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)

R5LOSApa **Oak Woodland / Shrubland / Grassland Mosaic**

General Information

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

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Vegetation Type

Woodland

Dominant Species*

QUFU	BOCU
QUSI	SCSC
QUMA	BOSA
QUST	HIBE

General Model Sources

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

LANDFIRE Mapping Zones

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Rapid AssessmentModel Zones

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

Geographic Range

This system occurs in the limestone and granite uplands of the Edwards Plateau Ecological Region in central Texas.

Biophysical Site Description

This system includes limestone and granite uplands of Central Texas. Geologic strata are primarily Cretaceous-aged limestone but this model also includes vegetation on Precambrian-aged granites in an area known as the Llano Uplift. Members within these geologic strata vary in their susceptibility to erosion and soil development. Hard bedded limestone of the Edwards Formation form a resistant cap over much of the plateau and isolated buttes or hills. Less resistant limestones form the side slopes and lower divides (Hill and Vaughn 1898). Soils vary from calcareous clays and clay loams over limestone to acidic sands over granite and vary from shallow and rocky to deep. Topography is primarily level to rolling.

Different site conditions lead to a mosaic of vegetation physiognomies and composition, even on level uplands that are believed to have existed in the region prior to European settlement (Beuchner 1944, Bray 1904, Smeins 1982, Riskind and Diamond 1988, Weniger 1988). Drought periods occurred during the mid 1950s and early 1980s and a drought cycle of every 20 years might be expected. Rainfall is generally associated with severe thunderstorms and amounts peak in spring and fall. There is a marked difference in precipitation from the eastern portions (85 cm/yr) of this system to the western portions (35 cm/yr) (Bomar 1983 in Riskind and Diamond 1988). This gradual drying from east to west across the region results in vegetation transitions from woodlands and tallgrasses to shrublands and shortgrasses. This model does not incorporate large rock outcrops, steeper slopes, canyons, and floodplains.

Vegetation Description

Historical accounts are inconsistent in the reporting of woody cover on the Edwards Plateau (Beuchner 1944, Bray 1904, Smeins 1982, Riskind and Diamond 1988, Weniger 1988). But it is generally accepted that grassland, shrubland and woodland areas all were present in the presettlement upland landscape

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

(Smeins 1982, Riskind and Diamond 1988, Weniger 1988). This model addresses the vegetation mosaic that includes dense shrublands, dense forests, open woodlands and grasslands. An important aspect of this model are the variable site conditions (substrate, landscape position, weather conditions and others) that lead to these different states and hence the mosaic of physiognomies that are believed to have co-existed in the region. Under certain fire regimes, a certain portion of the landscape is considered to be predisposed to have a dense cover of shrubs, open woodland, grassland or dense forest depending on site conditions.

In many parts of this region, Quercus fusiformis is the predominant tree in the woodland and forest class where it typically occurs with Juniperus ashei, Quercus buckleyi, Celtis laevigata var. reticulata, Ulmus crassifolia, and Fraxinus texensis. In areas with soils derived from a siliceous limestone or granite, Quercus marilandica and Quercus stellata may dominate the forest and woodland areas (Beuchner 1944, Tharp 1939, Walters and Wyatt 1982, Whitehouse 1933). Quercus sinuata var. breviloba is the diagnostic shrub in the shrublands, and occurs along with Sophora secundiflora, Eisenhardtia texana, Diospyros texana, Rhus virens, Ziziphus obtusifolia, Condalia hookeri, Colubrina texana, Ungnadia speciosa, Berberis trifoliate, and Forestiera pubescens. The grasslands vary from primarily tall grasses (dominated by Schizachyrium scoparium (little bluestem), Sorghastrun nutans (Indiangrass), Panicum virgatum (Switch grass), Muhlenbergia lindheimeri, Bouteloua curtipendula, Stipa leucotricha (Texas Wintergrass), Eriochloa sericea (Texas cupgrass), Bothriochloa saccharoides (silver bluestem), Bothriochloa barbinoides (cane blustem), Eragrostis spp. (lovegrass), and Andropogon gerardii (big bluestem) to mid grasses (dominated by Bouteloua curtipendula (side-oats grama), Bouteloua gracilis (blue grama), Erioneuron pilosum (hairy tridens), Aristida spp., Sporobolus cryptandrus (sand dropseed), but shortgrass areas (dominated by Hilaria belangeri (curly-mesquite), Buchloe dactyloides (buffalograss), Hilaria mutica (tobosa)) persist on very droughty or shallow soils throughout and dominate in the far western parts of the region.

