13940

North-Central Interior Oak Savanna

BpS Model/Description Version: Aug. 2020

Update: 4/17/2018

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Vegetation Type

Steppe/Savanna

Map Zones

42

Geographic Range

Northern oak savanna occurs in a complex, shifting mosaic with oak woodlands, barrens and prairies in the Midwest. This type occurs in southern Lower Michigan, northwestern Ohio, northern Indiana, northeastern Illinois, southern Wisconsin, southeastern to northwestern Minnesota, throughout Iowa, northern Missouri, and eastern Nebraska. This savanna/woodland/prairie type historically occurred as an ecotone between mesic hardwood forest and tallgrass prairie.

This model represents the system in map zones (MZ)s 38, 42 and 43. Within these map zones north-central interior oak savanna occurs in sections (Cleland et al. 2007) 222M, 251B, 251C, 251E, 251G, 251H.

Biophysical Site Description

Within the area of the Prairie Border forests (Abrams 1992), prairie vegetation dominated the landscape with oak-hickory forests existing within fire-protected ravines or along stream corridors forming gallery forests (Abrams 1992). Our model abstracts prairie types to include xeric and dry-mesic types (Curtis 1959). Xeric prairies were maintained by shallow soils (< 4in) on steep slopes (usually to the southwest) with extreme runoff of rainwater. Xeric prairies also occurred on flat uplands where soil is shallow and has low water holding capacity. In general, these prairie types are found in both glaciated and non-glaciated areas. They are excessively to well drained, with shallow depth to bedrock or sandy soils. Fertility ranges from poor acidic to richer neutral soils limited by moisture. Thin loess over bedrock is prevalent in western ranges of this type in the Driftless Area of Minnesota and Iowa. This type occurs in both driftless areas with sharper topography and in glaciated areas among glacial till and outwash and well-drained sand and gravel deposits. Level sites occurred on glacial outwash with a very porous subsoil of sand and gravel. Rolling areas were characterized by glacial till of recessional moraines or on residual loess soils.

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 (Anderson and Bowles 1999, Whitney 1994). Over time, forest edges expanded and contracted based on topographic variability and fire frequency and intensity exhibiting a continuum of grassland, “grub,” open savanna woodlands, or canopied forests. Much has been written concerning these systems and excellent reviews can be found in Curtis (1959), Whitney (1994) and Anderson, Fralish, and Baskin (1999).

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 [*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.

Oak grubs and shrubs characterize this system. Recurring fires in advanced oak regeneration stimulates the resprouting response evidenced by the grubs (from the German *gruben*, 'to dig') 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" 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).

Savannas and woodlands represent relatively open forest systems along the prairie-forest continuum (for extreme variety see Anderson et al. 1999). Generally, these systems have example species from true open prairies, woodlands, and closed canopy forests, with oak species dominating the arboreal layer (Abrams 1992). For the purposes of FRCC we have adopted fairly average canopy closure values of 0-10% closure for prairie, 10-25% closure to indicate savanna, while woodlands exhibit 25-60% canopy closure (see discussion in Anderson and Bowles 1999 for variation across range).

BpS Dominant and Indicator Species

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| QUAL | *Quercus alba* | White oak |
| QUVE | *Quercus velutina* | Black oak |
| QUMA2 | *Quercus macrocarpa* | Bur oak |
| ANGE | *Andropogon gerardii* | Big bluestem |
| CORYL | *Corylus* | Hazelnut |
| SCHIZ4 | *Schizachyrium* | Little bluestem |
| SONU2 | *Sorghastrum nutans* | Indiangrass |
| CEAM | *Ceanothus americanus* | New jersey tea |

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, e.g., 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 Biophysical Setting (BpS).

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

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 | 532 | 1 |  |  |
| Moderate (Mixed) | 167 | 3 |  |  |
| Low (Surface) | 5 | 96 |  |  |
| 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

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

The northern oak savanna type includes several matrix communities such as mesic and dry-mesic oak openings, dry oak barrens, mixed oak and oak-hickory woodlands, and a variety of small and large patch prairie types.

