous Vegetation (CEGL003368, G1G2)
- *Chamaecyparis lawsoniana / Vaccinium ovatum* Forest (CEGL000048, G1)
- *Empetrum nigrum - Gaultheria shallon* Dwarf-shrubland (CEGL000971, G2)
- *Festuca rubra* Stabilized Dune Herbaceous Vegetation (CEGL001774, G1)
- *Gaultheria shallon - Vaccinium ovatum / Pteridium aquilinum* Shrubland (CEGL000972, G3)
- *Juncus falcatus - Trifolium wormskioldii* Herbaceous Vegetation (CEGL001570, G4)
- *Leymus mollis ssp. mollis - Abronia latifolia* Herbaceous Vegetation (CEGL001796, G2?)
- *Lupinus littoralis* Dune Herbaceous Vegetation (CEGL001974, G3)
- *Picea sitchensis - Pinus contorta / Gaultheria shallon - Vaccinium ovatum* Forest (CEGL000403, G3)
- *Picea sitchensis - Tsuga heterophylla / Rhododendron macrophyllum - Vaccinium ovatum* Forest (CEGL002603, G1)
- *Pinus contorta var. contorta - Pseudotsuga menziesii / Morella californica - Vaccinium ovatum* Forest (CEGL000151, G3)
- *Pinus contorta var. contorta / Arctostaphylos columbiana* Woodland (CEGL002682, G1)
- *Pinus contorta var. contorta / Arctostaphylos uva-ursi* Woodland (CEGL002605, G1)
- *Pinus contorta var. contorta / Gaultheria shallon - Rhododendron macrophyllum - Vaccinium ovatum* Forest (CEGL000152, G1)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- North Pacific Coastal Interdunal Wetland (CES204.062)

DISTRIBUTION

Range: This system is found throughout the northern Pacific Coast, including large inlets such as Puget Sound, from south-central British Columbia to the central Oregon coast (roughly Coos Bay).
Divisions: 204:C
Nations: CA, US
Subnations: BC, OR, WA
Map Zones: 1:C, 2:C, 3:C
USFS Ecomap Regions: 242A:CC, M242A:CC
TNC Ecoregions: 1:C, 2:C, 69:P

SOURCES

References: Brown 1990, Chappell and Christy 2004, Christy et al. 1998, Comer et al. 2003, Holland and Keil 1995, Karl et al. 2009, Littell et al. 2009, Pickart 1987, Pickart 1997, Pickart and Barbour 2007, Pickart and Sawyer 1998, PRBO Conservation Science 2011, Thilenius 1995, Wiedemann 1984, Wiedemann 1990, WNHP 2011, Zarnetske et al. 2010
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722794#references
Description Author: C. Chappell, G. Kittel, mod. M.S. Reid and R. Crawford
Version: 14 Jan 2014 **Stakeholders:** Canada, West
Concept Author: K. Boggs, C. Chappell, G. Kittel **ClassifResp:** West

NORTH PACIFIC MONTANE MASSIVE BEDROCK, CLIFF AND TALUS (CES204.093)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Cliff (Substrate); Talus (Substrate); Rock Outcrops/Barrens/Glades; Temperate [Temperate Oceanic]; Canyon
FGDC Crosswalk: Vegetated, No dominant lifeform, Sparsely vegetated, Boulder, gravel, cobble, or talus
National Mapping Codes: EVT 2733; ESLF 3155; ESP 1733

CONCEPT

Summary: This ecological system is found from foothill to subalpine elevations and includes barren and sparsely vegetated landscapes (generally <10% vascular plant cover) of steep cliff faces, narrow canyons, and larger rock outcrops of various igneous, sedimentary, and metamorphic bedrock types. Also included are unstable scree and talus that typically occur below cliff faces. The dominant process is drought, especially farther south in its distribution, and other extreme growing conditions created by exposed rock or unstable slopes typically associated with steep slopes. Alaskan montane rock and talus probably has a significant component on nonvascular species, and is not drought-limited. Fractures in the rock surface and less steep or more stable slopes may be occupied by small patches of dense vegetation, typically scattered trees and/or shrubs. Characteristic trees includes *Chamaecyparis nootkatensis*, *Tsuga* spp., *Thuja plicata*, *Pseudotsuga menziesii* (not in Alaska), or *Abies* spp. There may be scattered shrubs present, such as *Acer circinatum*, *Alnus viridis*, and *Ribes* spp. Soil development is limited as is herbaceous cover. Mosses or lichens may be very dense, well-developed and display cover well over 10%.
Classification Comments: This system was distinguished from montane cliffs and barrens in the Rockies based on a change in floristic division and the apparent abundance of nonvascular cover on rocks compared to drier divisions. It also includes cliffs, barrens and rock outcrops in coastal southeastern Alaska, if they are not covered with snow and ice.

DISTRIBUTION

Range: This system occurs from northern California (north of Sierra Nevada Cliff and Canyon (CES206.901)) to southeastern Alaska.
Divisions: 204:C
Nations: CA, US
Subnations: AK, BC, OR, WA
Map Zones: 1:C, 2:C, 3:P, 7:C, 77:C, 78:C
USFS Ecomap Regions: 242A:CC, 242B:C?, 342D:C?, 342H:CP, 342I:CC, M242A:CC, M242B:CC, M242C:CC, M242D:CC, M261A:CC, M261D:CP
TNC Ecoregions: 1:C, 2:C, 3:C, 4:C, 5:P, 69:C, 70:C, 81:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.769606#references
Description Author: R. Crawford, mod. M.S. Reid
Version: 10 Dec 2008
Stakeholders: Canada, West
Concept Author: R. Crawford
ClassifResp: West

NORTH PACIFIC SERPENTINE BARREN (CES204.095)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Barren
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Non-Diagnostic Classifiers: Montane [Lower Montane]; Herbaceous; Moss/Lichen (Nonvascular); Serpentine; Ultramafic with low Ca:Mg ratio; Very Shallow Soil; Xeric; Unconsolidated
National Mapping Codes: ESLF 3159

CONCEPT

Summary: This uncommon ecological system is found in the east and west Cascades. It is usually found on steep slopes with loosely consolidated soils and harsh soil chemical conditions (large rock outcrops and gravelly soil), although exposed ridges occur. This system occurs primarily in the Wenatchee Mountains in the east Cascades between 760 and 2100 m elevation (2500-7000 feet) on thin rocky, ultramafic (peridotite, serpentinite) soils of varying extent up to several square km. Most sites support often stunted conifers, typically stress-tolerant species. Not all ultramafic outcrops support a distinct vegetation. Only those with very low Ca:Mg ratio impact biotic composition, whereas others reflect increased influence of soil drought on ultramafic material. These systems are highly variable and are described here to include barren slopes to patches of nearly closed forests. Low-elevation sites support *Pseudotsuga menziesii*, *Pinus ponderosa*, and *Pinus monticola* trees with a sparse ground cover with *Aspidotis densa*, *Arctostaphylos nevadensis*, and *Pseudoroegneria spicata*. Higher elevations have *Pinus contorta var. latifolia*, *Pinus albicaulis*, *Abies lasiocarpa*, and *Tsuga mertensiana* with *Juniperus communis*, *Ledum glandulosum*, *Vaccinium scoparium*, *Poa curtifolia*, and *Festuca viridula*.
Classification Comments: This is very similar to Mediterranean California Serpentine Barrens (CES206.905) of California and southern Oregon but tends to have a more developed woody component, whereas the California serpentine barrens are more herbaceous.
Similar Ecological Systems:
- Mediterranean California Serpentine Barrens (CES206.905)

Component Associations:
- *Pinus ponderosa / Aspidotis densa* Woodland (CEGL000847, G1)
- *Pseudotsuga menziesii / Aspidotis densa* Woodland (CEGL000896, G1)

DISTRIBUTION

Range: This uncommon system is found in the east and west Cascades of Washington.
Divisions: 204:C
Nations: US
Subnations: WA
Map Zones: 1:C, 2:C, 7:C
USFS Ecomap Regions: M242A:CC, M242B:C?, M242C:CP, M242D:CP
TNC Ecoregions: 3:P, 4:C, 81:C

SOURCES

References: Del Moral 1982, Kruckeberg 1984, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.769619#references
Description Author: R. Crawford
Version: 30 Mar 2005
Stakeholders: West
Concept Author: R. Crawford
ClassifResp: West

NORTH-CENTRAL APPALACHIAN ACIDIC CLIFF AND TALUS (CES202.601)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Barren
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Cliff (Substrate); Talus (Substrate); Temperate; Acidic Soil
Non-Diagnostic Classifiers: Lowland; Sideslope; Very Shallow Soil; Ustic; Landslide
National Mapping Codes: ESLF 3154

CONCEPT

Summary: This system comprises sparsely vegetated to partially wooded cliffs and talus slopes in the Central Appalachians and adjacent ecoregions, occurring on rocks of acidic lithology and lacking any indicators of enriched conditions. This cliff system occurs at low to mid elevations from central New England south to Virginia, and up to 1500 m in West Virginia. It consists of vertical or near-vertical cliffs and the talus slopes below, formed on hills of granitic, sandstone, or otherwise acidic bedrock. In some cases, especially in periglacial areas, this system may take the form of upper-slope boulderfields without adjacent cliffs, where talus forms from freeze/thaw action cracking the bedrock. Most of the substrate is dry and exposed, but small (occasionally large) areas of seepage are often present. Vegetation in seepage areas tends to be more well-developed and floristically different from the surrounding dry cliffs. The vegetation is patchy and often sparse, punctuated with patches of small trees that may form woodlands in places. *Juniperus virginiana* is a characteristic tree species, *Toxicodendron radicans* a characteristic woody vine, and *Polypodium virginianum* a characteristic fern. Within its range, *Pinus virginiana* is often present.
Classification Comments: More complete data are needed to clarify the diagnostic differences between this system and similar systems to the north, south, and west: Laurentian-Acadian Acidic Cliff and Talus (CES201.569), Cumberland Acidic Cliff and Rockhouse (CES202.309), and Central Interior Acidic Cliff and Talus (CES202.689).
Similar Ecological Systems:
- Central Interior Acidic Cliff and Talus (CES202.689)--occurs farther west.
- Cumberland Acidic Cliff and Rockhouse (CES202.309)--occurs to the south.
- Laurentian-Acadian Acidic Cliff and Talus (CES201.569)

Related Concepts:
- Chestnut Oak: 44 (Eyre 1980) Finer
- Northern Red Oak: 55 (Eyre 1980) Finer
- Pitch Pine: 45 (Eyre 1980) Finer
- Virginia Pine: 79 (Eyre 1980) Finer

DESCRIPTION

Environment: This cliff system consists of vertical or near-vertical cliffs at low to mid elevations and the talus slopes below, formed on hills of granitic, sandstone, or otherwise acidic bedrock. Most of the substrate is dry and exposed, but small (occasionally large) areas of seepage are often present.
Vegetation: Vegetation in seepage areas tends to be more well-developed and floristically different from the surrounding dry cliffs. The vegetation is patchy and often sparse, punctuated with patches of small trees that may form woodlands in places. *Juniperus virginiana* is a characteristic tree species, *Toxicodendron radicans* a characteristic woody vine, and *Polypodium virginianum* a characteristic fern.
Dynamics: Periodic rockslides maintain the open character of this system. Fire is generally not an important factor, since steep slopes and rockslides prevent extensive vegetation development, limiting litter accumulation.

Component Associations:
- Appalachian - Alleghenian Sandstone Dry Cliff Sparse Vegetation (CEGL006435, G4Q)
- *Asplenium montanum* Central Appalachian Sandstone Sparse Vegetation (CEGL004391, GNR)
- *Betula alleghaniensis - Quercus rubra / Polypodium virginianum* Woodland (CEGL006320, G3G5)
- *Betula lenta - Quercus prinus / Parthenocissus quinquefolia* Woodland (CEGL006565, G4)
- *Juniperus virginiana / Corydalis sempervirens* Cliff Sparse Vegetation (CEGL006422, G4)
- *Kalmia latifolia - Gaylussacia baccata - Vaccinium (angustifolium, pallidum) - Menziesia pilosa* Shrubland (CEGL003939, G2)
- *Lasallia (papulosa, pensylvanica) - Dimelaena oreina - (Melanelia culbersonii)* Nonvascular Vegetation (CEGL004142, G5)
- *Lasallia papulosa - Stereocaulon glaucescens - Chrysothrix chlorina* Nonvascular Vegetation (CEGL004143, G1?)
- Sandstone Midwest Dry Cliff Sparse Vegetation (CEGL002045, G4G5)
- Sandstone Midwest Moist Cliff Vegetation (CEGL002287, G4G5)
- *Umbilicaria mammulata* Nonvascular Vegetation (CEGL004387, G4?)
- *Umbilicaria muehlenbergii - Lasallia papulosa - (Melanelia stygia)* Nonvascular Vegetation (CEGL004389, G2?)

DISTRIBUTION

Range: This system is found from central New England and New York south to Virginia.
Divisions: 202:C
Nations: US
Subnations: CT, MA, MD, NJ, NY, OH, PA, VA, WV
Map Zones: 60:C, 61:C, 62:C, 63:P, 64:P, 65:C
USFS Ecomap Regions: 221E:CC, M221A:CC, M221B:CC, M221D:CC
TNC Ecoregions: 49:C, 52:?, 59:C, 60:C, 61:C

SOURCES

References: Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723008#references
Description Author: S.C. Gawler, mod. L.A. Sneddon
Version: 23 Jan 2012 **Stakeholders:** East, Midwest, Southeast
Concept Author: S.C. Gawler **ClassifResp:** East

NORTH-CENTRAL APPALACHIAN CIRCUMNEUTRAL CLIFF AND TALUS (CES202.603)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Barren
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Cliff (Substrate); Talus (Substrate); Temperate; Alkaline Soil
Non-Diagnostic Classifiers: Moderate (100-500 yrs) Persistence; Lowland; Sideslope; Circumneutral Soil; Very Shallow Soil; Ustic; Landslide
National Mapping Codes: ESLF 3153

CONCEPT

Summary: This cliff system occurs at low to mid elevations from central New England south to Virginia and West Virginia. It consists of vertical or near-vertical cliffs and steep talus slopes where weathering and/or bedrock lithology produce circumneutral to calcareous pH and enriched nutrient availability. Substrates include limestone, dolomite and other rocks. The vegetation varies from sparse to patches of small trees, in places forming woodland or even forest vegetation. *Fraxinus* spp., *Tilia americana*, and *Staphylea trifolia* are woody indicators of the enriched setting. *Thuja occidentalis* may occasionally be present but is more characteristic of the related Laurentian-Acadian system to the north. The herb layer is typically not extensive but includes at least some species that are indicators of enriched conditions, e.g., *Impatiens pallida*, *Pellaea atropurpurea, Asplenium platyneuron*, or *Woodsia obtusa*.

Similar Ecological Systems:
- Central Appalachian Alkaline Glade and Woodland (CES202.602)--overlaps with this system in all but the northernmost portions of the range; it is closely related but distinguished by being in a setting other than cliff/talus (e.g., rocky ridges) and by having a greater prominence of graminoids in the ground layer.
- Central Interior Calcareous Cliff and Talus (CES202.690)
- Laurentian-Acadian Calcareous Cliff and Talus (CES201.570)--occurs farther north.
- Southern Interior Calcareous Cliff (CES202.356)--includes circumneutral cliff and talus communities from southern Virginia south.

Related Concepts:
- Eastern Redcedar: 46 (Eyre 1980) Finer
- Northern White-Cedar: 37 (Eyre 1980) Finer
- Sugar Maple - Basswood: 26 (Eyre 1980) Finer
- Sugar Maple: 27 (Eyre 1980) Finer

Component Associations:
- *Acer saccharum - Fraxinus americana - Juglans cinerea / Staphylea trifolia / Adlumia fungosa* Forest (CEGL006577, GNR)
- *Acer saccharum - Quercus muehlenbergii / Carex platyphylla* Forest (CEGL006162, GNR)
- *Acer saccharum - Quercus muehlenbergii* Forest (CEGL005010, GNR)
- *Acer saccharum - Tilia americana - Fraxinus americana / Ostrya virginiana / Geranium robertianum* Woodland (CEGL005058, G3G5)
- *Acer saccharum - Tilia americana / Staphylea trifolia / Dryopteris marginalis - (Impatiens pallida)* Forest (CEGL006471, G3G4)
- *Asplenium ruta-muraria - Pellaea atropurpurea* Sparse Vegetation (CEGL004476, G3G4)
- *Hydrangea arborescens / Sedum ternatum - Polypodium virginianum* Shrubland (CEGL006479, GNR)
- *Pellaea atropurpurea* Cliff Sparse Vegetation (CEGL006527, GNR)
- *Thuja occidentalis / Carex eburnea - Pellaea atropurpurea* Woodland (CEGL002596, G2G3)
- *Tilia americana - Fraxinus americana / Acer pensylvanicum - Ostrya virginiana / Parthenocissus quinquefolia - Impatiens pallida* Woodland (CEGL008528, G3)

DISTRIBUTION

Range: This system ranges from central New England and New York south to Virginia and West Virginia. The extent of the Virginia range remains to be documented, but it appears to be absent from the Southern Blue Ridge and Southern Ridge and Valley portions of the state.
Divisions: 202:C
Nations: US
Subnations: CT, MA, MD, NH, NJ, NY, OH, PA, VA, VT, WV
Map Zones: 53:C, 59:P, 61:C, 62:?, 63:P, 64:C, 65:C, 66:P
USFS Ecomap Regions: 221Ae:CCP, 221Af:CCP, 221Ag:CCP, 221B:CC, 221D:CC, 221E:CC, M221A:CC, M221B:CC
TNC Ecoregions: 52:C, 59:P, 60:?, 61:C

SOURCES

References: Comer et al. 2003, Vanderhorst pers. comm.

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723006#references
Description Author: S.C. Gawler, mod. M. Pyne
Version: 05 May 2008 **Stakeholders:** East, Midwest, Southeast
Concept Author: S.C. Gawler **ClassifResp:** East

NORTHEASTERN EROSIONAL BLUFF (CES203.498)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Barren
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Deep Soil; Unconsolidated; Bluff
National Mapping Codes: ESLF 3209

CONCEPT

Summary: These steep, linear cliffs form where erosion in deep glacial or alluvial deposits has left tall (>3 m), nearly vertical banks of sand, silt, clay, or a mixture. They typically develop in landscapes that are otherwise of rather low relief. The substrate is unconsolidated and provides habitat for certain animals that burrow into steep banks, such as bank swallows and certain invertebrates. Vegetation is very sparse, mostly herbaceous, and variable in composition. Characteristic herbs are those adapted to the unstable substrate and regular disturbance, such as *Schizachyrium scoparium, Andropogon gerardii, Danthonia spicata, Agrostis gigantea, Carex tonsa var. rugosperma (= Carex rugosperma), Ionactis linariifolius, Lespedeza capitata, Polygonella articulata*, and *Lechea intermedia*, as well as weedy herbs such as *Elymus repens (= Elytrigia repens), Veronica officinalis*, and *Oenothera biennis*. Scattered individuals of the low shrub *Comptonia peregrina* may occur, and less frequently individuals of *Vaccinium angustifolium* or *Vaccinium pallidum*. The somewhat more stable portions of the bank may have sparse and usually small trees of *Betula papyrifera, Betula populifolia*, or *Populus tremuloides*. A few New England occurrences support populations of the state-rare plants *Lupinus perennis* and *Hudsonia ericoides*. Known examples occur in the Chesapeake Bay, some maritime bluffs along the Northern Atlantic Coast, the Lake Erie and Lake Ontario coastlines, and some of the larger northeastern rivers.
Classification Comments: These features are very narrow but may extend over hundreds of meters or more. They are distinctly different from adjacent habitats. They are sometimes referred to as cliffs; the usage of "cliff" and "bluff" is colloquially inconsistent, though in some references "bluff" refers to features in unconsolidated material and "cliffs" involve consolidated rock. There is high floristic heterogeneity across the range of this system.
Related Concepts:
- Dry River Bluff (Sperduto and Nichols 2004) Undetermined
- Dry Riverside Bluff (Swain and Kearsley 2001) Undetermined
- Erosional River Bluff (Thompson and Sorenson 2000) Undetermined
- Erosional Slope/Bluff (Edinger et al. 2002) Broader

DESCRIPTION

Dynamics: This system is subject to continuing erosion from wind or water such that persistent vegetation rarely develops. Instability can also lead to slumps where large sections of the bank let go.

Component Associations:
- Eroding Clay Bank Sparse Vegetation (CEGL002584, GNR)
- Maritime Erosional Bluffs and Cliffs Sparse Vegetation (CEGL006618, GNR)

SPATIAL CHARACTERISTICS

Spatial Summary: Linear features that may extend for only a few tens of meters to hundreds of meters or more.

