**14210**

**Central Tallgrass Prairie**

BpS Model/Description Version: Aug. 2020

|  |  |  |  |
| --- | --- | --- | --- |
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**Vegetation Type**

Herbaceous

**Map Zones**

31, 38, 42, 43, 44, 50, 51

**Model Splits or Lumps**

This Biophysical Setting (BpS) is lumped with 1488 and 1420.

**Geographic Range**

This type is found across central midwestern states with typical prairie border forests and prairie peninsula region of eastern states Iowa, northwestern Missouri, Minnesota, Wisconsin, Illinois, Indiana, Kentucky, and Ohio. The system interfaces and mingles on the east with the oak savanna and on the west with mixedgrass prairie. It is distributed with north-central sand and gravel tallgrass, which represents the dry prairie segment and likely intermingles with the northern tallgrass prairie to the north. Central tallgrass prairie is found in ECOMAP sections 222Ma, 222Mb, 222Na, 222L, 222K, 222Jb, Jh, and Ji, 251Cf, and Ch, 251Ga, Gb, and Gc. In map zone (MZ) 38, found primarily in subsections of 251H and 251G.

**Biophysical Site Description**

Prairie dominated the landscape with oak-hickory forests existing within fire-protected ravines or along stream corridors forming gallery forests (Abrams 1992). While the region is strongly influenced by dry continental air flow patterns and periodic drought, historic fire frequency determined the prairie-forest boundary with much variation based on topography, fuel breaks, ignition sources, and climate (Whitney 1994; Anderson and Bowles 1999). Much has been written concerning these systems, and excellent reviews can be found in Curtis (1959), Whitney (1994), and Anderson, Fralish, and Baskin (1999). The area is primarily mollic grassland soils incorporating mesic and hydric prairie types (Curtis 1959). 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**

Dominated by big bluestem (*Andropogon gerardii*), Indiangrass (*Sorghastrum nutans*), and prairie dropseed (*Sporobolus heterolepsis*) on more mesic sites, with prairie cordgrass (*Spartina pectinata*) and bluejoint grass dominating the wet sites. Secondary species such as little bluestem (*Schizachyrium scoparium*) and porcupine grass (*Stipa spartea*) occupied the drier portions of these uplands and soil types and varied in importance. Forb families had their largest representation in aster and legume. 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*.

**BpS Dominant and Indicator Species**

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| ANGE | *Andropogon gerardii* | Big bluestem |
| SONU2 | *Sorghastrum nutans* | Indiangrass |
| SPHE | *Sporobolus heterolepis* | Prairie dropseed |
| SPPE | *Spartina pectinata* | Prairie cordgrass |

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

**Disturbance Description**

Frequent fires impacted this prairie system every 1-3yrs, maintaining grass and forb vegetation. Insect and small mammal herbivory impacts composition and dominance. Large mammals were present, including bison, elk, and deer, but impacts were likely minimal. Fire played an important role in the maintenance of the tallgrass prairie (Curtis 1959; Vogl 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 prairies 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 were 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.

Maximum estimates of fire behavior for central tallgrass prairie, based on a conservative model in Twidwell et al. (2016), is 540m min-1 for rate of fire spread, 50,372kW m-1 for fireline intensity, and 11.3m for flame length.

Today’s prescribed fires have reduced maximum rate of fire spread and fireline intensity 81 and 85%, on average, while maximum flame length has been reduced 59% (Twidwell et al. 2016).

**Fire Frequency**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Percent of All Fires** | **Min FI** | **Max FI** |
| Replacement | 4 | 100 | 2 | 5 |
| Moderate (Mixed) |  |  |  |  |
| Low (Surface) |  |  |  |  |
| All Fires | 4 | 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**

Within regions of varied topography, type patches are typically large (>1,000ac), most prevalent on flat to rolling topography. 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.

Between 1984-2014, within MZs 31, 38, and 43 (Central Tallgrass Prairie), 98, 122, and 318 wildfires occurred, respectively (MTBS 2016). The largest wildfires during this time period were~77,000ac in MZ31, ~68,000ac in MZ38, and ~122,000ac in MZ43 (MTBS 2016). Mean wildfire size within MZs 31, 38, and 43 was ~8,000, 4,000, and 3,900ac, respectively (MTBS 2016).

**Adjacency or Identification Concerns**

Central tallgrass prairie would be adjacent to north-central interior oak savanna, north-central oak barrens, north-central interior sand and gravel prairie, and sedge meadows and wet prairie.

Synonymous names for this system include: mesic prairie, wet prairie, deep soil prairie, and blacksoil prairie.

This BpS might be confused with the north-central interior sand and gravel prairie.

