14120

North-Central Interior Sand and Gravel Tallgrass Prairie

BpS Model/Description Version: Aug. 2020

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| **Modelers** |  | **Reviewers** |  |
| John Harrington | jaharrin@wisc.edu | Doug Cox | mteecology@frontiernet.net |
| Richard Henderson | Richard.Henderson@wisconsin.gov | Mike Kost | kostma@michigan.gov |
| Brad Slaughter | slaughterb@michigan.gov | Becky Schillo | SchilloR@michigan.gov |

Vegetation Type

Herbaceous

Map Zones

52

Geographic Range

This Biophysical Setting (BpS) occurs on glacial features such as kames, eskers, moraines, sandplains, along eolian dunes, and on lakeplains, excluding the Great Lakes, in the northern Midwest, primarily Minnesota, Wisconsin and Michigan (NatureServe 2007). In map zone (MZ) 52, this system was likely of local occurrence, where prairie would have occupied small patches in a matrix of oak savanna and oak-hickory forest, likely concentrated in the Southern Michigan/Northern Indiana Drift Plains Ecoregion of northern Iindiana (Woods et al. 1998). Smaller, more widely dispersed occurrences would have occurred on appropriate substrates in the till plains of west-central Ohio and central Indiana.

Biophysical Site Description

Within MZ52, North-Central Interior Sand and Gravel Tallgrass Prairie occupied kames, eskers, moraines, lakeplains, and sandplains characterized by a sandy, rocky, or gravelly substrate. This BpS was likely concentrated in the Southern Michigan/Northern Indiana Drift Plains Ecoregion of northern Indiana, where these glacial features are common (Woods et al. 1998). The BpS also occurred locally on the rolling till plains of west-central Ohio and central Indiana, where substrate and natural disturbances favored the development of sand and gravel prairie. This model abstracts prairie types to include xeric and dry-mesic types (Curtis 1959).

Vegetation Description

Grasses formed the matrix of the prairie with sideoats grama (*Bouteloua curtipendula*) and little bluestem (*Schizachyrium scoparium*) being the main indicator species. Big bluestem (*Andropogon gerardii*), Indian grass (*Sorghastrum nutans*), needlegrass (*Hesperostipa spartea*) and prairie dropseed (*Sporobolus heterolepsis*) also dominate many dry to dry-mesic prairies (Whitney 1994). Numerous forbs such as composites – *Aster* spp., *Silphium* spp., blazingstars (*Liatris* spp.) and coneflower (*Echinacea pallida*), legumes, prairie clovers (*Petalostemum* spp.), roundheaded bushclover (*Lespedeza capitata*) and leadplant (*Amorpha canescens*) amongst many others – were also present. Fuel complexes consisted of short- or tall-grass prairie forbs and shrubs with little or no tree regeneration.

Oak grubs and shrubs characterize this system. Recurring fires in advanced oak regeneration stimulates the resprouting response evidenced by the grubs or multi-stemmed stump sprouts of black oak (*Q. velutina*), bur oak (*Q. macrocarpa*), white oak (*Q. alba)* and others (Abrams 1992). Shrub species include New Jersey tea (*Ceanothus americanus*), hazelnut (*Coylus, americana*), gray dogwood (*Cornus racemosa*) and sumac (*Rhus* spp.). Over a period of years, massive root systems developed, and the term "grub" (from the German *gruben*, 'to dig'), referenced the laborious method of removing these root wads in clearing areas for planting (Anderson and Bowles 1999). Fuel complexes were characterized as “stunted brush prairie” comprised of mixed prairie grasses and forbs with coppicing oak stems about 1-1.5m in height (Curtis 1959, Anderson and Bowles 1999).

BpS Dominant and Indicator Species

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| SCSC | *Schizachyrium scoparium* | Little bluestem |
| SONU2 | *Sorghastrum nutans* | Indiangrass |
| BOCU | *Bouteloua curtipendula* | Sideoats grama |
| HESP11 | *Hesperostipa spartea* | Porcupinegrass |

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

Disturbance Description

Historically, before European settlement, frequent fires impacted this prairie system every 1-5yrs, maintaining grass and forb vegetation. Insect and small mammal herbivory impacts composition and dominance (Howe et al 2006). Large mammals were present in low densities, main grazers were elk and deer with impacts likely being minimal.

Shrub and tree establishment and longevity was influenced by fire intensity and return interval.

Fire intensity will be influenced by topography, weather, productivity and aspect. For example, productive soils on level terrains supported more intensive fires and the areas with fire breaks or leeward sides/north-facing slopes generally supported more savanna types. Fire intensity varied based on humidity and temperature. Fire intensity also varies with aspect and slope. For example, south and west facing steep slopes would have burned at a higher intensity resulting in few trees and shrubs.

Oak wilt occurred on sand prairies and likely resulted in mortality of larger oak groups especially when they occurred in high densities. This was not modeled due to the general lack of larger oak groups in this BpS.

Diseases and insects can impact species composition. However, specific impacts are not clearly understood and therefore not modeled.