DISTRIBUTION

Range: This system is currently documented from the Chesapeake Bay north to Maine and along the shores of Lakes Erie and Ontario.
Divisions: 201:C; 202:C; 203:C
Nations: CA, US
Subnations: CT?, MA, MD, ME, NH, NY, PA, VA?, VT
Map Zones: 60:C, 63:C, 64:P, 65:C, 66:C
USFS Ecomap Regions: 211E:CC, 221A:CC, 222I:CC, 232H:CC
TNC Ecoregions: 48:C, 58:C, 62:C, 63:C, 64:C

SOURCES

References: Eastern Ecology Working Group n.d., Edinger et al. 2002, Sperduto and Nichols 2004, Swain and Kearsley 2001, Thompson and Sorenson 2000
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.820014#references
Description Author: S.C. Gawler
Version: 25 Feb 2010 **Stakeholders:** Canada, East, Midwest, Southeast
Concept Author: S.C. Gawler **ClassifResp:** East

NORTHERN ATLANTIC COASTAL PLAIN SANDY BEACH (CES203.301)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Barren
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Beach (Substrate); Graminoid; Coast
National Mapping Codes: ESLF 3124

CONCEPT

Summary: This system includes sparsely vegetated ocean beaches constituting the outermost zone of coastal vegetation ranging from northern North Carolina (north of Bodie Island) northward to the terminus of extensive sandy coastlines and the beginning of rocky coasts. Examples generally extend seaward from foredunes but may include flats behind breached foredunes. Although these habitats are situated just above the mean high tide limit, they are constantly impacted by waves and may be flooded by high spring tides and storm surges (Fleming et al. 2001). Constant salt spray and rainwater maintain generally moist conditions. Substrates consist of unconsolidated sand and shell sediments that are constantly shifted by winds and floods. Dynamic disturbance regimes largely limit vegetation to pioneering, salt-tolerant, succulent annuals. *Cakile edentula ssp. edentula* and *Salsola kali (= Salsola caroliniana)* are usually most numerous and characteristic. Other scattered associates include *Sesuvium maritimum, Polygonum glaucum, Polygonum ramosissimum var. prolificum, Suaeda linearis* and *Suaeda maritima*, and *Atriplex cristata (= Atriplex pentandra)*.
Classification Comments: In Virginia, this system is distributed along the ocean side of the Eastern Shore (Accomack and Northampton counties) and on Cape Henry and False Cape (City of Virginia Beach).
Similar Ecological Systems:
- Central Atlantic Coastal Plain Sandy Beach (CES203.064)--is found to the south.
- Northern Atlantic Coastal Plain Dune and Swale (CES203.264)

Related Concepts:
- Beach Strand (Gawler and Cutko 2010) Finer

DESCRIPTION

Environment: This system includes sparsely vegetated ocean beaches that constitute the outermost zone of coastal vegetation ranging from northern North Carolina northward to the northern end of extensive sandy coastlines and the beginning of rocky coasts in southern Maine. Examples generally extend seaward from foredunes but may include flats behind breached foredunes. The beach includes the sand intertidal shore and the low-gradient sand above the daily high tide line, which is between the foredune and the Atlantic Ocean. This area of upper beach is affected by wind and salt spray, seasonal high tides, and storm surge.
Dynamics: The process of sand movement due to the forces of wind and water are part of the natural dynamics of beach ecosystems. This includes transport of sand along the coast, and movement of sand by wind or water between the dunes, beach and subtidal areas. If not restricted by infrastructure or engineered hard structures, beaches and dunes can migrate as coastlines change over time in response to the action of wind and water. The beaches of the Atlantic coast are affected by two tides per day. Extensive construction of high, artificial dunes along the Atlantic coast has reduced the extent of these habitats by increasing oceanside beach erosion and eliminating the disturbance regime that creates and maintains overwash flats.

Component Associations:
- *Cakile edentula ssp. edentula - Chamaesyce polygonifolia* Sparse Vegetation (CEGL004400, G4G5)
- *Sesuvium portulacastrum - Atriplex* spp. - *Suaeda* spp. Sparse Vegetation (CEGL004406, G3)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Northern Atlantic Coastal Plain Dune and Swale (CES203.264)

DISTRIBUTION

Range: This system ranges from northern North Carolina northward to the northern end of extensive sandy coastlines and the beginning of rocky coasts in southern Maine.
Divisions: 203:C
Nations: US
Subnations: CT, DE, MA, MD, ME, NC, NH, NJ, NY, RI, VA
Map Zones: 60:C, 65:C, 66:C
USFS Ecomap Regions: 211D:CC, 221A:CC, 232A:CC, 232H:CC, 232I:CC
TNC Ecoregions: 57:C, 58:C, 62:C

SOURCES

References: Comer et al. 2003, Defeo et al. 2009, Fleming et al. 2001, Gawler and Cutko 2010
Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723190#references
Description Author: R. Evans
Version: 06 Feb 2014 **Stakeholders:** East, Southeast
Concept Author: R. Evans **ClassifResp:** East

NORTHWESTERN GREAT PLAINS CANYON (CES303.658)

CLASSIFIERS

Classification Status: Standard

Primary Division: Western Great Plains (303)
Land Cover Class: Barren
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Non-Diagnostic Classifiers: Very Shallow Soil; Flood Scouring; Canyon
FGDC Crosswalk: Vegetated, Tree-dominated, Open tree canopy, Deciduous open tree canopy
National Mapping Codes: EVT 2341; ESLF 4148; ESP 1341

CONCEPT

Summary: This system occurs primarily along springbranch and dry canyons. Soils can range from deep loams to alluvial to sandy. Limestone and sandstone rock outcrops and cliffs are common. This system often contains elements of other systems that form a complex, small-patch or linear mosaic. Ecological processes are related to canyon landforms and patchy vegetation. Examples of this system are found along the Niobrara and North Platte rivers in Nebraska. Areas along the tributaries of the White River and within the Black Hills region of South Dakota also may be considered part of this system. Vegetation varies locally depending on aspect, slope position and substrate and can range from riparian vegetation to xeric or mesic woodlands. Rock outcrops with sparse vegetation are also common. Dominant tree species include *Quercus macrocarpa, Populus deltoides, Fraxinus pennsylvanica, Ulmus rubra, Pinus ponderosa*, and *Juniperus scopulorum* and *Juniperus virginiana*; shrub species may be present as well. This system can grade into areas dominated by *Pinus ponderosa*. Other system elements contained in this system include Western Great Plains Cliff and Outcrop (CES303.665) on south aspects and rims; Western Great Plains Riparian (CES303.956) in drainages, and Rocky Mountain Lower Montane-Foothill Shrubland (CES306.822) and Northwestern Great Plains Shrubland (CES303.662), but unique geology and dynamics bring these together to form this canyon system. Occasionally, fens may occur in canyon bottom seeps.

Related Concepts:
- Bur Oak: 236 (Eyre 1980) Finer
- Bur Oak: 42 (Eyre 1980) Finer
- Cottonwood - Willow: 235 (Eyre 1980) Finer
- Cottonwood: 63 (Eyre 1980) Finer
- Great Plains Wooded Draw, Ravine and Canyon (Rolfsmeier and Steinauer 2010) Broader
- Paper Birch: 18 (Eyre 1980) Finer

DESCRIPTION

Vegetation: Vegetation can vary locally with aspect, slope position and substrate. It can range from riparian to mesic to xeric woodlands. Several tree species, such as *Quercus macrocarpa, Populus deltoides, Betula papyrifera, Fraxinus pennsylvanica, Ulmus rubra*, and *Pinus ponderosa*, and shrub species, such as *Juniperus virginiana* and *Juniperus scopulorum*, can occur within this system. Cover of these species can range from less than 10% on rock outcrops to greater than 60%.

Component Associations:
- *Betula papyrifera - (Tilia americana, Quercus macrocarpa)* Canyon Forest (CEGL002013, G2?)
- *Carex pellita - Carex* spp. - *Schoenoplectus tabernaemontani* Fen Herbaceous Vegetation (CEGL002041, G1)
- *Cercocarpus montanus / Bouteloua curtipendula* Shrubland (CEGL001086, G5)
- *Populus deltoides (ssp. wislizeni, ssp. monilifera) / Distichlis spicata* Woodland (CEGL000939, G2)
- *Populus deltoides (ssp. wislizeni, ssp. monilifera) / Salix exigua* Woodland (CEGL002685, G3)
- *Populus deltoides - (Salix amygdaloides) / Salix (exigua, interior)* Woodland (CEGL000659, G3G4)
- *Populus deltoides - Fraxinus pennsylvanica* Forest (CEGL000658, G2G3)
- *Populus deltoides / Carex pellita* Woodland (CEGL002649, G2)
- *Populus deltoides / Panicum virgatum - Schizachyrium scoparium* Woodland (CEGL001454, G2)
- *Quercus macrocarpa / Andropogon gerardii - Hesperostipa spartea* Woodland (CEGL002053, G2G3)
- *Quercus macrocarpa / Andropogon gerardii - Panicum virgatum* Woodland (CEGL002052, G1G2)
- *Quercus macrocarpa / Cornus drummondii / Aralia nudicaulis* Forest (CEGL002072, G4)
- *Salix exigua* / Mesic Graminoids Shrubland (CEGL001203, G5)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Northwestern Great Plains Shrubland (CES303.662)
- Rocky Mountain Lower Montane-Foothill Shrubland (CES306.822)
- Western Great Plains Cliff and Outcrop (CES303.665)
- Western Great Plains Riparian (CES303.956)

Adjacent Ecological System Comments: Other system elements contained in this system include Western Great Plains Cliff and Outcrop (CES303.665) on south aspects and rims; Western Great Plains Riparian (CES303.956) in drainages, and Rocky Mountain

Lower Montane-Foothill Shrubland (CES306.822) and Northwestern Great Plains Shrubland (CES303.662), but unique geology and dynamics bring these together to form this canyon system.

DISTRIBUTION

Range: This system occurs along springbranch and dry canyons along the Niobrara and North Platte rivers in Nebraska and likely ranges north along the tributaries of the White River and areas within the Black Hills region of South Dakota.
Divisions: 303:C
Nations: US
Subnations: NE, SD?, WY?
Map Zones: 22:?, 29:C, 30:?, 31:C, 33:?, 38:C, 39:?, 40:?
USFS Ecomap Regions: 331K:PP, 331L:PP, 331M:P?, M331I:PP
TNC Ecoregions: 26:C, 33:C, 35:P

SOURCES

References: Midwestern Ecology Working Group n.d., Steinauer and Rolfsmeier 2000
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.735388#references
Description Author: S. Menard
Version: 27 May 2004 **Stakeholders:** Midwest, West
Concept Author: S. Menard and K. Kindscher **ClassifResp:** Midwest

ROCKY MOUNTAIN ALPINE BEDROCK AND SCREE (CES306.809)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Alpine Slopes; Alpine/AltiAndino [Alpine/AltiAndino]; Talus (Substrate); Rock Outcrops/Barrens/Glades; Oligotrophic Soil; Very Shallow Soil
Non-Diagnostic Classifiers: Temperate [Temperate Continental]; Glaciated; Unconsolidated
National Mapping Codes: ESLF 3135

CONCEPT

Summary: This ecological system is restricted to the highest elevations of the Rocky Mountains, from Alberta and British Columbia south into New Mexico, west into the highest mountain ranges of the Great Basin. It is composed of barren and sparsely vegetated alpine substrates, typically including both bedrock outcrop and scree slopes, with nonvascular- (lichen) dominated communities. Exposure to desiccating winds, rocky and sometimes unstable substrates, and a short growing season limit plant growth. There can be sparse cover of forbs, grasses, lichens and low shrubs.
Related Concepts:
- Alpine Rangeland (410) (Shiflet 1994) Intersecting

Component Associations:
- *Aquilegia caerulea - Cirsium scopulorum* Scree Sparse Vegetation (CEGL001938, GU)
- *Aquilegia flavescens - Senecio megacephalus* Sparse Vegetation (CEGL005899, G2G3)
- *Athyrium americanum - Cryptogramma acrostichoides* Sparse Vegetation (CEGL005900, G2G3)
- *Cirsium scopulorum - Polemonium viscosum* Herbaceous Vegetation (CEGL001959, GU)
- *Claytonia megarhiza* Herbaceous Vegetation (CEGL001878, GU)
- *Ivesia cryptocaulis* Alpine Sparse Vegetation (CEGL002735, G1)
- *Phacelia hastata - (Penstemon ellipticus*) Sparse Vegetation (CEGL005901, G2G3)
- *Polemonium viscosum* Herbaceous Vegetation (CEGL001928, G3G4)
- *Saxifraga bronchialis* Scree Slope Sparse Vegetation (CEGL005902, G3?)
- *Saxifraga mertensiana* Cliff Crevice Sparse Vegetation (CEGL005903, G2?)
- *Senecio taraxacoides - Oxyria digyna* Herbaceous Vegetation (CEGL001932, GU)
- Sparse (on rock and unconsolidated substrates) Nonvascular Vegetation (CEGL002888, GNR)

DISTRIBUTION

Range: Restricted to the highest elevations of the Rocky Mountains, from Alberta and British Columbia south into New Mexico, west into the highest mountain ranges of the Great Basin.
Divisions: 304:C; 306:C
Nations: CA, US
Subnations: AB, AK?, AZ, BC, CO, ID, MT, NM, NV, OR, UT, WA, WY
Map Zones: 1:P, 9:P, 10:C, 12:P, 15:P, 16:C, 17:C, 18:?, 19:C, 21:C, 22:P, 23:C, 24:C, 25:C, 28:C, 29:P
USFS Ecomap Regions: 331G:PP, 331J:P?, 341A:C?, 341B:CC, 341E:CP, 341F:CP, 341G:CC, 342A:CC, 342B:C?, 342C:C?, 342D:CP, 342H:C?, 342J:CP, M242D:PP, M313A:CC, M331A:CC, M331B:CC, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M331J:CC, M332A:CC, M332B:CC, M332D:CC, M332E:CC, M332F:CC, M332G:CP, M333A:CC, M333B:CC, M333C:CC, M333D:CC, M334A:??, M341A:CC, M341B:CC, M341C:CC, M341D:CC
TNC Ecoregions: 7:C, 8:C, 9:C, 11:C, 19:C, 20:C, 21:C, 68:C

SOURCES

References: Anderson 1999a, Comer et al. 2003, Cooper et al. 1997, Komarkova 1976, Komarkova 1980, Meidinger and Pojar 1991, NCC 2002, Neely et al. 2001, Nelson 1998, Willard 1963
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722864#references
Description Author: NatureServe Western Ecology Team
Version: 20 Feb 2003 **Stakeholders:** Canada, Midwest, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

ROCKY MOUNTAIN CLIFF, CANYON AND MASSIVE BEDROCK (CES306.815)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Rocky Mountain (306)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Ridgetop bedrock outcrop; Talus (Substrate); Rock Outcrops/Barrens/Glades; Oligotrophic Soil; Very Shallow Soil; Landslide; Canyon; Cliff (Landform)
Non-Diagnostic Classifiers: Escarpment; Long (>500 yrs) Persistence; Montane [Upper Montane]; Montane [Montane]; Montane [Lower Montane]; Lowland [Foothill]; Temperate [Temperate Continental]; Butte
National Mapping Codes: ESLF 3129

CONCEPT

Summary: This ecological system of barren and sparsely vegetated landscapes (generally <10% plant cover) is found from foothill to subalpine elevations on steep cliff faces, narrow canyons, and smaller rock outcrops of various igneous (intrusives), sedimentary, and metamorphic bedrock types. It is located throughout the Rocky Mountains and northeastern Cascade Ranges in North America. Also included are unstable scree and talus slopes that typically occur below cliff faces. In general these are the dry sparsely vegetated places on a landscape. The biota on them reflect what is surrounding them, unless it is an extreme parent material. There may be small patches of dense vegetation, but it typically includes scattered trees and/or shrubs. Characteristic trees includes species from the surrounding landscape, such as *Pseudotsuga menziesii, Pinus ponderosa, Pinus flexilis, Populus tremuloides, Abies concolor, Abies lasiocarpa*, or *Pinus edulis* and *Juniperus* spp. at lower elevations. There may be scattered shrubs present, such as species of *Holodiscus, Ribes, Physocarpus, Rosa, Juniperus*, and *Jamesia americana, Mahonia repens, Rhus trilobata*, or *Amelanchier alnifolia*. Soil development is limited, as is herbaceous cover.
Classification Comments: This has a very broad elevation range (<3350 m) for a system; consider dividing into foothills/montane and subalpine. And/or by floristic division. This is in the Okanagan and Rockies as the montane sparse. North Pacific Montane Massive Bedrock, Cliff and Talus (CES204.093) includes everything in the Cascades and west, except the northeastern Cascades, where occurrences are this system (CES306.815). Inter-Mountain Basins Cliff and Canyon (CES304.779) occurs in the dry foothills on the east side of EDC MapZone1.
Related Concepts:
- CL Cliff (Ecosystems Working Group 1998) Broader
- RO Rock (Ecosystems Working Group 1998) Broader
- TA Talus (Ecosystems Working Group 1998) Broader

Component Associations:
- *Abies concolor - (Pseudotsuga menziesii) / Jamesia americana - Holodiscus dumosus* Scree Woodland (CEGL000890, GNR)
- *Abies lasiocarpa / Holodiscus dumosus* Scree Woodland (CEGL000918, G3)
- *Abies lasiocarpa / Salix brachycarpa* Scree Woodland (CEGL000922, GUQ)
- *Abies lasiocarpa / Salix glauca* Scree Woodland (CEGL000923, GUQ)
- *Abies lasiocarpa / Saxifraga bronchialis* Scree Woodland (CEGL000924, G4)
- *Abies lasiocarpa* Scree Woodland (CEGL000925, G5?)
- *Aletes anisatus - Scutellaria brittonii* Scree Herbaceous Vegetation (CEGL001948, GU)
- *Athyrium americanum* Sparse Vegetation (CEGL001849, GU)
- *Carex nardina* Scree Herbaceous Vegetation (CEGL001812, GNR)
- Granite - Metamorphic Black Hills Rock Outcrop Sparse Vegetation (CEGL002295, G4)
- *Heuchera bracteata - Heuchera parvifolia var. nivalis* Herbaceous Vegetation (CEGL001971, GU)
- *Holodiscus dumosus* Rock Outcrop Sparse Vegetation (CEGL002801, GNR)
- Igneous - Metamorphic Black Hills Butte Sparse Vegetation (CEGL005283, GNR)
- *Jamesia americana - (Physocarpus monogynus, Holodiscus dumosus)* Rock Outcrop Shrubland (CEGL002783, GNR)
- *Picea engelmannii / Saxifraga bronchialis* Scree Sparse Vegetation (CEGL000893, G4)
- *Pinus contorta* Scree Woodland (CEGL000766, G5?)
- *Pinus flexilis* Scree Woodland (CEGL000815, G3Q)
- *Pinus ponderosa / Ribes inerme* Scree Woodland (CEGL000876, G4)
- *Pinus ponderosa* Limestone Cliff Sparse Vegetation (CEGL002055, G4?)
- *Populus tremuloides / Physocarpus malvaceus - Amelanchier alnifolia* Scree Woodland (CEGL000945, G4Q)
- *Pseudotsuga menziesii / Holodiscus dumosus* Scree Woodland (CEGL000902, G3G4)
- *Pseudotsuga menziesii* Scree Woodland (CEGL000911, G5)
- *Ribes cereum / Leymus ambiguus* Shrubland (CEGL001124, G2)
- *Rubus idaeus* Scree Shrubland (CEGL001134, GU)
- *Saxifraga rivularis* Herbaceous Vegetation (CEGL001930, GU)

- Scree - Talus Black Hills Sparse Vegetation (CEGL002307, GNR)
- Sparse (on rock and unconsolidated substrates) Nonvascular Vegetation (CEGL002888, GNR)

DISTRIBUTION

Range: This system is located throughout the Rocky Mountain, including the isolated island ranges of central Montana, and northeastern Cascade Ranges in North America.
Divisions: 306:C
Nations: CA, US
Subnations: AB, AK?, AZ, BC, CO, ID, MT, NM, OR, TX, UT, WA, WY
Map Zones: 1:C, 8:?, 9:P, 10:C, 12:?, 15:P, 16:C, 17:C, 18:P, 19:C, 20:C, 21:C, 22:C, 23:C, 24:C, 25:C, 26:C, 27:C, 28:C, 29:C, 33:C
USFS Ecomap Regions: 313A:CC, 313B:CC, 313D:CC, 315A:CC, 315H:CC, 321A:CC, 331A:C?, 331B:CC, 331D:C?, 331G:CC, 331H:CC, 331I:CP, 331J:CC, 331K:CP, 331N:CP, 341A:CC, 341B:CC, 341C:CC, 341F:CC, 341G:CC, 342A:CP, 342B:CC, 342C:CC, 342D:CP, 342E:CC, 342F:CP, 342G:CP, 342H:CP, 342I:CP, 342J:CC, M242B:CP, M242C:CC, M242D:CC, M313A:CC, M313B:CC, M331A:CC, M331B:CC, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M331J:CC, M332A:CC, M332B:CC, M332D:CC, M332E:CC, M332F:CC, M332G:CC, M333A:CC, M333B:CC, M333C:CC, M333D:CC, M334A:CC, M341A:CC, M341B:CC, M341C:CC
TNC Ecoregions: 7:C, 8:C, 9:C, 20:C, 21:C, 25:C, 26:C, 68:C

SOURCES

References: Andrews and Righter 1992, Comer et al. 2003, Ecosystems Working Group 1998, Hess and Wasser 1982, Larson et al. 2000a, NCC 2002, Neely et al. 2001, Peet 1981
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722858#references
Description Author: NatureServe Western Ecology Team, mod. M.S. Reid
Version: 04 Apr 2005 **Stakeholders:** Canada, Midwest, Southeast, West
Concept Author: NatureServe Western Ecology Team **ClassifResp:** West

SIERRA NEVADA CLIFF AND CANYON (CES206.901)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Cliff (Substrate); Talus (Substrate); Rock Outcrops/Barrens/Glades; Mediterranean [Mediterranean Xeric-Oceanic]; Canyon
Non-Diagnostic Classifiers: Canyon Mosaic; Montane [Upper Montane]; Montane [Montane]; Montane [Lower Montane]; Lowland [Foothill]; Forest and Woodland (Treed); Shrubland (Shrub-dominated); Moss/Lichen (Nonvascular); Ridge/Summit/Upper Slope; Very Shallow Soil; Landslide; Needle-Leaved Tree; Broad-Leaved Evergreen Shrub; Graminoid; Nonvascular; Cliff (Landform)
National Mapping Codes: ESLF 3171

CONCEPT

Summary: Found from foothill to subalpine elevations throughout the Sierra Nevada and nearby mountain ranges, these are barren and sparsely vegetated areas (<10% plant cover) of steep cliff faces, narrow canyons, and smaller rock outcrops of various igneous, sedimentary, and metamorphic bedrock. This system also includes unstable scree and talus slopes typically occurring below cliff faces. Scattered vegetation may include *Abies magnifica*, *Pseudotsuga menziesii*, *Pinus contorta var. murrayana*, *Pinus ponderosa*, *Pinus jeffreyi*, *Populus tremuloides*, or *Pinus monophylla*, *Juniperus osteosperma*, and *Cercocarpus ledifolius* at lower elevations. There may be shrubs including species of *Arctostaphylos* or *Ceanothus*. Soil development is limited as is herbaceous cover.

