LANDFIRE Biophysical Setting Model

***Biophysical Setting* 3911500 Western 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** 7/17/2007

Modeler 1	Tom Bragg	tbragg@mail.unomaha.edu	**Reviewer**	modeler was reviewer	
Modeler 2			**Reviewer**	Gary Willson	gwillson2@unlnotes.unl.edu
Modeler 3			**Reviewer**		

Vegetation Type
Upland Grassland/Herbaceous

General Model Sources
☑ Literature
☐ Local Data
☑ Expert Estimate

Dominant Species
ANGE
SONU2
PAVI2
SPPE

Map Zone
39

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

This system occurs in the central US including IA, eastern NE, southwest MN, northwest MO, southeast SD and northeast KS and interfaces and mingles on the east with the oak savanna and on the west with mixedgrass prairie.

This would occur in ECOMAP sections 251A and B in MZs 39 and 40.

Biophysical Site Description

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 (NatureServe 2007).

The area is primarily mollic grassland soils incorporating xeric mesic, and hydric prairie types (Curtis 1959). Xeric prairies were maintained by shallow soils on steep slopes, flat uplands, and ridges where rainwater runoff was greatest resulting in low water-holding capacity. Mesic prairies occurred on flat and rolling topography including some on glacial outwash with porous subsoil of sand and gravel. Rolling areas were characterized by glacial till of recessional moraines or on residual aeolian loess deposits. Soil profiles consist of a black surface layer rich in organic material with high water-holding capacity. Wet prairies were found on poorly drained soils in drainage ways and concave positions on uplands an din lowlands along waterways or in areas subject to inundation. Lowland prairies were in and along waterways or in areas subject to frequent inundation. Soils are rich in organic matter and show evidence of inundation in a gleying layer 3-4ft below the surface. The region is strongly influenced by dry

**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.

continental air flow patterns and periodic drought (Whitney 1994).

Vegetation Description

This system is dominated by big bluestem (Andropogon gerardii), Indiangrass (Sorghastrum nutans) and switchgrass (Panicum virgatum) on more mesic sites with prairie cordgrass (Spartina pectinata) dominating the wet sites. Secondary species such as little bluestem (Schizachyrium scoparium), sideoats grama (Bouteloua curtipendula), porcupine grass (Stipa spartea) and junegrass (Koeleria macrantha) occupied the more xeric uplands and soil types and varied in importance. At the western extent of this type, buffalograss (Buchloe dactyloides), blue grama (Bouteloua gracilis) and Dicanthelium spp.increased with grazing. Conspicuous perennial forbs included the genera Asclepias, Aster, Echinacea, Helianthus, Solidago, Liatris, Dalea and Viola. Prairie shrubs include the genera Amorpha, Rosa spp. and Ceanothus. The effect of large ungulates, bison and elk, was less prominent than further west, but no doubt contributed to the patchiness of burns.

Disturbance Description

Fire played an important role in the maintenance of the tallgrass prairie especially in the eastern portion with climatic factors more important to the west (Curtis 1959, Vogel 1974, Anderson 1990). 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 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. Little is know about native ungulate grazing in this area. It is generally accepted that bison grazing was less in this grassland than in grasslands to the west. Further, it has been recently suggested that elk populations may have been large enough to have an effect on vegetative composition.

It has also been suggested that in addition to fire, drought, grazing and insect outbreaks (Rocky Mountain locust) would have impacted all classes.

Adjacency or Identification Concerns

As indicated, this system interfaces and mingles on the east with oak savanna and on the west with mixedgrass prairie. On the east, there would be limited woody invasion from protected areas during periods of increased precipitation. The woody component would be limited to the edge the prairie and would not exhibit any appreciable effect overall. Since mixedgrass prairie is to the west, there would be little effect except in periods of extended drought the percentage of the mixedgrass species would increase.

Some synonymous classifications would be: Eastern part of ECOMAP section 251 (Prairie Parkland - Temperate) (Bailey 1994) No. 74 (Bluestem Prairie) (Kuchler No. 74 (Bluestem Prairie)).

This system is also similar to BpS 1420 Northern Tallgrass. Models for each are very similar.

Today, there is significantly less prairie and more forest with concomitant changes in the fire regime and large ungulate grazing.

There are several successional stages that may have been rare historically that may now be extensive (e.g.

**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.

prairie areas invaded by woody species). Historically, some woody plant invasion may have occurred but it was limited to protected areas close to seed sources such as along the eastern interface with the savanna and around woody pockets and river valleys.

