13100

North-Central Interior Dry-Mesic Oak Forest and Woodland

BpS Model/Description Version: Aug. 2020

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Vegetation Type

Forest and Woodland

Map Zone

52

Geographic Range

Within map zone (MZ) 52, this system is concentrated in the Southern Michigan/Northern Indiana Drift Plains Level III Ecoregion, which is more or less congruous with the Northeastern Moraine and Kettle Natural Division of Lindsey et al. (1969). The system also occurs in association with oak savanna and prairie in Ohio, primarily occurring in the Darby Plains and Mad River Interlobate Area Level IV Ecoregions and also on upland sand deposits in the Huron/Erie Lake Plains Ecoregion in northwest Ohio and northeast Indiana (Braun 1950; Lindsey et al. 1969; Woods et al. 1998).

Biophysical Site Description

This system occurs most commonly on level to rolling glacial drift plains and coarse-textured end moraines, kames, and outwash plains in north-central Indiana. Dry-mesic oak forest and woodland also occurs in association with oak savanna and prairie on level to rolling drift plains in the region of Ohio known as the Darby Plains and locally elsewhere within the Eastern Corn Belt Plains. Well-drained sand deposits in the Huron/Erie Lake Plains also support dry-mesic oak forest and woodland. Oak-dominated forests typically occur in areas of relatively steep surface drainage profiles and/or on soils with excessive internal drainage or coarser textures than silt loam (Lindsey et al. 1969). 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 this system. 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.

Vegetation Description

Typically, the vegetation consists of forests dominated by oaks, especially white oak (*Quercus alba*), black oak (*Quercus velutina*), and red oak (*Quercus rubra*). 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 & 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.

Along with oaks are varying amounts of hickory (*Carya glabra* and *Carya ovata*), red maple (*Acer rubrum*), black cherry (*Prunus serotina*), and sassafras (*Sassafras albidum*). Subcanopies and shrub layers are usually well developed by witch-hazel (*Hamamelis virginiana*), flowering dogwood (*Cornus florida*), and hop-hornbeam (*Ostrya virginiana*). Common low woody shrubs include brambles (*Rubus* spp.), black currant (*Ribes cynosbati*), and both native and invasive roses (*Rosa* spp.). Graminoid species such as *Carex pensylvanica*, *Danthonia spicata*, and *Andropogon gerardii* are also common.

For the drier settings of this system, oaks dominated the pre-settlement vegetation, especially white oak (*Quercus alba*), black oak (*Quercus velutina*), northern pin oak (*Quercus ellipsoidalis*), and bur oak (*Quercus macrocarpa*). These dry settings are distinguished from more mesic sites by stronger dominance of black oak and northern pin oak and a general lack of red oak except in later seral stages. Associates include pignut hickory (*Carya glabra*), red maple (*Acer rubrum*), black cherry (*Prunus serotina*), and sassafras (*Sassafras albidum*). Small tree associates include witch-hazel (*Hamamelis virginiana*), flowering dogwood (*Cornus florida*), and hop-hornbeam (*Ostrya virginiana*). Common low woody shrubs include brambles (*Rubus* spp.), black currant (*Ribes cynosbati*), and native roses (*Rosa* spp.). Graminoid species such as *Carex pensylvanica*, *Danthonia spicata*, and *Andropogon gerardii* are also common. In the most acidic lake plain physiographic systems, ericaceous shrubs such as wintergreen (*Gualtheria procumbens*), lowbush blueberry (*Vaccinium angustifolium*), and huckleberry (*Gaylussacia baccata*) become common. Bracken fern (*Pteridium aquilinum*) can be dominant in the most nutrient-poor outwash and lake plain landscapes.

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 |
| QUCO2 | *Quercus coccinea* | Scarlet oak |
| SAAL5 | *Sassafras albidum* | Sassafras |
| QURU | *Quercus rubra* | Northern red oak |
| ACRU | *Acer rubrum* | Red maple |
| POTR5 | *Populus tremuloides* | Quaking aspen |

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 >95% of the ignitions over these landscapes. Vegetation types varied based on fire frequency and intensity. Grassland prairies burned often with fire rotations approximately <5yrs and were probably associated with flat to slightly rolling terrain that effectively carried fire. These grasslands, deliberately maintained by Native Americans for hunting purposes, were probably scattered throughout the forest matrix. Oak-hickory grubs (tree-sprout and shrub thickets) occurred where fire frequency was a bit less, probably 5-10yrs. Also, grub conditions would arise immediately after catastrophic burns that would top-kill tree-dominated communities. Savannas and woodlands developed within a moderate burning regime, with fire return times averaging every 4-17yrs (Henderson and Long 1984). Closed-canopy oak-hickory forests would develop where fire return intervals (FRIs) stretched beyond 15yrs. Shade-tolerant, fire-sensitive maples (and associated late-successional trees) would regenerate and form understories beneath oak-hickory canopies when fire was excluded over several decades (25-40yrs). With continued fire exclusion, maple and other late-successional species would gradually replace overstory oaks and hickories through gap capture (Sutherland and Hutchinson 2003). 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. Historically, buffalo grazing would have similarly maintained open conditions in very localized patches within savannas. Currently, an overabundance of deer is limiting oak regeneration in portions of MZ52. 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.