This type intergrades and can be confused with more open expressions of North-Central Interior Dry-Mesic Oak Forest and Woodland (BpS 1310) and North-Central Interior Dry Oak Forest and Woodland (BpS 1311). It can be distinguished from these systems in some cases by a higher percentage of sand (though not to the excessive levels of the North-Central Oak Barrens) in ECOMAP sections 222K and 222R. This type can also intergrade with North-Central Oak Barrens (BpS 1395) as soils become increasingly sandy. In 222L it is also associated with moderate levels of silt. In ECOMPA sections 222K and 222L it is associated with the SSURGO taxonomic particle size of “fine-silty” and fine-silty over clayey

Today, northern oak savanna in the upper Midwest is limited to small, degraded remnants. Circa 1800, oak savanna communities covered some 11-13 million ha (27-32 million ac) of the Midwest. Presently oak savanna remnants occur on just 0.02% of their circa 1800 extent (Nuzzo 1986). Following European settlement of prairies, settlement and conversion to agriculture of oak savanna rapidly followed (Kenoyer 1930). Many towns, college campuses, parks, and cemeteries of the Midwest were established on former oak savanna (Packard 1988, Bronny 1989, Chapman 1984).

Alteration of historic fire regimes has shifted most oak savannas into woodlands and forest (Faber-Langendoen 1993, Curtis 1959, Cottam 1949). The decrease in Native American populations across the Midwest in the 1700-1800s likely resulted in a decrease in fire frequency. Wildfire suppression policies instituted in the 1920s in concert with road construction, expansion of towns, and increased agriculture caused a dramatic decrease in fire frequency and intensity (Abrams 1992). The reduction of fire in the landscape resulted in the succession of open oak savanna to closed-canopy forests with little advanced regeneration of oaks and a vanishing graminoid component (Chapman et al. 1995). With the absence of fire, oak savannas converted to closed canopy forest within decades (estimates range from 25-40yrs) (Stout 1946, Curtis 1959) with more mesic savannas, such as bur oak plains, deteriorating more rapidly (Packard 1993, Abrams 1992). The rapid conversion to oak forest occurred because of the prevalence in the understory of oak grubs, which are repeatedly fire-suppressed oaks with huge root masses that allowed them to achieve canopy ascension following release from annual fires (Bowles and McBride 1998, Kline 1997, Chapman 1984, Cottam 1949). Frequently these oak grubs were *Quercus velutina* (black oaks), which became canopy codominants with the advent of fire suppression.

Oak savanna remnants are often depauperate in floristic diversity as the result of fire suppression and subsequent woody encroachment, livestock grazing, and the invasion of exotic species. Sustained grazing introduced soil disturbance, prevented oak establishment, and caused decreases in native forbs and grasses with increases in weeds (native and exotic) (Jones 2000, McPherson 1997, Bray 1960).

Groundlayer vegetation of savanna remnants has been inhibited by low levels of light filtering through the dense overstories and impenetrable understories (often dominated by exotic shrubs) and by the thick litter layers that have accumulated from over a century of fire suppression (Bowles and McBride 1998).

Issues or Problems

This type covers a broad geographic range and encompasses a variety of savanna, barrens, woodlands and prairie types that may have experienced different surface fire return intervals ranging from 1-5yrs. Historical fire size is unknown but historical accounts indicate that vast acreages burned within a single fire event.

Native Uncharacteristic Conditions

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 | A | A | A | A | A | A | A | A | A | A |
| Herb | 0.5-1.0 | A | A | A | A | A | A | A | A | A | A |
| Herb | >1.0 | A | A | A | A | A | A | A | A | A | A |
| Shrub | 0-0.5 | A | A | A | A | A | A | A | A | A | A |
| Shrub | 0.5-1.0 | A | A | A | A | A | A | A | A | A | A |
| Shrub | 1.0-3.0 | A | A | A | A | A | A | A | A | A | A |
| Shrub | >3.0 | A | A | A | A | A | A | A | A | A | A |
| Tree | 0-5 | A | A | B | B | B | B | C | C | D | D |
| Tree | 5-10 | A | A | B | B | B | B | C | C | D | D |
| Tree | 10-25 | A | A | B | B | B | B | C | C | D | D |
| Tree | 25-50 | A | A | B | B | B | B | C | C | D | D |
| Tree | >50 | A | A | B | B | B | B | C | C | D | D |

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 22 Early Development 1 - All Structures

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| ANGE | Andropogon gerardii | Big bluestem | Low-Mid |
| SCHIZ4 | Schizachyrium | Little bluestem | Low-Mid |
| QUMA2 | Quercus macrocarpa | Bur oak | Upper |
| POTR5 | Populus tremuloides | Quaking aspen | Upper |

Description

Class consisting of prairie grasses and forbs which dominate open grassland with scattered oak grubs and clumps of shrubs. These grubs can become trees in this class, but are fairly scattered.

Upper Layer Lifeform is not the dominant lifeform. Herbs, up to 1m tall, ranging in cover from 0-100%, tending towards 100%.

