Rapid Assessment Reference Condition Model

The Rapid Assessment is a component of the LANDFIRE project. Reference condition models for the Rapid Assessment were created through a series of expert workshops and a peer-review process in 2004 and 2005. For more information, please visit www.landfire.gov. Please direct questions to helpdesk@landfire.gov.

Potential Natural Vegetation Group (PNVG)

R9AWCF **Atlantic White Cedar Forest**

General Information

Contributors *(additional contributors may be listed under "Model Evolution and Comments")*

Modelers

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Reviewers

Vegetation Type

Forested

Dominant Species*

CHTH

General Model Sources

- [x] Literature
- [x] Local Data
- [x] Expert Estimate

LANDFIRE Mapping Zones

66 58
65 55
60 46

Rapid AssessmentModel Zones

- [ ] California
- [ ] Great Basin
- [ ] Great Lakes
- [ ] Northeast
- [ ] Northern Plains
- [ ] N-Cent.Rockies
- [ ] Pacific Northwest
- [ ] South Central
- [x] Southeast
- [ ] S. Appalachians
- [ ] Southwest

Geographic Range

The largest stands of Atlantic White Cedar historically occurred in peatlands of coastal North Carolina and southeastern Virginia, with the next largest in New Jersey. Other substantial stands were found as far north as Appleton Bog, Maine, the northern limit of the species (Stockwell 1999). Numerous small, isolated stands were sprinkled in sandy and mucky sloughs through the interior sandhills of the Carolinas and Georgia, south to coastal wetlands of the Florida Panhandle.

Biophysical Site Description

White cedar occupies a rather narrow hydrologic position toward the wet end of the moisture gradient, intermediate between that of non-pyrophytic cypress-gum swamp in the South, or maple swamp in the Northeast, and various drier or more fire-exposed wetland vegetation types. In the great peatlands, it requires periodic replacement fire for establishment of new stands or expansion of existing stands into adjacent communities. Stand replacement may occur by catastrophic crown fire under extreme burning conditions, or by consumption of peat by ground fire. In coastal stands, rising sea level appears to prevent stand replacement on the seaward side, while the stand may expand upslope on the inland side.

Vegetation Description

The presettlement extent range wide was likely about 350,000-500,000 acres of which only 5-10% remains. In the Virginia/Carolina peatlands, however, where the largest stands occurred, only around 1-4% of Atlantic White Cedar dominanted stands remain after 400 years of exploitation and wetland alteration. The primary habitat was peat soils which ranged in depth up to 2-3 meters in the Great Dismal Swamp of Virginia and North Carolina, the locale of the largest known stand at 112,000 acres (Akerman 1923). In addition to the peatland type, numerous smaller stands can be found on wet sands, mucky sands and organic substrates in southern sandhill sloughs from the Carolinas to Florida, and in glacial kettles and wet depressions in outwash plains left behind by melting glacial ice in the Northeast. The largest remaining stands are in NJ where there may be roughly 22,500 acres having >25% cedar cover. The highest elevation stand is near 1500 feet in High Point Swamp, New Jersey, while the lowest stands occur at sea level in New

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.

Jersey and North Carolina, where some stands are now being flooded by rising sea level.

The tree and its lumber were formerly known as "juniper" in the boatbuilding and timber industry and a few juniper fishing boats still ply the waters of the Chesapeake Bay. Stands that regenerated from crown fire may have nearly pure cover of white cedar. The most common subcanopy species are red maple (Acer rubrum), red bay (Persea palustris) and sweet bay (Magnolia virginiana). Shrubs, in various parts of the range, include gallberry (Ilex glabra), Inkberry (Ilex coriacea), Leucothoe racemosa, Virginia willow (Itea virginica) and many others. Herbs, chiefly ferns and sedges, are typically sparse but mosses may be abundant.

In large coastal peatlands, white cedar occurs as one element of a landscape scale patch mosaic with the patch type dependent upon the depth of the water table at the time of the fire that regenerated the stand. As such, this is one of the only true shifting mosaic types of the eastern U.S. Other patch elements are swamp black gum (Nyssa biflora), pond pine (Pinus serotina), and bald cypress (Taxodium distichum and Taxodium ascendens). The existence of a patch of any particular species at any time is stochastic (Frost 1996). If the water table is near enough to the surface at the time of the burn so that the seed bank is undisturbed, a dense, pure stand is likely to regenerate. If a few centimeters of the surface peat are burned away, destroying the seed bank, species in nearby stands may seed in creating patches of red maple, swamp black gum or pond pine. If the water table has been drawn down by evapotranspiration to ½ to 1 meter below the surface—as often happens in the summertime—peat may burn out to a depth sufficient to pool water. In this case, a patch of bald cypress can be created.

