13110

North-Central Interior Dry Oak Forest and Woodland

BpS Model/Description Version: Aug. 2020

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Vegetation Type

Forest and Woodland

Map Zones

51

Geographic Range

This system occurs throughout southern lower Michigan primarily in Macomb, Oakland, Livingston, Washtenaw, Jackson, Hillsdale, Shiawassee, St. Joseph, Kalamazoo, Barry, Kent, Montcalm and southern Newago Counties (Comer 1995). This encompasses Sections 222J and 222U (Cleland et al. 2007). This system occurs in 222Jg, 222Jh, 222Jc, 222Jb, 222Ja, 222Ua and 222Ue.

Biophysical Site Description

This system occurs most commonly in the interlobate region of southern Michigan where outwash, ice-contact and end moraine landforms are situated between former glacial lobes. Other landforms suitable for development of the dry oak forest are sandy lake plain and dunes. Common to all these landforms is somewhat excessively drained, acidic soil characterized by sand and loamy sand. 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-mesic oak-hickory forests and dry mixed oak forests can occur in very similar landscape settings. Slight differences in soil moisture holding capacity and pH can often be the defining factor. Dry mixed oak forests tend to occupy exposed kame tops and esker ridges in ice-contact terrain or on very excessively drained, highly acidic soil on flat outwash plains or sand lake plain. High exposure to desiccating wind and high solar radiation also favors development of dry mixed oak forests over dry-mesic oak-hickory forests. Soil texture of the former is usually no heavier than a loamy sand, whereas soil of the latter can be as heavy as a sandy clay loam in the lower pedon.

Furthermore, greater fire frequency historically may have selected for more fire-tolerant oaks than hickories. Native Americans played a critical role in the development and maintenance of mixed oak 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*). American chestnut (*Castanea dentata*) was once dominant or codominant in the very southeastern portion of southern Michigan. Currently, decades of fire suppression have created subcanopies and shrub layers that are 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 (*Gualtheria procumbens*), lowbush blueberry (*Vaccinium angustifolium*), 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 |
| CADE12 | *Castanea dentata* | American chestnut |
| 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 fire regime is predominantly characterized by low-severity surface fires, but replacement fires would have also occurred at 35-200yrs frequency. 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 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 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 stratums of differing heights that will 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, 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 remnant oak forests in southern Michigan. 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 | 136 | 7 |  |  |
| Moderate (Mixed) | 111 | 8 |  |  |
| Low (Surface) | 11 | 85 |  |  |
| 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 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 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 close 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 to 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. However, succession of previous oak barrens, such as in Allegan County, to closed oak forests has added to the total area of current dry oak forests.

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

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 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 the early-seral stage.

*Maximum Tree Size Class*  
None

Class B 9 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 51 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.

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

Class D 34 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.

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

Class E 4 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. Class E is characterized by closed canopy forest that can persist in the absence of disturbance. Surface fires will have little effect.

*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 | 0.01 | 100 | 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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