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 Zone

44

Geographic Range

Province 222. For MI 222J.

Biophysical Site Description

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 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.

Vegetation Description

Oaks dominated the presettlement vegetation, especially white oak (Que*rcus alba),* black oak (*Quercus velutina*), northern pin oak (*Quercus ellipsoidalis*) and bur oak (*Quercus macrocarpa*). This system is distinguished from North-Central Interior Dry-Mesic Oak Forest and Woodland (1310) 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*). American chestnut (*Castanea dentata*), now largely eliminated due to chestnut blight, was an infrequent associate in the very far southeastern portion of Michigan. Small trees 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*), 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 |
| PRSE2 | *Prunus serotina* | Black cherry |
| SAAL5 | *Sassafras albidum* | Sassafras |
| QUMA2 | *Quercus macrocarpa* | Bur oak |

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-to-moderate severity surface fires. Historically, indigenous fires accounted for more than 95% of the ignitions over these landscapes. Vegetation types varied based on fire frequency and severity. Grassland prairies burned frequently (annually or biennially) and were strongly associated with flat-to-slightly rolling terrain that effectively carried fire (Anderson 1999). 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 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, grazing would have similarly maintained open conditions in savannas and cause problems for oak species in recruiting into the overstory. Ungulate grazing was probably an important contributing factor maintaining oak-dominated open lands (savannas, woodlands) in presettlement times. Currently, an overabundance of deer is limiting oak regeneration in remnant oak forests in southern Michigan. Ice damage, periodic insect defoliation, and the now-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. 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.

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Percent of All Fires** | **Min FI** | **Max FI** |
| Replacement | 105 | 13 |  |  |
| Moderate (Mixed) | 98 | 14 |  |  |
| Low (Surface) | 19 | 73 |  |  |
| All Fires | 14 | 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

This type intergrades and can be easily confused with North-Central Interior Dry-Mesic Oak Forest and Woodland (1310). Fire suppression within the last century has allowed this system to be converted to that system on the loamier soils within the historic range of this type. This type can be distinguished from the Dry-Mesic Oak Forest and Woodland by somewhat sandier soils ore more exposed topographic settings with higher incoming solar radiation (south and west facing slopes).

This type can intergrade with North-Central Oak Barrens (1395), especially in 222R and northwestern 222K, but can be distinguished by occupying sites that are less excessively drained and more silty than those of the barrens. Soils are generally more well-drained than for the Dry-Mesic Oak Forest and Woodland, but are not excessively sandy as for the Oak Barrens.

This type is also found on steep, dry south and west facing slopes and the tops of bluffs in Section 222L where it intergrades with Paleozoic Plateau Bluff and Talus (1517).

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 FRIs 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 west to east 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 out compete 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 forest 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 grazing, due to higher deer densities than historically (at least in Wisconsin) further suppress recruitment of oaks and exacerbates the trend toward closed-canopy mesophytic species. Invasive species, including garlic mustard (*Alliaria petiolata*), buckthorn (*Rhamnus cathartica*) and honeysuckle *(Lonicera* spp.) are becoming increasingly prevalent in the understories of some stands.

This model was imported from map zone 50 by Brendan Ward on 10/10/07.

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

NOTE 03/31/08: As a result of final QC for LANDFIRE National by Jennifer Long the user-defined min and max fire return intervals for REPLACEMENT, MIXED and SURFACE severity fire were deleted because they were not consistent with the modeled fire return interval for this fire severity type.

This model was larglely adopted from Kost and Lee (5113110 who adopted their model from R6OAHI by Daniel Yaussy and Aaron Kloss.

Comments from R6OAHI: This model replaces the model R8OAKdm from the Southern Appalachians model zone. This is a modification of the OKH4 FRCC model developed by Nowacki, Hutchinson, Iverson and Van-Gundy. We added a pathway from Class B to Class E to represent a portion of the landscape that is too moist to burn. Possible reviewers: Greg Nowacki, Marc Abrams, Burton Barnes (bvb@umich.edu), Dennis Albert and Joshua Cohen.

