13110

North-Central Interior Dry Oak Forest and Woodland

BpS Model/Description Version: Aug. 2020

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| **Modelers** |  | **Reviewers** |  |
| Jeff Lee | leejg@michigan.gov | Randy Swaty | rswaty@tnc.org |
| Michael Kost | kostma@michigan.gov | Jim Drake | jim\_drake@natureserve.org |
| Brad Slaughter | slaughterb@michigan.gov | None | None |

**Reviewed by:** John Shuey

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 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 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. Dry oak forest and woodland occurs in generally the same settings as dry-mesic oak forest and woodland but is associated with greater fire frequency due to local landscape characteristics or anthropogenic activity. 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 northern pin oak (*Quercus ellipsoidalis*). Along with oaks are pignut hickory (*Carya glabra*), red maple (*Acer rubrum*), black cherry (*Prunus serotina*), and sassafras (*Sassafras albidum*). Red oak (*Quercus rubra*) and white ash (*Fraxinus americana*), characteristic of dry-mesic to mesic forests, have increased due to fire suppression (NatureServe 2007). Currently, decades of fire suppression have created subcanopies and shrub layers that are dominated 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. In the most acidic lake plain physiographic systems, ericaceous shrubs such as wintergreen (*Gaultheria 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 |
| QUEL | *Quercus ellipsoidalis* | Northern pin oak |
| QUCO2 | *Quercus coccinea* | Scarlet oak |
| CAGL8 | *Carya glabra* | Pignut hickory |
| GABA | *Gaylussacia baccata* | Black huckleberry |
| SAAL5 | *Sassafras albidum* | Sassafras |
| PRSE2 | *Prunus serotina* | Black cherry |

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

Disturbance Description

The North-Central Interior Dry Oak Forest and Woodland is predominantly Fire Regime I, characterized by low-severity surface fires, but replacement fires of Fire Regime IV would have also occurred at 35-200yr frequency. 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 as frequent as annually 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 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 forests would develop where fire return intervals (FRIs) stretched beyond 20-40yrs (Crow 1988). Shade-tolerant, fire-sensitive maples (and associated late-successional trees) would regenerate and form understories beneath oak canopies when fire was excluded over several decades. With continued fire exclusion, maple and other late-successional species would gradually replace overstory oaks through gap capture (Sutherland and Hutchinson 2003). These shade-tolerant species would eventually form layered strata of differing heights that would modify the microclimate and light environment to favor self-replacement with exclusion of oaks. A mosaic of vegetation types comprised oak landscapes contingent on fire history (Cutter and Guyette 1994). From a gross landscape perspective, oak forests occurred in a contiguous matrix integrated with oak savannas, grasslands, 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, bison grazing would have similarly maintained open conditions in very localized patches within savannas. Currently, an overabundance of deer is limiting oak regeneration in remnant oak forests 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 | 149 | 6 |  |  |
| Moderate (Mixed) | 152 | 6 |  |  |
| Low (Surface) | 11 | 88 |  |  |
| All Fires | 9 | 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 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 patches are virtually always integrated in the larger landscape scale with mesic maple-dominated forests, dry-mesic oak-hickory forests, and dry oak barrens. 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) were needed for maples to manifest their dominance. Dry-mesic oak-hickory forests often occurred adjacent to dry oak forests, defined by a topographic position that had more amenable well-drained soil, lower solar radiation, better moisture conditions, and more protection from drying winds and recurring fires. Lower slopes on north and east aspects were typical of oak-hickory forests whereas ridge tops and upper slopes on south and west aspects favored dry oak forests. Oak forests also graded into savannas and barrens (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 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. Fires often burned from a west to east direction and stopped on the western edge of rivers (Gleason 1913), leaving eastern edges forested.

Currently, under the past century's practice of fire suppression, oak 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. Furthermore, due to the naturally short life span of northern pin oak, red maple is poised to maintain its dominance once it has established a stable population. Its modifying effects on understory shade and quick nutrient uptake will exclude the understory intolerant northern pin oak. Implications for forestry, wildlife, and pest and disease outbreaks become apparent in the future.

Today, with fragmentation, development, and mesophytic species invasion, few original dry oak forests remain.