In the absence of historic fire, invasive problems have increased dramatically, including gray dogwood, American plum, and hazelnut. Exotics that have become invasive due to agricultural practices and roadside plantings include reed canary grass, leafy spurge (*Euphorbia esula*), sweet clover (*Melilotus alba*), crown vetch, yellow parsnip, and birds foot trefoil. Domestic livestock grazing is also an issue. For many regions in MZs 31 and 38 and the western region of MZ43, eastern red cedar is highly abundant and encroaching at alarming rates.

Today this system has a severely reduced native cover (~99.9% loss), particularly for the mesic component of this type, due to conversion to other uses such as agriculture. In addition to the massive reduction in extent of mesic prairie, the scale of its occurrence has also severely been altered. Currently, this type occurs in fragmented small patches ranging from 1-10ac. Altering of the type is due to grazing and reduced fire, resulting in greater shrub and tree component and a variety of native and non-native shrubs as well as non-native cool season grasses (brome, bluegrass, quackgrass, and redtop), resulting in reduced diversity.

This system has mainly been converted to agriculture and other development. Invasion of cool-season grasses and shrubs often mask the identification of this type. It may be difficult to determine the difference between old fields and native prairie patches by using aerial photos or remote sensing data.

Again, species composition and structure were dependent on local factors such as topography, soil conditions, fire regime, plant competition, and plant-animal interactions (Anderson and Bowles 1999).

As indicated, this system interfaces and mingles on the east with oak savanna and on the west with mixedgrass prairie (in Nebraska and the Dakotas). 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 differs functionally from North-Central Interior Sand and Gravel Tallgrass Prairie due to fire intensity -- heavier fuel leading to higher fire intensity and a stronger competition from grass, making it more difficult for trees and shrubs to move into this system.

**Issues or Problems**

The plant-animal interactions are not fully understood for this model, and numerous studies of these phenomena are ongoing. Research exists for bison/fire interaction in detail in the western range of this system (i.e., Kansas and Nebraska). Also, there is possible overlap with the North Central Interior Oak Savanna model (BpS ID 1394, MZs 41, 50, and 51). There is variation in oak species composition across the broad region covered by this model (i.e., bur oak [*Quercus macrocarpa*] increases in prevalence in the western portion of the range). There is also great variation in prairie type across this region. Within the western ranges of this type, there was a grazing and fire interaction. As one moves east in this region, fire increases to where it is the major disturbance factor for this type and grazing drops out as an influence. The species composition also changes from east to west. 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. It is generally accepted that bison grazing was less in this grassland than in grasslands to the west. Even within this type, grazing likely played a larger role as one moves from east to west. Further, it has been recently suggested that elk populations may have been large enough to have an effect on vegetative composition. Some woody plant invasion may have occurred, but it was limited to areas close to seed sources, such as along the eastern interface with the savanna and around woody pockets and river valleys.

**Native Uncharacteristic Conditions**

Many small trees and shrubs would be uncharacteristic of this system historically but occurs today due to the lack of fire. For many regions in MZs 31 and 38 and the western region of MZ43, eastern red cedar is highly abundant and is encroaching at alarming rates. Domestic livestock grazing has also severely degraded this system. Haying would also have altered the species composition, especially for forbs species. Insects may not be as prevalent in modern times due to fragmentation (hypothesis by Tim Christiansen, personal communication).

**Comments**

For MZ44, this model was imported from MZ50 without changes except that, in MZ50, BpS 1421 was lumped with BpS 1488 and 1420. This lump does not apply in MZ44 because BpS 1488 and 1420 do not occur in the MZ. The MZ50 model was developed by John Harrington and Rich Henderson and reviewed by Robert Dana (Robert.Dana@dnr.state.mn.us), Dave Cleland (dcleland@fs.fed.us), and Tim Christiansen (tim.christiansen@us.army.mil). Modeler-ship was not changed in MZ44 because no changes were made to the description or the model. No review was received for MZ44.

Suggested reviewers: Dave Borneman; see also sand and gravel parried reviewers. This model was reviewed at the Landfire Vegetation Modeling Workshop for MZs 50, 51, and 41 by Elena Conteras, Randy Swaty, Mike Kost, Chris Weber, Doug Cox, and Becky Schillo.

This model was adapted from the Rapid Assessment model R4PRTGc Tallgrass Prairie -- Central created by Daryl Smith daryl.smith@uni.edu and reviewed by Tom Bragg (tom.bragg@mail.unomaha.edu), John Ortmann (jortmann@tnc.org), and an anonymous reviewer.