DISTRIBUTION

Range: Found from foothill to subalpine elevations throughout the Sierra Nevada and nearby mountain ranges.
Divisions: 206:C
Nations: US
Subnations: CA, NV, OR
Map Zones: 4:?, 6:C, 7:C, 12:C
USFS Ecomap Regions: 322A:??, 341D:CC, 341E:CC, 341F:CC, 342B:CC, M261D:CC, M261E:CC, M261F:CC
TNC Ecoregions: 4:C, 5:C, 12:C

SOURCES

References: Barbour and Major 1988, Comer et al. 2003, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722780#references
Description Author: P. Comer, T. Keeler-Wolf
Version: 17 Mar 2003
Stakeholders: West
Concept Author: P. Comer, T. Keeler-Wolf
ClassifResp: West

SOUTH FLORIDA SHELL HASH BEACH (CES411.271)

CLASSIFIERS

Classification Status: Standard

Primary Division: Caribbean (411)
Land Cover Class: Barren
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Beach (Substrate); Graminoid; Coast
National Mapping Codes: ESLF 3138

CONCEPT

Summary: This system represents carbonate sand beaches of the Florida Keys and south Florida mangrove islands (after Johnson and Barbour 1990). The vegetation is poorly known but apparently includes at least one endemic species, *Chamaesyce garberi*. Other diagnostic species may include *Piscidia piscipula* and *Pithecellobium keyense*.
Classification Comments: No associations have currently been described in the NVC for this system. More information is needed. See Johnson and Barbour (1990) for more information.
Related Concepts:
- Unconsolidated Substrate (FNAI 1990) Broader

Component Associations:
- *Uniola paniculata* - *Hymenocallis latifolia* Herbaceous Vegetation (CEGL003966, G1?)

DISTRIBUTION

Range: The range of this system includes Cape Sable (the southernmost point of mainland Florida), Ten Thousand Islands (Collier County), Florida Keys, and islands in Biscayne Bay (near Miami).
Divisions: 411:C
Nations: US
Subnations: FL
Map Zones: 56:C
TNC Ecoregions: 54:C

SOURCES

References: Comer et al. 2003, Johnson and Barbour 1990
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723215#references
Description Author: R. Evans
Version: 17 Mar 2009
Concept Author: R. Evans
Stakeholders: Southeast
ClassifResp: Southeast

SOUTH TEXAS SALT AND BRACKISH TIDAL FLAT (CES301.461)

CLASSIFIERS

Classification Status: Standard

Primary Division: Madrean Semidesert (301)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Wetland
Diagnostic Classifiers: Tidal / Estuarine [Haline]
FGDC Crosswalk: Vegetated, No dominant lifeform, Sparsely vegetated
National Mapping Codes: EVT 2500; ESLF 3113; ESP 1500

CONCEPT

Summary: This system includes regularly to irregularly flooded hypersaline tidal flats (often exceeding a thousand acres in size). Dominants include a variety of vascular and nonvascular species. The cyanobacteria (blue-green algae) *Lyngbya* spp. may dominate thousands of acres. Total vegetative cover is quite variable, from near total absence of vascular plants to a dense cover of one of several dominant species including *Batis maritima, Monanthochloe littoralis, Spartina spartinae, Borrichia frutescens*, and *Sarcocornia perennis*. In addition to the dominants, other halophytic plants of this system include *Atriplex matamorensis, Distichlis spicata, Sarcocornia perennis, Sporobolus virginicus, Maytenus phyllanthoides, Prosopis reptans, Borrichia frutescens, Suaeda linearis, Suaeda conferta, Monanthochloe littoralis, Lycium carolinianum var. quadrifidum, Spartina spartinae, Sesuvium portulacastrum, Rayjacksonia phyllocephala*, and *Blutaparon vermiculare*. In addition to dominating non-vegetated areas, algal mats of blue-green and sometimes green algae are characteristically present, visible even in densely vegetated pannes. Blue-green algae may contribute significantly more biomass than vascular species. Widely scattered *Avicennia germinans* (and, less frequently, other mangroves) may occur.

Related Concepts:
- Clay Loma/Wind Tidal Flats (Jahrsdoerfer and Leslie 1988) Intersecting
- Coastal Brushland Potholes (Jahrsdoerfer and Leslie 1988) Intersecting
- Mangrove: 106 (Eyre 1980) Finer
- South Texas: Algal Flats (6610) [CES301.461.2] (Elliott 2011) Finer
- South Texas: Wind Tidal Flats (6600) [CES301.461.1] (Elliott 2011) Finer

DESCRIPTION

Environment: This system occurs in tidal and other hypersaline situations along upper marsh edges and in tidal flats ranging in scale from narrow bands to hundreds of hectares along the Gulf Coast of southern Texas and Mexico. It is regularly to irregularly flooded by shallow brackish waters as a result of lunar, wind and storm tides. As these waters evaporate, high concentrations of salt accumulate, producing hypersaline conditions, forming "salt pannes." It is found on recent wind-distributed coastal sands along barrier island and mainland shores of hypersaline lagoons and bays where evaporation often exceeds freshwater input. Tidal fluctuations and wind continue to redistribute these sands. Landforms are extensive, very gentle (nearly flat) slopes.
Vegetation: Some sites may have sparse vegetation consisting of *Salicornia bigelovii, Salicornia virginica (= Salicornia depressa), Batis maritima, Suaeda linearis, Sesuvium portulacastrum, Monanthochloe littoralis*, and/or *Distichlis spicata*, but are typically unvegetated or covered by a layer of *Lyngbya* spp. The development of vast areas dominated by *Lyngbya* spp. occurs with appropriate frequency and duration of inundation. Higher flats may be too dry to support the algae, and at lower elevation, flats may remain inundated for extended periods. Occasionally flats (usually not those supporting extensive blue-green algae) may develop a substantial herbaceous cover, especially during years of increased rainfall. Development of significant areas of marsh grasses such as *Spartina patens* or *Spartina alterniflora* is generally lacking. Scattered individuals of *Avicennia germinans* occur within these flats.

Component Associations:
- *Avicennia germinans / Batis maritima* Shrubland (CEGL007757, G3?)
- *Batis maritima - Sarcocornia pacifica* Dwarf-shrubland (CEGL003956, G5)
- *Borrichia frutescens / Spartina spartinae* Shrubland (CEGL004617, G3G4)
- *Lyngbea* spp. Wind-Tidal Flat Nonvascular Vegetation (CEGL007840, G4)
- *Sarcocornia pacifica* - (*Batis maritima, Distichlis spicata*) Dwarf-shrubland (CEGL002278, G4)
- *Spartina spartinae - Monanthochloe littoralis - Suaeda linearis* Herbaceous Vegetation (CEGL004614, G3?)

DISTRIBUTION

Range: This system ranges south of Corpus Christi Bay along the northern Gulf of Mexico.
Divisions: 301:C
Nations: US
Subnations: TX
Map Zones: 36:C
USFS Ecomap Regions: 255D:CC, 315E:??
TNC Ecoregions: 31:C

SOURCES

References: Comer et al. 2003, Elliott 2011, Jahrsdoerfer and Leslie 1988

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723125#references

Description Author: J. Teague, mod. M. Pyne and L. Elliott

Version: 18 Feb 2011

Concept Author: J. Teague

Stakeholders: Southeast

ClassifResp: Southeast

SOUTHEAST FLORIDA BEACH (CES411.272)

CLASSIFIERS

Classification Status: Standard

Primary Division: Caribbean (411)
Land Cover Class: Barren
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Beach (Substrate); Graminoid; Coast
National Mapping Codes: ESLF 3136

CONCEPT

Summary: This beach ecological system is the southernmost of its kind along the mainland coast of North America. Its southerly location distinguishes it from other types along the Atlantic Coast, primarily due to the prevalence of the tropical flora it supports. This type is related to Southwest Florida Beach (CES411.276) but is affected directly by much higher wave energy from the Atlantic. This region has some of the highest wave energy along the entire Atlantic Coast.
Classification Comments: Apparently few, if any, associations have currently been described in the NVC for this system. More information is needed.
Similar Ecological Systems:
- Southwest Florida Beach (CES411.276)

DESCRIPTION

Environment: Its southerly location distinguishes this system from others along the Atlantic Coast, primarily due to the prevalence of the tropical flora it supports. This system is affected directly by much higher wave energy from the Atlantic than the beaches on the southwest coast of Florida. The southeast coastal region has some of the highest wave energy along the entire Atlantic Coast (Tanner 1960).
Dynamics: This region has some of the highest wave energy along the entire Atlantic Coastal Plain (Tanner 1960). The process of sand movement due to the forces of wind and water are part of the natural dynamics of beach ecosystems. This includes transport of sand along the coast, and movement of sand by wind or water between the dunes, beach and subtidal areas. If not restricted by infrastructure or engineered hard structures, beaches and dunes can migrate as coastlines change over time in response to the action of wind and water. The beaches of southeast Florida are affected by two tides per day.

Component Associations:
- *Ipomoea pes-caprae - Cakile lanceolata* Herbaceous Vegetation (CEGL004403, G3G4)

DISTRIBUTION

Range: Endemic to south Florida.
Divisions: 411:C
Nations: US
Subnations: FL
Map Zones: 56:C
TNC Ecoregions: 54:C

SOURCES

References: Comer et al. 2003, Defeo et al. 2009, FNAI 2010a, Tanner 1960
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723214#references
Description Author: R. Evans, mod. C. Nordman
Version: 14 Jan 2014
Concept Author: R. Evans
Stakeholders: Southeast
ClassifResp: Southeast

SOUTHEASTERN COASTAL PLAIN CLIFF (CES203.398)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Barren
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Cliff (Substrate)
National Mapping Codes: ESLF 3206

CONCEPT

Summary: This ecological system consists of steep to vertical or overhanging outcrops of unconsolidated sediment or rock in the Gulf and Atlantic coastal plains. They occur on lower bluffs adjacent to rivers or streams. The vegetation is generally sparse, limited to plants growing on bare substrate, small ledges, and other favorable microsites. The flora is a mix of herbs, shrubs, vines, tree seedlings, and some larger trees, with bryophytes potentially dominant in some examples. It typically includes opportunistic species of open and disturbed areas, along with species from adjacent forest communities and other species of wet and dry open areas. Dense shrubby or woodland vegetation may occur on the edges. Occasional examples may have denser bryophyte vegetation.
Classification Comments: More information is needed on the associations that belong to this system. Compared to cliffs of other regions, the soft Coastal Plain cliffs tend to be more frequently disturbed and more dynamic. Soil development and primary succession would quickly replace any examples that are not periodically disturbed and renewed by slumping, generally caused by undercutting by streams. Smaller slumps and active erosion by upland runoff may also disturb the communities. This is the primary rock outcrop system of the Coastal Plain, but small shaded outcrops of limestone or sandstone may be included in other systems.
Similar Ecological Systems:
- Southern Coastal Plain Mesic Slope Forest (CES203.476)
- Southern Piedmont Cliff (CES202.386)

DESCRIPTION

Environment: These cliffs occur on steep to vertical or overhanging outcrops of coastal plain substrates, usually sand, clay, or sandstone. Outcrops typically occur along rivers or streams, where undercutting causes slumps that periodically renew the bare substrate. Most of these cliffs are dry, but small zones of seepage are often present, especially at the top. One association represents small clay cliffs that are kept wet by seepage. Lower portions of cliffs may periodically flood.
Dynamics: Coastal plain cliffs appear to be dynamic on a moderate time scale. Due to the soft substrate, groundwater discharge, and stream undercutting, periodic slumping of part or all of the cliff occurs. This slumping is likely necessary to prevent erosion, soil development, and primary succession from developing a forest system on the site. Microsite disturbance may also come from erosion by runoff and potentially by windthrow of trees on the edge. The types of plants that may grow on cliffs is limited by the harsh conditions to those with adaptations to drought and limited nutrients (Edwards et al. 2013).

Component Associations:
- Coastal Plain Acidic Cliff Sparse Vegetation (CEGL004388, G2?)

SPATIAL CHARACTERISTICS

Spatial Summary: This is a small-patch system, most examples covering less than one acre. Examples tend to occur as isolated small patches.
Size: Most examples naturally cover an acre or less. Size is somewhat ambiguous for this system, in that vertical surfaces may be as extensive as horizontal surfaces.
Adjacent Ecological Systems:
- Atlantic Coastal Plain Blackwater Stream Floodplain Forest (CES203.247)
- Atlantic Coastal Plain Brownwater Stream Floodplain Forest (CES203.248)
- Atlantic Coastal Plain Small Blackwater River Floodplain Forest (CES203.249)
- Southern Atlantic Coastal Plain Dry and Dry-Mesic Oak Forest (CES203.241)
- Southern Atlantic Coastal Plain Mesic Hardwood Forest (CES203.242)

Adjacent Ecological System Comments: Bordered by upland forest systems above and laterally, and by floodplain forest systems or a river below.

DISTRIBUTION

Range: This system is potentially scattered throughout the Gulf and Atlantic coastal plains.
Divisions: 203:C
Nations: US
Subnations: AL, GA, LA, MS, NC, SC, TX, VA?
USFS Ecomap Regions: 232C:CC, 232H:CC, 232I:CC, 232J:CC
TNC Ecoregions: 43:P, 53:C, 56:C, 57:C

SOURCES

References: Edwards et al. 2013, McLean 1989, Schafale and Weakley 1990, Southeastern Ecology Working Group n.d.

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.821932#references

Description Author: M.P. Schafale

Version: 06 Feb 2014 **Stakeholders:** East, Southeast

Concept Author: M.P. Schafale **ClassifResp:** Southeast

SOUTHERN APPALACHIAN GRANITIC DOME (CES202.297)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Rock Outcrops/Barrens/Glades
National Mapping Codes: ESLF 3126

CONCEPT

Summary: This ecological system consists of smooth, curved, exfoliated outcrops of massive granite and related rocks in the Southern Blue Ridge and adjacent upper/inner Piedmont. Smooth rock without crevices is the primary factor in the distinctive ecological character of this system. The outcrop surface is largely bare rock but has thin soil mats around the edges and patchily throughout. Mats vary in depth with age and level of development. Granitic domes have a distinctive pattern of cyclical primary succession. The resulting vegetation is a complex of small patches of different species and structure on soil mats of different depths, ranging from mosses and lichens to herbs to shrubs and trees. Deeper soils often have pine-dominated vegetation with dense shrubs.
Classification Comments: Granitic domes are clearly related to other rock outcrop systems in the southern Appalachians. Most similar in the region are Southern and Central Appalachian Mafic Glade and Barrens (CES202.348), which are distinguished by having more continuous vegetation and only a minority of bare rock, resulting from a more irregular rock surface or less steep slope. Glades and barrens occur on a wider range of rock types, but it is possible that granitic domes develop into glades over long periods of time (probably centuries or longer) if exfoliation ceases to occur. Southern Appalachian Montane Cliff and Talus (CES202.330) and Southern Appalachian Rocky Summit (CES202.327) differ in having more fractured rock, with vegetation dominated by plants rooted in fixed microsites related to crevices, ledges, and other small features. Southern Piedmont Granite Flatrock and Outcrop (CES202.329) is most similar to Southern Appalachian Granitic Dome (CES202.297) in occurring on smooth, exfoliated outcrops and having vegetation driven by soil mat dynamics. Some species are shared, but biogeography and climatic differences make for vegetation that is different.

Deeper soils often have pine-dominated vegetation with dense shrubs, resembling that of Southern Appalachian Montane Pine Forest and Woodland (CES202.331). These communities should be treated as part of this system if they are closely associated with exfoliation outcrops with the more distinctive granitic dome communities. The same is true of closely associated islands and stunted patches of vegetation resembling Southern Appalachian Oak Forest (CES202.886).

While this system as a whole is characterized by sparse vegetation, individual plots may have decidedly non-sparse vegetation, with as much as 70% total cover, mostly herbaceous; this is a typical problem when scaling up from a plot to a system.

Similar Ecological Systems:
- Southern and Central Appalachian Mafic Glade and Barrens (CES202.348)
- Southern Appalachian Montane Cliff and Talus (CES202.330)
- Southern Appalachian Montane Pine Forest and Woodland (CES202.331)
- Southern Appalachian Rocky Summit (CES202.327)
- Southern Piedmont Granite Flatrock and Outcrop (CES202.329)

Related Concepts:
- Chestnut Oak: 44 (Eyre 1980) Finer
- Northern Red Oak: 55 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs on exfoliated granitic outcrops. In the upper/inner Piedmont, it usually occurs as isolated hills (inselbergs or monadnocks) that stand above the surrounding landscape. In the Blue Ridge, it usually occurs as part of larger mountain ranges but often still as somewhat distinctive knobs. Granite, granitic gneiss, and related rocks without many internal joints tend to fracture in thin sheets parallel to the surface, forming curved outcrops with smooth surfaces largely lacking crevices. Granitic dome outcrops develop on upper to midslopes, and most face south. Most individual outcrops grade from nearly level to very steep. The outcrop surface is largely bare rock but has thin soil mats around the edge and in patches throughout. Mats vary in depth with age and level of development. The smooth rock without crevices is the primary factor in the distinctive ecological character of this system. Distinct microenvironments are created by small irregularities in the rock surface and by areas of seepage at the edge. Elevation is an important factor affecting different associations within the system.
Vegetation: Most of the rock surface is bare or has only crustose or foliose lichen cover. Vegetation occurs as a series of small patches in the thin soil mats, with the kind of vegetation closely related to depth of the mat. Bare rock may have moss patches. The thinnest soils usually have a set of fine forbs, many of them annual. Slightly deeper soils often have grasses dominating. Deeper soils support shrubs or small trees. The flora shares some species with other rock outcrops of similar elevations but has some distinctive species and different dominance of species. Some characteristic plants of Southern Appalachian granitic domes include grasses and graminoids *Carex biltmoreana* and *Bulbostylis capillaris*; *Schizachyrium scoparium* is a frequent grass at lower elevations. Forbs include *Pycnanthemum* spp., *Krigia montana, Hypericum gentianoides*, and *Houstonia longifolia*. Some other unusual plants include

the lichens *Lasallia papulosa, Umbilicaria caroliniana*, and the mat-forming fern allies *Selaginella tortipila* and *Selaginella rupestris*.
Dynamics: Granitic domes have a distinctive pattern of cyclical primary succession. Soil mats appear and deepen over time in a process that links vegetational and soil development, but are eventually destroyed by wind throw, drought, other natural disturbances, or simply falling off the rock. The result is a pattern with mats of different levels of development at any given time. Mat dynamics are different in different parts of the rock, with older mats and more permanent patterns near the edges, and sparser and younger mats in the interior. The dynamics are further modified by microtopography and the presence of seepage. The overall vegetation patterns likely respond to climatic cycles and natural disturbance events. The thin soils make these communities sensitive to drought, especially the long-lived woody species.