There was a grazing and fire interaction within the western ranges of this type in Wisconsin and Minnesota. 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.

Proximity of seed source is important to probability of shrub and tree invasion. Proximity is related to isolation of trees/ shrubs. Less edge equals lower probability of tree/shrub invasion.

Health and vigor of the sod influences shrub/tree invasion. Better health of sod reduces probability of successful establishment of trees and shrubs.

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Percent of All Fires** | **Min FI** | **Max FI** |
| Replacement | 4 | 96 | 1 | 8 |
| Moderate (Mixed) |  |  |  |  |
| Low (Surface) | 90 | 4 |  |  |
| All Fires | 3 | 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 small (<200ac) limited by topography, but in regions of level topography on extensive sands and gravel deposits these could be much larger.

Adjacency or Identification Concerns

North-central interior oak savanna, North-central oak barrens, central tallgrass prairie, and adjacent sedge meadows and wet prairie are the systems that would be adjacent to this BpS.

Synonymous local classifications include bluff prairie, hill prairie, sand prairie, limestone prairie, dry prairie

This Bps might be confused with the central tallgrass prairie systems.

In the absence of historic fire invasive problems have increased dramatically, including eastern red cedar (*Juniperus virginiana*). Exotics that have become invasive due to agricultural practices and roadside plantings include leafy spurge (*Euphorbia esula*), knapweed, sweet clover (*Melilotus alba*), and crown vetch, and birds foot trefoil. Domestic livestock grazing is also an issue.

Today this system has severely reduced native cover (~99% loss) due to conversion to other uses such as agriculture. Altering of the type is due to grazing and reduced fire resulting in greater shrub and tree component, e.g, red cedar (*Juniperus virginiana),* oak species (*Quercus* spp.,) and a variety of native and non-native shrubs, and non-native cool season grasses (brome, bluegrass, quackgrass, redtop), resulting in reduced diversity.

Agriculture on level sand prairie where irrigation will support crops is a type conversion that might be present today such that the historical condition is unidentifiable. Invasion of cool season grasses and shrubs often mask the identification of this type.

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

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. Also, there is possible overlap with the North-Central Interior Oak Savanna model. There is variation in oak species composition across the broad region covered by this model (i.e., bur oak [*Quercus macrocarpa*] occurs in the western portion of the range).

For all oak systems, oak wilt is becoming more wide-spread due to an increased number of mature oaks, and the amount of wood being moved around.

Native Uncharacteristic Conditions

Many small trees and shrubs would be uncharacteristic of this system historically but occurs today due to the lack of fire. Domestic livestock grazing has eliminated many native species and has altered species composition. There is not much of the grassy stages left due to altered fire regimes and with grazing the species have shifted.

Comments

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 | UN | UN | UN | UN | UN | A | A | A | A | A |
| Herb | 0.5-1.0 | UN | UN | UN | UN | UN | A | A | A | A | A |
| Herb | >1.0 | UN | UN | UN | UN | UN | A | A | A | A | A |
| Shrub | 0-0.5 | B | B | B | B | B | UN | UN | UN | UN | UN |
| Shrub | 0.5-1.0 | B | B | B | B | B | UN | UN | UN | UN | UN |
| Shrub | 1.0-3.0 | B | B | B | B | B | UN | UN | UN | UN | UN |
| Shrub | >3.0 | B | B | B | B | B | UN | UN | UN | UN | UN |
| Tree | 0-5 | C | C | C | C | UN | UN | UN | UN | UN | UN |
| Tree | 5-10 | C | C | C | C | UN | UN | UN | UN | UN | UN |
| Tree | 10-25 | C | C | C | C | 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 81 Early Development 1 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| SCSC | Schizachyrium scoparium | Little bluestem | Upper |
| SONU2 | Sorghastrum nutans | Indiangrass | Upper |
| BOCU | Bouteloua curtipendula | Sideoats grama | Upper |
| HESP11 | Hesperostipa spartea | Porcupinegrass | Upper |

Description

Grasses formed the matrix of the prairie with big bluestem (*Andropogon gerardii*), Indian grass (*Sorghastrum nutans*), little bluestem (*Schizachyrium scoparium*), needlegrass (*Hesperostipa spartea*), prairie dropseed (*Sporobolus heterolepsis*) and sideoats grama (*Bouteloua curtipendula*) dominating many dry to dry-mesic prairies (Whitney 1994). Numerous forbs such as composites – *Aster* spp., *Silphium* spp., blazingstars (*Liatris* spp.), and coneflower (*Echinaceas pallida*), legumes, prairie clovers (*Petalostemum* spp.), roundheaded bushclover (*Lespedeza capitata*), and leadplant (*Amorpha canescens*) among many others – were also present. Fuel complexes consisted of short- or tall-grass prairie forbs and shrubs with little or no tree regeneration. Fuel complexes consisted of short- or tall-grass prairie forbs.