*Maximum Tree Size Class*  
Medium 9-21"DBH

Class B 63 Late Development 1 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| QUAL | Quercus alba | White oak | Upper |
| QUMA2 | Quercus macrocarpa | Bur oak | Upper |
| ANGE | Andropogon gerardii | Big bluestem | Lower |
| CORYL | Corylus | Hazelnut | Middle |

Description

This is a system of widely-scattered, large-diameter oaks and shrub clumps within a matrix of prairie grasses and forbs (21-60% canopy closure).

*Maximum Tree Size Class*  
Large 21-33"DBH

Class C 13 Late Development 2 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| QUAL | Quercus alba | White oak | Upper |
| QUMA2 | Quercus macrocarpa | Bur oak | Upper |
| QUVE | Quercus velutina | Black oak | Lower |

Description

Open canopy (60-80% canopy closure) oak-dominated woodland with high stem density. These oak groves occupy areas of the landscape that frequently escape fire due to topographic position.

*Maximum Tree Size Class*  
Very Large >33"DBH

Class D 2 Late Development 3 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| QUAL | Quercus alba | White oak | Upper |
| QUMA2 | Quercus macrocarpa | Bur oak | Upper |
| CAOV2 | Carya ovata | Shagbark hickory | Upper |
| PRSE2 | Prunus serotina | Black cherry | Low-Mid |

Description

This is a closed-canopy (81-100%) oak-dominated forest with scattered hickories. These oak groves occupy areas of the landscape that frequently escape fire due to topographic position.

*Maximum Tree Size Class*  
Large 21-33"DBH

Model Parameters

Deterministic Transitions

|  |  |  |  |
| --- | --- | --- | --- |
| **From Class** | **Begins at (yr)** | **Succeeds to** | **After (years)** |
| Early1:ALL | 0 | Late1:OPN | 50 |
| Late1:OPN | 51 | Late1:OPN | 999 |
| Late2:OPN | 51 | Late2:OPN | 999 |
| Late3:CLS | 51 | Late3: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** |
| Alternative Succession | Early1:ALL | Late3:CLS | 0.001 | 1000 | Yes | 0 |
| Alternative Succession | Early1:ALL | Late2:OPN | 0.001 | 1000 | Yes | 0 |
| Wind or Weather or Stress | Early1:ALL | Early1:ALL | 0.001 | 1000 | No | 0 |
| Native Grazing | Early1:ALL | Early1:ALL | 0.001 | 1000 | No | 0 |
| Replacement Fire | Early1:ALL | Early1:ALL | 0.005 | 200 | Yes | 0 |
| Mixed Fire | Early1:ALL | Early1:ALL | 0.01 | 100 | No | 0 |
| Surface Fire | Early1:ALL | Early1:ALL | 0.2 | 5 | No | 0 |
| Alternative Succession | Late1:OPN | Late2:OPN | 1 | 1 | Yes | 25 |
| Wind or Weather or Stress | Late1:OPN | Late1:OPN | 0.001 | 1000 | No | 0 |
| Native Grazing | Late1:OPN | Late1:OPN | 0.001 | 1000 | No | 0 |
| Replacement Fire | Late1:OPN | Early1:ALL | 0.001 | 1000 | Yes | 0 |
| Mixed Fire | Late1:OPN | Early1:ALL | 0.005 | 200 | Yes | 0 |
| Surface Fire | Late1:OPN | Late1:OPN | 0.2 | 5 | No | 0 |
| Alternative Succession | Late2:OPN | Late3:CLS | 1 | 1 | Yes | 30 |
| Native Grazing | Late2:OPN | Late2:OPN | 0.001 | 1000 | No | 0 |
| Wind or Weather or Stress | Late2:OPN | Early1:ALL | 0.001 | 1000 | Yes | 0 |
| Replacement Fire | Late2:OPN | Early1:ALL | 0.001 | 1000 | Yes | 0 |
| Mixed Fire | Late2:OPN | Late1:OPN | 0.002 | 500 | Yes | 0 |
| Surface Fire | Late2:OPN | Late2:OPN | 0.2 | 5 | No | 0 |
| Native Grazing | Late3:CLS | Late3:CLS | 0.001 | 1000 | No | 0 |
| Wind or Weather or Stress | Late3:CLS | Early1:ALL | 0.001 | 1000 | Yes | 0 |
| Replacement Fire | Late3:CLS | Early1:ALL | 0.001 | 1000 | Yes | 0 |
| Mixed Fire | Late3:CLS | Late1:OPN | 0.025 | 40 | Yes | 0 |
| Surface Fire | Late3:CLS | Late3:CLS | 0.1 | 10 | No | 0 |

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