Component Associations:
- *(Quercus prinus) / Vaccinium pallidum / Schizachyrium scoparium - Danthonia spicata / Cladonia* spp. Herbaceous Vegetation (CEGL004990, G1G2)
- *Carex biltmoreana - Pycnanthemum* spp. - *Krigia montana* Herbaceous Vegetation (CEGL004523, G2G3)
- *Lasallia papulosa - Umbilicaria caroliniana* Nonvascular Vegetation (CEGL004386, G2?)
- *Quercus rubra / Rhododendron catawbiense - Rhododendron arborescens* Woodland (CEGL004503, G2)
- *Selaginella rupestris - Schizachyrium scoparium - Hypericum gentianoides - Bulbostylis capillaris* Herbaceous Vegetation (CEGL007690, G2)
- *Selaginella tortipila - Krigia montana - Houstonia longifolia* Herbaceous Vegetation (CEGL004283, G2G3)

SPATIAL CHARACTERISTICS

Spatial Summary: Large-patch system, most examples covering a few acres.
Size: Most examples naturally cover a few acres, with a few examples up to 10 or more acres. Most examples occur in a few clusters where geology is suitable (e.g., the Blue Ridge escarpment at the South Carolina-North Carolina border and the Brushy Mountains in North Carolina), but most examples in these clusters are probably far enough apart to be considered separate occurrences. Individual knobs may have a cluster of several closely associated outcrops separated by small patches of forest.
Adjacent Ecological Systems:
- Southern and Central Appalachian Mafic Glade and Barrens (CES202.348)
- Southern Appalachian Oak Forest (CES202.886)

Adjacent Ecological System Comments: Surrounded by forest systems on deeper soils less influenced by bedrock, most typically Southern Appalachian Oak Forest (CES202.886). Patches of oak forests may occur in a mosaic with the granitic domes.

DISTRIBUTION

Range: This system is restricted to the Southern Blue Ridge and adjacent upper/inner Piedmont in the Carolinas and Georgia.
Divisions: 202:C
Nations: US
Subnations: GA?, NC, SC
Map Zones: 57:C, 59:C
USFS Ecomap Regions: 221D:CC, 231A:CC, 231I:CC
TNC Ecoregions: 51:C, 52:C

SOURCES

References: Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723194#references
Description Author: M. Schafale and R. Evans, mod. M. Pyne
Version: 24 Feb 2011
Concept Author: M. Schafale and R. Evans
Stakeholders: Southeast
ClassifResp: Southeast

SOUTHERN APPALACHIAN MONTANE CLIFF AND TALUS (CES202.330)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Barren
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Moss/Lichen (Nonvascular); Cliff (Substrate)
National Mapping Codes: ESLF 3186

CONCEPT

Summary: This system consists of steep to vertical or overhanging rock outcrops (and related steep talus slopes) of the Southern Blue Ridge and adjacent parts of other ecoregions. It occurs on lower slopes, usually in river gorges or bluffs. The sparse vegetation is limited to plants growing on bare rock, small ledges, and crevices. Vegetation is primarily bryophytes, lichens, and herbs, with sparse trees and shrubs rooted in deeper soil pockets and crevices.
Classification Comments: This system is distinguished from other rock outcrops by a combination of low topographic position, vertical orientation, large amount of bare rock, and absence of specialized environments such as exfoliated granite, limestone or dolomite, and spray from waterfalls. In contrast, Southern Appalachian Rocky Summit (CES202.327) occurs in high topographic positions; they have more horizontal rock but may have some substantial vertical surfaces. Southern and Central Appalachian Mafic Glade and Barrens (CES202.348) are more horizontally oriented and have much more vegetation cover. Southern Appalachian Granitic Dome (CES202.297) may have steep portions but has smooth, unfractured rock surfaces with soil largely confined to mats adhering to the rock surface. The division of rock outcrop systems may be too fine and warrant combining some; however, each system has distinctive characteristics of structure and some distinctive flora.

The primary variation within this system, which could be the basis for further subdivision, is the distinction between mafic and felsic rock. The distribution north and west needs review. See also Cumberland Acidic Cliff and Rockhouse (CES202.309).
Similar Ecological Systems:
- Appalachian Shale Barrens (CES202.598)
- Cumberland Acidic Cliff and Rockhouse (CES202.309)
- Southern and Central Appalachian Mafic Glade and Barrens (CES202.348)
- Southern Appalachian Granitic Dome (CES202.297)
- Southern Appalachian Rocky Summit (CES202.327)
- Southern Appalachian Spray Cliff (CES202.288)
- Southern Piedmont Cliff (CES202.386)

Related Concepts:
- Dry Sandstone Cliff (Evans 1991) Intersecting
- Moist Sandstone Cliff (Evans 1991) Intersecting

DESCRIPTION

Environment: This system occurs on steep rock outcrops on lower slopes and occasionally higher in topographically sheltered sites. River gorges are probably the most common landforms, with bluffs of more open river valleys or meandering rivers also common. The substrate is mostly bare bedrock, which is steep to vertical or overhanging. Most examples are on felsic metamorphic rock such as gneiss or schist, a smaller number on mafic metamorphic rock or felsic or mafic igneous rock. [Examples may occur on any kind of rock except limestone and dolomite, with felsic metamorphic rock the most common in the Southern Blue Ridge and sandstone the most common in the Cumberland Mountains. Mafic metamorphic rocks form a less common but important fraction of examples, along with some more extreme rocks such as quartzite.] The physical structure of cliffs of metamorphic rock is usually irregular, with some ledges and crevices. [Sedimentary rocks often form more vertical cliffs, but with bedding planes and joints forming deep crevices that provide rooting sites.] Moisture levels vary drastically over short distances. Seepage of groundwater from adjacent soils or through rock fractures often creates permanently or seasonally flooded microsites, while lack of soil makes other portions extremely dry. In less sheltered topography, slope aspect affects overall moisture levels to some degree. Rock or soil chemistry appears to be the most important factor affecting different associations on sites that have the physical structure to belong to this system. Elevation may also be an important factor causing variation, though few examples are known at high elevation.
Vegetation: Vegetation is sparse. Bryophytes and lichens may cover portions of the open rock. Vascular plants are limited to sparse rooting sites in soil pockets, ledges, and crevices. Some of these microsites may be deep enough to support shrubs or even stunted trees, while most support only herbs. The woody plants are usually species from surrounding forests, and may be mesophytic or xerophytic. The herbs include a suite of rock outcrop specialists such as *Saxifraga michauxii, Hylotelephium telephioides, Asplenium montanum,* and *Polypodium* spp. Mafic rock outcrops have an additional suite of specialist herbs, a number of them rare. Herbs from the surrounding forest are often also present and may make up a significant fraction of the flora.
Dynamics: The dynamics of this system have received little study. Most cliff communities are probably stable over long periods of time, with fine-scale disturbances affecting microsites. Rock falls, slides, and other mass movement are rare, but represent catastrophic disturbance to part or all of a cliff, and may be important in the long term for keeping cliffs open. Animal movements may be locally

important. Fire probably has little effect on cliffs, which have too little vegetation to carry fire and which tend to occur in topography that is not conducive to fire spread. Because of the limited natural disturbance and the fragility of soil and vegetation, human disturbance by trampling edges and by climbing may be particularly destructive.

Component Associations:
- *(Hydrangea arborescens) / Heuchera villosa - Asplenium trichomanes - Thalictrum clavatum / Conocephalum salebrosum* Shrubland (CEGL008435, G2)
- *(Hydrangea arborescens) / Heuchera villosa - Dicentra eximia - Campanula divaricata* Shrubland (CEGL008546, G2)
- *(Hydrangea arborescens, Toxicodendron radicans) / Heuchera americana - (Dichanthelium depauperatum, Woodsia obtusa)* Shrubland (CEGL004395, G3?)
- *Asplenium montanum - Heuchera villosa* Felsic Cliff Sparse Vegetation (CEGL004980, G3G4)
- *Parthenocissus quinquefolia / (Dicentra eximia)* Sparse Vegetation (CEGL004454, G2G3Q)
- *Physocarpus opulifolius / Campanula divaricata - Tradescantia subaspera - (Packera plattensis)* Sparse Vegetation (CEGL004759, G1?)
- *Umbilicaria mammulata* Nonvascular Vegetation (CEGL004387, G4?)

SPATIAL CHARACTERISTICS

Spatial Summary: Small-patch system, most examples covering a few acres. Examples tend to occur as isolated small patches or occasional small clusters.
Size: Most examples naturally cover an acre or less. A few occur as complexes of closely associated patches, but the aggregate size is still small. Size is somewhat ambiguous for this system, in that vertical surfaces may be as extensive as horizontal surfaces.
Adjacent Ecological Systems:
- Southern and Central Appalachian Cove Forest (CES202.373)
- Southern Appalachian Low-Elevation Pine Forest (CES202.332)
- Southern Appalachian Montane Pine Forest and Woodland (CES202.331)
- Southern Appalachian Oak Forest (CES202.886)
- Southern Appalachian Spray Cliff (CES202.288)

Adjacent Ecological System Comments: This system is surrounded by forest systems on deeper soils less influenced by bedrock, most typically Southern and Central Appalachian Cove Forest (CES202.373), Southern Appalachian Oak Forest (CES202.886), or various floodplain forest systems. Southern Appalachian Low-Elevation Pine Forest (CES202.332) or Southern Appalachian Montane Pine Forest and Woodland (CES202.331) may sometimes adjoin.

DISTRIBUTION

Range: Scattered throughout the Southern Appalachians and incidentally into adjacent ecoregions, from northern Alabama and Georgia through Virginia.
Divisions: 202:C
Nations: US
Subnations: GA, KY, NC, SC, TN, VA
Map Zones: 48:?, 53:P, 54:C, 57:C, 59:C, 61:C
TNC Ecoregions: 50:?, 51:C, 52:C

SOURCES

References: Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723173#references
Description Author: M. Schafale and R. Evans
Version: 18 Apr 2006 **Stakeholders:** East, Southeast
Concept Author: M. Schafale and R. Evans **ClassifResp:** Southeast

SOUTHERN APPALACHIAN ROCKY SUMMIT (CES202.327)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Rock Outcrops/Barrens/Glades
National Mapping Codes: ESLF 3178

CONCEPT

Summary: This system represents treeless rock outcrops of the southern Appalachian Mountains, primarily in western North Carolina and eastern Tennessee. Outcrops may be vertical to horizontal, rugged or fractured rock outcrops of peaks, ridgetops, upper slopes, and other topographically exposed locations (Schafale and Weakley 1990). Higher elevation examples occur from 1200 to 2030 m in elevation; other examples may be found at elevations of 305 m (1000 feet) or lower on foothills. These outcrops occur on felsic to mafic rocks and are distinguished from surrounding systems by the prevalence of bare or lichen-encrusted rocks. The vegetation component of this system is generally characterized by a mixture of low-growing lifeforms, especially lichens, mosses, and short-statured forbs. Less commonly, graminoids and low shrubs are encountered. Species common to all outcrop vegetation types include *Carex misera, Saxifraga michauxii*, and *Vaccinium corymbosum* (Wiser and White 1999).
Classification Comments: The primary variation within this system, which could be the basis for further subdivision, is the distinction between low and high elevation. High-elevation rocky summits may have a unique biogeographic history of having been adjacent to alpine tundra that existed in the region during the Pleistocene and of now providing a refugium for some of its flora. Their climate is substantially different from the lower elevation examples. However, their structure and the dynamics that results from it are probably similar.
Similar Ecological Systems:
- Southern and Central Appalachian Mafic Glade and Barrens (CES202.348)
- Southern Appalachian Granitic Dome (CES202.297)
- Southern Appalachian Montane Cliff and Talus (CES202.330)
- Southern Piedmont Cliff (CES202.386)
- Southern Piedmont Glade and Barrens (CES202.328)
- Southern Piedmont Granite Flatrock and Outcrop (CES202.329)

Related Concepts:
- High Elevation Rocky Summit (Schafale and Weakley 1990) Finer
- Low Elevation Rocky Summit (Schafale and Weakley 1990) Finer

DESCRIPTION

Environment: This system occurs on rugged rock outcrops on peaks, ridgetops, upper slopes, and other topographically exposed landforms. Elevations may range from nearly the highest in the region (1200-2030 m), down to 305 m (1000 feet) or lower on foothills. The rock outcrops are irregular, with substantial horizontal surfaces, as well as often vertical surfaces, and generally with fractures. This structure allows soil accumulation in local pockets, sometimes to fair depth, even though most of the substrate is bare rock. Bedrock may be a variety of types. Erosion-resistant rocks such as felsic gneisses and schists or quartzite are most common, but mafic rocks such as amphibolite are also important substrates. Granite and granitic gneiss sometimes form rocky summits, but more often form the smoother outcrops that support Southern Appalachian Granitic Dome (CES202.297) or Southern and Central Appalachian Mafic Glade and Barrens (CES202.348). Moisture conditions are generally quite dry due to lack of soil but may be heterogeneous. Local deep crevices may accumulate water funneled from bare rock. Seepage is occasionally present but is usually minor. Climate varies substantially with elevation and has a strong effect on variation within the system. Higher elevation sites have high rainfall and receive substantial additional moisture from fog and rime ice.
Vegetation: Vegetation is sparse or patchy, with substantial expanses of lichen-covered or bare rock. Vegetation cover may be >25% (i.e., not technically "sparse") in local areas (including some plots), but the overall effect is of sparse vegetation. Mosses are usually present but often do not have substantial cover. A suite of typical rock outcrop herbs, including *Saxifraga michauxii, Carex misera, Paronychia argyrocoma, Heuchera villosa, Krigia montana*, and *Hylotelephium telephioides (= Sedum telephioides)*, is usually present, along with more widespread herbs of open areas such as *Danthonia spicata, Danthonia compressa, Schizachyrium scoparium, Potentilla canadensis*, and *Houstonia caerulea*. High-elevation examples have an additional suite of herbs, which include some northern disjunct species such as *Minuartia groenlandica, Sibbaldiopsis tridentata, Trichophorum caespitosum*, and *Huperzia selago*. A suite of narrow endemic herbs is also characteristic of many high-elevation examples. Herbs of the adjacent forests may be present in small numbers. Shrubs and stunted trees are usually present in patches, where crevices or deeper soil accumulations are present. A few shrubs, such as *Leiophyllum buxifolium*, are largely limited to this system, but most are widespread species of dry forests and woodlands. Shrubs in the Ericaceae family are particularly prominent. Wiser and White (1999) found that in high-elevation rocky summits, less than a third of the flora was limited to rock outcrop sites.
Dynamics: The dynamics of this system have received little study. Most rocky summit sites are probably stable over long periods of

time, but variations in the always stressful environment may disturb and change vegetation. The role of crevices and soil in depressions as the primary rooting site makes for a relatively stable pattern of plant distribution and potentially long-lived individuals. This is in contrast to the shallow soil mats predominating in granitic domes. Between disturbances, accumulation of soil and succession of vegetation to greater woody abundance may occur. Fire may naturally be uncommon or fairly common. The topographically high location of this system would make it likely that fires would spread into it, though the sparse fuels would allow only patchy burning. Fires have been indicated to be important in preventing dense woody growth from encroaching on open outcrops in at least some instances. Rock falls or other mass movements are rare, but may be important in creating rock outcrops and keeping them open in the long term. Periodic drought is probably a significant disturbance. Animals and freeze-thaw action may be important disturbances at a local scale. Because of the fragility of soil and vegetation, human disturbance by trampling edges and by climbing may be particularly destructive.

Component Associations:
- *Leiophyllum buxifolium - (Hudsonia montana) / Selaginella tortipila - Carex umbellata* Quartzite Outcrop Dwarf-shrubland (CEGL007010, G1)
- *Minuartia groenlandica - Paronychia argyrocoma - Saxifraga michauxii* Herbaceous Vegetation (CEGL008509, G1)
- *Saxifraga michauxii - Carex misera - Calamagrostis cainii* Herbaceous Vegetation (CEGL004278, G1)
- *Saxifraga michauxii - Carex misera - Danthonia spicata - Krigia montana* Herbaceous Vegetation (CEGL004279, G2)
- *Saxifraga michauxii - Carex misera - Oclemena acuminata - Solidago glomerata* Herbaceous Vegetation (CEGL004277, G1)
- *Saxifraga michauxii - Cheilanthes lanosa - Hylotelephium telephioides* Herbaceous Vegetation (CEGL004989, G1)
- *Saxifraga michauxii* Herbaceous Vegetation (CEGL004524, G3?)
- *Schizachyrium scoparium - Saxifraga michauxii - Coreopsis major* Herbaceous Vegetation (CEGL004074, G1)

Spatial Characteristics

Adjacent Ecological Systems:
- Central and Southern Appalachian Spruce-Fir Forest (CES202.028)
- Southern and Central Appalachian Mafic Glade and Barrens (CES202.348)
- Southern Appalachian Grass and Shrub Bald (CES202.294)
- Southern Appalachian Northern Hardwood Forest (CES202.029)

Distribution

Range: This system is found at a variety of elevations in the southern Appalachian Mountains, primarily in western North Carolina and eastern Tennessee.
Divisions: 202:C
Nations: US
Subnations: GA, NC, SC, TN
Map Zones: 57:C
TNC Ecoregions: 51:C

Sources

References: Comer et al. 2003, Schafale and Weakley 1990, Wiser and White 1999
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723176#references
Description Author: M. Schafale, mod. M. Pyne
Version: 18 Apr 2006
Concept Author: M. Schafale
Stakeholders: Southeast
ClassifResp: Southeast

SOUTHERN APPALACHIAN SPRAY CLIFF (CES202.288)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Barren
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Cliff (Substrate)
National Mapping Codes: ESLF 3145

CONCEPT

Summary: This system consists of rock outcrops that are kept wet by spray from waterfalls, primarily in the Southern Blue Ridge, and possibly elsewhere in the Southern Appalachians region. The rocks are often densely or moderately covered with bryophytes or algae. The sparse vascular vegetation is limited to plants growing on bare rock, small ledges and crevices.
Classification Comments: This system is distinguished from all others in its range by its being kept wet by spray. Other outcrop systems, especially Southern Appalachian Montane Cliff and Talus (CES202.330), may have local wet areas created by seepage but will be dominated by dry microsites. Other interpretations of this system are that it could be combined with other cliff systems of the Appalachians.
Similar Ecological Systems:
- Southern Appalachian Montane Cliff and Talus (CES202.330)

Related Concepts:
- Moist Sandstone Cliff (Evans 1991) Broader

DESCRIPTION

Environment: Vegetation of this system occurs on rock outcrops adjacent to waterfalls, where spray from the falls keeps the rock wet for long periods. These outcrops are usually near-vertical, but horizontal surfaces at the base, boulder piles, and grottos are also common. The rock may be of any type, and the substrate may occasionally be saprolite rather than hard rock. Soil is limited to accumulations in crevices and on ledges. The rock may be permanently wet or may be wet seasonally when stream flow is high. Wetness is constant enough that this system may be considered a wetland, though some of the impacts of soil saturation do not occur. Seepage often makes portions of the rock wetter than areas covered just by spray. The typical topographic setting, in narrow gorges or enclosed valleys, makes for high local humidity and moderated temperature fluctuations.
Vegetation: Vegetation is usually a mix of growth forms and may be very patchy. Bryophytes, both mosses and liverworts, are often dense. Vascular vegetation may be sparse, but some examples are dense. Characteristic rock outcrop herbs such as *Saxifraga michauxii, Asplenium montanum*, and *Heuchera* spp. are usually present, along with some herbs of moist forests and seeps, such as *Galax urceolata, Thalictrum clavatum, Houstonia serpyllifolia, Circaea alpina*, and *Impatiens capensis*. A few examples are grassy. Examples on basic rock or with basic seepage have additional calciphilic herbs. A number of rare species, especially mosses, liverworts, and ferns but also including some forbs, grasses, and sedges, may be present. These spray cliffs can be exceptionally diverse in mosses and liverworts of widely differing biogeographic origins (Zartman and Pittillo 1998). Shrubs and trees are usually present, at least on edges and often also rooted in crevices and ledges. *Rhododendron maximum, Kalmia latifolia*, and *Tsuga canadensis* are among the most frequent. Woody vines may also be prominent.
Dynamics: The dynamics of this system have received little study. The spray cliff environment is probably unusually stable (Schafale and Weakley 1990), with its sheltered topographic position limiting wind influence, dryness, and extreme temperatures. Most individual plants are probably long-lived. The presence of tropical disjunct bryophytes and ferns at some spray cliffs is related to the very stable, moderate environment, and to the dispersal abilities of those species (Zartman and Pittillo 1998). Droughts affect streamflow and must affect moisture levels, but most streams large enough to support spray cliffs will probably never dry up. Occasional rockfalls and scouring related to flash floods represent infrequent disturbances to occurrences or parts of them. Physical evidence of flooding and erosion observed at many spray cliff sites includes uprooted trees and detached soil mats, suggesting that flood conditions have the potential to influence community structure and spatial arrangement of spray cliff vegetation (Zartman and Pittillo 1998). Distance from the stream edge forms a gradient from high flooding frequency on streamside sites to minimal flooding on elevated sites. This disturbance gradient seems to explain, in part, differences in species composition patterns between certain spray cliff associations (Zartman and Pittillo 1998).

