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

50

Geographic Range

This system spans from the eastern edge of the Great Plains, south to the Ozarks and eastward to western Ohio and Kentucky. The northern boundary of this vegetation occurs in LANDFIRE map zone (MZ)50.

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 (*Quercus alba*), black oak (*Quercus velutina*), and bur oak (*Quercus macrocarpa*) (Bolliger et al. 2004). 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. In Wisconsin, associates include black cherry (*Prunus serotina*), shagbark hickory (*Carya ovata*), and black walnut (*Juglans nigra*). Small trees associates include hop-hornbeam (*Ostrya virginiana*) and boxelder (*Acer negundo*). Common low woody shrubs include hazelnut (*Corylus americana*), 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 (in zone 50)

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| QUAL | *Quercus alba* | White oak |
| QUVE | *Quercus velutina* | Black oak |
| QUEL | *Quercus ellipsoidalis* | Northern pin oak |
| PRSE2 | *Prunus serotina* | Black cherry |
| 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. In Wisconsin, oak woodlands and forest occurred in a mosaic of small patches within a landscape dominated by oak savanna (Bolliger et al. 2004). Across the landscape, 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). Oak grubs (tree-sprout and shrub thickets) occurred where frequent prairie fires killed the tops of young trees that continue to sprout from deeply established root systems (Curtis 1959, Anderson and Bowles 1999). Savannas and woodlands developed within a moderate burning regime, with fire return times suggested to be between 5-15yrs. Closed-canopy oak forests would develop where fire return intervals stretched beyond 20-40yrs (Crow, 1988). If fire is excluded for several decades, more shade-tolerant and fire-sensitive species would gradually replace overstory oaks and oak regeneration is limited (Nowacki and Abrams 2008). Successional forest changes take more time in dry oak forests when site conditions are more xeric (Johnson et al. 2009).

Historically, grazing would have similarly maintained open conditions in savannas and was probably an important contributing factor maintaining oak-dominated open lands (savannas and woodlands) in presettlement times (Anderson 2006). High deer populations can also limit oak regeneration (Rooney and Waller 2003). Ice-damage, periodic insect defoliation and the passenger pigeon (now extinct) 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 (McEwan et al. 2011).

Archeological and ecological evidence suggests that Native Americans played a critical role in the development and maintenance of oak-hickory landscapes through fire ignition (Abrams and Nowacki 2008). However, the spatial extent of indigenous fire impact is unknown (Munoz et al. 2014). Lightning strikes would have provided an additional source of ignition. Regardless of the source, fire was historically an important control on ecological systems in this region, including dry oak forest and woodland.

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Percent of All Fires** | **Min FI** | **Max FI** |
| Replacement | 102 | 13 |  |  |
| Moderate (Mixed) | 96 | 14 |  |  |
| Low (Surface) | 19 | 73 | 2 | 25 |
| 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

In Wisconsin, pre-European American settlement oak woodlands and forests occurred infrequently in small patches, within a larger matrix of oak savanna (Bolliger et al. 2004). Fire, the dominant disturbance, occurred frequently across large-scale landscapes.

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 or 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 siltier 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).

In Wisconsin, especially near the Tension Zone or on bluffs in the Driftless Area, this cover type can also include some components of pine (especially white pine).

Oak forest patches are virtually always integrated in the larger landscape scale with mesic maple-dominated forests, dry-mesic oak-hickory forests, dry oak barrens, and oak savanna. 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. NOTE: red maple problem is more prevalent in eastern United States, especially not on dry oak forests in Wisconsin.

Issues or Problems

Due to the absence of fire, dry oak forests in Wisconsin are succeeding to brush and eastern red cedar on dry sites and to boxelder, elms, black cherry, and red maple on more mesic sites (Epstein et al. 2002).

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 (Schulte et al. 2011).

Today, with fragmentation, development, and mesophytic species invasion, few original dry oak forest remain. However, succession of previous oak barrens to closed oak forests can add to the total area of current dry oak forests.

Native Uncharacteristic Conditions

Red maple may or may not be a problem in southern Wisconsin oak forests, particularly not dry oak forests. See the silviculture handbook: http://dnr.wi.gov/topic/ForestManagement/documents/24315/51.pdf

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 | 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 = 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 (4yrs+), 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 26 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. Might also include scrub oak (Curtis 1959).

(Curtis 1959 defined savanna as <50% canopy cover)

*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 |
| QUMA2 | Quercus macrocarpa | Bur oak | Upper |

Description

WOODLAND. This class is defined as oak woodland.

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

Class D 29 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 |
| QUMA2 | Quercus macrocarpa | Bur oak | Upper |
| PRSE2 | Prunus serotina | Black cherry | Upper |

Description

OAK FOREST. Class D is defined as a closed-canopy oak forest.