The principal exotic that may be a problem, at least in more mesic locations, is smooth brome. There are others (leafy spurge, Canada thistle, etc.) but the extent to which they occur specifically in MZs 31, 39 or 40 is not known by modeler.

There are also invasive woody species such as buckthorn, Russian olive, and salt cedar. These species pose significant threats in tallgrass prairie.

There may be some (perhaps many) species lost and ecosystems no longer representative of historical conditions.

Native Uncharacteristic Conditions

Large areas of invading woody plants is uncharacteristic of historical conditions.

Scale Description

Most fires were stand replacement in nature. Once ignited, dormant season fires would have spread over a large area until reaching a major firebreak (e.g. previously burned area, major river, rugged terrain, etc.). Growing season fires may have been frequent but smaller in size than dormant season fires due to the greenness of the fuel and rain following lightning ignition. Growing season fires during drought years would have been much like dormant season fires. Mixed fires were probably limited to patchy grazed areas or areas where fuel was not uniformly cured.

Issues/Problems

Much of the literature on fire in the tallgrass prairie does not include interaction with herbivory (Engle and Bidwell 2001), thus interpreting effects must be qualified. In addition, little is know about native ungulate grazing in this area. It is generally accepted that bison grazing was less in this grassland than in grasslands to the west. Further, it has been recently suggested that elk populations may have been large enough to have an effect on vegetative composition.

Comments

This model for MZs 31, 39 and 40 was adapted from the model from the Rapid Assessment: R4PRTGc Tallgrass Prairie Central created by Daryl Smith and reviewed by Tom Bragg and John Ortmann.

Vegetation Classes

Class A **55 %**

Early Development 1 Open

Upper Layer Lifeform

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

Fuel Model

1

Indicator Species and Canopy Position

ANGE
Upper
SONU2
Upper
PAVI2
Upper
SPPE
Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	50 %
Height	Herb 0m	Herb >1.1m
Tree Size Class		

- [ ] Upper layer lifeform differs from dominant lifeform.

Description

**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.

This class lasts just one year. It is a post-fire, post-grazing community from immediately after a replacement fire until one year after the fire. From the blackened state, there is a rapid regrowth of fire positive and fire neutral perennial vegetation to maximum height by end of the growing season. Warm season grasses and fire positive forbs display increased height, flowering and fruiting and appear to be more abundant depending on season of the burn. Annual, biennial and short-lived perennial species occupy space opened by litter removal. Fire neutral perennial forbs maintain pre-fire composition, but may appear to be reduced. Fire negative species are reduced. No litter is present in this class.

Annual burns and sometimes two burns in a single year (spring burns can easily be followed by fall, dormant season burns) can occur in some spots. For fire (and to some extent grazing) in pre-European times, there really are only two basic stages, one immediately after the fire (until fuel accumulates) and a second stage before the next fire (which is any time after a year's growth has accumulated as fuel – a fire can occur as soon as this amount of fuel is available). You can make further subdivisions if you want, such as the time until fuel accumulates to pre-burn conditions but this is difficult to identify (not easily mapped) and isn't really an important factor in burning since a fire can occur with only one growing season's fuel accumulation. It seems that historically, any portion of the mapzone that did not burn would have succeeded to trees some time ago and that, at least theoretically, there would be little if any of this sere in the pre-European landscape. Subsequent stages occur today in the absence of historic disturbances.

Most likely fires occurred at least every 5-7yrs in the Northern TGP (3-4yrs in the central TGP), and more likely to be four to five years or less, even in the west. Virtually all fires (except, perhaps, summer fires) would have been replacement fires. The exception would have been unburned patches in which no burning occurred.

Grazing was modeled as affecting 50% of this class each year. Grazers preference for the younger, more succulent species in recently burned areas created patches with shorter vegetation and an increased forb composition. These patches were less likely to burn and may have changed the overall vegetation structure of this class. It can be inferred that the effect of large ungulates, bison and elk, was less prominent than further west, but their grazing and browsing no doubt affected the composition of the vegetation and burn regime. So long as there were grazers in sufficient numbers, records indicate they would have grazed most of the burned areas.

Because of LANDFIRE mapping rules, canopy cover is arbitrary number. These classes should actually be defined on the ground by biomass, litter and species.

This class can also be distinguished from B based on fuel model (fuel model 3 for class B versus fuel model 1 for class A) and biomass.

Class B **40 %**

Mid Development 1 Closed

Upper Layer Lifeform

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

Fuel Model

3

Indicator Species and Canopy Position

ANGE
Upper
SONU2
Upper
PAVI2
Upper
SPPE

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	51 %	100 %
Height	Herb 0m	Herb >1.1m
Tree Size Class		

- [ ] Upper layer lifeform differs from dominant lifeform.

