

13100

North-Central Interior Dry-Mesic Oak Forest and Woodland

BpS Model/Description Version: Aug. 2020

Modelers		Reviewers	
Gregory Nowacki	gnowacki@fs.fed.us	Dave Cleland	dcleland@fs.fed.us
Randy Swaty	rswaty@tnc.org	Bredan Ward	bward@fs.fed.us
None	None	Jim Drake	jim_drake@natureserve.org

Vegetation Type

Forest and Woodland

Map Zones

49

Geographic Range

This BpS is common in Sections 222K and 222J and is scattered in ravines and other mesic sites in Sections 251C, 251D and 223G.

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-mesic oak forest are sandy ground moraine and lake plains. 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 North-Central Interior Oak Savanna (BpS 1394) rather than this system (Curtis 1959).

For LANDFIRE mapping, SSURGO map units with moderate to high silt percentages (>40%) on uplands, with taxonomic particle sizes of “fine-silty” or “fine-loamy over sandy” may prove useful for mapping this system. Sites expected to have higher fire frequencies on “fine-loamy” may be included for mapping this system, whereas lower frequencies on these sites would likely indicate North-Central Interior Maple-Basswood Forest (BpS 1314). Soil orders are generally Alfisols with Mollisols becoming more important at the interface with prairie and savanna systems.

Additionally, relevant for the driest sites (from Aaseng et al. 2003): Present on hummocky stagnation moraines on well-drained, gravelly, loamy, calcareous till in northwestern Minnesota. With the dry settings of this system occurring on stagnation moraines, the parent material typically is gravelly, loamy, calcareous till but may also include sandy lacustrine deposits. Soils have very dark surface horizons typical of prairies, suggesting these sites were formerly occupied by prairie or open woodland. Soils have firm, clayey subsoil horizons that perch snowmelt and rainfall. These clayey horizons have elements of precipitated lime, and deeper horizons are highly calcareous. Soils are well drained, and the soil-moisture regime is fresh.

Drier settings of this type 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.

Additionally, relevant for the more mesic settings of this system (from Aaseng et al. 2003): Dry-mesic hardwood forests on undulating sand flats, hummocky moraines, and river bluffs. Present mostly on fine sand or sand-gravel soils. Often on south- or west-facing slopes but common also on flat to undulating sandy lake plains. The more mesic expressions of this system is reported to occur on three landforms (from Aaseng et al. 2003):

GLACIAL LAKE PLAINS-Common. Present on undulating sand flats that were deposited in the shallow waters of Glacial Lake Grantsburg. Parent material is stoneless, well sorted fine sand. It was initially calcareous, but soils are now leached of carbonates. Subsoil horizons capable of perching snowmelt are lacking, but general fine-sand texture and occasional bands of silt and gravel can help to retain some soil moisture. Densely cemented layers of sand that may reflect past positions of the water table occur at depth and can help hold water for deeply rooted plants. Soils are excessively drained and the soil-moisture regime is moderately dry.

STAGNATION MORAINES—Occasional. Present on hummocky moraines, often adjacent to fire-prone outwash plains and tunnel valleys that were occupied in the past by brushland or prairie. Parent material is a discontinuous cap of partially sorted gravelly sand over a base of denser till and is often complexly stratified. Parent material can be calcareous or noncalcareous; when calcareous, soils are leached of free carbonates to at least 30in (75cm). Although some clays have accumulated in the subsoil, clays are insufficient to perch snowmelt and rainfall. The complex stratification allows these sites to retain some rainfall, and water is available to deeply rooted plants just above the dense till. Where the sandy cap is thick, the soils are excessively drained, and the soilmoisture regime is moderately dry. Where the cap is thinner, the soils are well drained, and the soil-moisture regime is fresh.