Component Associations:
- *Trichophorum caespitosum - Osmunda regalis - Rhynchospora capitellata - Oxypolis rigidior* Herbaceous Vegetation (CEGL008490, G1Q)
- *Vittaria appalachiana - Heuchera parviflora var. parviflora - Houstonia serpyllifolia / Plagiochila* spp. Herbaceous Vegetation (CEGL004302, G2)

SPATIAL CHARACTERISTICS

Spatial Summary: Small-patch system, most examples covering less than one acre. Examples tend to occur as isolated small patches.
Size: Most examples naturally cover well less than one acre, and well-developed and diverse examples may be as small as 100 square

meters. Complexes of multiple patches are almost never found. Size is somewhat ambiguous for this system, in that vertical surfaces may be as extensive as horizontal surfaces.

Adjacent Ecological Systems:

- Southern and Central Appalachian Cove Forest (CES202.373)
- Southern Appalachian Montane Cliff and Talus (CES202.330)

Adjacent Ecological System Comments: This system is usually surrounded by mesic forest systems, including Southern and Central Appalachian Cove Forest (CES202.373). Some may be associated with Southern Appalachian Montane Cliff and Talus (CES202.330) on drier rock exposures.

DISTRIBUTION

Range: This system occurs scattered throughout the Southern Appalachians and incidentally into adjacent ecoregions, from northern Alabama and Georgia through Virginia.
Divisions: 202:C
Nations: US
Subnations: AL, GA, KY, NC, SC, TN, VA, WV?
Map Zones: 48:?, 53:C, 57:C, 61:C
TNC Ecoregions: 50:?, 51:C, 52:C

SOURCES

References: Comer et al. 2003, Edwards et al. 2013, Evans 1991, Schafale and Weakley 1990, Zartman and Pittillo 1998
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723200#references
Description Author: M. Schafale and R. Evans, mod. M. Pyne
Version: 14 Jan 2014 **Stakeholders:** East, Southeast
Concept Author: M. Schafale and R. Evans **ClassifResp:** Southeast

SOUTHERN ATLANTIC COASTAL PLAIN FLORIDA BEACH (CES203.535)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Barren
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland; Wetland
National Mapping Codes: ESLF 3181

CONCEPT

Summary: This beach ecological system is found along the Atlantic Coast from the St. Johns River in northeastern Florida south to approximately Cape Canaveral. Unlike Southern Atlantic Coastal Plain Sea Island Beach (CES203.383) north of the St. Johns River, this system is subject to higher wave energy and a greater component of sand. The vegetation of this area is distinct from that farther south along the coast of Florida, lacking the tropical element found south of Cape Canaveral.
Classification Comments: Apparently few, if any, associations have currently been described in the NVC for this system. More information is needed.
Similar Ecological Systems:
- Southern Atlantic Coastal Plain Sea Island Beach (CES203.383)--dovetails this system to the north.

Related Concepts:
- Unconsolidated Substrate (FNAI 1990) Broader

DESCRIPTION

Environment: The beach includes the sand intertidal shore and the low-gradient sand above the daily high tide line, which is between the foredune and the Atlantic Ocean. This area of upper beach is affected by wind and salt spray, seasonal high tides, and storm surge.
Vegetation: Characteristic species include mostly annual herbs, such as *Cakile edentula ssp. harperi, Chamaesyce polygonifolia, Chamaesyce bombensis, Sesuvium portulacastrum, Salsola kali ssp. kali (= Salsola caroliniana),* and *Amaranthus pumilus*. On Cumberland Island National Seashore in southeastern Georgia, perennials such as *Croton punctatus* and *Uniola paniculata* also can be important. The vegetation of this area is distinct from that farther south along the coast of Florida, lacking the tropical element found south of Cape Canaveral (Johnson and Muller 1993a).
Dynamics: The process of sand movement due to the forces of wind and water are part of the natural dynamics of beach ecosystems. This includes transport of sand along the coast, and movement of sand by wind or water between the dunes, beach and subtidal areas. If not restricted by infrastructure or engineered hard structures, beaches and dunes can migrate as coastlines change over time in response to the action of wind and water. The beaches of the east coast of Florida are affected by two tides per day.

Component Associations:
- *Cakile edentula ssp. harperi* Sparse Vegetation (CEGL004401, G3)

DISTRIBUTION

Range: This system is found along the Atlantic Coast from the St. Johns River in northeastern Florida south to approximately Cape Canaveral.
Divisions: 203:C
Nations: US
Subnations: FL
Map Zones: 55:C, 56:C
USFS Ecomap Regions: 232G:CC
TNC Ecoregions: 55:C, 56:C

SOURCES

References: Defeo et al. 2009, FNAI 1990, Johnson and Muller 1993a, Southeastern Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723067#references
Description Author: R. Evans, mod. C.W. Nordman and M. Pyne
Version: 14 Jan 2014
Concept Author: R. Evans
Stakeholders: Southeast
ClassifResp: Southeast

SOUTHERN ATLANTIC COASTAL PLAIN SEA ISLAND BEACH (CES203.383)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Barren
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Beach (Substrate); Coastal plain
National Mapping Codes: ESLF 3150

CONCEPT

Summary: This ecological system represents beaches and overwash flats in the Sea Island region of South Carolina and Georgia. The entire region is distinctive, and wave energy is generally lower here than any other point along the Atlantic coast. Huge quantities of fine-textured sediments are deposited by the region's alluvial rivers, many of which drain relatively large interior areas of the Piedmont, where clay is an abundant by-product of weathering and erosion. These beaches are distinguished from others of the Atlantic coast by the prevalence of fine-textured sediments. The low wave energy and high tidal range create relatively short barrier islands (as opposed to the long narrow islands of North Carolina and the Gulf of Mexico). In addition, the extensive Continental Shelf coupled with low wave energy contributes to a paucity of shell components of the beach substrates.

Similar Ecological Systems:

- Southern Atlantic Coastal Plain Florida Beach (CES203.535)--dovetails this system to the south.

DESCRIPTION

Environment: Sea island beaches are found on the true barrier islands present in the region. Wave energy is generally lower here than any other point along the Atlantic coast (Tanner 1960). Low wave energy and high tidal range create relatively short barrier islands (as opposed to long narrow islands of North Carolina and the Gulf of Mexico).
Vegetation: See descriptions in Hillestad et al. (1975) from Cumberland Island.
Dynamics: The process of sand movement due to the forces of wind and water are part of the natural dynamics of beach ecosystems. This includes transport of sand along the coast, and movement of sand by wind or water between the dunes, beach and subtidal areas. If not restricted by infrastructure or engineered hard structures, beaches and dunes can migrate as coastlines change over time in response to the action of wind and water. The beaches of the Atlantic coast are affected by two tides per day.

Component Associations:

- *Cakile edentula ssp. harperi* Sparse Vegetation (CEGL004401, G3)
- *Ipomoea imperati - Cakile edentula ssp. harperi* Herbaceous Vegetation (CEGL007009, G3?)

DISTRIBUTION

Range: This system is found in the Sea Island region of South Carolina and Georgia, extending to the St. Johns River in northern Florida.
Divisions: 203:C
Nations: US
Subnations: FL, GA, SC
Map Zones: 55:C, 58:C
USFS Ecomap Regions: 232C:CC
TNC Ecoregions: 56:C

SOURCES

References: Comer et al. 2003, Defeo et al. 2009, Hillestad et al. 1975, Tanner 1960
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723133#references
Description Author: R. Evans, mod. M. Pyne
Version: 06 Feb 2014
Concept Author: R. Evans
Stakeholders: Southeast
ClassifResp: Southeast

SOUTHERN ATLANTIC COASTAL PLAIN XERIC RIVER DUNE (CES203.497)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Dune (Substrate)
FGDC Crosswalk: Vegetated, Shrub-dominated, Shrubland, Mixed evergreen-deciduous shrubland
National Mapping Codes: EVT 2388; ESLF 5319; ESP 1388

CONCEPT

Summary: This system encompasses a range of vegetation present on inland sand dunes of the Atlantic Coastal Plain of Georgia. These dunes are associated with certain rivers such as the Ohoopee and Canoochee and are apparently eolian in origin, formed of riverine alluvial sands. The sandy soils are deep, coarse, and xeric in nature. The vegetation consists of an assemblage of xeric communities that also occur in other xeric habitats in the Coastal Plain. These include *Pinus palustris - Quercus laevis* communities and a scrub community akin to Inland Florida Scrub, but lacking *Pinus clausa*. This system is distinguished from more typical xeric sandhills of the Coastal Plain by its occurrence on the deep sands of river dunes. Xeric river dunes have a similar fire-return interval to other upland systems of which *Pinus palustris* is a component, but the fuels are fires tend to be patchy, leaving some unburned areas.

Related Concepts:
- Dwarf oak-evergreen shrub forest (Wharton 1978) Equivalent
- Longleaf Pine: 70 (Eyre 1980) Finer
- Southern Scrub Oak: 72 (Eyre 1980) Finer

DESCRIPTION

Environment: These dunes are apparently eolian in origin, formed of reworked riverine alluvial sands. The sandy soils are deep, coarse, and xeric in nature. These deep coarse sand dunes have formed from winds blowing exposed sand from the riverbars in the Pleistocene (Edwards et al. 2013). They occur on the east and northeast sides of rivers which flow southeast (Bozeman 1971) in south Georgia, such as the Altamaha, Ohoopee, Flint, Satilla and Canoochee (Edwards et al. 2013). The dune system is most developed along the east side of the Ohoopee River, which is 35 miles long and about 40,000 acres (Edwards et al. 2013).

Vegetation: Upland plant communities include longleaf pine - turkey oak, dwarf oak, oak hammock, and rosemary scrub (Wharton 1978). On the Altamaha River, there is *Pinus palustris, Pinus elliottii, Quercus laevis, Aristida beyrichiana, Quercus hemisphaerica,* and *Quercus virginiana* (these last two may be from examples from which fire has been excluded) (J. Thompson, GDNR, pers. comm.)

Dynamics: About half of the woody species are evergreen, but there is greater cover of deciduous shrubs, and there are more shrubs than herbs (Harper 1906). This contrasts with other *Pinus palustris* habitats, which tend to be grass-dominated with a high diversity of herbs. Both *Ceratiola ericoides* and *Chrysoma pauciflosculosa* are evergreen shrubs and are fire-sensitive. *Chrysoma pauciflosculosa* seeds are able to spread to newly available open sandy and unburned habitat in local areas where they occur, but *Ceratiola ericoides* seeds are heavy, landing mostly near the mother plant, are inhibited by allelopathy, and generally start germinating after death of mother shrub, in same vicinity (M. Hodges pers. comm.). These shrubs may persist with the sparse *Pinus palustris* due to their metapopulation dynamics; certain subpopulations may be lost to occasional wildland fires, but new subpopulations also form where seeds germinate. While *Ceratiola ericoides* will generally not persist if burned more frequently than every 20 years (Johnson 1982), in some Florida habitats, population models of *Ceratiola ericoides* on Georgia xeric river dune sandhills suggest that burns at least as frequently as every 10 years may be important for maintaining open habitat and promoting recruitment of new shrubs (Schmidt 2006). These river dune habitats are naturally topographically isolated by a river on one (west or southwest) side and typically are adjacent to pine flatwoods on the other (east or northeast) side. Consequently, they have been partially protected from large wildland fires and may have a similar or lower fire-return interval than typical dry *Pinus palustris* habitats. The accumulation of fuel in these xeric river dune habitats is slow and does not support the frequent continuous fires that can occur in *Pinus palustris* habitats which have higher nutrient availability. The natural fire-return interval may have varied from 5 to 10 years depending on the fertility of the site and accumulation of fuels (Edwards et al. 2013). Where xeric river dunes are connected to pine flatwoods, fires would have been more frequent, and fires were patchy, leaving many unburned patches (M. Hodges pers. comm.). Fuels include *Pinus palustris* needles and dead leaves of *Aristida purpurascens, Aristida beyrichiana, Quercus laevis, Triplasis americana,* and other plants. Small areas along the Altamaha River sand ridge have broadleaf evergreen tall-shrub and small-tree vegetation, called the Georgia River Dune Myrtle Oak Scrub NVC Association (Bozeman 1971). These areas apparently burn only rarely (perhaps at high intensity), if at all, and are somewhat similar to oak scrub found in Florida.

Component Associations:
- *Ceratiola ericoides - (Chrysoma pauciflosculosa) / Polygonella polygama / Cladonia leporina* Shrubland (CEGL003864, G2?)
- *Chrysoma pauciflosculosa - (Clinopodium coccineum)* Dwarf-shrubland (CEGL003946, G1G2)
- *Pinus palustris / Quercus laevis - Quercus geminata / Ceratiola ericoides* Woodland (CEGL004491, G1G2)
- *Quercus myrtifolia - Quercus geminata - Hamamelis virginiana - (Elliottia racemosa)* Shrubland (CEGL004715, G1Q)

DISTRIBUTION

Range: This system is endemic to river-associated dunes in the South Atlantic Coastal Plain of Georgia, such as along the Ohoopee and Canoochee rivers (Wharton 1978), as well as other watersheds. Reports of similar or related vegetation from North and South Carolina are being investigated.
Divisions: 203:C
Nations: US
Subnations: GA
Map Zones: 55:C
USFS Ecomap Regions: 232J:CC
TNC Ecoregions: 56:C

SOURCES

References: Ambrose pers. comm., Bozeman 1971, Comer et al. 2003, Covell et al. 1984, Edwards et al. 2013, Eyre 1980, Harper 1906, Johnson 1982, NatureServe 2011, Oswalt et al. 2012, Schafale pers. comm., Schmidt 2006, Thompson pers. comm., Wahlenberg 1946, Wharton 1978
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723089#references
Description Author: R. Evans, mod. C.W. Nordman and M. Pyne
Version: 14 Jan 2014 **Stakeholders:** Southeast
Concept Author: R. Evans **ClassifResp:** Southeast

SOUTHERN CALIFORNIA COAST RANGES CLIFF AND CANYON (CES206.904)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Primary Division: Mediterranean California (206)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Canyon Mosaic; Mediterranean [Mediterranean Xeric-Oceanic]; Xeric; Landslide
Non-Diagnostic Classifiers: Montane [Lower Montane]; Lowland [Foothill]; Lowland [Lowland]; Shrubland (Shrub-dominated); Moss/Lichen (Nonvascular); Cliff (Substrate); Talus (Substrate); Rock Outcrops/Barrens/Glades; Very Shallow Soil; Canyon; Cliff (Landform)
National Mapping Codes: ESLF 3168

CONCEPT

Summary: Found from foothill and montane elevations of California's Transverse and Peninsular ranges, these are barren and sparsely vegetated areas (<10% plant cover) of steep cliff faces, narrow canyons, and smaller rock outcrops of various igneous, sedimentary, and metamorphic bedrock type. This system also includes unstable scree and talus slopes typically occurring below cliff faces. Scattered vegetation may include shrub species from surrounding coastal chaparral, such as *Ceanothus megacarpus, Ceanothus leucodermis, Cercocarpus montanus var. minutiflorus (= Cercocarpus minutiflorus), Arctostaphylos glauca*, and *Xylococcus bicolor*. Soil development is limited as is herbaceous cover.

DISTRIBUTION

Range: Found from foothill and montane elevations of California's Transverse and Peninsular ranges.
Divisions: 206:C
Nations: MX, US
Subnations: CA, MXBC(MX)
Map Zones: 4:C
USFS Ecomap Regions: 261B:PP, 262A:PP, 322C:PP
TNC Ecoregions: 16:C

SOURCES

References: Barbour and Major 1988, Comer et al. 2003, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722777#references
Description Author: P. Comer, T. Keeler-Wolf
Version: 17 Mar 2003
Stakeholders: Latin America, West
Concept Author: P. Comer, T. Keeler-Wolf
ClassifResp: West

SOUTHERN COASTAL PLAIN SINKHOLE (CES203.495)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Barren
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland; Wetland
Diagnostic Classifiers: Rock Outcrops/Barrens/Glades
Non-Diagnostic Classifiers: Depressional; Isolated Wetland [Partially Isolated]
National Mapping Codes: ESLF 3184

CONCEPT

Summary: This system consists of deep sinkhole depressions with steep vertical walls of exposed limestone in the Gulf Coastal Plain of Florida and Georgia (other depressions formed in karstic regions that are shallow and lacking in steep vertical walls with exposed rock are accommodated by other systems). These cylindrical- or conical-shaped depressions form in karstic environments where cavities have been eroded in underlying limestone. As cavities enlarge, cavern roofs eventually collapse forming these steep-sided depressions. Some examples drain readily and contain standing water for short periods of time, while others contain permanent lakes. The steep-sided limestone walls are typically sparsely vegetated with mosses, liverworts, and ferns, with occasional herbs and shrubs in crevices where organic soils have developed (FNAI 1990). The steepness and depth of these depressions help create a generally moist microclimate which is often enhanced by seepage from surrounding uplands, and the presence of standing water.
Classification Comments: Excluded from this system are sinkholes of extreme southern Florida and the Mid-Atlantic Coastal Plain of the Carolinas which do not develop such extreme depth and microclimatic features.
Similar Ecological Systems:
- East Gulf Coastal Plain Depression Pond (CES203.558)
- East Gulf Coastal Plain Sandhill Lakeshore Depression (CES203.292)

Related Concepts:
- Sinkhole (FNAI 1990) Equivalent
- Water Tupelo - Swamp Tupelo: 103 (Eyre 1980) Finer

DESCRIPTION

Environment: Examples may be found in cylindrical- or conical-shaped limesink depressions with steep vertical walls of exposed limestone in northern and possibly central Florida. These depressions form in karstic environments where cavities have been eroded in underlying limestone. As cavities enlarge, cavern roofs eventually collapse forming these steep-sided depressions. Some examples drain readily and contain standing water for short periods of time, while others contain permanent lakes. The steep-sided limestone walls are typically sparsely vegetated with mosses, liverworts, and ferns, with occasional herbs and shrubs in crevices where organic soils have developed (FNAI 1990). The steepness and depth of these depressions help create a generally moist microclimate which is often enhanced by seepage from surrounding uplands and the presence of standing water.
Vegetation: The steep-sided limestone walls are typically sparsely vegetated with mosses, liverworts, and ferns, with occasional herbs and shrubs in crevices where organic soils have developed (FNAI 1990). In the East Gulf Coastal Plain, *Adiantum capillus-veneris* and *Thelypteris kunthii* are generally the dominant herbs. *Decumaria barbara* is often a common to codominant festooning vine. Other species may include *Aristolochia serpentaria*, *Selaginella ludoviciana*, *Carex* spp., and others. Bryophytes are abundant and lush, usually dominated by the thallose liverwort *Dumortiera hirsuta*. In Panhandle Florida, *Thelypteris ovata, Toxicodendron radicans, Decumaria barbara*, and *Parthenocissus quinquefolia* are also reported in association with *Adiantum*. Southern examples contain *Adiantum tenerum*, which dominates the herb layer, with scattered individuals of *Parietaria praetermissa, Arenaria lanuginosa*, and other ferns. Calciphilic mosses, especially *Anomodon rostratus*, are abundant.
Dynamics: These limesink depressions where this ecological system is found form in karstic environments where cavities have been eroded in underlying limestone. As the cavities enlarge, cavern roofs eventually collapse forming these steep-sided depressions. Some examples drain readily and contain standing water for short periods of time, while others contain permanent lakes. The steep-sided limestone walls are typically sparsely vegetated with distinctive mosses, liverworts, and ferns, with occasional herbs and shrubs in crevices where organic soils have developed (FNAI 1990). The steepness and depth of these depressions help create a generally moist microclimate which is often enhanced by seepage from surrounding uplands and the presence of standing water.