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 | UN | UN |
| Tree | 5-10 | B | B | B | C | C | C | E | E | E | E |
| Tree | 10-25 | B | B | B | C | C | C | E | E | D | D |
| Tree | 25-50 | UN | UN | UN | C | C | C | E | E | D | D |
| Tree | >50 | UN | UN | UN | C | C | C | E | E | 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 4 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. Class A is grassland prairie maintained by frequent fire (mean fire return interval [MFRI] 5yrs). Native Americans burned these areas frequently to maintain habitat for ungulates (hunting) and native plant gathering. If fire is absent for a few years (four years plus), tree seedlings or sprouts from "grubs" (sprouts from ancient root systems) would be released, moving the community to savanna conditions. 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 helped maintained these grasslands.

*Maximum Tree Size Class*  
None

Class B 25 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. This is an open system with a scattering of trees (10-25% tree cover). Savannas were maintained by surface burns occurring every 10yrs. Areas that did not burn at this frequency would convert to woodlands. Grazing helped maintain the openness of this system.

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

Class C 36 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

WOODLAND. This class is defined as oak woodland. The canopy closure is less than 60% but greater than 25%. Woodlands were maintained by surface fire frequency occurring every 25yrs. If fire is absent from this community for an extended period (e.g., 50yrs), stand density continues to increase, moving the community to a closed-canopy (60-100%), oak forest (Class D).

An occasional replacement fire (500yr MFRI) will move this community back to an open grassland stage. There are mixed fires that can send cells from C to either C or B depending on conditions every 100yrs.

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

Class D 30 Late Development 1 - Closed

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

OAK FOREST. Class D is defined as a closed-canopy oak forest. Infrequent fire (every 50yrs) maintained open understories with some oak regeneration. During extended period of no fire, these forests would convert to mesophytic species, especially along rivers and streams that served as fire barriers. This conversion is a result of species shift from dominant oaks to dominant maple, basswood and beech, which do not support fire as readily.

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

Class E 5 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. Closed-canopy, mixed mesophytic forests would develop under the absence of fire for extended periods (150yrs). Dense, multi-canopied understories of shade-tolerant species would develop. Class E is characterized by closed canopy forest that can persist in the absence of disturbance. Surface fires had little effect due to the prevailing mesophytic conditions (cool and damp understory conditions; moist retaining and rapidly decaying leaf litter). Replacement fires are very rare and would revert the system to early succession open class A.

*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:CLS | 51 | Late1:CLS | 999 |
| Late2:CLS | 300 | 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:CLS | 1 | 1 | Yes | 30 |
| Replacement Fire | Mid1:OPN | Early1:ALL | 0.002 | 500 | Yes | 0 |
| Wind or Weather or Stress | Mid1:OPN | Early1:ALL | 0.004 | 250 | Yes | 0 |
| Mixed Fire | Mid1:OPN | Early1:ALL | 0.005 | 200 | Yes | 0 |
| Native Grazing | Mid1:OPN | Mid1:OPN | 0.01 | 100 | No | 0 |
| Surface Fire | Mid1:OPN | Mid1:OPN | 0.1 | 10 | No | 0 |
| Alternative Succession | Mid2:OPN | Late1:CLS | 1 | 1 | Yes | 50 |
| 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 |
| Mixed Fire | Mid2:OPN | Mid1:OPN | 0.01 | 100 | Yes | 0 |
| Surface Fire | Mid2:OPN | Mid2:OPN | 0.04 | 25 | No | 0 |
| Alternative Succession | Late1:CLS | Late2:CLS | 1 | 1 | Yes | 75 |
| Replacement Fire | Late1:CLS | Early1:ALL | 0.001 | 1000 | Yes | 0 |
| Mixed Fire | Late1:CLS | Mid2:OPN | 0.005 | 200 | Yes | 0 |
| Surface Fire | Late1:CLS | Late1:CLS | 0.04 | 25 | No | 0 |
| Replacement Fire | Late2:CLS | Early1:ALL | 0.001 | 1000 | Yes | 0 |
| Mixed Fire | Late2:CLS | Late1:CLS | 0.005 | 200 | Yes | 0 |
| Wind or Weather or Stress | Late2:CLS | Late2:CLS | 0.007 | 143 | No | 0 |
| Surface Fire | Late2:CLS | Late1:CLS | 0.01 | 100 | Yes | 0 |

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