**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.

Description Upper

This is the community that develops post-fire, post-grazing after a few months or a year or so.

Historically, there was probably no significant amount of time after burning (assuming spring – summer fires) that grazing did not occur.

This stage continues to be dominated by big bluestem (Andropogon gerardii), Indiangrass (Sorghastrum nutans) and switchgrass (Panicum virgatum) on more mesic sites with prairie cordgrass (Spartina pectinata) dominating the wet sites. Secondary species such as little bluestem (Schizachyrium scoparium), sideoats grama (Bouteloua curtipendula), porcupine grass (Stipa spartea), and junegrass (Koeleria macrantha) occupied the more xeric uplands and soil types and varied in importance. At the western extent of this type buffalograss (Buchloe dactyloides), blue grama (Bouteloua gracilis) and Dicanthelium spp increase with grazing. Perennial forbs include genera such as Asclepias, Aster, Echinacea, Helianthus, Solidago, Liatris, Dalea and Viola. Noticeable scattered shrubs, Amorpha, Rosa spp and Coenothus, annually increase in size. Litter accumulates annually. Annuals, biennials and short-lived perennials gradually become less abundant.

Fire occurs approximately every 4-5yrrs, causing a transition to A half the time and half the time remaining in B. In dormant season burns, everything above ground is burned. Historically, however, grazing would have resulted in patchy fuel which would have resulted in patchy burns such that only a percentage of the total area would have burned.

Grazing occurs on 50% of the class each year. Grazing is part of the disturbance since historically, anything burned was probably grazed shortly thereafter. Consequently, there probably was never an ungrazed area of any consequence. Also, historic grazing probably did not alter basic species composition, just above-ground growth (similar to fire). However, because grazing occurs after fire, it was modeled to sometimes mimic the fire response, half the time causing a transition back to A (conceivably just one year setback) and half the time remaining in this class.

Wind/weather stress modeled as occurring every 25yrs causing a transition back to class A.

Because of LANDFIRE mapping rules, canopy cover is arbitrary number. These classes should actually be defined on the ground by biomass, litter and species.

This class can also be distinguished from A based on fuel model (fuel model 3 for class B versus fuel model 1 for class A) and biomass.

Class C **5 %**

Late Development 1 Closed

Indicator Species and Canopy Position

RHGL
Upper
CORNU
Upper
ANGE
Lower
PAVI2
Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	20 %
Height	Tree 0m	Tree 10m
Tree Size Class		

☐ Upper layer lifeform differs from dominant lifeform.

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☑ Tree

Fuel Model

3

Description

**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.

This is the woody invasive stage including an ungrazed thatch accumulation stage starting at seven years and that would have been very rare pre-European times. At this point at approximately eight years, trees and shrubs would be beyond the effects of fire or grazing.

With lack of grazing for the long term, the prairie matrix weakens and is succeeded by woody cover of shrubs and trees, depending on proximity of woody seed sources. Probability of a replacement fire = 0.1; surface fire = 0.05. However, once this stage is fully wooded, neither fire nor grazing will remove the woody component.

Grazing is modeled to occur on five percent of this class each year. However, once this stage is fully wooded, neither fire nor grazing will remove the woody component.

Wind/weather stress was modeled as occurring every 25yrs, taking this class back to class 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 10000
Min 10
Max 100000

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	5	3	5	0.2	98
Mixed					
Surface	300	1	300	0.00333	2
All Fires	5			0.20334	

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
- [x] Native Grazing
- [ ] Competition
- [ ] Other (optional 1)
- [ ] Other (optional 2)

References

Anderson, Roger. 1990. The Historic Role of Fire in the North American Grassland. In Fire in North American Tallgrass Prairie ed. By S.L. Collins and L.L. Wallace. University of Oklahoma Press.

Curtis, J.T. 1959. The Vegetation of Wisconsin. University of Wisconsin Press.

Higgins, Kenneth F. 1986. Interpretation and Compendium of Historical Fire Accounts in the Northern Great Plains. Resource Publication 161. United States Department of the Interior Fish and Wildlife Service.

NatureServe. 2007. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA, U.S.A. Data current as of 10 February 2007.

Vogel, R.J. 1974. Effects of fire on grasslands. In Fire and Ecosystems, ed. By T.T. Kozlowski and C.E. Ahlgren, Academic Press, NY.

Whitney, G.G. 1994. From Coastal Wilderness to Fruited Plain: a history of environmental change in temperate North America from 1500 to the present. Cambridge University Press.

**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.