RIVER BLUFFS-Common. Present on steep (20–50%) south- or west-facing slopes along the Minnesota River valley and other major streams. Soils are developed on eroded calcareous till or cut-faces of gravelly terraces well above modern alluvium. Free carbonates are present at or close to the surface and topsoil layers are thin because of surface erosion. Soils are somewhat excessively to excessively drained. Soil moisture regime is dry to moderately fresh.

Vegetation Description

Typically, the vegetation consists of forests dominated by oaks, especially white oak (*Quercus alba*), black oak (*Quercus velutina*) and red oak (*Quercus rubra*). Black oaks were generally more abundant on more xeric, sandier sites, whereas red oak was generally more abundant on more mesic, loamier sites. Red oak can also develop under a moderate overstory of the other oaks. Bur oak was occasionally present on sites with higher fire frequency or on thin calcareous soils (Curtis 1959). White oak spans the range of edaphic conditions encapsulated by this system. *Prunus serotina* capitalizes on canopy gaps, but rarely achieves significant canopy dominance (McCune & Cottam 1985). Other hardwood species, including *Juglans nigra*, *Juglans cinerea*, *Celtis occidentalis*, *Ulmus americana* and *Acer negundo* were occasionally found in the southern extent of this system on more mesic sites with lower fire frequencies.

Along with oaks are varying amounts of hickory (*Carya glabra* and *Carya ovata*), red maple (*Acer rubrum*), black cherry (*Prunus serotina*) and sassafras (*Sassafras albidum*). Subcanopies and shrub layers are usually well-developed 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*, *Andropogon gerardii* are also common.

For the drier settings of this system, oaks dominated the presettlement vegetation, especially white oak (*Quercus alba*), black oak (*Quercus velutina*), northern pin oak (*Quercus ellipsoidalis*) and bur oak (*Quercus macrocarpa*). These dry settings are distinguished from more mesic sites 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*). 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*, *Andropogon gerardii* are also common. In the most acidic lake plain physiographic systems, ericaceous shrubs such as wintergreen (*Gaultheria 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	<i>Quercus alba</i>	White oak
QUVE	<i>Quercus velutina</i>	Black oak
CAGL8	<i>Carya glabra</i>	Pignut hickory
QUCO2	<i>Quercus coccinea</i>	Scarlet oak
SAAL5	<i>Sassafras albidum</i>	Sassafras
QURU	<i>Quercus rubra</i>	Northern red oak
ACRU	<i>Acer rubrum</i>	Red maple
POTR5	<i>Populus tremuloides</i>	Quaking aspen

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

Disturbance Description

The North-Central Interior Dry-Mesic Oak Forest and Woodland (oak-hickory forest) is predominantly Fire Regime I, characterized by low-severity surface fires. 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 approximately less than five years and were probably 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-hickory savannas occurred where fire frequency was a bit less, probably 5-15yrs. Woodlands developed within a moderate burning regime, with fire return times averaging every 15-25yrs. Closed-canopy oak-hickory forests would develop where fire return intervals stretched

beyond 25yrs. Shade-tolerant, fire-sensitive maples (and associated late-successional trees) would regenerate and form understories beneath oak-hickory canopies when fire was excluded over many decades (50yrs). With continued fire exclusion, maple and other late-successional species would gradually replace overstory oaks and hickories through gap capture (Sutherland et al 2003). A mosaic of vegetation types comprised oak-hickory landscapes contingent on fire history (Cutter and Guyette 1994). From a gross landscape perspective, oak-hickory 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. 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.

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.

The North-Central Interior Dry Oak Forest and Woodland is predominantly Fire Regime I, characterized by low-to-moderate severity surface fires. 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 strata 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.

Fire Frequency

Severity	Avg FI	Percent of All Fires	Min FI	Max FI
Replacement	75	17		
Moderate (Mixed)	47	27		
Low (Surface)	23	56	2	25
All Fires	13	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-hickory 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-hickory patches are virtually always integrated in the larger landscape scale with mesic maple-dominated forests and dry oak savannas. 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 to 150yrs) without fire were needed for maples to manifest their dominance. Oak-hickory forests also graded into savannas (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-hickory 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. Currently, under the past century's practice of fire suppression, oak-hickory 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. Implications to forestry, wildlife, and pest and disease outbreaks become apparent.

