13950

North-Central Oak Barrens

BpS Model/Description Version: Aug. 2020

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Vegetation Type

Steppe/Savanna

Map Zones

41, 42, 43, 49, 52

Geographic Range

North-Central Oak Barrens occur in a complex, shifting mosaic with open prairie, oak savanna, and dry oak woodlands in the upper Midwest. This type occurs in southern lower Michigan, northwestern Ohio, northern Indiana, northeastern Illinois, southern Wisconsin and southeastern to northwestern Minnesota. The system is found in ECOMAP (Cleland et al. 2007) subsections: 222J: b, h, g and sand deposits in the Huron/Erie Lake Plains Ecoregion, corresponding to the Oak Openings region west of Toledo in northwest Ohio, and on well-drained slopes and coarse-textured substrates in the Southern Michigan/Northern Indiana Drift Plains Ecoregion in northern Indiana (Woods et al. 1998).

Biophysical Site Description

North-Central Oak Barrens occur on well-drained, nearly level to slightly undulating sandy glacial outwash, and less often on sandy moraines or ice contact features. Oak barrens typically occur in the driest landscape positions, such as ridge tops, steep slopes, south and west facing slopes, and flat sand plains. This xeric, fire-prone community is characterized by soils that are infertile, coarse-textured, well-drained sand or loamy sand with moderately to slightly acid pH and low water retaining capacity. Soils contain low organic matter and lack the fine-textured alluvial horizon associated with soils of the oak openings (oak savannas) and are thus droughty. Oak barrens typically occur in bands surrounding prairie (Chapman et al. 1995, Michigan Natural Features Inventory 2003). In general, oak barrens are most prevalent on the western side of major firebreaks such as rivers (Leitner et al. 1991, Grimm 1984, Curtis 1959). In the 1800s, the oak savanna communities (e.g., oak barrens, oak openings, oak savannas) covered some 11-13m ha (27-32m ac) of the Midwest (Nuzzo 1986).

Vegetation Description

The oak barrens community is a heterogeneous savanna vegetation type with variable physiognomy in time and space. Structurally, oak barrens range from dense thickets of brush and understory scrub oak within a matrix of grassland to park-like open woods of widely spaced mature oak with virtually no shrub or sub-canopy layer above the open forb and graminoid understory (Chapman et al. 1995, Bowles and McBride 1998, Michigan Natural Features Inventory 2003). The physiognomic variations, which occur along a continuum, are the function of the complex interplay between fire frequency and intensity (Chapman et al. 1995). Typically, oak barrens grade into prairie on one edge and dry forest on the other. As noted by Bray (1958) and Curtis (1959), the flora of this community is a mixture of prairie and forest species, with prairie forbs and grasses more abundant in high light areas and forest forbs and woody species in the areas of low light.

The canopy layer generally varies from 5-60% cover (Chapman et al. 1995) and is dominated or co-dominated by *Quercus velutina* (black oak) and *Quercus alba* (white oak). These species of oak are also prevalent in the sub-canopy in shrubby clumps, especially where fire intensity is high. In addition, *Acer rubra* (red maple), *Prunus serotina* (black cherry), *Populus grandidentata* (bigtooth aspen), *Populus tremuloides* (trembling aspen) and *Quercus ellipsoidalis* (northern pin oak) are often found in the overstory and sub-canopy of this community. Northern pin oak is especially common on excessively well-drained sites. Prevalent species of the subcanopy layer include *Cornus* spp. (dogwood species), *Corylus americana* (American hazelnut) and *Prunus* spp. (cherry species), and in Michigan, Sassafras albidum (sassafras).

Characteristic shrubs include: *Amelanchier* spp. (serviceberry), *Arctostaphylos uva-ursi* (bearberry), *Ceanothus americanus* (New Jersey tea), *Comptonia peregrina* (sweetfern), *Corylus americana, Cornus* spp., *Corylus cornuta* (beaked hazelnut), *Cratageus* spp. (hawthorn species), *Gaultheria procumbens* (wintergreen), *Gaylussacia baccata* (huckleberry), *Prunus americana* (wild plum), *Prunus virginiana* (choke cherry), *Prunus pumila* (sand cherry), *Rosa carolina* (pasture rose), *Rubus flagellaris* (northern dewberry), *Salix humilis* (prairie or upland willow) and *Vaccinium angustifolium* (low sweet blueberry) and in Michigan, *Rhus copalina* (shining sumac), *Ptelea trifoliate* (hop tree) and *Quercus prinoides* (dwarf chestnut or dwarf chinkapin oak).