Issues or Problems

Native Uncharacteristic Conditions

Though present historically, red maple has been typified as the "native invasive" in oak 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 silvicultural practices. Many occurrences of dry oak forest and woodland likely represent fire-suppressed oak barrens and savanna.

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 | B | B | B | UN | UN | UN | UN |
| Tree | 5-10 | C | C | C | C | C | C | D | D | E | E |
| Tree | 10-25 | C | C | C | C | C | C | D | D | E | E |
| Tree | 25-50 | C | C | C | C | C | C | D | D | E | E |
| Tree | >50 | C | C | 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 3 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

Class A is grassland maintained by frequently recurring fire (5yrs). Native Americans used these lands for hunting and agriculture/native plant gathering. If fire is absent for a few years, tree seedlings and sprouts will establish and move the community to the mid-seral, open stage. 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 A.

*Maximum Tree Size Class*  
None

Class B 8 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 |
| QUEL | Quercus ellipsoidalis | Northern pin oak | Mid-Upper |
| CAGL8 | Carya glabra | Pignut hickory | Upper |

Description

This is an early tree regeneration (root and stump sprouts) phase.

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

Class C 38 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 |
| QUEL | Quercus ellipsoidalis | Northern pin oak | Upper |
| CAGL8 | Carya glabra | Pignut hickory | Upper |

Description

This class is defined as oak savanna and woodland. The canopy closure is <60%.

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

Class D 48 Late Development 1 - Open

Indicator Species

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

Description

Class D is defined as an oak forest. Open understories of oak seedlings exist. If the late-succession open forest type persists for many decades 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, basswood, and beech, which do not support fire as readily.

Class E 3 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

Maple forests develop during the absence of fire. Dense understories of shade-tolerant species develop.

*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 | 5 |
| Mid1:OPN | 6 | Mid2:OPN | 50 |
| Mid2:OPN | 51 | Mid2:OPN | 999 |
| Late1:OPN | 51 | Late1:OPN | 999 |
| Late2:CLS | 131 | 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 | 0.2 | 5 | Yes | 0 |
| Alternative Succession | Mid1:OPN | Late1:OPN | 1 | 1 | Yes | 30 |
| Replacement Fire | Mid1:OPN | Early1:ALL | 0.002 | 500 | Yes | 0 |
| Mixed Fire | Mid1:OPN | Early1:ALL | 0.005 | 200 | Yes | 0 |
| Native Grazing | Mid1:OPN | Mid1:OPN | 0.01 | 100 | No | 0 |
| Wind or Weather or Stress | Mid1:OPN | Early1:ALL | 0.01 | 100 | Yes | 0 |
| Surface Fire | Mid1:OPN | Mid1:OPN | 0.1 | 10 | No | 0 |
| Alternative Succession | Mid2:OPN | Late1:OPN | 1 | 1 | Yes | 25 |
| Replacement Fire | Mid2:OPN | Early1:ALL | 0.002 | 500 | Yes | 0 |
| Native Grazing | Mid2:OPN | Mid2:OPN | 0.01 | 100 | No | 0 |
| Mixed Fire | Mid2:OPN | Mid2:OPN | 0.01 | 100 | No | 0 |
| Surface Fire | Mid2:OPN | Mid2:OPN | 0.1 | 10 | No | 0 |
| Alternative Succession | Late1:OPN | Late2:CLS | 1 | 1 | Yes | 80 |
| Replacement Fire | Late1:OPN | Early1:ALL | 0.001 | 1000 | Yes | 0 |
| Mixed Fire | Late1:OPN | Mid2:OPN | 0.005 | 200 | Yes | 0 |
| Surface Fire | Late1:OPN | Late1:OPN | 0.1 | 10 | No | 0 |
| Replacement Fire | Late2:CLS | Early1:ALL | 0.001 | 1000 | Yes | 0 |
| Mixed Fire | Late2:CLS | Late1:OPN | 0.002 | 500 | Yes | 0 |
| Wind or Weather or Stress | Late2:CLS | Late2:CLS | 0.007 | 143 | No | 0 |
| Surface Fire | Late2:CLS | Late2:CLS | 0.01 | 100 | No | 0 |

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