Replacement fires occur frequently in early successional seral class A and maintain the system. Grass cover in this stage truly should be in the high cover ranges. It would be a different area/system if it were lower.

This class would go to change if fire and seed source were unavailable. We would like to model this as time since disturbance without a probability, but because that's unallowable, we modeled with a probability. Also, distance to seed (from birds, wind, small mammals) would influence whether we change state without fire.

Small mammals and invertebrates and tree pathogens such as oak wilt probably occurred historically, but we were unsure of impact, so they were not modeled.

*Maximum Tree Size Class*  
None

Class B 16 Mid Development 1 - All Structures

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| BOCU | Bouteloua curtipendula | Sideoats grama | Low-Mid |
| SCSC | Schizachyrium scoparium | Little bluestem | Middle |
| COAM3 | Corylus americana | American hazelnut | Upper |
| CORA6 | Cornus racemosa | Gray dogwood | Upper |

Description

This is the shrub-oak grub representing prairie with scattered shrub and seedling sprouts or grubs. This vegetation is experiencing recurring fires in advanced oak regeneration, which stimulates the resprouting grubs. Fuel complexes are characterized as "stunted brush prairie" comprised of mixed prairie grasses and forbs with shrubs and coppicing oak stems about 1-1.5m in height (Curtis 1959; Anderson and Bowles 1999).

This is the brush-phase that occurs without fire. A replacement fire can occur and could maintain the system. Fire would be more effective in reducing the shrub component and sending the system back to regeneration if the system were to go through a real drought. In an average year, fire would set back shrub growth but they would resprout. Also, it would have to be a very intense frequent fire to replace the system. However, if shrubs are just starting to come in, it might be easier to have a replacement event.

Severe drought cycles, modeled as a wind/weather/stress event. Therefore, if fire occurs around these drought events, it might replace the system, especially if shrubs are in the beginning stages. It's questionable as to whether a filled-up shrub stage would be replaced or would just set back a bit. It is questionable as to whether this stage is truly part of this system or whether it's transitioned to another type.

Class B can move on through alternate succession if there is a seed source combined with weather conditions and lack of fire.

Surface fires are possible in this stage, because as the shrubs get taller, surface fire will creep along the grass and not topkill the shrubs. As we get more surface fire, this class actually transitions forward.

*Maximum Tree Size Class*  
Seedling <4.5ft

Class C 3 Mid Development 2 - All Structures

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| BOCU | Bouteloua curtipendula | Sideoats grama | Lower |
| COAM3 | Corylus americana | American hazelnut | Middle |
| QUERC | Quercus | Oak | Upper |
| SCSC | Schizachyrium scoparium | Little bluestem | Low-Mid |

Description

This class would rarely occur, and would return to prairie unless a succession of catastrophic fire with high intensity or extremely intense fires successively were to happen. Also, time of year and seasonality of fires could influence a replacement event, which might have occurred infrequently.

Fuel complexes for savanna areas were largely prairie grasses and forbs in the understory with widely scattered fire-resistant shrub and oak stems forming the overstory.

Surface fires could have occurred because it's a tree/shrub system which won't get topkilled.

Replacement fires could happen under the right conditions to take it all the way back to regeneration or just knock it back under the right conditions. This would happen when there is enough fire intensity to top kill the trees, but not enough successive fires to take this box back to all grass. Drought would increase the fire effect in this class.

*Maximum Tree Size Class*  
Pole 5-9" DBH

Model Parameters

Deterministic Transitions

|  |  |  |  |
| --- | --- | --- | --- |
| **From Class** | **Begins at (yr)** | **Succeeds to** | **After (years)** |
| Early1:OPN | 0 | Early1:OPN | 999 |
| Mid1:ALL | 6 | Mid1:ALL | 999 |
| Mid2:ALL | 20 | Mid2: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** |
| Alternative Succession | Early1:OPN | Mid1:ALL | 0.008 | 125 | Yes | 0 |
| Replacement Fire | Early1:OPN | Early1:OPN | 0.2857 | 4 | No | 0 |
| Alternative Succession | Mid1:ALL | Mid2:ALL | 0.01 | 100 | Yes | 0 |
| Surface Fire | Mid1:ALL | Mid1:ALL | 0.017 | 59 | No | 0 |
| Wind or Weather or Stress | Mid1:ALL | Mid1:ALL | 0.033 | 30 | No | 0 |
| Replacement Fire | Mid1:ALL | Early1:OPN | 0.04 | 25 | Yes | 0 |
| Replacement Fire | Mid1:ALL | Mid1:ALL | 0.25 | 4 | No | 0 |
| Replacement Fire | Mid2:ALL | Early1:OPN | 0.005 | 200 | Yes | 0 |
| Wind or Weather or Stress | Mid2:ALL | Mid2:ALL | 0.033 | 30 | No | 0 |
| Replacement Fire | Mid2:ALL | Mid1:ALL | 0.04 | 25 | Yes | 0 |
| Surface Fire | Mid2:ALL | Mid2:ALL | 0.25 | 4 | No | 0 |

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