Disturbance Description

This PNVG is classified as fire regime type IV (with some II and V), with a fire return interval of 25-300 years. Fire frequency is driven by where the stand occurs in the fire landscape. In the southern sandhills, fires may sweep through bottomland sloughs as often as every two years but white cedar is rarely affected, occurring as it does in pockets inaccessible to fire because of steep side slopes. While sensitive to fire, trees on the stand margins have charred bark from the frequent light fires but are not killed. This usually occurs only on the margin so surface fire was not included in the model. In wetlands accessible to fire from one side but protected on the other, there may be a fire frequency gradient. In the Great Dismal Swamp of Virginia and North Carolina, there was historically a conspicuous fire frequency gradient with canebrake (a frequent-fire type) on the east side, which carried fire into the eastern margins of white cedar, maintaining a patchwork of young stands. No fire could approach from the west side which was guarded by a zone of wet swamp at the toe of the Suffolk Scarp. Under severe burning conditions, however, fires carried into the center of the Dismal from canebrakes on the south and east at intervals of 100-300 years. Between these extremes there were areas burned at intermediate intervals, giving a fire frequency gradient with stands 25 to 300 years old dating to past fires. Hurricanes and tornadoes cause occasional blowdowns, especially where adjacent openings along roads, ditches and logged patches reduce stand integrity and permit access to winds that otherwise may have rolled across the closed canopy. The relative importance of wind as a disturbance may increase northward as fire frequency drops, but stands in kettles embedded in more flammable communities such as pitch pine could be expected to be killed under rare, severe burning conditions with wind when fire had access to crowns from long flame-length fires in adjacent pitch pine communities with shrubby understories.

Adjacency or Identification Concerns

There is no Küchler type corresponding to this PNVG. Portions of the Atlantic White Cedar forest were included in his type 113, Southern floodplain forest; type 114, Pocosin and several other types. Dominant species include Atlantic White Cedar (Chamaecyparis thyoides).

Scale Description

Sources of Scale Data ☑ Literature ☐ Local Data ☑ Expert Estimate

Historical stands ranged in size from those in small glacial kettles < 1 acre to the largest stand of 112,000 acres which occurred in the Great Dismal Swamp. Disturbances affecting stands in the peatlands were the

largest, with fire behavior similar to that of boreal forest but with smaller patch size, ranging from 50-10,000 acres.

Issues/Problems

Many localities for Atlantic white cedar today consist of mixed species stands. These are uncharacteristic and may be misinterpreted as natural mixed stands. Historical records and photos from around 1900 suggest that the original stands were nearly pure white cedar. The species composition has changed following repeated logging. While seed dispersal occasionally produces a cedar tree or two in other forest types, most sites with Chamaecyparis scattered among other wetland species can be shown to be post-logging remnants of preexisting dense stands rather than natural mixed species community types. In the peatlands, logging usually leads to capture of the site by understory species such as red maple, swamp black gum, red bay and sweet bay because white cedar regeneration is prevented by shading from logging slash.

There are a number of factors implicated in the decline of white cedar (Frost 1995). In some cases ditching and road building caused large scale disruption of the hydrology and lead to flooding (if near sea level), or drainage that resulted in deep peat burns, peat subsidence, oxidation and exposure of mineral soil. Additional peat lands were lost by conversion to agriculture. Logging contributed to the decline of white cedar through: post logging site preemption by understory or stump sprouting species, shading of the seed bed by logging slash, and destruction of saplings by post logging fires in slash. There was also a tendency to log only cedar patches, leaving adjacent noncommercial swamp forest or, in the South, pocosin communities intact. This eliminates the possibility for expansion of the cedar stand (at best a new stand could reoccupy 100% of the original site). Historical and field evidence from the larger stands show a stepwise reduction in stand area, with a large portion of the site lost to other species each time a stand was logged. Fire suppression, also implicated in the decline of white cedar, eliminates an opportunity for white cedar to invade patches occupied by other species. Long-term, there is no evidence that white cedar can succeed itself without fire.

Model Evolution and Comments

This model replaces R7AWCF from the Northeast model zone for the PNVG's entire distribution.

Suggested reviewers include William Patterson, III, and Glenn Motzkin. In this model the path A,B,E represents Atlantic white cedar dynamics on major peatlands and path A,C,D represents dynamics in glacial kettles and outwash plain depressions in the north, and sandhill sloughs in the south. This model covers only the situation where Atlantic white cedar replaces itself after fire. It would require a considerably more complex model to include the alternative seres leading to red maple, pond pine, bald cypress and swamp black gum that are initiated when the seed bank is destroyed by shallow peat burns.

*Succession Classes***

Succession classes are the equivalent of "Vegetation Fuel Classes" as defined in the Interagency FRCC Guidebook (www.frcc.gov).

