13100

North-Central Interior Dry-Mesic Oak Forest and Woodland

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

Forest and Woodland

Map Zones

39

Geographic Range

This system occurs in Province 222. In MI, this occurs in ECOMAP section 222J, and in WI in sections 222K and 222L.

Historically, this type was quite extensive in MI, IN, IL, MO, IA, WI and MN (NatureServe 2007).

The Dry-Mesic Oak Forest occurs throughout the Lakes Region including northwest MN through central MN and into northern WI. It occupies the tension zone between prairies to the west and south and the forests of the Lakes region. This system occurs on the Allegheny, Piedmont, and Cumberland plateaus. It continues west to the Ozark and Ouachita Highlands.

In MZs 39 and 40, it might occur in coulees and river breaks or just on the outskirts of MN, on the eastern edges of the mapzones grading into MN.

Biophysical Site Description

This system is found throughout the glaciated regions of the Midwest, typically in gently rolling landscapes. It can occur on uplands within the prairie matrix and near floodplains, or on rolling glacial moraines and among kettle-kame topography. Soils are typically well-drained Mollisols or Alfisols that range from loamy to sandy loam in texture (NatureServe 2007).

This system occurs most commonly on interlobates where outwash, ice-contact, and end moraine landforms are situated between former glacial lobes. Other landforms suitable for development of the dry-mesic oak forest are sandy ground moraine and lake plains. Common to all these landforms is well-drained, acidic soil characterized by loamy sand and sandy loam. Dry landscape settings, such as on western and southern aspects and upper slopes and ridge tops are conducive to the development of North-Central Interior Dry Oak Forest and Woodland (1311) or North-Central Interior Oak Savanna (1394) rather than this system (Curtis 1959). Eastern and northern slopes with sufficient fire frequency to minimize the mesophytic species are more conducive to the development of this system. Historically, this system represented a small percentage of the oak forest and savanna types (Curtis 1959).

For LANDFIRE mapping, SSURGO map units with moderate to high silt percentages (>40%) on uplands, with taxonomic particle sizes of “fine-silty” or “fine-loamy over sandy” may prove useful for mapping this system. Sites expected to have higher fire frequencies on “fine-loamy” may be included for mapping this system, whereas lower frequencies on these sites would likely indicate North-Central Interior Maple-Basswood Forest (1314). Soil orders are generally Alifsols with Mollisols becoming more important at the interface with prairie and savanna systems.

Vegetation Description

Forest cover can range from a dense to moderately open canopy and there is commonly a dense shrub layer. Fire-resistant oak species, in particular Quercus macrocarpa, Quercus rubra, Quercus velutina and/or Quercus alba, dominate the overstory. There are also varying amounts of hickory, Carya spp., including Carya ovata, Carya cordiformis and Carya alba (= Carya tomentosa), are diagnostic in portions of the range of this system. Depending on site location and overstory canopy density, the understory may include species such as Corylus americana, Amelanchier spp., Maianthemum stellatum, Caulophyllum thalictroides, Laportea canadensis, Trillium grandiflorum, Aralia nudicaulis and Urtica dioica. Occasionally, prairie grasses such as Andropogon gerardii and Panicum virgatum may be present (NatureServe 2007).

There might also be varying amounts of black cherry (Prunus serotina) and sassafras (Sassafras albidum). American chestnut (Castanea dentata) was once dominant or codominant in the very southeastern portion of southern MI. Common low woody shrubs include brambles (Rubus spp.), black currant (Ribes cynosbati). Graminoid species such as Carex pensylvanica, Danthonia spicata, Andropogon gerardii are also common.

Black oaks were generally more abundant on more xeric, sandier sites, whereas red oak was generally more abundant on more mesic, loamier sites. Red oak can also develop under a moderate overstory of the other oaks. Bur oak was occasionally present on sites with higher fire frequency or on thin calcareous soils (Curtis 1959). White oak spans the range of edaphic conditions encapsulated by this system. Prunus serotina capitalizes on canopy gaps, but rarely achieves significant canopy dominance (McCune and Cottam 1985). Other hardwood species, including Juglans nigra, Juglans cinerea, Celtis occidentalis, Ulmus americana and Acer negundo were occasionally found in the southern extent of this system on more mesic sites with lower fire frequencies.