The ground layer is dominated by graminoids and forbs. Common species include *Scizhachyrium scoparium* (little bluestem), *Andropogon gerardii* (big bluestem) and *Carex pensylvanica* (Pennsylvania sedge), with Pennsylvania sedge often replacing the bluestems in shaded areas and fire-suppressed communities. Other prevalent herbs of the oak barrens include: *Aster oolentangiensis* (sky-blue aster), *Aureolaria* spp. (false foxglove), *Coreopsis lanceolata* (tickseed), *Cyperus filiculmis* (nut grass), *Danthonia spicata* (poverty oats), *Deschampsia flexuosa* (hair grass), *Euphorbia corollata* (flowering spurge), *Helianthus divaricatus* (tall sunflower), *Hypericum perforatum* (St. John’s-wort), *Koeleria macrantha* (June grass), *Krigia biflora* (dwarf dandelion), *Lathyrus ochroleucus* (white pea), *Lespedeza hirta* (hairy lespedeza), *Liatris aspera* (blazing star), *Liatris cylindrica* (dwarf blazing star), *Lupinus perennis* (wild lupine), *Monarda fistulosa* (wild bergamot), *Panicum implicatum* (grass panicum), *Pedicularis canadensis* (wood betony), *Stipa avenacea* (needle grass), *Stipa spartea* (needle grass), *Tephrosia virginiana* (goats-rue) and *Viola pedata* (birdfoot violet).

BpS Dominant and Indicator Species

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| QUAL | *Quercus alba* | White oak |
| QUEL | *Quercus ellipsoidalis* | Northern pin oak |
| QUVE | *Quercus velutina* | Black oak |
| ANGE | *Andropogon gerardii* | Big bluestem |
| CORYL | *Corylus* | Hazelnut |
| SCHIZ4 | *Schizachyrium* | Little bluestem |
| GABA | *Gaylussacia baccata* | Black huckleberry |
| CAPE6 | *Carex pensylvanica* | Pennsylvania sedge |

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

Disturbance Description

Cottam (1949) and Curtis (1959) suggested that oak savannas originated when prairie fires spread into surrounding closed oak forest with enough intensity to create open canopy conditions (also see Anderson and Brown 1986, Anderson and Bowles 1999). Other researchers have proposed that savannas also originated following invasion of prairie by oaks during prolonged lulls in annual fire regimes (Anderson and Bowles 1999, Grimm 1984). Repeated low-intensity fires working in concert with drought and windthrow then maintained these savannas (Faber-Langendoen and Tester 1993, Curtis 1959, Stout 1946). Within dry-mesic savanna systems, such as oak openings, it is likely that annual or nearly annual fire disturbance was the primary abiotic factor influencing savanna structure and composition. Fires prevented canopy closure and the dominance of woody vegetation (Leitner et al. 1991). Presently, the prevalent catalyst of fires is lightning strike, but historically, Native Americans played an integral role in the fire regime, accidentally and/or intentionally setting fire to prairie and savanna ecosystems (Anderson and Bowles 1999, Bowles and McBride 1998, Dorney and Dorney 1989, Chapman 1984, Grimm 1984, Day 1953). Where large-scale herbivores (i.e., elk and bison) were abundant, grazing may have helped inhibit the succession of oak savanna to woodland (Ritchie et al. 1998, McClain et al. 1993).

The character of oak barrens can differ dramatically, primarily as the result of varying fire intensity and frequency, which are influenced by climatic conditions, soil texture, topography, size of physiographic and vegetative units, and landscape context (i.e., proximity to water bodies and fire-resistant and fire-conducive plant communities) (Anderson and Bowles 1999, Chapman et al. 1995, Bowles et al. 1994, Grimm 1984). Historically, fire regimes were also influenced by the number and distribution of indigenous peoples (Chapman 1984). Infrequent, high-intensity fires may kill mature oaks and produce savannas and barrens covered by abundant scrubby oak sprouts. Park-like openings with widely spaced trees and an open graminoid/forb understory are maintained by frequent, low-intensity fires, which occur often enough to restrict maturation of oak seedlings and encroachment by other woody species (Peterson and Reich 2001, Chapman et al. 1995, Faber-Langendoen and Davis 1995).

