11500

Western Great Plains Tallgrass Prairie

BpS Model/Description Version: Aug. 2020

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| --- | --- | --- | --- |
| **Modelers** |  | **Reviewers** |  |
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| None | None | None | None |
| None | None | None | None |

Vegetation Type

Herbaceous

Map Zone

38

Geographic Range

This system occurs in the western part of the Great Plains in the western parts of Nebraska, Kansas, North Dakota, South Dakota, and Oklahoma and in eastern Montana and Colorado. In map zone (MZ) 38, it occurs in Sections 332E, 332F, and 315B.

Biophysical Site Description

This system is found primarily on loamy, moderately deep, and rich Mollisols throughout the Western Great Plains Division. These soils tend to be more mesic and deeper 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 eolian 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 and in 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 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 June grass (*Koeleria macrantha*) occupied the more xeric uplands and soil types and varied in importance. At the western extent of this type, buffalo grass (*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 prominent and no doubt contributed to the patchiness of burns.

BpS Dominant and Indicator Species

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| ANGE | *Andropogon gerardii* | Big bluestem |
| SONU2 | *Sorghastrum nutans* | Indiangrass |
| PAVI2 | *Panicum virgatum* | Switchgrass |
| SPPE | *Spartina pectinata* | Prairie cordgrass |

Species names are from the NRCS PLANTS database. Check species codes at http://plants.usda.gov.

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 was a major disturbance. Elk probably contributed to the impact of grazing and browsing as well. The elk may have contributed to the reduction of young woody saplings invading prairie adjacent to protected woody areas. Little is known about native ungulate grazing in this area. 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.

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Percent of All Fires** | **Min FI** | **Max FI** |
| Replacement | 5 | 98 | 3 | 5 |
| Moderate (Mixed) |  |  |  |  |
| Low (Surface) | 341 | 2 |  |  |
| All Fires | 5 | 100 |  |  |

Fire interval is expressed in years for each fire severity class and for all types of fire combined (All Fires). Average FI is the central tendency modeled. Percent of all fires is the percent of all fires modeled in that severity class. Minimum and Maximum FIs show the relative range of fire intervals as estimated by model contributors, if known.

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.

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 of the prairie and would not exhibit any appreciable effect overall. Since mixedgrass prairie is to the west, there would be little effect except that in periods of extended drought, the percentage of the mixedgrass species would increase.

This system is also similar to Biophysical Setting (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., 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.

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 known about native ungulate grazing in this area.

Issues or 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 known about native ungulate grazing in this area.

Native Uncharacteristic Conditions

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

Comments

Because of LANDFIRE mapping rules, canopy cover ranges for the succession classes are arbitrary. These classes should be defined on the ground by biomass, litter, and species.

For MZ38, this model was adopted from the same BpS in MZ31 by Randy Swaty (rswaty@tnc.org).

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, Gary Wilson, and John Ortmann.

Succession Classes

**Mapping Rules**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Upper Layer Lifeform** | **Height (m)** | **Canopy Cover (%)** | | | | | | | | | |
| **0-10** | **11-20** | **21-30** | **31-40** | **41 - 50** | **51-60** | **61-70** | **71-80** | **81-90** | **91-100** |
| Herb | 0-0.5 | A | A | A | A | A | B | B | B | B | B |
| Herb | 0.5-1.0 | A | A | A | A | A | B | B | B | B | B |
| Herb | >1.0 | A | A | A | A | A | B | B | B | B | B |
| Shrub | 0-0.5 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Shrub | 0.5-1.0 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Shrub | 1.0-3.0 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Shrub | >3.0 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Tree | 0-5 | C | C | UN | UN | UN | UN | UN | UN | UN | UN |
| Tree | 5-10 | C | C | UN | UN | UN | UN | UN | UN | UN | UN |
| Tree | 10-25 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Tree | 25-50 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Tree | >50 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |

Succession class letters A-E are described in the Succession Class Description section. Some classes use a leafform distinction where a qualifier is added to the class letter: Brdl (broadleaf), Con (conifer), or Mix (mixed conifer and broadleaf). UN refers to uncharacteristic native or a combination of height and cover that would not be expected under the reference condition. NP refers to not possible or a combination of height and cover which is not physiologically possible for the species in the BpS.