This model does not address the natural vegetation of canyons, steeper slopes and narrow to broad floodplains along streams that dissect the region.

Disturbance Description

Fire is the primary natural disturbance that is preventing all classes from becoming closed forests and shrublands. Mixed intensity fires are thought to be the predominant fire type in this landscape and are used in the model to exemplify the variability in fuel caused in part by the variability in fine fuels (grasses), both spatially and physiognomically (shortgrass, mixedgrass and tallgrass) and the abiotic variability in site conditions. Current conditions and historical accounts suggest that fine fuels varied from mid/tall grass to mid/short grasses in part due to a decrease in rainfall and increase in evapotransporation from east to west on the plateau, but also related to soil depth and grazing (Beuchner 1944, Fowler 1988, Riskind and Diamond 1988). Site conditions, patchy and variable fuels, drought and grazing by native ungulates may act synergistically to promote the establishment of woody species. Once woody plants are established in the grassland, they may act as “nurse” plants to facilitate the establishment of other woody plants, increasing the movement toward a closed canopy system (Fowler 1988).

Frequent fires are thought to have occurred during all seasons (Diamond 1997, Smeins 1980) with winter and summer fires having different effects on the vegetation. Seasonality of fire in combination with drought years, normal years or wet years will produce varying results. Replacement fires (Classes D and E) were more likely during the summer droughts where preceding years allowed for sufficient fuel build-up.
While native grazing also acts to maintain the system in a grassland state, disturbances such as grazing and fire can act synergistically during droughts to reduce the cover of fine fuels and promote woody invasion into grasslands. The frequency of fire required to prevent woody invasion of the grassland may be longer in midgrass systems as opposed to shortgrass systems (Fuhlendorf and Smeins 1997).

In areas with sparse fine fuels the fires may have been wind driven shrub fires. In areas with heavier fine fuels the fires may have been mosaics of mixed severity.

Fractures and fissures in rock outcrop areas with sparse fuels are places where fire sensitive trees and shrubs could maintain a presence, and provide a constant seed source.

“Areas with flat or rolling uplands and fairly deep soils tend to have larger scale fires at higher frequency, while areas with significant topographic relief and/or shallow soils over massive limestone tend to have smaller scale fires at lower frequency (Diamond et al. 1995). Natural breaks such as rivers and moist canyons served to limit the spread of fire. The scale of fires probably increased from east to west with fires in the Southern and Eastern Balcones Escarpment stratification units being smaller than those of the remainder of the ecoregion. Fires on the scale of 20,000 acres (~8,000 ha) may be a reasonable estimate for the system away from the escarpment. Fires probably occurred on a much smaller scale, perhaps on the order of 2,000 acres (~800 ha) for large occurrences along the escarpment. Likewise, bison were known from the ecoregion historically (Weniger 1997). However, herd size may have been greater on the western plateau than along the escarpment, where topography may have made movement difficult and dangerous. These disturbances also lead to patch dynamics, which may differ with differing topographic, edaphic, and geologic context. In different situations, disturbance patches may revert to shallow alkaline soil shrublands, mixed grass prairie, or savannah.” (L. Elliott unpubl. doc.)

Adjacency or Identification Concerns

The vegetation included in this model is covered in part by Edwards Plateau Limestone Forest, Woodland and Glade (CES303.660), Edwards Plateau Granitic Forest, Woodland and Glade (a new system, CES303.xxx), Edwards Plateau Limestone Shrubland (CES303.041), Western Great Plains Mesquite Woodland and Shrubland (CES303.668), and Central Mixedgrass Prairie (CES303.659) Ecological Systems (NatureServe 2005)

Embedded within this system are hardwood/juniper slope forests, canyons and floodplain forests many of which would act as firebreaks on the landscape. These systems are not being covered in the PNV models. Current conditions are very different from what has been described here. In particular, the present day landscape is occupied by large areas of forest dominated by a mixed Juniper-Oak forest and many areas that once supported tall- to mid-grass savannas have been converted into shortgrass grasslands and barrens due to overgrazing. This existing vegetation is not directly addressed here, though closed canopy forests are included in the model (Class E).

