LANDFIRE Biophysical Setting Model

Biophysical Setting 3514230 Southeastern Great Plains Tallgrass Prairie

☐ *This BPS is lumped with:*
☐ *This BPS is split into multiple models:*

General Information

Contributors (also see the Comments field) **Date** 4/18/2007

Modeler 1 Bob Hamilton bhamilton@tnc.org **Reviewer** Bruce Hoagland
Modeler 2 Doug Ladd dladd@tnc.org **Reviewer**
Modeler 3 **Reviewer**

Vegetation Type
Upland Grassland/Herbaceous

General Model Sources
☐ Literature
☐ Local Data
☑ Expert Estimate

Dominant Species
ANGE
SCSC
SONU2
PAVI2
OLIGO3
SPCO16
AMPS
RUHI2

Map Zone
35

Model Zone
☐ Alaska
☐ California
☐ Great Basin
☐ Great Lakes
☐ Hawaii
☐ Northeast
☐ Northern Plains
☐ N-Cent.Rockies
☐ Pacific Northwest
☑ South Central
☐ Southeast
☐ S. Appalachians
☐ Southwest

Geographic Range
Central US from southeastern NE through Kansas Flint Hills into OK, east into northwestern AR, western MO and southwest IA bordering and mingling with oak-hickory vegetation types.

Biophysical Site Description
Soils are generally fine-textured Mollisols occurring in thin layers over shale with some areas of deeper soils, especially on lower slopes and lowlands. In AR, small area of this community occur along the Arkansas River Valley, a topoedaphic region characterized by broad, level to gently rolling uplands derived from shales. The combined effect of droughty soils, reduced precipitation, and prevailing level topography create conditions highly conducive to the ignition and spread of fires. This region includes large prairie areas in eastern OK and western MO south of the glacial line. Soil and precipitation encourage tree and shrub invasion in the absence of fire although woody communities occur in fire-protected microsites. Precipitation gradient decreases from east to west with precipitation adequate to allow tree and shrub establishment in the absence of fire. Hardwoods restricted to fire-protected ravines and along stream corridors forming gallery forests.

Vegetation Description
Tallgrass prairie is dominated by big bluestem (Andropogon gerardii), little bluestem (Schizachyrium scoparium), Indiangrass (Sorghastrum nutans) and switchgrass (Panicum virgatum). Secondary species vary in importance regionally depending on topography and soil moisture relations and include sideoats grama (Bouteloua curtipendula), needlegrass (Achnatherum spartea), Junegrass (Koeleria macrantha), buffalograss (Buchloe dactyloides), blue grama (Bouteloua gracilis) and composite dropseed (Sporobolus compositus). At the southwestern extent of this type sideoats grama (Bouteloua curtipendula), buffalograss (Buchloe dactyloides) and blue grama (Bouteloua gracilis) increase in percent cover.

**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

Western wheatgrass (Pascopyrum smithii), porcupine grass (Hesperostipa spartea) and various Nassella and Hesperostipa become more important in the northern half of this type. Several short stature grasses such as Dicanthelium spp. and Carex spp. are also important throughout the type, particularly following heavy grazing. Annual forbs can include prarie (common) broomweed (Amphiachyris dracunculoides). Conspicuous perennial forbs include the genera Ambrosia, Helianthus, Soladago, Liatris, Dalea, Viola and Antennaria. Shrubs that are important include Rosa spp., Salix, Symphoricarpos, Rhus and in the southern part of the region today Juniperus virginiana is rapidly increasing in the absence of fire. Bison disturbance was historically an important disturbance that increased heterogeneity of patches on the landscape. A problem with much of the literature on fire in prairies, and therefore a caution, is that it does not include interaction with herbivory (Engle and Bidwell 2001). The interaction of large herbivore grazing and fire is critical to the vegetation and patch dynamics of the tallgrass prarie. Where and when fire occured largely determined where and when herbivores were on the landscape. The altering of fuel loads by herbivores had a reciprocal effect on where and when fire would occur.