Oak wilt occurred on barrens likely resulting in mortality of larger oak groups especially when they occurred in high densities.

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Percent of All Fires** | **Min FI** | **Max FI** |
| Replacement | 339 | 1 |  |  |
| Moderate (Mixed) | 245 | 2 |  |  |
| Low (Surface) | 5 | 97 |  |  |
| All Fires | 5 | 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

The expected fire regimes for this type are I (frequent ground fires) and III (mixed severity). The ground fire was the more commonly occurring fire disturbance, but when dry conditions combined with dense stand conditions, a mixed-severity fire could result, with the fire crowning into the canopy where fuel ladders were present. The scale of these fires is thought to occur on tens of thousands of acres.

Adjacency or Identification Concerns

The northern oak savanna type includes several matrix communities such as mesic and dry-mesic oak openings, dry oak barrens, mixed oak and oak-hickory woodlands, and a variety of small and large patch prairie types.

This system intergrades with North-Central Interior Oak Savanna (Biophysical Setting [BpS] 13940) on somewhat sandy sites and North-Central Interior Dry Oak Forest and Woodland (BpS 13110) at relatively sharp transitions between areas of higher and lower sand content. This system can be distinguished by high sand content. This system intergrades with Laurentian Pine-Oak Barrens (BpS 1407) along its northern extent. This system is found in Province 222 whereas Laurentian Pine-Oak Barrens is found north of the tension zone in Province 212.

In the absence of fire and with the prevalence of anthropogenic disturbance such as logging, off-road vehicle recreation, and livestock grazing, the following exotic species may be dominant components of the herbaceous layer of oak barrens: *Agropyron repens* (quack grass), *Agrostis stolonifera* (creeping bent), *Asparagus officinalis* (wild asparagus), *Centaurea maculosa* (spotted knapweed), *Hieracium* spp. (hawkweeds), *Poa compressa* (Canada bluegrass), *Poa pratensis* (Kentucky bluegrass), *Rumex acetosella* (sheep sorrel) and *Tragopogon dubius* (goat’s beard).

Issues or Problems

Changed mixed fire probability in classes C and D to send more to B based on LANDSUM results (MH Weber - MFSL 11/13/07). This type covers a broad geographic range and encompasses a variety of prairie, barrens and woodland types that may have experienced different surface fire return intervals ranging from one to five years. Historical fire size is unknown but historical accounts indicate that vast acreages burned within a single fire event.

This model was updated on 10/24/2007 by Randy Swaty to lump classes D and E.

Native Uncharacteristic Conditions

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 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Herb | 0.5-1.0 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Herb | >1.0 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| 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 | A | A | A | UN | UN | UN | UN | UN | UN | UN |
| Tree | 5-10 | A | A | B | B | B | B | C | C | D | D |
| Tree | 10-25 | A | A | B | B | B | B | C | C | D | D |
| Tree | 25-50 | A | A | B | B | B | B | C | C | D | D |
| Tree | >50 | A | A | B | B | B | B | C | C | 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 31 Early Development 1 - All Structures

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| ANGE | Andropogon gerardii | Big bluestem | Lower |
| SCHIZ4 | Schizachyrium | Little bluestem | Lower |
| POTR5 | Populus tremuloides | Quaking aspen | Low-Mid |
| QUVE | Quercus velutina | Black oak | Upper |

Description

The dominant lifeform is herbs, up to 1m, 0-100% cover, tending towards 100%.

Open prairie with grasses and forbs dominating open grasslands with scattered oak grubs and clumps of shrubs, ranging to early successional barrens/brush prairie with scattered young oak trees and clumps of shrubs occurring within a matrix of prairie grasses and forbs.

*Maximum Tree Size Class*  
Seedling <4.5ft

Class B 64 Late Development 1 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| QUVE | Quercus velutina | Black oak | Upper |
| QUAL | Quercus alba | White oak | Low-Mid |
| ANGE | Andropogon gerardii | Big bluestem | Lower |
| SCHIZ4 | Schizachyrium | Little bluestem | Lower |

Description

Oak barrens: This is a system of widely-scattered, large-diameter oaks and shrub clumps within a matrix of prairie grasses and forbs.