BpS Dominant and Indicator Species

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| QUAL | *Quercus alba* | White oak |
| QUVE | *Quercus velutina* | Black oak |
| CAGL8 | *Carya glabra* | Pignut hickory |
| CAOV2 | *Carya ovata* | Shagbark hickory |
| SAAL5 | *Sassafras albidum* | Sassafras |
| QURU | *Quercus rubra* | Northern red oak |
| ACRU | *Acer rubrum* | Red maple |

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

Disturbance Description

The North-Central Interior Dry-Mesic Oak Forest and Woodland (oak-hickory forest) is predominantly Fire Regime I, characterized by low-severity surface fires. Historically, indigenous fires accounted for over 95% of the ignitions over these landscapes. Vegetation types varied based on fire frequency and intensity. Grassland prairies burned often with fire rotations approximately less than five years and were probably associated with flat-to-slightly rolling terrain that effectively carried fire (Anderson and Bowles 1999). These grasslands, deliberately maintained by Native Americans for hunting purposes, were probably scattered throughout the forest matrix. Oak-hickory savannas occurred where fire frequency was a bit less, probably 5-15yrs. Woodlands developed within a moderate burning regime, with fire return times averaging every 15-25yrs.

Native Americans played a critical role in the development and maintenance of oak-hickory landscapes through fire ignition. Natives burned these landscapes for a variety of reasons. Fire encouraged open habitats which, in turn, increased food-producing plants (forbs, mast) and ungulate herbivores (meat). Also, lightning-strike ignitions, though limited in frequency, would have provided an additional source of ignition.

A mosaic of vegetation types comprised oak-hickory landscapes contingent on fire history (Cutter and Guyette 1994). From a gross landscape perspective, oak-hickory forests occurred in a contiguous matrix integrated with oak savannas, grassland prairies, and mesic forests dominated by red and sugar maple. Fire frequency and intensity determined the proportion of each of these landscape ecosystems across the landscape matrix.

Closed-canopy oak-hickory forests would develop where fire return intervals stretched beyond 25yrs. Shade-tolerant, fire-sensitive maples (and associated late-successional trees) would regenerate and form understories beneath oak-hickory canopies when fire was excluded over many decades (50yrs). With continued fire exclusion, maple and other late-successional species would gradually replace overstory oaks and hickories through gap capture (Sutherland et al. 2003).

Historically, grazing would have similarly maintained open conditions in savannas and cause problems for oak species in recruiting into the overstory.

Ice-damage, periodic insect defoliation, and the extinct passenger pigeon may have likely contributed to increased oak canopy openings that facilitated light penetration to the forest floor, and, ultimately, greater possibility of germination and recruitment of oaks.

Periodic drought, intensified by local conditions, such as slope, southern exposure, or sandy soil, also inhibit growth of mesophytic trees (NatureServe 2007).

Some feel that catastrophic stand replacement fires occurred every 80yrs with low-intensity underburns every 10yrs (Phil Graeve, pers comm).

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Percent of All Fires** | **Min FI** | **Max FI** |
| Replacement | 113 | 17 |  |  |
| Moderate (Mixed) | 43 | 43 |  |  |
| Low (Surface) | 47 | 40 |  |  |
| All Fires | 19 | 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

Pre-European oak-hickory forests covered hundreds of thousands of contiguous acres. When considered as a matrix with savannas and prairies, estimated acreage increases significantly.

Adjacency or Identification Concerns

Though often contiguous, oak-hickory patches are virtually always integrated in the larger landscape scale with mesic maple-dominated forests and dry oak savannas. Mesic maple forests were relegated to those areas where fire was restricted through facilitation by an edaphic factor such as heavy-textured soil or high water table or by natural fire breaks such as bodies of water and slightly protected depressions. Prolonged intervals (100-150yrs) without fire were needed for maples to manifest their dominance.

Oak-hickory forests also graded into savannas (i.e., oak openings) when fire intervals shortened to the point where woody regeneration of overstory tree species was limited. Exposed areas where wind could carry flames at great distances tend to exhibit more savanna vegetation structure than a close oak-hickory forest. In areas where flat outwash extended beyond ice-contact terrain or end moraine, savannas would typically occur in the former abutting a closed forest on the latter landforms.

This system is distinguished from other forested systems within the region by a dry-mesic edaphic condition that is transitional between dry oak forests and woodlands and mesic hardwood forests, such as maple-basswood forests (NatureServe 2007).

With fire suppression, this system expanded into sites formerly occupied by disturbance maintained savannas (Leach & Givnish 1999).

Currently, under the past century's practice of fire suppression, oak-hickory forests are succeeding into a red maple-dominated forest. Continued fire suppression has also resulted in succession to mesic hardwoods, such that in many locations, no oak species are regenerating. Prolific sprouting ability, light, wind-carried fruits, and the tendency to cast dense shade has enabled red maple to outcompete white and black oak in these systems. Without fire as a natural disturbance that prevents establishment of fire-sensitive species, mesophytic species are free to invade and recruit into the overstory. Implications to forestry, wildlife, and pest and disease outbreaks become apparent.