Disturbance Description

The region is characterized by frequent surface fires, both lightning and anthropogenic in origin (Higgins 1986). Due to the abundance of fine fuel surface fires in the dormant season (spring, fall, winter) were usually replacement fires; however growing season fires could have been more variable in summers with abundant moisture leaving areas of incomplete herbaceous fuel combustion. Mixed fires occurred infrequently in heavily grazed or wet areas. Natural fires were possible during the dormant season through spring and during the late-growing season (Bragg 1982, Higgins 1986, Engle and Bidwell 2001), dependant on the availability of dry fine fuel sufficient to carry a fire. Fires (probably ignited by lightning) likely occured in the summer but ignitions would not have spread as well as dormant season fires due to higher fuel moisture. Prior to extirpation of bison, the fire return interval was estimated to have been from 1-3yrs based on observation 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). The accounts of fire size, however, followed the loss of bison as a major disturbance factor in the Great Plains and, thus, may not reflect historic reference fire conditions which may have been more patchy. For example, Risser (1990) suggests that bison grazing affected fire patterns and thus the landscape patterns in tallgrass prairie. Recent studies suggest that bison - and other grazing/browsing wildlife species - preferentially seek out the new growth of recently burned areas affecting patch composition (e.g. Jackson 1965, Risser 1990, Steuter 1986, Coppedge and Shaw 1998, Fuhlendorf and Engle 2004). The fire/grazing interaction was critical to the dynamics of the tallgrass system.

The grazing disturbance is considered in this model by reducing the average fire return interval probability in the grassland box. However, as oak-hickory regeneration becomes established, these species become largely fire resistant with age. Surface fires within woodland and forest types occurred every 12-15yrs, reducing duff layers and allowing recruitment of oak-hickory stems.

Adjacency or Identification Concerns

Tallgrass prarie is the primaray herbaceous component of the cross-timbers landscape. Praries openings are found intermixed with the forest and woodlands of the cross-timbers ranging in size from less than one acre up to thousands of acres.

Mixedgrass is found generally to the west of the tallgrass prarie although both short and mixed grass inclusions are present at a smaller scale based upon topoedaphic conditions.

Native Uncharacteristic Conditions

**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

Eastern redcedar (Juniperus virginiana) and ashe juniper (J. asheii) would have occurred in riparian areas or other fire protected sites historically. Fire suprression and/or inadaquate fire intensity due to lack of fine fuel (from intensive grazing), and planting in some areas has allowed eastern redcedar and ashe juniper to spread into upland prarie areas today.

Osage orange (Maclura pomifera), which would have historically been relegated to fire protected sites, was actively planted for shelterbelts around homesteads and living fences and has spread from those sites into praries. The control of Osage orange is very difficult becasue of its resprouting ability and fire tolerance.

In general, there is much more woody vegetation in and around riparian areas today than there would

Scale Description

Using the fire/bison interaction model first proposed by Steuter (1986), recent modifications propose that anywhere from 1/6 to 1/3 of the landscape likely burned (Fuhlendorf and Engle 2004). Typically, following fire-induced green-up, intensive bison grazing alters community structure such that burned and grazed areas differ significantly from unburned areas (Steuter 1986; Fuhlendorf and Engle 2001, 2004). Heavily grazed and trampled burned areas, which, due to differential grazing, are dominated by forbs and thus would not burn in the next 1-3yrs creating mixed fire intensity. Bison grazing, thus, drove or at the least strongly influenced fire and fire return intervals which, in turn, influenced bison grazing distribution. This patch-burn model, which depicts a landscape composed of a continuously shifting mosaic of patches with a short time period of duration, is believed to best represent the historic fire regime. It is also consistent with the scenario essential to perpetuate habitat for certain native prairie species. For example, the patch-burn model provides conditions to maintain suitable lek sites, nesting sites and brood rearing habitat for prairie chickens (Tympanicus cupido) which occurred in large numbers prior to European settlement (Sparks and Masters 1996). Both the fire/bison and patch burn cattle grazing experiments that have recently been done are acknowlaged to be a scale-downed verion of the reference condition dynamics but have been shown to be very sucesful at maintinag all trophic levels of biodiversity (Fuhlendorf et al. 2006).

Issues/Problems

Classifying tallgrass prarie into sucssional stages that are mappale given LANDFIRE rules was extremely challenging. The structure and composition of this system would have varied considerably given variations in climate, grazing and fire. Furthermore, there was some disagreement amongst modelers and reviewers about whether or not to include shrub and tree sucessional pathways within the VDDT model or if it should include grass. The current model reflecting the majority opinion includes sucessional pathways for shrubs and trees but they represent a very small portion of the the landscape.

Comments

For MZ35 this model was adopted without changes from the same BpS for MZ32.

For MZs 32 and 44 this model was initaited from the Rapid Assessment Southern Tallgrass Prairie model (R5PRTG) by Ron Masters and Tom Bragg and reviewed by David Engle (dme@mail.pss.okstate.edu) and Douglas Zollner (dzollner@tnc.org). Bob Hamilton worked on the model and description for MZ32 and Doug Ladd worked on the model and description for MZ44. Based on review comments the regional lead, merged the two similar models such that one description and one VDDT model would represent this system throughout MZs 32 and 44.