Scale Description

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

The components of this system once covered the majority of the Edwards Plateau in central Texas, an area of approximately 16 million acres. “Areas with flat or rolling uplands and fairly deep soils tend to have larger scale fires at higher frequency, while areas with significant topographic relief and/or shallow soils over massive limestone tend to have smaller scale fires at lower frequency (Diamond et al. 1995). Natural breaks such as rivers and moist canyons served to limit the spread of fire. The scale of fires probably increased from east to west with fires in the Southern and Eastern Balcones Escarpment stratification units being smaller than those of the remainder of the ecoregion. Fires on the scale of 20,000 acres (~8,000 ha) may be a reasonable estimate for the system away from the escarpment. Fires probably occurred on a much smaller scale, perhaps on the order of 2,000 acres (~800 ha) for large occurrences along the escarpment” (Elliott 2002).

Issues/Problems

This model may be trying to incorporate too many states that coexisted in the historical landscape, a dense shrubland, forest, woodland and grassland mosaic. All persisted and were controlled by site conditions, fire and grazing. Also, the grassland component transitioned from tall to mid to short, partly as a result of a decrease in rainfall from east to west, but also as a result of site conditions. Within this landscape, bare rock, thin soils and deeper soils exist. Information from some publications is not included here and it would be good to conduct a thorough literature review and consult with other experts and reassess this model.

Model Evolution and Comments

Judy Teague, Lee Elliot, Ron Masters, Fred Smeins, David Diamond, Samuel Fuhlendorf, Steve Archer

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 All Struct

Description

(Early-seral) Class A includes the first two years after a burn and fine fuels are expected to green up within one growing season and be attractive to grazers. By the end of Class 2, in normal years, fine fuels would be well developed but little thatch would have built up. This condition includes sparse to moderate cover of mid to tall grasses and forbs with a scattered canopy of trees and shrubs resprouting. Woody cover of resprouting shrubs and trees is below 5%. This class would also have some cover (appx. 10-20%) that is comprised of bare rock. The mosaic on the landscape would have open areas of bare rock, thin soil areas with some bare ground and discontinuous grass cover and then other areas with more continuous grass cover. Grass cover varies from primarily tall grasses (dominated by Schizachyrium scoparium (little bluestem), Sorghastrun nutans (Indiangrass), Panicum virgatum (Switch grass), Stipa leucotricha (Texas Wintergrass), Eriochloa sericea (Texas cupgrass), Bothriochloa saccharoides (silver bluestem), Bothriochloa barbinoides (cane blustem), Eragrostis spp. (lovegrass), and Andropogon gerardii (big bluestem) to mid grasses (dominated by Bouteloua curtipendula (side-oats grama), Bouteloua gracilis (blue grama), Erioneuron pilosum (hairy tridens), Aristida spp., Sporobolus

Dominant Species* and Canopy Position

SCSC	Upper
STLE5	Upper
BOCU	Upper
HIBE	Upper

Upper Layer Lifeform

- [x] Herbaceous
- [ ] Shrub
- [ ] Tree

Fuel Model 3

Structure Data (for upper layer lifeform)

	Min	Max
Cover	75 %	85 %
Height	Herb Short <0.5m	Herb Tall > 1m
Tree Size Class	no data	

- [ ] Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Even though there are trees and shrubs in this class, their cover is below 10% and therefore the herb layer is considered the upper layer lifeform here.

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

cryptandrus (sand dropseed), but shortgrass areas (dominated by Hilaria belangeri (curly-mesquite), Buchloe dactyloides (buffalograss), Hilaria mutica (tobosa)) persist on very droughty or shallow soils and in the western parts of the region. Grasses grade from taller grasses in the eastern part of the region to short grasses in the western part of the region. Also some evidence suggests that taller grasses are present on the slopes where more water is available in the cracks that on the upland flats where more soil is developed but the soils are more droughty (Fowler 1988).

Class B **15 %**

Mid1 Closed

Description

(Mid-closed) Class B is comprised of a closed canopy shrubland with shrub and small tree (to 6') cover of greater than 50% and a sparse to moderate herbaceous understory. Cover of mid to tall grasses and forbes is < 30%. Scattered larger trees may be present with a cover of less than 10%. This class would also have some cover (appx. 10-20%) that is comprised of bare rock. This class would be expected to succeed class A in the absence of fire. However, it persisted in the historic landscape in patches (shinneries) in a mosaic with grasslands, woodlands and forests. Quercus sinuata var. breviloba is the predominant shrub in the shrublands, along with Sophora secundiflora, Eisenhardtia texana, Diospyros texana, Rhus virens, Ziziphus obtusifolia, Condalia hookeri, Colubrina texana, Ungnadia speciosa, Berberis trifoliate, and Forestiera pubescens. After shrubs primarily of Quercus sinuata var. breviloba are established, the shrubland

Dominant Species* and Canopy Position

QUSI	Upper
DITE	Upper
RHVI	Upper
SCSC	Lower

Upper Layer Lifeform

- ☐ Herbaceous
- ☑ Shrub
- ☐ Tree

Fuel Model 7

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	50 %	80 %
Height	Shrub Dwarf <0.5m	Shrub Medium 1.0-2.9m
Tree Size Class	no data	

☐ 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.

physiognomy can be maintained with periodic fire. In the absence of fire, the shrublands are expected to succeed and mature into a closed canopy forest. These areas are expected to occupy approximately 23 percent of the landscape.