**Description**

Class A 54 Early Development 1 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| ANGE | Andropogon gerardii | Big bluestem | Upper |
| SONU2 | Sorghastrum nutans | Indiangrass | Upper |
| PAVI2 | Panicum virgatum | Switchgrass | Upper |
| SPPE | Spartina pectinata | Prairie cordgrass | Upper |

Description

This class is very short. It is a post-fire, post-grazing community from immediately after a replacement fire until ~1yr 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: 1) immediately after the fire (until fuel accumulates) and 2) 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 MZ 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 Tallgrass Prairie (3-4yrs in the central Tallgrass Prairie) and more likely to be 4-5yrs 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.

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 farther 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.

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

*Maximum Tree Size Class*  
None

Class B 40 Mid Development 1 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| ANGE | Andropogon gerardii | Big bluestem | Upper |
| SONU2 | Sorghastrum nutans | Indiangrass | Upper |
| PAVI2 | Panicum virgatum | Switchgrass | Upper |
| SPPE | Spartina pectinata | Prairie cordgrass | Upper |

Description

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 June grass (*Koeleria macrantha*) occupied the more xeric uplands and soil types and varied in importance. At the western extent of this type, buffalo grass (*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 *Ceanothus*, annually increase in size. Litter accumulates annually. Annuals, biennials, and short-lived perennials gradually become less abundant.

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 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 can sometimes mimic the fire response.

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

*Maximum Tree Size Class*  
None

Class C 6 Late Development 1 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| RHGL | Rhus glabra | Smooth sumac | Upper |
| CORNU | Cornus | Dogwood | Upper |
| ANGE | Andropogon gerardii | Big bluestem | Lower |
| PAVI2 | Panicum virgatum | Switchgrass | Lower |

Description

This is the woody invasive stage including an ungrazed thatch accumulation stage that would have been very rare pre-European times. At this point, at ~8yrs, 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. However, once this stage is fully wooded, neither fire nor grazing will remove the woody component.

*Maximum Tree Size Class*  
None

Model Parameters

Deterministic Transitions

|  |  |  |  |
| --- | --- | --- | --- |
| **From Class** | **Begins at (yr)** | **Succeeds to** | **After (years)** |
| Early1:OPN | 0 | Mid1:CLS | 1 |
| Mid1:CLS | 2 | Late1:CLS | 7 |
| Late1:CLS | 8 | Late1:CLS | 999 |

Probabilistic Transitions

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Disturbance Type** | **Disturbance occurs In** | **Moves vegetation to** | **Disturbance Probability** | **Return Interval (yrs)** | **Reset Age to New Class Start Age After Disturbance?** | **Years Since Last Disturbance** |
| Replacement Fire | Early1:OPN | Early1:OPN | 0.2 | 5 | Yes | 0 |
| Native Grazing | Early1:OPN | Early1:OPN | 0.5 | 2 | Yes | 0 |
| Wind or Weather or Stress | Mid1:CLS | Early1:OPN | 0.04 | 25 | Yes | 0 |
| Replacement Fire | Mid1:CLS | Mid1:CLS | 0.1 | 10 | No | 0 |
| Replacement Fire | Mid1:CLS | Early1:OPN | 0.1 | 10 | Yes | 0 |
| Native Grazing | Mid1:CLS | Mid1:CLS | 0.25 | 4 | No | 0 |
| Native Grazing | Mid1:CLS | Early1:OPN | 0.25 | 4 | Yes | 0 |
| Wind or Weather or Stress | Late1:CLS | Early1:OPN | 0.04 | 25 | Yes | 0 |
| Surface Fire | Late1:CLS | Late1:CLS | 0.05 | 20 | No | 0 |
| Native Grazing | Late1:CLS | Late1:CLS | 0.05 | 20 | No | 0 |
| Replacement Fire | Late1:CLS | Early1:OPN | 0.1 | 10 | Yes | 0 |

References

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

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

Higgins, K.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.: Fire and Ecosystems. Kozlowski, T.T. and C.E. Ahlgren, eds. Academic Press, New York.

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.