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

Class E 5 Late Development 2 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| QUAL | Quercus alba | White oak | Upper |
| QUVE | Quercus velutina | Black oak | Upper |
| PRSE2 | Prunus serotina | Black cherry | Upper |
|  | Carya ovata | Shagbark hickory | Upper |

Description

Mature dry oak forest. Closed-canopy, more shade tolerant and fire-intolerant species develop in the absence of fire for extended periods (150yrs). Class E is characterized by closed canopy forest of species that can tolerate dry soil conditions and can persist in the absence of disturbance.

Mesophytic forests would be very unlikely to develop on dry sites at the time of settlement.

See: http://dnr.wi.gov/topic/EndangeredResources/Communities.asp?mode=detail&Code=CTFOR012WI)

*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 |

References

Abrams, M. D., and G. J. Nowacki. 2008. Native Americans as active and passive promoters of mast and fruit trees in the eastern USA. The Holocene 18:1123–1137.

Anderson, R. C. 2006. Evolution and origin of the Central Grassland of North America: climate, fire, and mammalian grazers. The Journal of the Torrey Botanical Society 133:626–647.

Anderson, R.C. and M.L. Bowles. 1999. Deep soil savannas and barrens of the midwestern United States, pp. 155-170. In R. C. Anderson, J. S. Fralish, and J. M. Baskin [eds.], Savannas, barrens, and rock outcrop plant communities of North America. Cambridge University Press, Cambridge, UK.

Bolliger, J., L. A. Schulte, S. N. Burrows, T. A. Sickley, and D. J. Mladenoff. 2004. Assessing Ecological Restoration Potentials of Wisconsin (U.S.A.) Using Historical Landscape Reconstructions. Restoration Ecology 12:124–142.

Braun, E.L. 1950. Deciduous forests of eastern North America. Hafner Publishing Company, New York, NY.

Comer, P.J., D.A. Albert, H.A. Wells, B.L. Hart, J.B. Raab, D.L. Price, D.M. Kashian, R.A. Corner, and D.W. Schuen. 1995. Michigan’s presettlement vegetation, as interpreted from the General Land Office Surveys 1816-1856. Michigan Natural Features Inventory, Lansing, MI. Digital Map.

Crow, T.R. 1988. Reproductive mode and mechanisms for self-replacement of northern red oak (Quercus rubra)—A review. Forest Science: 34:19-40.

Curtis, J.T. 1959. The Vegetation of Wisconsin. University of Wisconsin Press, Madison, WI.

Cutter, B.E. and R.P. Guyette, 1994. Fire history of an oak-hickory ridge top in the Missouri Ozarks. American Midland Naturalist 132: 393-398.

Gleason, H.A. 1913. The relation of forest distribution and prairie fires in the Middle West. Torreya 13: 173-181.

Greller, A.M. 1988. Deciduous forest. Pages 288-316 in: M.G. Barbour and W.D. Billings, editors. North American terrestrial vegetation. Cambridge University Press, New York.

Henderson, N.R. and J.N. Long. 1984. A comparison of stand structure and fire history in two black oak woodlands in northwestern Indiana. Botanical Gazette 145: 222-228.

Johnson, P. S., S. R. Shifley, and R. Rogers. 2009. The Ecology and Silviculture of Oaks. 2 edition. CABI, Wallingford, Oxon ; New York.

McEwan, R. W., J. M. Dyer, and N. Pederson. 2011. Multiple interacting ecosystem drivers: toward an encompassing hypothesis of oak forest dynamics across eastern North America. Ecography 34:244–256.

Munoz, S. E., D. J. Mladenoff, S. Schroeder, and J. W. Williams. 2014. Defining the spatial patterns of historical land use associated with the indigenous societies of eastern North America. Journal of Biogeography 41:2195–2210.

Nowacki, G. J., and M. D. Abrams. 2008. The Demise of Fire and “Mesophication” of Forests in the Eastern United States. BioScience 58:123–138.

Rooney, T. P., and D. M. Waller. 2003. Direct and indirect effects of white-tailed deer in forest ecosystems. Forest Ecology and Management 181:165–176.

Schuler, T.M. and McClain, W.R. 2003. Fire history of a ridge and valley oak forest. Newtown Square, PA, USDA Forest Service, Northeastern Forest Service.

Schulte, L. A., E. C. Mottl, and B. J. Palik. 2011. The association of two invasive shrubs, common buckthorn (Rhamnus cathartica) and Tartarian honeysuckle (Lonicera tatarica), with oak communities in the midwestern United States. Canadian Journal of Forest Research 41:1981–1992.