Component Associations:
- *Adiantum capillus-veneris - Thelypteris kunthii / Dumortiera hirsuta* Herbaceous Vegetation (CEGL004717, G3?)
- *Adiantum tenerum - Parietaria praetermissa - Arenaria lanuginosa* Herbaceous Vegetation (CEGL004469, G2?)

DISTRIBUTION

Range: This ecological system is restricted to the Gulf Coastal Plain of Alabama, Florida and Georgia.
Divisions: 203:C
Nations: US
Subnations: AL, FL, GA

Map Zones: 55:C, 56:C, 99:C
TNC Ecoregions: 53:C, 55:C

SOURCES

References: Comer et al. 2003, Eyre 1980, FNAI 1990
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723091#references
Description Author: R. Evans
Version: 06 Feb 2014
Concept Author: R. Evans
Stakeholders: Southeast
ClassifResp: Southeast

SOUTHERN INTERIOR CALCAREOUS CLIFF (CES202.356)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Barren
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Cliff (Substrate)
National Mapping Codes: ESLF 3185

CONCEPT

Summary: This ecological system encompasses calcareous cliffs of the Southern Ridge and Valley and adjacent areas of the Cumberland Plateau with a few disjunct localities in the Southern Appalachians. This system includes vertical to near-vertical rock faces of limestone and dolomite. These cliffs are typically dry but may contain relatively small embedded seepage patches. Both wet and, more commonly, dry expressions are included. Due to harsh edaphic conditions, including verticality, these cliffs are nearly unvegetated, however, *Asplenium ruta-muraria* and *Pellaea atropurpurea* may be characteristic plants. Some cliffs have scattered *Thuja occidentalis* trees which may be very old (>800 years) and more genetically diverse than northern populations. This system also covers a narrow zone of vegetation, often herbaceous, at the horizontal clifftop where growing conditions are harsh and often gladelike.

Similar Ecological Systems:
- Central Interior Calcareous Cliff and Talus (CES202.690)
- North-Central Appalachian Circumneutral Cliff and Talus (CES202.603)

Related Concepts:
- Dry Limestone Cliff (Evans 1991) Intersecting
- Eastern Redcedar: 46 (Eyre 1980) Finer
- Moist Limestone Cliff (Evans 1991) Intersecting
- Northern White-Cedar: 37 (Eyre 1980) Finer

DESCRIPTION

Environment: This system includes vertical to near-vertical rock faces of limestone and dolomite. These cliffs are typically dry but may contain relatively small embedded seepage patches. Both wet and, more commonly, dry expressions are included. Disjunct examples in the southern Appalachians attributed to this system include Hot Springs and Linville Caverns area. It presumably includes both the Bull Cave and Calf Cave area in the Smokies.

Vegetation: Due to harsh edaphic conditions, including verticality, these cliffs are nearly unvegetated; however, *Asplenium ruta-muraria* and *Pellaea atropurpurea* may be characteristic plants. Some cliffs have scattered *Thuja occidentalis* trees which may be very old (>800 years) and genetically diverse. This system also covers a narrow zone of vegetation, often herbaceous, at the horizontal clifftop where growing conditions are harsh and often gladelike. Some other plant species that may be found include calciphilic herbs such as *Aquilegia canadensis, Dodecatheon meadia, Symphyotrichum ericoides, Symphyotrichum oblongifolium, Cystopteris bulbifera, Bouteloua curtipendula, Pellaea atropurpurea, Dryopteris marginalis, Allium cernuum, Heuchera americana, Carex oligocarpa, Asplenium trichomanes, Arabis hirsuta, Arabis lyrata, Phlox subulata, Hylotelephium telephioides (= Sedum telephioides),* and *Saxifraga virginiensis*. Woody species may occur scattered throughout or at the margins; these species include *Juniperus virginiana, Rhus aromatica, Toxicodendron radicans, Hydrangea arborescens, Fraxinus americana, Parthenocissus quinquefolia, Cercis canadensis, Tilia americana, Carya* spp., *Quercus muehlenbergii, Ostrya virginiana*, and *Cornus florida*.

Component Associations:
- *Asplenium ruta-muraria - Pellaea atropurpurea* Sparse Vegetation (CEGL004476, G3G4)
- *Carex leptalea - Parnassia grandifolia - Juncus coriaceus - Solidago patula* Ridge and Valley Herbaceous Vegetation (CEGL004944, G2)
- *Rhus aromatica - Celtis tenuifolia / Carex eburnea* Shrubland (CEGL004393, G3)
- *Schizachyrium scoparium - Sporobolus compositus var. compositus - Rudbeckia fulgida var. fulgida* Wooded Herbaceous Vegetation (CEGL004078, G2)
- *Thuja occidentalis / Carex eburnea - Pellaea atropurpurea* Woodland (CEGL002596, G2G3)
- *Thuja occidentalis* Limestone Seepage Woodland (CEGL003675, G2G3Q)

DISTRIBUTION

Range: This system is found in the Southern Ridge and Valley and adjacent areas of the Cumberland Plateau with a few disjunct localities in the Southern Appalachians.
Divisions: 202:C
Nations: US
Subnations: AL, KY, NC, TN, VA
Map Zones: 48:C, 53:C, 57:C

TNC Ecoregions: 50:C, 51:C

SOURCES

References: Comer et al. 2003

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723156#references

Description Author: R. Evans, C. Nordman, M. Pyne

Version: 23 Feb 2010 **Stakeholders:** East, Southeast

Concept Author: R. Evans, C. Nordman, M. Pyne **ClassifResp:** Southeast

SOUTHERN INTERIOR SINKHOLE WALL (CES202.357)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Barren
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Cliff (Substrate); Alkaline Soil
National Mapping Codes: ESLF 3163

CONCEPT

Summary: This system represents vertical shaft sinkholes and the characteristic vegetation associated with their steep walls in the southern Ridge and Valley and adjacent Interior Low Plateau regions of the southeastern United States. Related examples in the Southern Blue Ridge are also covered here. Examples are normally dominated by *Cystopteris bulbifera* and *Asplenium rhizophyllum* or the liverwort *Dumortiera hirsuta*.

Similar Ecological Systems:
- Central Interior Calcareous Cliff and Talus (CES202.690)--may be in effect a subset of CES202.690.

Related Concepts:
- Moist Limestone Cliff (Evans 1991) Broader

DESCRIPTION

Environment: This system represents vertical shaft sinkholes and their steep walls.
Vegetation: Examples are normally dominated by *Cystopteris bulbifera* and *Asplenium rhizophyllum* or the liverwort *Dumortiera hirsuta*. An example from the Chattahoochee National Forest contains *Heuchera villosa, Adiantum pedatum, Asplenium rhizophyllum, Carex platyphylla, Cystopteris protrusa, Hepatica nobilis var. acuta, Laportea canadensis*, and *Solidago flexicaulis*. Additional species at a similar site in Great Smoky Mountains National Park include *Sedum ternatum, Physocarpus opulifolius, Pellaea atropurpurea*, and *Packera obovata*. Additional types may be developed as more information becomes available.

Component Associations:
- *Cystopteris bulbifera - (Asplenium rhizophyllum)* Sparse Vegetation (CEGL004394, G3G4)
- *Cystopteris bulbifera / Dumortiera hirsuta* Sinkhole Wall Sparse Vegetation (CEGL004988, G1)

DISTRIBUTION

Range: This system is found in the Southern Ridge and Valley and adjacent Interior Low Plateau regions of the southeastern United States and the Southern Blue Ridge, with rare and limited occurrences in the Upper East Gulf Coastal Plain.
Divisions: 202:C
Nations: US
Subnations: AL, KY, MS, NC, TN
Map Zones: 46:P, 47:C, 48:C, 53:C, 57:C
TNC Ecoregions: 43:C, 44:C, 50:C, 51:C

SOURCES

References: Comer et al. 2003
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723155#references
Description Author: R. Evans and C. Nordman, mod. M. Pyne
Version: 23 Feb 2010
Concept Author: R. Evans and C. Nordman
Stakeholders: Southeast
ClassifResp: Southeast

SOUTHERN PIEDMONT CLIFF (CES202.386)

CLASSIFIERS

Classification Status: Standard

Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Barren
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Cliff (Substrate)
National Mapping Codes: ESLF 3156

CONCEPT

Summary: This ecological system consists of steep to vertical or overhanging rock outcrops in the Piedmont. They occur on lower to midslopes, usually in river gorges or bluffs. The sparse vegetation is limited to plants growing on bare rock, small ledges, and crevices. Vegetation is primarily bryophytes, lichens, and herbs, with sparse trees and shrubs rooted in deeper soil pockets and crevices. The types of plants that may grow on cliffs are limited by the harsh conditions to those with adaptations to drought and limited nutrients. Examples of this system occur on steep rock outcrops on lower slopes, occasionally higher in topographically sheltered sites. River bluffs are the primary setting. Cliffs may have any aspect, but north-facing cliffs seem to be more common. The substrate is mostly bare bedrock, which is steep to vertical or overhanging. Most examples are on felsic metamorphic rock such as gneiss or schist, but a smaller number occur on mafic metamorphic rock, felsic or mafic igneous rock, or sedimentary rock. Vascular plants are limited to sparse rooting sites in soil pockets, ledges, and crevices.
Classification Comments: More information is needed on the associations that belong to this system.

This system is distinguished from other rock outcrops by a combination of low topographic position, vertical orientation, large amount of bare rock, and absence of specialized environments such as exfoliated granite, limestone or dolomite, and spray from waterfalls. In contrast, Southern Appalachian Rocky Summit (CES202.327) occurs in high topographic positions; they have more horizontal rock but may have some substantial vertical surfaces. Southern Piedmont Glade and Barrens (CES202.328) is more horizontally oriented and have much more vegetation cover. The division of rock outcrop systems may be too fine and warrant combining some; however, each system has distinctive characteristics of structure and some distinctive flora.

This system is distinguished from Southern Appalachian Montane Cliff and Talus (CES202.330) by floristic differences. Southern Appalachian Montane Cliff and Talus (CES202.330) has a number of species absent or scarce in the Piedmont, differences that may be related to elevation, regional climate, or to biogeography. However, upper Piedmont cliffs that have Appalachian flora are included in that system (CES202.330).

The primary variation within this system, which could be the basis for further subdivision, is the distinction between mafic and felsic rock, with the rare sedimentary rock examples a third category. Sedimentary rock examples in the Piedmont resemble other Piedmont cliffs more than they resemble cliffs of sedimentary rocks in the interior ecoregions.
Similar Ecological Systems:
- Southeastern Coastal Plain Cliff (CES203.398)
- Southern Appalachian Montane Cliff and Talus (CES202.330)
- Southern Appalachian Rocky Summit (CES202.327)
- Southern Piedmont Glade and Barrens (CES202.328)
- Southern Piedmont Granite Flatrock and Outcrop (CES202.329)

DESCRIPTION

Environment: Examples of this system occur on steep rock outcrops on lower slopes, occasionally higher in topographically sheltered sites. River bluffs are the primary setting. Cliffs may have any aspect, but north-facing cliffs seem to be more common. The substrate is mostly bare bedrock, which is steep to vertical or overhanging. Most examples are on felsic metamorphic rock such as gneiss or schist, a smaller number on mafic metamorphic rock, felsic or mafic igneous rock, or sedimentary rock. The physical structure of most cliffs in the Piedmont is irregular, with some ledges and crevices, and with steep, vertical, and even overhanging portions intermixed. Moisture levels vary drastically over short distances. Seepage of ground water from adjacent soils or through rock fractures often creates permanently or seasonally flooded microsites, while lack of soil makes other portions extremely dry. In less sheltered topography, slope aspect affects overall moisture levels to some degree. Rock or soil chemistry appears to be the most important factor affecting different associations on sites that have the physical structure to belong to this system.
Vegetation: No vascular plant associations have yet been defined for this system. Vegetation is sparse. Bryophytes and lichens may cover portions of the open rock. Vascular plants are limited to sparse rooting sites in soil pockets, ledges, and crevices. Some of these microsites may be deep enough to support shrubs or even trees, while most support only herbs. The woody plants are usually species from surrounding forests, and may be mesophytic or xerophytic. The herbs include a variety of species of open dry habitats, such as *Schizachyrium scoparium, Danthonia spicata, Houstonia purpurea*, and *Coreopsis major*, along with a few rock outcrop specialists such as *Polypodium virginianum, Saxifraga virginiensis,* and *Heuchera* spp. A number of bryophyte species may be present. Mafic rock outcrops have an additional suite of specialist herbs, including *Aquilegia canadensis, Arabis lyrata, Anemone berlandieri*, and *Sedum glaucophyllum*. Herbs from the surrounding forest are often also present and may make up a significant fraction of the flora.

Dynamics: The dynamics of this system have received little study. Most cliff communities are probably stable over long periods of time, with fine-scale disturbances affecting microsites. Rock falls, slides, and other mass movement are rare, but represent catastrophic disturbance to part or all of a cliff, and may be important in the long term for keeping cliffs open. The types of plants that may grow on cliffs are limited by the harsh conditions to those with adaptations to drought and limited nutrients (Edwards et al. 2013). Animal movements may be locally important. Fire probably has little effect on cliffs, which have too little vegetation to carry fire and which tend to occur in topography that is not conducive to fire spread. Because of the limited natural disturbance and the fragility of soil and vegetation, human disturbance by trampling of edges and by climbing may be particularly destructive.

Component Associations:
- *Cystopteris bulbifera - (Asplenium rhizophyllum)* Sparse Vegetation (CEGL004394, G3G4)
- *Lasallia papulosa - Lasallia pensylvanica* Nonvascular Vegetation (CEGL004385, G2?)
- Piedmont Acidic Cliff Sparse Vegetation (CEGL003979, G2?)
- Piedmont Mafic Cliff Sparse Vegetation (CEGL003982, G2?)

SPATIAL CHARACTERISTICS

Spatial Summary: Small-patch system, most examples covering less than one acre. Examples tend to occur as isolated small patches, occasionally as small clusters.
Size: Most examples naturally cover an acre or less. A few occur as complexes of closely associated patches, but the aggregate size is still small. Size is somewhat ambiguous for this system, in that vertical surfaces may be as extensive as horizontal surfaces.
Adjacent Ecological Systems:
- Southern Piedmont Dry Oak-(Pine) Forest (CES202.339)
- Southern Piedmont Large Floodplain Forest (CES202.324)
- Southern Piedmont Mesic Forest (CES202.342)
- Southern Piedmont Small Floodplain and Riparian Forest (CES202.323)

Adjacent Ecological System Comments: Surrounded by forest systems on deeper soils less influenced by bedrock, most typically Southern Piedmont Dry Oak-(Pine) Forest (CES202.339) above and Southern Piedmont Large Floodplain Forest (CES202.324) or Southern Piedmont Small Floodplain and Riparian Forest (CES202.323) below.

DISTRIBUTION

Range: Scattered throughout the Piedmont and incidentally into the Coastal Plain, from northern Alabama and Georgia north into Virginia.
Divisions: 202:C; 203:C
Nations: US
Subnations: AL, GA, NC, SC, VA
Map Zones: 54:C, 58:C, 59:C, 61:C
TNC Ecoregions: 52:C, 57:C

SOURCES

References: Comer et al. 2003, Edwards et al. 2013, McLean 1989, Schafale and Weakley 1990
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723130#references
Description Author: M. Schafale, mod. M. Pyne
Version: 06 Feb 2014 **Stakeholders:** East, Southeast
Concept Author: M. Schafale **ClassifResp:** Southeast

SOUTHERN PIEDMONT GRANITE FLATROCK AND OUTCROP (CES202.329)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Central Interior and Appalachian (202)
Land Cover Class: Barren
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland; Wetland
Diagnostic Classifiers: Rock Outcrops/Barrens/Glades
Non-Diagnostic Classifiers: Seepage-Fed Sloping; Isolated Wetland [Strictly Isolated]
National Mapping Codes: ESLF 3175

CONCEPT

Summary: This ecological system consists of smooth, exfoliated outcrops of massive granite and related rocks in the eastern and central Piedmont of the southeastern United States, and rarely in the adjacent Atlantic Coastal Plain, there confined to the fall-line where erosion has exposed underlying rocks. Examples occur from Virginia south to Alabama but are found most abundant in the upper Piedmont of Georgia. Some noteworthy examples in central Georgia include Stone Mountain, Panola Mountain, and Arabia Mountain in DeKalb, Henry, and Rockdale counties. Depending upon the location, examples may rise above the surrounding landscape by as much as 200 m, or may lie flush with the surrounding land surface. The vegetation is a complex of small-patch communities of different species and structure occupying different microhabitats which are present on the outcrops, ranging from mosses and lichens, to herbs, to shrubs and trees. In some areas, these microhabitats include solution pits or depressions that retain water and form a distinctive wetland community. This outcrop system supports a relatively large number of endemic plants.
Classification Comments: Granitic domes are clearly related to other rock outcrop systems in the Piedmont but are distinct in their flora and vegetation mat succession. The smooth rock surface is crucial to their development. More fractured granitic rocks do not form this distinct system. In contrast, Southern Piedmont Cliff (CES202.386) has vertically oriented rock outcrops that tend to have fractures and ledges. Southern Piedmont Glade and Barrens (CES202.328) is similarly horizontally oriented but has denser vegetation and rather different flora. Southern Appalachian Rocky Summit (CES202.327), which barely overlaps the range of this system, has fractured rock and occurs in topographically high settings in rugged topography.

This system is closely related to Southern Appalachian Granitic Dome (CES202.297), with which it shares the distinctive structure and vegetation mat dynamics of exfoliated outcrops. The flat orientation of the flatrocks makes pools more important in them. Climatic and biogeographic differences lead to floristic differences between the two systems. The massive Piedmont outcrops in the Atlanta vicinity (Wharton 1978) are included here, the distinction between "dome" (CES202.297) and "flatrock (CES202.329) perhaps being an overly specific use of vague and conceptual terminology.

Similar Ecological Systems:
- Southern Appalachian Granitic Dome (CES202.297)
- Southern Appalachian Rocky Summit (CES202.327)
- Southern Piedmont Cliff (CES202.386)
- Southern Piedmont Glade and Barrens (CES202.328)

Related Concepts:
- Rock Outcrops (Wharton 1978) Broader
- Virginia Pine: 79 (Eyre 1980) Finer

DESCRIPTION

Environment: This system occurs on exfoliated granitic outcrops; these are Precambrian metamorphic rocks generally found in the Piedmont Plateau (McVaugh 1943). Outcrops are level or gently sloped, occurring as low domes up to 200 m above the surrounding landscape or as flatrocks varying considerably in size (Shure 1999). Smooth rock without crevices is the primary factor in the distinctive ecological character of this system. Granite, granitic gneiss, and related granitoid rocks (Edwards et al. 2013) without many internal joints tend to fracture into thin sheets parallel to the surface, forming outcrops with smooth surfaces largely lacking crevices. The outcrop surface is largely bare rock but has thin soil mats around the edges and in patches throughout. Mats vary in depth with age and level of development. Distinct microenvironments are created by small irregularities in the rock surface and by areas of seepage at the edge. Some examples (e.g., in central Georgia) may have prominent seepage-related features, where areas of perennial herbaceous vegetation are very wet in the winter and spring. In these cases, the only vegetated areas on the granite outcrop are seepage-related. One possible substrate is the Lilesville granite.
Vegetation: Most of the rock surface is bare or has only crustose or foliose lichen cover. Vegetation occurs as a series of small patches in the thin soil mats, or seasonal pools, with the community type dependent on the nature of the depression and depth of the soil mat (if any). Bare rock may have moss patches or straggling vines including *Gelsemium sempervirens*. The thinnest soils usually have a set of fine forbs, many of them annual. Slightly deeper soils often have grasses dominating. Deeper soils support shrubs or small trees, including *Vaccinium arboreum* and *Pinus virginiana*. A distinctive woodland of pines or pines and oaks occurs on the continuous shallow soils surrounding the outcrop. The flora shares some species with other rock outcrops of the Piedmont, but has some distinctive species and different dominance of species. Some characteristic plant species include the forbs *Minuartia glabra*, *Minuartia uniflora*, and *Packera tomentosa*; one common grass is *Schizachyrium scoparium*. Other unusual plants include the

mat-forming fern ally *Selaginella rupestris*, the unusual floating aquatic annual *Amphianthus pusillus*, the quillworts *Isoetes melanospora* and *Isoetes tegetiformans*, the diminuitive succulents *Diamorpha smallii* and *Talinum teretifolium*, as well as *Cyperus granitophilus*, *Diodia teres*, and *Croton willdenowii*.