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

Class C 3 Late 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 | Low-Mid |
| COAM3 | Corylus americana | American hazelnut | Lower |

Description

Oak-dominated woodland with high stem density. These oak groves occupy areas of the landscape that frequently escape fire due to topographic position.

*Maximum Tree Size Class*  
Very Large >33"DBH

Class D 2 Late Development 3 - 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 |
| COAM3 | Corylus americana | American hazelnut | Middle |

Description

This is a closed-canopy oak-dominated forest. These oak groves occupy areas of the landscape that frequently escape fire due to topographic position.

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

Model Parameters

Deterministic Transitions

|  |  |  |  |
| --- | --- | --- | --- |
| **From Class** | **Begins at (yr)** | **Succeeds to** | **After (years)** |
| Early1:ALL | 0 | Late1:OPN | 50 |
| Late1:OPN | 51 | Late1:OPN | 999 |
| Late2:OPN | 51 | Late2:OPN | 999 |
| Late3:CLS | 51 | Late3: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** |
| Alternative Succession | Early1:ALL | Late3:CLS | 0.001 | 1000 | Yes | 0 |
| Alternative Succession | Early1:ALL | Late2:OPN | 0.001 | 1000 | Yes | 0 |
| Native Grazing | Early1:ALL | Early1:ALL | 0.001 | 1000 | No | 0 |
| Wind or Weather or Stress | Early1:ALL | Early1:ALL | 0.002 | 500 | No | 0 |
| Replacement Fire | Early1:ALL | Early1:ALL | 0.005 | 200 | Yes | 0 |
| Optional 1 | Early1:ALL | Early1:ALL | 0.033 | 30 | No | 0 |
| Surface Fire | Early1:ALL | Early1:ALL | 0.2 | 5 | No | 0 |
| Alternative Succession | Late1:OPN | Late2:OPN | 1 | 1 | Yes | 25 |
| Native Grazing | Late1:OPN | Late1:OPN | 0.001 | 1000 | No | 0 |
| Wind or Weather or Stress | Late1:OPN | Early1:ALL | 0.002 | 500 | Yes | 0 |
| Replacement Fire | Late1:OPN | Early1:ALL | 0.002 | 500 | Yes | 0 |
| Mixed Fire | Late1:OPN | Early1:ALL | 0.005 | 200 | Yes | 0 |
| Optional 1 | Late1:OPN | Late1:OPN | 0.033 | 30 | No | 0 |
| Surface Fire | Late1:OPN | Late1:OPN | 0.2 | 5 | No | 0 |
| Alternative Succession | Late2:OPN | Late3:CLS | 1 | 1 | Yes | 30 |
| Native Grazing | Late2:OPN | Late2:OPN | 0.001 | 1000 | No | 0 |
| Replacement Fire | Late2:OPN | Early1:ALL | 0.001 | 1000 | Yes | 0 |
| Wind or Weather or Stress | Late2:OPN | Early1:ALL | 0.002 | 500 | Yes | 0 |
| Insects or Disease | Late2:OPN | Late1:OPN | 0.005 | 200 | Yes | 0 |
| Mixed Fire | Late2:OPN | Late1:OPN | 0.017 | 59 | Yes | 0 |
| Optional 1 | Late2:OPN | Late2:OPN | 0.033 | 30 | No | 0 |
| Surface Fire | Late2:OPN | Late2:OPN | 0.2 | 5 | No | 0 |
| Native Grazing | Late3:CLS | Late3:CLS | 0.001 | 1000 | No | 0 |
| Replacement Fire | Late3:CLS | Early1:ALL | 0.001 | 1000 | Yes | 0 |
| Wind or Weather or Stress | Late3:CLS | Early1:ALL | 0.002 | 500 | Yes | 0 |
| Insects or Disease | Late3:CLS | Late2:OPN | 0.005 | 200 | Yes | 0 |
| Mixed Fire | Late3:CLS | Late1:OPN | 0.025 | 40 | Yes | 0 |
| Optional 1 | Late3:CLS | Late3:CLS | 0.033 | 30 | No | 0 |
| Surface Fire | Late3:CLS | Late3:CLS | 0.1 | 10 | No | 0 |

Optional Disturbances

Optional 1: drought

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