**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

Vegetation Classes

Class A 96 %

Early Development 1 All Structure

Upper Layer Lifeform

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

Fuel Model

3

Indicator Species and Canopy Position

ANGE Upper
HELIA3 Upper
SONU2 Upper
SCSC Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	100 %
Height	Herb 0m	Herb >1.1m
Tree Size Class		

- [x] Upper layer lifeform differs from dominant lifeform.

Shrub and tree species are relatively infrequent and, if present, constitute <10% cover in the area.

Description

0-999yrs. Grassland class. Dominated by little bluestem, big bluestem, Indiangrass, prairie cordgrass and switchgrass. Numerous forbs such as Helianthus spp. (sunflower genus), prairie clovers (Petalostemum spp.), and coneflowers (Echinacea pallida and Ratibida pinnata), amongst many others, were present. Fuel complexes consisted of short- or tall-grass prairie forbs and shrubs with little or no tree regeneration. Replacement fire every 1-2yrs maintains the class. Lack of disturbance (prob. = 0.01) moves class to B.

In this early stage, grasses will be more nutritious and palatable, grazing by bison, antelope, deer, rodents and lagomorphs would be common and maintain this class.

Class B 3 %

Mid Development 1 Closed

Upper Layer Lifeform

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

Fuel Model

3

Indicator Species and Canopy Position

SCSC Upper
ANGE Mid-Upper
SONU2 Mid-Upper
RHUS Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	80 %
Height	Shrub 1.1m	Shrub 3.0m
Tree Size Class		

- [ ] Upper layer lifeform differs from dominant lifeform.

Description

10-999yrs. This class represents a shrubby prairie. Grass and forb species remain the same as in class A. Shrub species include climbing rose (Rosa setigera), prairie rose (Rosa caroliniana); leadplant (Amorpha canescens); Prairie willow (Salix humilis); smooth sumac (Rhus glabra), winged sumac (Rhus copalina), rough dogwood (Cornus drummondii), persimmon (Diospyros virginiana) and oak sapplings (Quercus spp.) The fuel model in this class starts at a 3; however with increased leaf litter, the fuel model moves to a 2. Mixed fires (every three years) and surface fires (every 20yrs) maintain the class. Replacement fires every 40yrs move the class to A. The lack of disturbance (prob. = 0.01) moves class to C.

**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

Class C 1 %

Mid Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species and Canopy Position

QUVE
Upper
QUMA3
Upper
DIVI5
Upper
FRAM2
Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	80 %
Height	Tree 5.1m	Tree 25m
Tree Size Class	Very Large >33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

20 -999yrs. This tree class is dominted by white ash (Fraxiunus americana), persimmon, shingle oak (Quercus imbricaria), slippery elm (Ulmus rubra), blackjack oak (Quercus marilandica) and black oak (Quercus velutina). Class B suceeds to C without fire. Trees in this class will be at least three meters tall and will range to 20m tall. The oak trees especially will increase in DBH in the open instead of increasing in height. Surface fire (every 25yrs) maintains the class. Rare mixed fires (every 700yrs) and weather/stress events (every 500yrs) move the class to B. Replacement fires every 40yrs move the class to A.

Class D 0 %

[Not Used] [Not Used]

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☐ Tree

Fuel Model

Indicator Species and Canopy Position

Structure Data (for upper layer lifeform)

	Min	Max
Cover	%	%
Height		
Tree Size Class		

☐ Upper layer lifeform differs from dominant lifeform.

Description

Class E 0 %

[Not Used] [Not Used]

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☐ Tree

Fuel Model

Indicator Species and Canopy Position

Structure Data (for upper layer lifeform)

	Min	Max
Cover	%	%
Height		
Tree Size Class		

☐ Upper layer lifeform differs from dominant lifeform.

Description

Disturbances

**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

Fire Regime Group:** II

Historical Fire Size (acres)

Avg 5000
Min 1
Max 10000

Sources of Fire Regime Data

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

Fire Intervals

	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	2			0.5	97
Mixed	83			0.01205	2
Surface	500			0.002	0
All Fires	2			0.51405	

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.

Additional Disturbances Modeled

- [ ] Insects/Disease
- [x] Wind/Weather/Stress
- [ ] Native Grazing
- [ ] Competition
- [ ] Other (optional 1)
- [ ] Other (optional 2)

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