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Percent of All Fires** | **Min FI** | **Max FI** |
| Replacement | 73 | 17 |  |  |
| Moderate (Mixed) | 46 | 27 |  |  |
| Low (Surface) | 22 | 56 | 2 | 25 |
| All Fires | 12 | 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 100s of 1,000s 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 closed 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. Currently, under the past century's practice of fire suppression, oak-hickory forests are succeeding into a red-maple-dominated forest. 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.

This system can be similar to North-Central Interior Maple Basswood Forest (BpS 1314). However, the Maple Basswood system typically occurs on gravelly, partially sorted, and weakly calcareous till. The maple basswood systems are less likely to have quaking aspen in the canopy (Aaseng et al. 2003).

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 Wisconsin). further suppresses 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.

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 FRI. Abundance of aspen, sassafras, and black cherry can also be attributed to fire suppression and poor silviculture 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 | UN | UN | UN | UN | UN | UN | UN | UN |
| Tree | 5-10 | B | B | C | C | C | C | UN | UN | UN | UN |
| Tree | 10-25 | B | B | C | C | C | C | D | D | E | E |
| Tree | 25-50 | B | B | C | C | C | C | D | D | E | E |
| Tree | >50 | B | B | C | C | C | C | D | D | 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 6 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 |
| POTR5 | Populus tremuloides | Quaking aspen | None |

Description

Prairie. Class A is 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.

*Maximum Tree Size Class*  
None

Class B 12 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 |
| POTR5 | Populus tremuloides | Quaking aspen | Lower |
| SCHIZ4 | Schizachyrium | Little bluestem | Lower |

Description

Savanna. Historically, this class would not succeed on to the next class with the maintenance disturbances of surface fires and native grazing.

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

Class C 13 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 |
| POTR5 | Populus tremuloides | Quaking aspen | Upper |
| QUMA2 | Quercus macrocarpa | Bur oak | Upper |

Description

Woodland. The canopy closure was <60%.

Historically, this class would not succeed on to the next class with the maintenance disturbances of surface fires and native grazing.

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

Class D 64 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 |
| POTR5 | Populus tremuloides | Quaking aspen | Upper |

Description

Oak Forest. Class D is defined as oak forest. The age class lasts indefinitely as long as surface fire occurs periodically. If the late-succession open forest type persists for 50yrs 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.

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

Class E 5 Late Development 1 - 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. Dense understories of shade-tolerant species develop. Surface fires would allow these systems to revert back to oak dominance.

*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 | 14 |
| Mid2:OPN | 15 | Mid2:OPN | 24 |
| Mid3:CLS | 25 | Mid3:CLS | 149 |
| Late1:CLS | 150 | 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** |
| 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 | 8 |
| Native Grazing | Mid1:OPN | Mid1:OPN | 0.01 | 100 | No | 0 |
| Replacement Fire | Mid1:OPN | Early1:ALL | 0.01 | 100 | Yes | 0 |
| Surface Fire | Mid1:OPN | Mid1:OPN | 0.05 | 20 | No | 0 |
| Alternative Succession | Mid2:OPN | Mid3:CLS | 1 | 1 | Yes | 8 |
| Replacement Fire | Mid2:OPN | Early1:ALL | 0.01 | 100 | Yes | 0 |
| Mixed Fire | Mid2:OPN | Mid1:OPN | 0.015 | 67 | Yes | 0 |
| Surface Fire | Mid2:OPN | Mid2:OPN | 0.05 | 20 | No | 0 |
| Alternative Succession | Mid3:CLS | Late1:CLS | 1 | 1 | Yes | 65 |
| Mixed Fire | Mid3:CLS | Mid1:OPN | 0.01 | 100 | Yes | 0 |
| Replacement Fire | Mid3:CLS | Early1:ALL | 0.01 | 100 | Yes | 0 |
| Mixed Fire | Mid3:CLS | Mid2:OPN | 0.02 | 50 | Yes | 0 |
| Surface Fire | Mid3:CLS | Mid3:CLS | 0.05 | 20 | No | 0 |
| Mixed Fire | Late1:CLS | Mid3:CLS | 0.001 | 1000 | Yes | 0 |
| Mixed Fire | Late1:CLS | Mid2:OPN | 0.001 | 1000 | Yes | 0 |
| Mixed Fire | Late1:CLS | Mid1:OPN | 0.001 | 1000 | Yes | 0 |
| Mixed Fire | Late1:CLS | Early1:ALL | 0.002 | 500 | Yes | 0 |
| Wind or Weather or Stress | Late1:CLS | Late1:CLS | 0.01 | 100 | No | 0 |

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