This system can be similar to North-Central Interior Maple Basswood Forest (BpS 1314). However, the Maple Basswood system typically occurs on gravelly, partially sorted and weakly calcareous till. The maple basswood systems are less likely to have quaking aspen in the canopy (Aaseng et al. 2003).

Issues or Problems

This system has largely converted to closed-canopy forests progressively increasing in mesophytic species. As these systems become increasing mesophytic, the ability to get fire back on the landscape becomes increasingly difficult.

Native grazing, due to higher deer densities than historically (at least in WI) further suppress recruitment of oaks and exacerbates the trend toward closed-canopy mesophytic species. Invasive species, including buckthorn (*Rhamnus cathartica*) and honeysuckle (*Lonicera* spp.) are becoming increasingly prevalent in the understories of some stands

Native Uncharacteristic Conditions

Though present historically, red maple has been typified as the "native invasive" in oak hickory 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 silviculture 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	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	E	E
Tree	5-10	B	B	C	C	C	C	UN	UN	E	E
Tree	10-25	B	B	C	C	C	C	D	D	E	E
Tree	25-50	UN	UN	UN	UN	UN	UN	D	D	E	E
Tree	>50	UN	UN	UN	UN	UN	UN	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 5 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
POTR5	Populus tremuloides	Quaking aspen	None

Description

Grassland prairie maintained by frequently recurring fire. Native Americans used these lands for hunting, and agriculture/native plant gathering.

Maximum Tree Size Class

None

Class B 12 Mid Development 1 - Open

Indicator Species

Maximum Tree Size Class

Large 21-33"DBH

Class E**5****Late Development 1 - 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. Maple forests develop during the absence of fire. Dense understories of shade-tolerant species develop. Surface fires would allow these systems to revert back to oak dominance.

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	4
Mid1:OPN	5	Mid1:OPN	14
Mid2:OPN	15	Mid2:OPN	24
Mid3:CLS	25	Mid3:CLS	149
Late1:CLS	150	Late1: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	0.1	10	Yes	0
Alternative Succession	Mid1:OPN	Mid2:OPN	1	1	Yes	8
Native Grazing	Mid1:OPN	Mid1:OPN	0.01	100	No	0
Replacement Fire	Mid1:OPN	Early1:ALL	0.01	100	Yes	0
Surface Fire	Mid1:OPN	Mid1:OPN	0.05	20	No	0
Alternative Succession	Mid2:OPN	Mid3:CLS	1	1	Yes	8
Replacement	Mid2:OPN	Early1:ALL	0.01	100	Yes	0

Fire						
Mixed Fire	Mid2:OPN	Mid1:OPN	0.015	67	Yes	0
Surface Fire	Mid2:OPN	Mid2:OPN	0.05	20	No	0
Alternative Succession	Mid3:CLS	Late1:CLS	1	1	Yes	65
Mixed Fire	Mid3:CLS	Mid1:OPN	0.01	100	Yes	0
Replacement Fire	Mid3:CLS	Early1:ALL	0.01	100	Yes	0
Mixed Fire	Mid3:CLS	Mid2:OPN	0.02	50	Yes	0
Surface Fire	Mid3:CLS	Mid3:CLS	0.05	20	No	0
Mixed Fire	Late1:CLS	Mid3:CLS	0.001	1000	Yes	0
Mixed Fire	Late1:CLS	Mid2:OPN	0.001	1000	Yes	0
Mixed Fire	Late1:CLS	Mid1:OPN	0.001	1000	Yes	0
Mixed Fire	Late1:CLS	Early1:ALL	0.002	500	Yes	0
Wind or Weather or Stress	Late1:CLS	Late1:CLS	0.01	100	No	0

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