Current fire suppression likely has allowed for other associates, such as Acer saccharum, Celtis occidentalis, Liriodendron tulipifera, Ostrya virginiana, and Juglans nigra, to become more prevalent, especially in upland areas along floodplains (NatureServe 2007). Due to decades of fire suppression, subcanopies and shrub layersare well-developed by witch-hazel (Hamamelis virginiana), flowering dogwood (Cornus florida), and hop-hornbeam (Ostrya virginiana).

Closed-canopy oak-hickory forests would develop where fire return intervals stretched beyond 25yrs. Shade-tolerant, fire-sensitive maples (and associated late-successional trees) would regenerate and form understories beneath oak-hickory canopies when fire was excluded over many decades (50yrs). With continued fire exclusion, maple and other late-successional species would gradually replace overstory oaks and hickories through gap capture (Sutherland et al. 2003).

Fire suppression may account for the more closed oak forest (classes D and E) examples of this system with the more mesic understory. It likely has allowed for other associates, such as Acer saccharum, Celtis occidentalis, Liriodendron tulipifera, Ostrya virginiana and Juglans nigra, to become more prevalent, especially in upland areas along floodplains.

Extensive conversion for agriculture has fragmented these systems. Remaining large areas of this system are likely under considerable pressure due to conversion to agriculture, pastureland and urban development (NatureServe 2007).

Native grazing, due to higher deer densities than historically (at least in WI) further suppress recruitment of oaks and exacerbates the trend toward closed-canopy mesophytic species. Invasive species, including buckthorn (Rhamnus cathartica) and honeysuckle (Lonicera spp.) are becoming increasingly prevalent in the understories of some stands.

Issues or Problems

This system has largely converted to closed-canopy forests progressively increasing in mesophytic species. As these systems become increasing mesophytic, the ability to get fire back on the landscape becomes increasingly difficult.

Native grazing, due to higher deer densities than historically (at least in WI) further suppress recruitment of oaks and exacerbates the trend toward closed-canopy mesophytic species.

Native Uncharacteristic Conditions

Though present historically, red maple has been typified as the "native invasive" in oak hickory forests. Its abundance in these systems measured in both stem density and basal area has grown considerably due to fire suppression and the marked increase in fire return interval. Abundance of aspen, sassafras and black cherry can also be attributed to fire suppression and poor silvicultural practices.

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 | 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 | B | B | B | UN | UN | UN | UN | UN | E | E |
| Tree | 5-10 | B | B | C | C | C | C | UN | UN | E | E |
| Tree | 10-25 | B | B | C | C | C | C | D | D | E | E |
| Tree | 25-50 | UN | UN | UN | UN | UN | UN | UN | UN | E | E |
| Tree | >50 | UN | UN | UN | UN | UN | UN | UN | UN | E | E |

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 2 Early Development 1 - All Structures

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| ANGE | Andropogon gerardii | Big bluestem | Upper |
| SCHIZ4 | Schizachyrium | Little bluestem | Upper |
| SONU2 | Sorghastrum nutans | Indiangrass | Upper |

Description

PRAIRIE. This class grassland prairie maintained by frequently recurring fire. Native Americans used these lands for hunting and agriculture/native plant gathering. If fire is absent for a few years, tree seedlings and sprouts would recruit into trees and form savannas. Heavy grazing, though unlikely to have large-scale impact, would have kept certain patches from progressing to a woody shrub vegetation stage and would have maintained class.

*Maximum Tree Size Class*  
None

Class B 14 Mid Development 1 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| QUAL | Quercus alba | White oak | Upper |
| QUVE | Quercus velutina | Black oak | Upper |
| ANGE | Andropogon gerardii | Big bluestem | Lower |
| SCHIZ4 | Schizachyrium | Little bluestem | Lower |

Description

SAVANNA. Savanna conditions occurred where fire was fairly frequent allowing some trees to develop (5-15yrs). This can also be a steady state expression of this system if fire frequency is high enough (though overlapping with savanna concept, many of which proved to be seral to this system), with older very sparse oaks. Any area that does not burn frequently would convert to woodland conditions.