Dynamics: Large numbers of soil island depression may be scattered across the surface of granite outcrops and occasional pools of shallow water may stand in certain depressions which trap rainfall (McVaugh 1943, Shure 1999). Where soil accumulates in depressions formed by exfoliating surface rock, a distinctive and fairly predictable pattern of successional changes occurs [see references in Shure (1999)]. Soil mats appear and deepen over time in a process that links vegetational and soil development, but are eventually destroyed by windthrow, drought, other natural disturbances. The result is a mosaic with mats of different levels of development at any given time. Mat dynamics are different in different parts of the rock, with older mats and more permanent patterns near the edges and sparser and younger mats in the interior. The dynamics are further modified by microtopography and the presence of seepage. The larger vegetation patterns such the relative amount of different stages likely respond to climatic cycles and natural disturbance events. The thin soils make these communities sensitive to drought, especially the long-lived woody species. Fire is probably rare in the interior, given the sparse fuel, but may be important in determining the size of the open area and may affect the dynamics of the bordering woodlands.

Severe droughts kill tree saplings growing in cracks and potholes, helping to retain the open character of the glades (Quarterman et al. 1993). There is an apparent zonation or patchiness to glade/barren vegetation, with different zones that may be identified by their characteristic plant species (Quarterman et al. 1993). These zones are apparently relatively stable, with woody plant encroachment evident only in relation to the invasion of shrubs and trees into potholes or crevices where soil accumulates more rapidly.

Component Associations:

- *Amphianthus pusillus - Isoetes melanospora - Isoetes tegetiformans* Herbaceous Vegetation (CEGL004342, G1)
- *Diamorpha smallii - Minuartia glabra - Minuartia uniflora - Cyperus granitophilus* Herbaceous Vegetation (CEGL004344, G3)
- *Packera tomentosa - Croton willdenowii - Schizachyrium scoparium - (Selaginella rupestris)* Herbaceous Vegetation (CEGL004298, G3)
- *Pinus (virginiana, taeda) / Juniperus virginiana - Chionanthus virginicus - Ulmus alata* Granitic Flatrock Border Forest (CEGL003993, G3?)
- *Talinum teretifolium - Minuartia glabra - Diodia teres - Croton willdenowii* Herbaceous Vegetation (CEGL003857, G2)

Spatial Characteristics

Spatial Summary: Small-patch system, most examples covering one to a relatively few acres.

Size: Most examples naturally cover one to a few acres, some less than one acre. A few examples exceed 10 acres. Most examples occur in a few clusters where geology is particularly suitable, such as central Georgia and northeastern North Carolina. A few examples are more isolated. Individual flatrocks may occur in complexes, separated by small patches of forest.

Adjacent Ecological Systems:

- Southern Piedmont Dry Oak-(Pine) Forest (CES202.339)

Adjacent Ecological System Comments: Surrounded by forest systems on deeper soils less influenced by bedrock, most typically Southern Piedmont Dry Oak-(Pine) Forest (CES202.339).

Distribution

Range: This system is found scattered in the eastern and central Piedmont, from Alabama to Virginia. Rare examples occur in the upper Piedmont. A few, occurring surrounded by Tertiary sediments in the Fall Zone, may be considered to be in the Coastal Plain.

Divisions: 202:C

Nations: US

Subnations: AL, GA, NC, SC, VA

Map Zones: 54:C, 59:C, 61:C

TNC Ecoregions: 52:C, 57:P

Sources

References: Baker 1956, Coffey 1964, Comer et al. 2003, DeSelm and Murdock 1993, Duffey et al. 1974, Edwards et al. 2013, Estes et al. 1979, Eyre 1980, McKinney and Lockwood 1999, McVaugh 1943, Murdock pers. comm., Nelson 1986, Noss 2013, Quarterman et al. 1993, Shure 1999, Taft 1997, Taft 2009, Taft et al. 1995, TNC 1996c, Wharton 1978, Wiens and Dyer 1975

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723174#references

Description Author: M. Schafale and R. Evans, mod. M. Pyne

Version: 14 Jan 2014

Concept Author: M. Schafale and R. Evans

Stakeholders: East, Southeast

ClassifResp: Southeast

SOUTHWEST FLORIDA BEACH (CES411.276)

CLASSIFIERS

Classification Status: Standard

Primary Division: Caribbean (411)
Land Cover Class: Barren
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Beach (Substrate); Coast
Non-Diagnostic Classifiers: Graminoid
National Mapping Codes: ESLF 3151

CONCEPT

Summary: This system ranges from Anclote Key southward to Cape Romano, Florida (Johnson and Barbour 1990). Within the northern Gulf of Mexico region, these beaches are distinguished by the highest species richness, greatest cover of succulents, and high cover of *Iva imbricata* and several tropical species (Barbour et al. 1987). Sands are relatively coarse and, unlike other beach systems of the northern Gulf of Mexico, are extremely rich in calcium from an abundance of calcareous shell fragments.
Classification Comments: Apparently, few associations have currently been described in the NVC for this system. More information is needed.
Similar Ecological Systems:
- Southeast Florida Beach (CES411.272)

Related Concepts:
- Beach Dune (FNAI 1990) Broader
- Unconsolidated Substrate (FNAI 1990) Broader

DESCRIPTION

Environment: The substrate of these beaches is composed of relatively coarse sands and, unlike other beach systems of the northern Gulf of Mexico, are extremely rich in calcium from an abundance of calcareous shell fragments.
Vegetation: These beaches are dominated by *Uniola*, but less so than other beach systems of the northern Gulf of Mexico. Other important species are *Iva imbricata*, *Oenothera humifusa*, *Scaevola plumieri*, and *Sesuvium portulacastrum*.

Component Associations:
- *Ipomoea pes-caprae* - *Cakile lanceolata* Herbaceous Vegetation (CEGL004403, G3G4)
- *Scaevola plumieri / Uniola paniculata* - *Iva imbricata* - *Cenchrus spinifex* Herbaceous Vegetation (CEGL003897, G3?)

DISTRIBUTION

Range: This system ranges from Anclote Key (border of Pasco and Pinellas counties) southward to Cape Romano, Florida (Collier County).
Divisions: 411:C
Nations: US
Subnations: FL
Map Zones: 56:C
TNC Ecoregions: 54:C

SOURCES

References: Barbour et al. 1987, Comer et al. 2003, Johnson and Barbour 1990
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723210#references
Description Author: R. Evans
Version: 23 Feb 2010
Concept Author: R. Evans
Stakeholders: Southeast
ClassifResp: Southeast

SOUTHWESTERN GREAT PLAINS CANYON (CES303.664)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Western Great Plains (303)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Canyon
Non-Diagnostic Classifiers: Very Shallow Soil; Flood Scouring
National Mapping Codes: ESLF 3176

CONCEPT

Summary: This ecological system occurs in both perennial and intermittent stream canyons of the southwestern Great Plains. Soils can range from deep loams to alluvial to sandy. The mosaic of soil types which have developed from sandstone, limestone, basalt, and shale parent materials creates a complex mosaic of grasslands, shrublands and woodlands within the canyon system (Shaw et al. 1989). Although the system combines many elements from Southern Rocky Mountain Juniper Woodland and Savanna (CES306.834), Rocky Mountain Lower Montane-Foothill Shrubland (CES306.822), Western Great Plains Shortgrass Prairie (CES303.672), and other shrublands, the varied geology, diverse soil types, and topographic dynamics together form a distinct ecological system characteristic of the canyons and dissected mesas of the southwestern Great Plains.

Vegetation varies both regionally and locally depending on latitude, aspect, slope position and substrate and can range from riparian vegetation to xeric or mesic woodlands and shrublands. Rock outcrops with sparse vegetation are also common. Open to moderately dense pinyon-juniper woodlands occupy most of the canyonland slopes. Scattered *Pinus edulis* may occur within these community types but are never dominant. Woodlands may be floristically similar to and intergrade with Southern Rocky Mountain Juniper Woodland and Savanna (CES306.834) but are distributed along rocky outcrops, canyon slopes and mesas. *Juniperus monosperma* is the most common tree species and forms extensive woodlands with a grassy understory of *Bouteloua eriopoda, Bouteloua gracilis, Bouteloua hirsuta, Bouteloua curtipendula,* and *Pleuraphis jamesii*, or sometimes with an open shrub layer dominated by *Cercocarpus montanus*. In Kansas, *Juniperus virginiana* can become more dominant and replace *Juniperus monosperma*. Isolated patches of *Pinus ponderosa* or *Populus tremuloides* are found in some locations. Shrublands occur on canyon bottoms, in narrow side canyons, and integrate with woodlands on upper slopes. A mosaic of shrub species is characteristic of canyon walls and slopes and varies with substrate and moisture availability. Common species include *Artemisia bigelovii, Cercocarpus montanus, Rhus trilobata, Ribes* spp., *Ptelea trifoliata, Philadelphus microphyllus*, and *Yucca glauca*. *Frankenia jamesii* and *Glossopetalon spinescens var. meionandrum* form a community restricted to gypsiferous and calciferous soils. Canyon floors often support a degraded shrubby grassland of *Ericameria nauseosa* and *Opuntia imbricata* with a grassy understory.

Because of the varied topography, relatively permanent water along streambeds and southern location, these canyonlands have a rich herpetofauna (Mackessy 1998). This system provides good habitat for a number of snake species that are otherwise uncommon in the Central Shortgrass Prairie ecoregion. Occasional seeps and springs of the canyon walls provide habitat for rare ferns.
Classification Comments: A new system (10-09), Llano Estacado Caprock Escarpment and Breaks Shrubland and Steppe (CES303.725), was created for the escarpment and breaks that follow the eastern edge of the Llano Estacado (Texas Panhandle) and includes the canyons along this escarpment (e.g., Palo Duro Canyon).
Similar Ecological Systems:
- Llano Estacado Caprock Escarpment and Breaks Shrubland and Steppe (CES303.725)
- Northwestern Great Plains Shrubland (CES303.662)
- Western Great Plains Cliff and Outcrop (CES303.665)

Related Concepts:
- Pinyon - Juniper: 239 (Eyre 1980) Finer. Pinyon is very scattered and not dominant so probably not extensive within this system.

Component Associations:
- *Artemisia bigelovii / Achnatherum hymenoides* Shrubland (CEGL000990, G3Q)
- *Cercocarpus montanus - Rhus trilobata / Andropogon gerardii* Shrubland (CEGL002912, G2G3)
- *Cercocarpus montanus / Achnatherum scribneri* Shrubland (CEGL002913, G3)
- *Cercocarpus montanus / Bouteloua curtipendula* Shrubland (CEGL001086, G5)
- *Cercocarpus montanus / Hesperostipa comata* Shrubland (CEGL001092, G2)
- *Cercocarpus montanus / Hesperostipa neomexicana* Shrubland (CEGL002911, G2G3)
- *Juniperus monosperma / Bouteloua curtipendula* Woodland (CEGL000708, G5)
- *Juniperus monosperma / Bouteloua eriopoda* Woodland (CEGL000709, GNR)
- *Juniperus monosperma / Bouteloua gracilis* Woodland (CEGL000710, G5)
- *Juniperus monosperma / Cercocarpus montanus - Ribes cereum* Woodland (CEGL000714, GU)
- *Juniperus monosperma / Cercocarpus montanus* Woodland (CEGL000713, GNR)
- *Juniperus monosperma / Hesperostipa neomexicana* Woodland (CEGL000722, G4)
- *Quercus gambelii / Symphoricarpos oreophilus* Shrubland (CEGL001117, G5)

- *Rhus trilobata* Rocky Mountain Shrub Herbaceous Vegetation (CEGL002910, G2)

Spatial Characteristics

Adjacent Ecological System Comments: This system can grade into in areas dominated by *Pinus* spp.

Distribution

Range: This system occurs in dry canyons and mesas in the southwestern portion of the Western Great Plains, ranging from Purgatoire and Apishipa canyons, tributaries of the Arkansas River in Colorado, and east into Kansas, Oklahoma and possibly north Texas.
Divisions: 303:C
Nations: US
Subnations: CO, KS, OK, TX?
Map Zones: 26:?, 27:C, 33:C, 34:?, 35:?
USFS Ecomap Regions: 315A:CC, 315B:C?, 331B:CC, 331I:CC, M313B:PP
TNC Ecoregions: 27:C, 28:?

Sources

References: CNHP 1999, Comer et al. 2003, Mackessy 1998, Shaw et al. 1989
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722994#references
Description Author: S. Menard and K. Kindscher
Version: 27 May 2004 **Stakeholders:** Midwest, Southeast, West
Concept Author: K. Decker, K. Schulz, S. Menard and K. Kindscher **ClassifResp:** Midwest

TEMPERATE PACIFIC FRESHWATER MUDFLAT (CES200.878)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Barren
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Wetland
Diagnostic Classifiers: Herbaceous; Temperate [Temperate Oceanic]; Extensive Wet Flat
Non-Diagnostic Classifiers: Lowland [Lowland]
National Mapping Codes: ESLF 3122

CONCEPT

Summary: Freshwater mudflats are found scattered throughout the temperate regions of the Pacific Coast of North America. In the Pacific Northwest, they occur primarily in seasonally flooded shallow lakebeds on floodplains, especially along the lower Columbia River. During any one year, they may be absent because of year-to-year variation in river water levels. Mudflats must be exposed before the vegetation develops from the seedbank. They are dominated mainly by low-stature annual plants. They range in physiognomy from sparsely vegetated mud to extensive sods of herbaceous vegetation. The predominant species include *Eleocharis obtusa*, *Lilaeopsis occidentalis*, *Crassula aquatica*, *Limosella aquatica*, *Gnaphalium palustre*, *Eragrostis hypnoides*, and *Ludwigia palustris*.
Classification Comments: Revised to eliminate overlap with North Pacific Intertidal Freshwater Wetland (CES204.875) and to better clarify the type, with input from John Christy.

Component Associations:
- *Euthamia occidentalis* Herbaceous Vegetation (CEGL003328, G3)
- *Ludwigia palustris - Polygonum hydropiperoides* Herbaceous Vegetation (CEGL003330, G2)

DISTRIBUTION

Range: This system is found throughout the temperate regions of the Pacific Coast of North America.
Divisions: 204:C; 206:C
Nations: US
Subnations: AK, CA, OR, WA
Map Zones: 1:C, 2:P, 3:C, 4:C, 7:C, 8:C, 9:C
USFS Ecomap Regions: 242A:CC, 242B:CC, M242A:CC, M242C:CP, M242D:CP
TNC Ecoregions: 2:C, 14:C, 15:C, 16:C

SOURCES

References: Chappell and Christy 2004, Comer et al. 2003, Holland and Keil 1995
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722797#references
Description Author: C. Chappell
Version: 07 Feb 2005
Stakeholders: West
Concept Author: C. Chappell
ClassifResp: West

TEMPERATE PACIFIC INTERTIDAL FLAT (CES204.879)

CLASSIFIERS

Conf.: 2 - Moderate
Classification Status: Standard
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Barren
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Wetland
Diagnostic Classifiers: Saline Water Chemistry; Temperate [Temperate Hyperoceanic]; Temperate [Temperate Oceanic]; Tidal / Estuarine [Haline]; Tidal / Estuarine [Oligohaline]
FGDC Crosswalk: Vegetated, No dominant lifeform, Sparsely vegetated, Unconsolidated material
National Mapping Codes: EVT 2669; ESLF 3116; ESP 1669

CONCEPT

Summary: Coastal flats are found along the north Pacific Coast from Kodiak Island and Cook Inlet, Alaska, south to central California. Tidal flats form a narrow band along oceanic inlets and are more extensive at the mouths of larger rivers. Algae are the dominant vegetation on mud or gravel flats where little vascular vegetation is present due to the daily (in some cases twice daily) tidal flooding of salt or brackish water. Characteristic species include *Vaucheria longicaulis* and *Enteromorpha* spp. Vascular species are sparse, if present, and may include salt-tolerant species such as *Eleocharis palustris, Salicornia* spp., *Plantago maritima, Glaux maritima*, and other plants common to lower salt marshes; cover is less than 10%. The dominant processes are tectonic uplift or subsidence, isostatic rebound, and sediment deposition.

Similar Ecological Systems:
- Alaska Arctic Tidal Flat (CES102.208)

Related Concepts:
- III.B.3.d - Halophytic herb wet meadow (Viereck et al. 1992) Intersecting
- III.D.2.a - Four-leaf marestail (Viereck et al. 1992) Intersecting

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Temperate Pacific Tidal Salt and Brackish Marsh (CES200.091)

DISTRIBUTION

Range: Along the north Pacific Coast from Kodiak Island and Cook Inlet, Alaska, south to central California.
Divisions: 105:P; 204:C
Nations: CA, US
Subnations: AK, BC, CA, OR, WA
Map Zones: 1:C, 2:C, 3:C, 4:?, 75:C, 76:C, 77:C, 78:C
USFS Ecomap Regions: 242A:CC, 261B:CC, 263A:CC, M242A:CC
TNC Ecoregions: 1:C, 2:C, 69:C, 70:C, 71:C

SOURCES

References: Boggs 2002, Comer et al. 2003, Holland and Keil 1995, Viereck et al. 1992, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722796#references
Description Author: K. Boggs and G. Kittel, mod. M.S. Reid
Version: 21 Aug 2008
Stakeholders: Canada, West
Concept Author: K. Boggs and G. Kittel
ClassifResp: West

TEXAS COAST BEACH (CES203.463)

CLASSIFIERS

Classification Status: Standard

Primary Division: Gulf and Atlantic Coastal Plain (203)
Land Cover Class: Barren
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland
Non-Diagnostic Classifiers: Forest and Woodland (Treed)
National Mapping Codes: ESLF 3192

CONCEPT

Summary: This ecological system includes sparsely vegetated ocean beaches constituting the outermost zone of coastal vegetation ranging from and including Boliver peninsula south to include Padre Island in Texas. These beaches are typically located on barrier islands and peninsulas, and they are generally well-developed with an established dune system behind them. Examples generally extend seaward from foredunes but may include flats behind breached foredunes. Although these habitats are situated just above the mean high tide limit, they are constantly impacted by wind and salt spray and may be flooded by storm surges. Characteristic dominants are xerophytes and include the perennials *Ipomoea pes-caprae* and *Ipomoea imperati* and the annual *Cakile geniculata*.
Related Concepts:
- Coastal Beach (6100) [CES203.463] (Elliott 2011) Equivalent

DESCRIPTION

Environment: This ecological system includes the typically sparsely vegetated, back beach area of the mainland and barrier islands composed of sand and shell fragments in a microtidal environment (<0.5m) as it transitions into more stabilized coastal communities. These areas generally lie near mean sea level (1 m) and are often found between foredunes and tidal waters. Examples are found on retreating, prograding and aggradating sandy barrier segments. In the case of beaches along bay margins, an active dune system is generally lacking and beaches lie between tidal waters and near-shore vegetation. Recently deposited sands are transported by gulf currents and distributed and redistributed by onshore winds. Landforms are very gently sloping and restricted to the margins of the Gulf of Mexico as well as interior bays. Soils are recently deposited sands.
Vegetation: Species such as *Ipomoea pes-caprae, Ipomoea imperati, Cakile* spp., and *Tidestromia lanuginosa* provide sparse vegetative cover.
Dynamics: This system is dependent on highly dynamic coastal geomorphology. The process of sand movement due to the forces of wind and water are part of the natural dynamics of beach ecosystems. This includes transport of sand along the coast, and movement of sand by wind or water between the dunes, beach and subtidal areas. If not restricted by infrastructure or engineered hard structures, beaches and dunes can migrate as coastlines change over time in response to the action of wind and water. Some beaches in this system are eroding and some are accreting (Morton et al. 2004). Beaches require a supply of sand and in some cases this supply has been altered through control of river outflow into the Gulf of Mexico (e.g., the diversion of the mouth of the Brazos River). Loss of this supply of sand and sediments results in a lack of sand to replenish natural beach erosion and loss of beach systems.

Component Associations:
- *Ipomoea pes-caprae - Ipomoea imperati - (Cakile geniculata)* Herbaceous Vegetation (CEGL004402, G3?)