Class C **50 %**

Mid1 Open

Description

(Mid-open) Class C is the young to mid-aged savanna. It is expected to have a moderate to dense cover of mid to tall grasses and forbes with an open canopy of trees and shrubs along with small clumps of trees (mottes). Woody cover may vary between 5 and 20%. This class would also have some cover (appx. 10-20%) that is comprised of bare rock. The grassland and woodland components of this class are maintained by mixed fire intensities. Canopy species include Quercus fusiformis, Quercus stellata, Quercus marilandica, and Quercus buckleyi. Herbaceous composition is similar to Class A.

Dominant Species* and Canopy Position

QUFU	Upper
QUSI	Middle
SCSC	Lower
STLE5	Lower

Upper Layer Lifeform

- [ ] Herbaceous
- [ ] Shrub
- [x] Tree

Fuel Model 2

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	5 %	20 %
Height	Tree Regen <5m	Tree Short 5-9m
Tree Size Class	Medium 9-21"DBH	

- [ ] Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Class D **20 %**

Late1 Open

Description

(Late-open) Class D is the mature, open canopy oak savanna with trees and shrubs more than 6' tall and a dense herbaceous understory of mid to tall grasses and forbes. It is maintained by fires of mixed intensity. Surface fires keep the wooded patches from getting bigger. Trees, present as scattered individuals and larger clumps (oak mottes) cover less than 35% of the area. This class could also have some cover (appx. 0-20%) that is comprised of bare rock. Species composition is similar to Class C

Dominant Species* and Canopy Position

QUFU	Upper
QUST	Upper
QUMA	Upper
SCSC	Lower

Upper Layer Lifeform

- [ ] Herbaceous
- [ ] Shrub
- [x] Tree

Fuel Model 2

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	10 %	50 %
Height	Tree Short 5-9m	Tree Medium 10-24m
Tree Size Class	Very Large >33"DBH	

- [ ] Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

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

with a greater diversity of trees (Ulmus crassifolia, Celtis laevigata var. reticulata, Juniperus ashei) occupying the mottes due to the lowered fire effect in the mottes. Herbaceous composition is similar to Classes A and C.

Class E **10 %**

Late1 Closed

Description

(Late-closed) Class E is the closed canopy oak forest with trees and shrubs more than 6' tall and a sparse herbaceous understory. Woody Cover is greater than 60%. This class would also have some cover (appx. 10-20%) that is comprised of bare rock. The highest richness of woody species occurs in this class including Quercus fusiformis, Juniperus ashei, Quercus buckleyi, Celtis laevigata var. reticulata, Ulmus crassifolia, and Fraxinus texensis, Quercus marilandica, Quercus stellata, Quercus sinuata var. breviloba, Cercis canadensis, Sophora secundiflora, Eisenhardtia texana, Diospyros texana, Rhus virens, Ziziphus obtusifolia, Condalia hookeri, Colubrina texana, Ungnadia speciosa, Berberis trifoliate, and Forestiera pubescens among others.
Studies have shown that fuel moisture is higher under live oak canopies than post oak canopies or open grassland (Fonteyn et.al. 1988). In a landscape subjected to fire, Juniperus ashei is more likely to occur in combination with other trees, especially live oak, where it will be protected from fire, than individually. Replacement fires in class E would only be expected during extreme drought years and possibly with summer fires (Fonteyn et. Al. 1988).

Dominant Species* and Canopy Position

QUFU	Upper
QUST	Upper
QUMA	Upper
JUAS	Middle

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model 9

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	50 %	100 %
Height	Tree Short 5-9m	Tree Medium 10-24m
Tree Size Class	Very Large >33"DBH	

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

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

Disturbances

Disturbances Modeled

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

Historical Fire Size (acres)

Avg: 20000
Min: 200
Max: 100000

Sources of Fire Regime Data

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

Fire Regime Group: 1

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	50			0.02	11
Mixed	10			0.1	56
Surface	17			0.05882	33
All Fires	6			0.17882	

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