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

Class C 35 Mid Development 2 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| QUAL | Quercus alba | White oak | Upper |
| QUVE | Quercus velutina | Black oak | Upper |
| SAAL5 | Sassafras albidum | Sassafras | Upper |
| QUMA2 | Quercus macrocarpa | Bur oak | Upper |

Description

WOODLAND. This class is defined as oak woodland where fire occurred every 15-25yrs. This class starts at approximately age 15yrs. However, this can also be a steady state expression of this system if fire frequency is high enough. The canopy closure was <60%.

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

Class D 43 Mid Development 3 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| QUAL | Quercus alba | White oak | Upper |
| QUVE | Quercus velutina | Black oak | Upper |
| QURU | Quercus rubra | Northern red oak | Upper |
| CAGL8 | Carya glabra | Pignut hickory | Upper |

Description

OAK FOREST. This can be distinguished from class E by species/EVT. The age class is 180-indefinite years as long as fire occurs periodically. If the late-succession open forest type persists for 100yrs without any type of fire, it will convert to a late-succession mixed mesophytic closed forest type. This conversion is a result of species shift from dominant oaks to dominant maple and beech, which do not support fire as readily.

The oaks are going to have a difficult time getting solid regeneration in this class (Curtis 1959) and will need a major canopy opening disturbance to move this to a more open state before they can establish more successfully.

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

Class E 6 Late Development 2 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| ACRU | Acer rubrum | Red maple | Upper |
| ACSA3 | Acer saccharum | Sugar maple | Upper |
| TIAM | Tilia americana | American basswood | Upper |
| QUAL | Quercus alba | White oak | Upper |

Description

MESOPHYTIC FOREST. Maple forests develop during the absence of fire. This class can be distinguished from class D by species/EVT. Dense understories of shade-tolerant species develop. These systems often arise on more moist sites adjacent to or on lee sides of streams, rivers and lakes that serve as fire barriers.

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

Model Parameters

Deterministic Transitions

|  |  |  |  |
| --- | --- | --- | --- |
| **From Class** | **Begins at (yr)** | **Succeeds to** | **After (years)** |
| Early1:ALL | 0 | Mid1:OPN | 4 |
| Mid1:OPN | 5 | Mid1:OPN | 999 |
| Mid2:OPN | 15 | Mid2:OPN | 999 |
| Mid3:CLS | 25 | Mid3:CLS | 999 |
| Late2:CLS | 150 | Late2: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** |
| Native Grazing | Early1:ALL | Early1:ALL | 0.01 | 100 | No | 0 |
| Replacement Fire | Early1:ALL | Early1:ALL | 0.1 | 10 | Yes | 0 |
| Alternative Succession | Mid1:OPN | Mid2:OPN | 1 | 1 | Yes | 10 |
| Native Grazing | Mid1:OPN | Mid1:OPN | 0.01 | 100 | No | 0 |
| Replacement Fire | Mid1:OPN | Early1:ALL | 0.025 | 40 | Yes | 0 |
| Surface Fire | Mid1:OPN | Mid1:OPN | 0.03 | 33 | No | 0 |
| Alternative Succession | Mid2:OPN | Mid3:CLS | 1 | 1 | Yes | 20 |
| Replacement Fire | Mid2:OPN | Early1:ALL | 0.005 | 200 | Yes | 0 |
| Mixed Fire | Mid2:OPN | Mid2:OPN | 0.015 | 67 | No | 0 |
| Mixed Fire | Mid2:OPN | Mid1:OPN | 0.015 | 67 | Yes | 0 |
| Surface Fire | Mid2:OPN | Mid2:OPN | 0.02 | 50 | No | 0 |
| Alternative Succession | Mid3:CLS | Late2:CLS | 1 | 1 | Yes | 100 |
| Replacement Fire | Mid3:CLS | Early1:ALL | 0.002 | 500 | Yes | 0 |
| Mixed Fire | Mid3:CLS | Mid1:OPN | 0.01 | 100 | Yes | 0 |
| Mixed Fire | Mid3:CLS | Mid2:OPN | 0.02 | 50 | Yes | 0 |
| Surface Fire | Mid3:CLS | Mid3:CLS | 0.025 | 40 | No | 0 |
| Mixed Fire | Late2:CLS | Mid3:CLS | 0.001 | 1000 | Yes | 0 |
| Mixed Fire | Late2:CLS | Mid2:OPN | 0.001 | 1000 | Yes | 0 |
| Mixed Fire | Late2:CLS | Mid1:OPN | 0.001 | 1000 | Yes | 0 |
| Replacement Fire | Late2:CLS | Early1:ALL | 0.001 | 1000 | Yes | 0 |
| Wind or Weather or Stress | Late2:CLS | Late2:CLS | 0.01 | 100 | No | 0 |

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