DISTRIBUTION

Range: Outermost zone of coastal vegetation ranging from and including Boliver peninsula south to include Padre Island in Texas.
Divisions: 203:C; 301:C
Nations: MX, US
Subnations: TX
Map Zones: 36:C, 37:C
USFS Ecomap Regions: 232E:CC, 255D:CC
TNC Ecoregions: 31:C

SOURCES

References: Comer et al. 2003, Defeo et al. 2009, Elliott 2011, Morton et al. 2004
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723123#references
Description Author: J. Teague, mod. M. Pyne and L. Elliott
Version: 10 Jan 2014
Concept Author: J. Teague
Stakeholders: Latin America, Southeast
ClassifResp: Southeast

WESTERN GREAT PLAINS BADLANDS (CES303.663)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Western Great Plains (303)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Badland; Badlands
Non-Diagnostic Classifiers: Temperate [Temperate Continental]; Ustic; Flood Scouring; W-Patch/High Intensity
National Mapping Codes: ESLF 3114

CONCEPT

Summary: This ecological system is found within the northern Great Plains region of the United States and Canada with some of the better known and extensive examples in North and South Dakota. In contrast to Western Great Plains Cliff and Outcrop (CES303.665), this system is typified by extremely dry and easily eroded, consolidated clay soils with bands of sandstone or isolated consolidates and little to no cover of vegetation (usually less than 10% but can be as high as 20%). Vegetated patches within the badlands system may have cover higher than 20%. In north-central Montana, badlands often are a mosaic of bare substrate with small patches of grasses and/or shrubs that may exceed 10% cover. In those areas with vegetation, species can include scattered individuals of many dryland shrubs or herbaceous taxa, including *Grindelia squarrosa*, *Gutierrezia sarothrae* (especially with overuse and grazing), *Sarcobatus vermiculatus*, *Atriplex gardneri*, *Artemisia pedatifida*, *Eriogonum* spp., *Muhlenbergia cuspidata*, *Pseudoroegneria spicata*, and *Arenaria hookeri*. Patches of *Artemisia* spp. can also occur. This system can occur where the land lies well above its local base level or below and is created by several factors, including elevation, rainfall, carving action of streams, and parent material.
Classification Comments: It has been proposed to change the name of this system to include "shale barrens." As with all predominantly "barren" systems, there will be patches of vegetated areas within the overall system. Small areas of "badlands" or "shale barrens" can also occur without major erosional processes actively taking place. An example location is Bitter Creek Area of Environmental Concern (BLM designation), which is much like a badland but not so eroded. The vegetation is sparse with *Juniperus horizontalis* and much bare ground; there is some grass cover as well. The driving process is erosion. Exactly where this transitions to Inter-Mountain Basins Shale Badland (CES304.789) in central Wyoming needs to be clarified.
Similar Ecological Systems:
- Western Great Plains Cliff and Outcrop (CES303.665)

Related Concepts:
- Western Great Plains Badlands (Rolfsmeier and Steinauer 2010) Equivalent

DESCRIPTION

Environment: A combination of factors such as elevation, rainfall, carving action of streams and parent material can contribute to the development of this system. This system is primarily a type of mature dissection with finely textured drainage pattern and steep slopes. This system contains extremely dry and easily erodible, consolidated clayey soils with bands of sandstone or isolated consolidates. This system is found within an arid to semi-arid climate with infrequent, but torrential, rains that cause erosion.
Vegetation: Vegetation in this system is limited by climate and soils and often is less than 10% cover. Scattered individuals of *Grindelia squarrosa*, *Gutierrezia sarothrae*, or *Eriogonum* spp. and/or patches of *Artemisia* spp. may occur.
Dynamics: This system contains highly erodible soils that can be strongly influenced by infrequent, but often torrential, rains.

Component Associations:
- *Arenaria hookeri* Barrens Herbaceous Vegetation (CEGL001951, GU)
- *Artemisia longifolia* Badlands Sparse Vegetation (CEGL002195, GNR)
- *Artemisia pedatifida - Atriplex gardneri* Shrubland (CEGL001525, G3?)
- *Atriplex gardneri - Picrothamnus desertorum* Dwarf-shrubland (CEGL001439, G2G3)
- *Atriplex gardneri / Artemisia tridentata* Dwarf-shrubland (CEGL001440, G3)
- *Atriplex gardneri / Monolepis nuttalliana* Dwarf-shrubland (CEGL001443, G3?)
- *Atriplex gardneri / Pascopyrum smithii* Dwarf-shrubland (CEGL001445, G3)
- *Eriogonum pauciflorum - Gutierrezia sarothrae* Badlands Sparse Vegetation (CEGL005270, G4G5)
- Eroding Great Plains Badlands Sparse Vegetation (CEGL002050, G4G5)
- *Panicum virgatum - (Pascopyrum smithii)* Herbaceous Vegetation (CEGL001484, G2Q)
- *Sarcobatus vermiculatus / Atriplex gardneri* Shrubland (CEGL001360, G4?)
- *Sarcobatus vermiculatus / Pseudoroegneria spicata* Shrubland (CEGL001367, G3)
- *Shepherdia argentea* Shrubland (CEGL001128, G3G4)

DISTRIBUTION

Range: This system ranges throughout the northern Great Plains region of the United States and Canada. Some of the best and well-known examples occur in North and South Dakota. Its western-most occurrence in Wyoming needs to be clarified, but it does

occur in the eastern portion of that state.
Divisions: 303:C
Nations: CA? , US
Subnations: MB?, MT, ND, NE, SD, WY
Map Zones: 20:C, 21:?, 22:?, 29:C, 30:C, 31:C, 33:?, 40:P
USFS Ecomap Regions: 331E:C?, 331F:CC, 331G:CC, 331H:C?, 331K:CP, 331L:CP, 331M:CC, 342A:CC, 342F:C?, 342G:C?, M331B:CC, M331I:CP, M334A:CC
TNC Ecoregions: 26:C, 34:P, 66:?, 67:P

SOURCES

References: Comer et al. 2003, Knight et al. 1987, Von Loh et al. 1999
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722995#references
Description Author: S. Menard and K. Kindscher, mod. G. Kittel and M.S. Reid
Version: 29 Jan 2007 **Stakeholders:** Canada, Midwest, West
Concept Author: S. Menard and K. Kindscher **ClassifResp:** Midwest

WESTERN GREAT PLAINS CLIFF AND OUTCROP (CES303.665)

CLASSIFIERS

Conf.: 2 - Moderate **Classification Status:** Standard
Primary Division: Western Great Plains (303)
Land Cover Class: Barren
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Non-Diagnostic Classifiers: Very Shallow Soil; Ustic; Flood Scouring; W-Patch/High Intensity; Cliff (Landform)
National Mapping Codes: ESLF 3142

CONCEPT

Summary: This system includes cliffs and outcrops throughout the Western Great Plains Division. Substrate can range from sandstone and limestone, which can often form bands in the examples of this system. Vegetation is restricted to shelves, cracks and crevices in the rock. However, this system differs from Western Great Plains Badlands (CES303.663) in that often the soil is slightly developed and less erodible, and some grass and shrub species can occur at greater than 10%. Common species in this system include short shrubs such as *Rhus trilobata* and *Artemisia longifolia* and mixedgrass species such as *Bouteloua curtipendula* and *Bouteloua gracilis* and *Calamovilfa longifolia*. Drought and wind erosion are the most common natural dynamics affecting this system.
Classification Comments: The granite glades and rock outcrops of the Llano Uplift of Texas have been reclassified to Llano Uplift Acidic Forest, Woodland and Glade (CES303.657). The carbonate glades, barrens, and cliffs of the Edwards Plateau of Texas have been reclassified to Edwards Plateau Carbonate Glade and Barrens (CES303.655) and Edwards Plateau Cliff (CES303.653), respectively.
Similar Ecological Systems:
- Southwestern Great Plains Canyon (CES303.664)
- Western Great Plains Badlands (CES303.663)

Related Concepts:
- Western Great Plains Cliff and Outcrop (Rolfsmeier and Steinauer 2010) Equivalent

DESCRIPTION

Environment: This system is includes cliff and outcrops throughout the Western Great Plains Division with substrate ranging from sandstone to limestone. Areas of shelves, cracks, and crevices accumulated materials and allow soils to develop enough to support more vegetation.
Vegetation: Short shrubs and mixedgrass species dominate the vegetation of this system. Common species include *Rhus trilobata, Artemisia longifolia, Bouteloua curtipendula, Bouteloua gracilis*, and *Calamovilfa longifolia*, although species can vary somewhat with substrate and exposure.
Dynamics: Drought and wind erosion are the major influences affecting this system.

Component Associations:
- *Arenaria hookeri* Barrens Herbaceous Vegetation (CEGL001951, GU)
- *Artemisia longifolia - Calamovilfa longifolia* Sparse Vegetation (CEGL001521, G3G4)
- *Lesquerella (gordonii, ovalifolia) - Schizachyrium scoparium* Herbaceous Vegetation (CEGL004917, G2G3)
- Limestone Butte Sparse Vegetation (CEGL002296, GNR)
- Sandstone Butte Sparse Vegetation (CEGL002297, GNR)
- Sandstone Great Plains Dry Cliff Sparse Vegetation (CEGL005257, G4G5)
- Sandstone Great Plains Xeric Butte - Bluff Sparse Vegetation (CEGL002290, GNR)
- Sandstone Midwest Dry Cliff Sparse Vegetation (CEGL002045, G4G5)
- Shale Barren Slopes Sparse Vegetation (CEGL002294, GNR)
- Siltstone - Sandstone Rock Outcrop Sparse Vegetation (CEGL002047, G4?)

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems:
- Northwestern Great Plains Canyon (CES303.658)

DISTRIBUTION

Range: This system ranges throughout the Western Great Plains Division from northern Texas to southern Canada.
Divisions: 303:C
Nations: CA, US
Subnations: CO, KS, MB, MT, ND, NE, NM, OK, TX, WY
Map Zones: 20:?, 22:?, 25:P, 26:C, 27:C, 28:P, 29:C, 30:C, 31:C, 33:C, 34:C, 35:C, 38:C, 39:?, 43:P
USFS Ecomap Regions: 251G:P?, 251H:PP, 315A:CC, 315B:CC, 315F:CC, 321A:CC, 331B:CC, 331C:CC, 331F:CC, 331G:CC, 331H:CC, 331I:CC, 331K:CP, 331L:CP, 332B:CP, 332C:CC, 332D:CC, 332E:C?, 342F:PP, M313B:CC, M331B:CC, M331F:CC, M331I:CC
TNC Ecoregions: 26:C, 27:C, 28:C, 33:C, 37:P, 66:P, 67:P

SOURCES

References: Comer et al. 2003

Full References:

See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.722993#references

Description Author: S. Menard and K. Kindscher

Version: 05 Mar 2003

Stakeholders: Canada, Midwest, Southeast, West

Concept Author: S. Menard and K. Kindscher

ClassifResp: Midwest

WESTERN NORTH AMERICAN BOREAL ACTIVE INLAND DUNE (CES105.116)

CLASSIFIERS

Conf.: 1 - Strong **Classification Status:** Standard
Primary Division: Montane Boreal (105)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Dune (Landform); Boreal [Boreal Subcontinental]
FGDC Crosswalk: Vegetated, No dominant lifeform, Sparsely vegetated, Unconsolidated material
National Mapping Codes: EVT 2613; ESLF 3202; ESP 1613

CONCEPT

Summary: Active inland dunes occur in boreal Alaska and western Canada as remnants of larger systems of dunes and sandsheets that developed under the climatic conditions of the late Pleistocene. Strong storm winds carried glacio-fluvial silts and sands across vast areas of northwestern North America. Most of these sand deposits have been stabilized by forest and tundra vegetation, but areas of active transport and deposition still exist. Some of the most noteworthy active areas are the Kobuk Dunes in western Alaska, the Carcross Dunes in southern Yukon, and the Lake Athabasca Dunes in northern Saskatchewan. These active dunes share many floristic elements and geomorphic processes. The main disturbance process is the transport and deposition of sand. Common landforms include transverse and longitudinal dunes, sandsheets, desert pavements, blowouts, and interdune slacks. Three dominant habitat types occur within boreal active dune systems: grassy, dry mountainous and boreal forest.
Classification Comments: This system is known as Boreal Active Inland Dune by the Alaska Natural Heritage Program.
Related Concepts:
- I.A.2.e - White spruce (open) (Viereck et al. 1992) Intersecting
- I.A.3.c - White spruce (woodland) (Viereck et al. 1992) Intersecting
- II.C.2.g - Willow low (open) (Viereck et al. 1992) Intersecting
- III.B.1.a - Seral herbs (Viereck et al. 1992) Intersecting

DESCRIPTION

Environment: Active inland dunes occur in boreal Alaska as remnants of a larger system of dunes and sandsheets that developed under the climatic conditions of the late Pleistocene. Strong storm winds carried glacio-fluvial silts and sands across vast areas of northwestern North America. Most of these sand deposits have been stabilized by forest and tundra vegetation, but areas of active transport and deposition still exist. Some of the most noteworthy active areas are the Kobuk Dunes in western Alaska, the Carcross Dunes in southern Yukon, and the Lake Athabasca Dunes in northern Saskatchewan. These active dunes share many floristic elements and geomorphic processes (Parker and Mann 2000). Common landforms include transverse and longitudinal dunes, sandsheets, desert pavements, blowouts, and interdune slacks. Three dominant habitat types occur within boreal active dune systems: grassy, dry mountainous and boreal forest (Parker 1998).
Vegetation: Active dunes support a unique assemblage of plant species, but plant cover is typically sparse and discontinuous. Three dominant habitat types occur within boreal active dune systems: grassy, dry mountainous and boreal forest (Parker 1998). Dunes of the Kobuk Valley feature four plant species listed as imperiled in Alaska: *Lupinus kuschei, Oxytropis kobukensis, Symphyotrichum yukonense (= Aster yukonensis)*, and *Corispermum ochotense var. alaskanum*. *Leymus mollis (= Leymus arenarius ssp. mollis)* usually restricted to a narrow strip along the coast, is also common on the Kobuk Dunes. Several Beringian endemics and species which are widely disjunct from their known distributions have also been documented (Parker and Mann 2000). *Carex sabulosa*, a sedge known from only four other sites in North America, can be found in Yukon Territory in dune systems near Carcross and Kusawa Lake; however, it does not occur in the Kobuk Dunes.
Dynamics: The main disturbance process is the transport and deposition of sand. In western Alaska, the prevailing sand transport direction is from southeast to northwest. Vegetation on the downwind side of the dune is gradually being buried in sand, while on the windward side vegetation is reestablishing. Within the dune complex, a wide variety of moisture regimes and successional stages occurs. Interdune slacks may feature wetland habitats, while xeric conditions prevail on active deposition surfaces. Along the dune margins, varying stages of boreal forest succession exist. Fire is not a major disturbance on active dunes; however, dunes now covered by forest and tundra may revert to active dunes after fire.

DISTRIBUTION

Range: Active inland dunes occur as isolated features in western Alaska and western Canada.
Divisions: 103:C; 105:C
Nations: CA, US
Subnations: AB, AK, BC?, SK, YT
Map Zones: 68:?, 70:?, 71:C, 72:?, 73:C, 74:?
TNC Ecoregions: 75:C, 77:C, 78:?, 79:?, 140:C

SOURCES

References: Mann et al. 2002, Parker 1998, Parker and Mann 2000, Western Ecology Working Group n.d.

Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817405#references
Description Author: T. Boucher, mod. M.S. Reid
Version: 30 Mar 2010 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

WESTERN NORTH AMERICAN BOREAL ALPINE FLOODPLAIN (CES105.135)

CLASSIFIERS

Classification Status: Standard

Primary Division: Montane Boreal (105)
Land Cover Class: Barren
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Wetland
Diagnostic Classifiers: Alpine/AltiAndino; Riparian Mosaic; Floodplain; Boreal [Boreal Subcontinental]
FGDC Crosswalk: Vegetated, No dominant lifeform, Sparsely vegetated, Unconsolidated material
National Mapping Codes: EVT 2637; ESLF 3203; ESP 1637

CONCEPT

Summary: This system includes active alpine and subalpine floodplains. Frequent river channel migration and associated flooding and fluvial processes constitute the major disturbances in this type. Soils develop on alluvium and are typically shallow and well-drained. This system includes a range of floodplain vegetation including shrubs (dwarf-, low, and tall), mesic herbaceous meadow, early-seral forbs, and barren gravel. Common shrubs include *Salix alaxensis, Salix* spp., *Betula nana*, and *Alnus viridis ssp. sinuata*. Common herbaceous species include *Chamerion latifolium, Lupinus* spp., *Mertensia paniculata, Erigeron acris, Achillea millefolium var. borealis*, and *Crepis* spp. (*Crepis nana* and *Crepis elegans*).
Classification Comments: This system is known as Alpine Floodplain by the Alaska Natural Heritage Program.
Related Concepts:

- II.B.2.a - Willow (open) (Viereck et al. 1992) Intersecting
- II.C.2.g - Willow low (open) (Viereck et al. 1992) Intersecting
- II.D.1.a - Dryas tundra (Viereck et al. 1992) Intersecting
- II.D.2.a - Bearberry tundra (Viereck et al. 1992) Intersecting
- II.D.2.b - Vaccinium tundra (Viereck et al. 1992) Intersecting
- II.D.2.c - Crowberry tundra (Viereck et al. 1992) Intersecting
- II.D.2.e - Cassiope tundra (Viereck et al. 1992) Intersecting
- II.D.3.a - Willow tundra (Viereck et al. 1992) Intersecting
- III.B.1.a - Seral herbs (Viereck et al. 1992) Intersecting

DESCRIPTION

Dynamics: This system is found along glacially- and non-glacially-fed streams.

DISTRIBUTION

Range: This system occurs in alpine and subalpine valleys of the boreal and boreal transition regions of Alaska.
Divisions: 104:C; 105:C; 204:C
Nations: CA, US
Subnations: AK
Map Zones: 68:?, 69:C, 70:C, 71:C, 72:?, 73:C, 74:C, 75:C, 76:P
TNC Ecoregions: 71:C, 72:C, 74:C, 75:C, 76:C, 77:C, 78:C, 79:C

SOURCES

References: Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817463#references
Description Author: T. Boucher
Version: 08 Aug 2008 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

WESTERN NORTH AMERICAN BOREAL ALPINE TALUS AND BEDROCK (CES105.130)

CLASSIFIERS

Classification Status: Standard

Primary Division: Montane Boreal (105)
Land Cover Class: Barren
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Alpine/AltiAndino; Hillslope bedrock outcrop; Ridgetop bedrock outcrop; Herbaceous; Talus (Landform); Boreal [Boreal Subcontinental]
FGDC Crosswalk: Vegetated, No dominant lifeform, Sparsely vegetated, Unconsolidated material
National Mapping Codes: EVT 2632; ESLF 3204; ESP 1632

CONCEPT

Summary: This ecological system occurs on talus- and bedrock-dominated sites above the dwarf-shrub zone, and also on early-seral alpine sites near glaciers. Sites are well-drained to excessively drained, and there is little soil development. They are often rocky and sparsely vegetated with forbs and graminoids such as *Draba* spp., *Saxifraga* spp., *Oxyria digyna, Festuca brachyphylla, Carex pyrenaica ssp. micropoda (= Carex micropoda),* and *Luzula* spp. Dwarf-shrubs are uncommon.
Classification Comments: This system is known as High Alpine Herbaceous by the Alaska Natural Heritage Program. In the Alaska classification, this is an herbaceous system, but cover of vascular plants is low (although not specifically mentioned in the description). NatureServe is treating this as part of the mosaic of alpine bedrock and talus in the boreal region. If the "high alpine herbaceous" really should be kept as its own system, then a "boreal alpine talus and bedrock" system will still need to be kept in the systems classification and described.
Related Concepts:
- III.B.1.c - Alpine herbs (Viereck et al. 1992) Broader

DESCRIPTION

Environment: This ecological system occurs on talus- and bedrock-dominated sites above the dwarf-shrub zone, and also on early-seral alpine sites near glaciers. Sites are well-drained to excessively drained, and there is little soil development (Viereck et al. 1992, DeVelice et al. 1999).
Vegetation: Sites are often rocky and sparsely vegetated with forbs and graminoids such as *Draba* spp., *Saxifraga* spp., *Oxyria digyna, Festuca brachyphylla, Carex pyrenaica ssp. micropoda (= Carex micropoda),* and *Luzula* spp. Dwarf-shrubs are uncommon.

DISTRIBUTION

Range: This system occurs in the high alpine (>1000 m elevation) of the boreal and boreal transition regions of Alaska.
Divisions: 105:C; 204:C
Nations: CA, US
Subnations: AK
Map Zones: 69:C, 70:C, 71:C, 73:C, 74:C, 75:C
TNC Ecoregions: 70:C, 71:C, 72:C, 74:C, 75:C, 76:C, 77:?, 78:C, 79:C

SOURCES

References: DeVelice et al. 1999, Viereck et al. 1992, Western Ecology Working Group n.d.
Full References:
See explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.817448#references
Description Author: T. Boucher
Version: 10 Dec 2008 **Stakeholders:** Canada, West
Concept Author: Western Ecology Group and Alaska Natural Heritage Program **ClassifResp:** West