Class A 5 %

Early1 Closed

Description

Class A, 0-7 yrs., is characterized by dense seedlings of Atlantic white cedar on moist peat that form a closed layer within 4-5 years. There are no other conspicuous species.

Dominant Species* and Canopy Position

CHTH2 Upper

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 5

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	80 %	100 %
Height	Tree Regen <5m	Tree Regen <5m
Tree Size Class	Sapling >4.5ft; <5"DBH	

☐ Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.

Class B 25 %

Mid1 Closed

Description

Class B, 8-70 yrs., is characterized by dense, even-aged, closed canopy stands in large peatlands where long interval catastrophic fire is the primary disturbance. The understory includes scattered stems of red maple, and thinly scattered shrubs such as Ilex glabra, Vaccinium corymbosum, and Itea virginica.

Dominant Species* and Canopy Position

CHTH2 Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	90 %	100 %
Height	Tree Medium 10-24m	Tree Medium 10-24m
Tree Size Class	Pole 5-9" DBH	

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

☐ Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Fuel Model 4

Class C 5 %

Mid2 Closed

Description

This class represents one of two major alternative mature stand types of white cedar. Class C, 8-70 yrs, represents small wetlands such as glacial kettle ponds in the northeast and sandhill sloughs and narrow zones along fire-frequent uplands and nonflammable wet swamps in the south Soils are wet sand, wet mucky sand and shallow peat (mostly <1 m).

Between 8-300 yrs, multi-aged stands can occur in stream bottom swamps where fire can reach the edge of the stand and conditions support occasional mosaic fires. In the northeast, these conditions result in small patches of white cedar and mixed species stands of Pinus rigida or red maple. In the south, mixed species stands can include bald cypress, Pinus taeda, Pinus serotina or other bottomland hardwoods. Species dominance changes as fire frequency decreases down the moisture gradient.

Dominant Species* and Canopy Position

CHTH2 Upper
TADI2 Upper
ACRU Middle

Structure Data (for upper layer lifeform)

	Min	Max
Cover	80 %	100 %
Height	Tree Medium 10-24m	Tree Tall 25-49m
Tree Size Class	Large 21-33"DBH	

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

☐ Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Fuel Model 4

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.

Class D 5 %

Late2 Closed

Description

This class represents old growth in the same small wetland sites and sloughs as in class C.

Dominant Species* and Canopy Position

CHTH2 Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	80 %	100 %
Height	Tree Medium 10-24m	Tree Tall 25-49m
Tree Size Class	Large 21-33"DBH	

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

☐ Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Fuel Model 4

Class E 60 %

Late1 Closed

Description

This old growth alternative was the more extensive type found in large peatlands such as the Great Dismal Swamp, where peat depth ranges 1-2 m or more in depth.

Class E, 30-300+ yrs., is a late seral, closed stand with trees up to 330 years old and 80 cm dbh (see photo of virgin white cedar in FRCC model at www.FRCC.gov). In old stands that have gone 100-300 years without fire, dead trees may begin to be replaced with other species including pitch pine (Pinus rigida), pond pine (Pinus serotina), bald cypress (Taxodium distichum), swamp black gum (Nyssa biflora), and on the Gulf Coast, slash pine (Pinus elliottii).

Generally no other tree species was co-dominant. As age increased beyond 200-300 years, individual tree mortality would be replaced with understory species such as red maple and swamp black gum, leading to a mixed stand.

Dominant Species* and Canopy Position

CHTH2 Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	90 %	100 %
Height	Tree Tall 25-49m	Tree Tall 25-49m
Tree Size Class	Large 21-33"DBH	

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

☐ Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Fuel Model 4

Disturbances

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.

Disturbances Modeled

- [x] Fire
- [ ] Insects/Disease
- [x] Wind/Weather/Stress
- [ ] Native Grazing
- [ ] Competition
- [ ] Other:
- [ ] Other

Historical Fire Size (acres)

Avg: 150
Min: 1
Max: 10000

Sources of Fire Regime Data

- [x] Literature
- [ ] Local Data
- [x] Expert Estimate

Fire Regime Group: **3**

I: 0-35 year frequency, low and mixed severity
II: 0-35 year frequency, replacement severity
III: 35-200 year frequency, low and mixed severity
IV: 35-200 year frequency, replacement severity
V: 200+ year frequency, replacement severity

Fire Intervals (FI)

Fire interval is expressed in years for each fire severity class and for all types of fire combined (All Fires). Average FI is central tendency modeled. Minimum and maximum show the relative range of fire intervals, if known. Probability is the inverse of fire interval in years and is used in reference condition modeling. Percent of all fires is the percent of all fires in that severity class. All values are estimates and not precise.

	Avg FI	*Min FI*	*Max FI*	*Probability*	*Percent of All Fires*
Replacement	200	25	350	0.005	34
Mixed	900	20	900	0.00111	8
Surface	115	10	500	0.0087	59
All Fires	68			0.01481	

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