***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 | A | A | B | B | B |
| Herb | 0.5-1.0 | A | A | A | A | A | A | A | B | B | B |
| Herb | >1.0 | A | A | A | A | A | A | A | B | B | B |
| Shrub | 0-0.5 | B | B | B | UN | UN | UN | UN | UN | UN | UN |
| Shrub | 0.5-1.0 | C | C | C | UN | UN | UN | UN | UN | UN | UN |
| Shrub | 1.0-3.0 | C | C | C | UN | UN | UN | UN | UN | UN | UN |
| Shrub | >3.0 | C | C | C | UN | UN | UN | UN | UN | UN | UN |
| Tree | 0-5 | C | C | C | UN | UN | UN | UN | UN | UN | UN |
| Tree | 5-10 | UN | UN | 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 40 Early Development 1 - Open

*Indicator Species*

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| ANGE | Andropogon gerardii | Big bluestem | Upper |
| SONU2 | Sorghastrum nutans | Indiangrass | Upper |
| SPPE | Spartina pectinata | Prairie cordgrass | Upper |
| SPHE | Sporobolus heterolepis | Prairie dropseed | Upper |

*Description*

Post-Fire Regrowth Stage -- Duration: 2yrs. From blackened state, rapid regrowth of fire-positive and fire-neutral perennial vegetation to maximum height by end of 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 accumulation in this class. Probability of a replacement fire is 1.00 as all surface fires are replacement in this system.

Upper-layer lifeform is not the dominant lifeform. Open refers to absence of tree or shrub canopy cover.

The cover in this class is defined as 0-70% for mapping purposes. However, it could really go up to 100% cover.

*Maximum Tree Size Class*  
None

Class B 58 Mid Development 1 - Open

*Indicator Species*

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| ANGE | Andropogon gerardii | Big bluestem | Upper |
| SONU2 | Sorghastrum nutans | Indiangrass | Upper |
| SPPE | Spartina pectinata | Prairie cordgrass | Upper |
| SPHE | Sporobolus heterolepis | Prairie dropseed | Upper |

*Description*

Unburned Stage -- Duration: 2-4yrs. This unburned stage continues to be dominated by big bluestem (*Andropogon gerardii*), Indiangrass (*Sorghastrum nutans*), and prairie dropseed on more mesic sites, with prairie cordgrass (*Spartina pectinata*) and bluejoint grass dominating the wet sites. Secondary species such as little bluestem (*Schizachyrium scoparium*) and porcupine grass (*Stipa spartea*) occupied the drier portions of these uplands and soil types and varied in importance. 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.

The cover in this class is defined for mapping purposes as 71-100%. Some shrubs might be coming up in this stage.

*Maximum Tree Size Class*  
None

Class C 2 Late Development 1 - All Structures

*Indicator Species*

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| ANGE | Andropogon gerardii | Big bluestem | Middle |
| SPPE | Spartina pectinata | Prairie cordgrass | Middle |
| SALI | Salix ligulifolia | Strapleaf willow | Upper |
| CORA6 | Cornus racemosa | Gray dogwood | Upper |

*Description*

Unburned Thatch Accumulation Stage – Duration: 5-20yrs. Continuation of unburned state from Class B; however, with lack of fire for the long term, the prairie matrix weakens, and it is succeeded by woody cover of shrubs and trees, depending on proximity of woody seed sources. Without fire, the length of this stage is dependent on precipitation and temperature as well as topography and soils. It can be inferred that the effect of large ungulates, bison and elk, was highly limited in this region of this type. Probability of a replacement fire is 0.33 approximately.

As thatch builds up, grasses will start to lose vigor and become less competitive, and then shrubs or trees might start moving in more, which would be uncharacteristic because that would be due in part to lack of fire.

Add successional class to account for encroachment of eastern red cedar and the potential for a closed-canopy juniper woodland state in MZs 31 and 38 and the western region of MZ43. This process is briefly described under the native uncharacteristic condition sections but is not accounted for as a potential successional class. An example of a late-development class consisting of closed-canopy juniper woodland is described in BpS 11320 -- 31.

Herbaceous layer is still dominant. But grass cover declining due to thatch; won't be as dense.

*Maximum Tree Size Class*  
None

Model Parameters

Deterministic Transitions

|  |  |  |  |
| --- | --- | --- | --- |
| **From Class** | **Begins at (yr)** | **Succeeds to** | **After (years)** |
| Early1:OPN | 0 | Mid1:OPN | 2 |
| Mid1:OPN | 3 | Mid1:OPN | 999 |
| Late1:ALL | 6 | Late1:ALL | 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 |
| Alternative Succession | Mid1:OPN | Late1:ALL | 0.01 | 100 | Yes | 0 |
| Wind or Weather or Stress | Mid1:OPN | Early1:OPN | 0.04 | 25 | Yes | 0 |
| Replacement Fire | Mid1:OPN | Mid1:OPN | 0.133 | 8 | No | 0 |
| Replacement Fire | Mid1:OPN | Early1:OPN | 0.2 | 5 | Yes | 0 |
| Wind or Weather or Stress | Late1:ALL | Early1:OPN | 0.04 | 25 | Yes | 0 |
| Replacement Fire | Late1:ALL | Early1:OPN | 0.08 | 13 | Yes | 0 |
| Replacement Fire | Late1:ALL | Mid1:OPN | 0.255 | 4 | Yes | 0 |

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