

14072

Laurentian Pine-Oak Barrens - Jack Pine

BpS Model/Description Version: Aug. 2020

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Vegetation Type

Forest and Woodland

Map Zones

41, 50, 51

Model Splits or Lumps

This BpS is split into multiple models:

This model is for the jack pine and jack pine-red pine forests of northern MN, WI, and MI.

Geographic Range

System occurs in northern lower MI, northern WI (212Ka), northern MN and eastern Ontario, north of the climatic tension zone (Curtis 1959) and is concentrated in the High Plains subsection in northern lower MI and in central WI subsection 212Q (Vora 1993). Also occurs in several locations in the Upper Peninsula of MI, and in northeastern WI (212Te) and is associated with the upper Mississippi and St. Croix Rivers in MN and WI (Comer 1996). There are scattered cases in WI's Northern Forest (212X).

Biophysical Site Description

Jack pine and red pine-jack pine (-hardwood) forests are endemic to very dry, nutrient-impooverished landscape ecosystems. These ecosystems occur in landforms deposited by high-energy glacial melt waters, principally outwash plains and glacial lakebeds, underlain by well-sorted, coarse-textured sandy soils with low water retaining capacity. They also occur in bedrock-controlled landforms with shallow soils of limited moisture storage capacity, and on sand ridges within peatland complexes (Cohen et al. 2002; Cleland et al. 2004). They are generally found in cooler climates north of the tension zone. The topography is flat to gently rolling, typically with long expanses capable of carrying wildfires with few natural fire breaks, and often in proximity to even more fire-prone pine barrens. The soils of this community are sandy, acidic, droughty and relatively infertile (Comer 1996). Where the system occurs on low sand ridges in peatland complexes, the higher water table promotes paludification, which results in accumulation of an organic horizon above the mineral layers. They become established in areas with continental climate, in which summers are typically short and warm to cool, and winters are cold (Pregitzer and Saunders 1999).

Vegetation Description

Pinus banksiana (jack pine) typically dominates the overstory canopy. *Pinus resinosa* (red pine) dominates some stands and may form a scattered supercanopy in stands otherwise dominated by jack pine. Most of these trees were likely removed during the logging era. *Quercus ellipsoidalis*

(northern pin oak) is also locally important. Canopy associates include *Acer rubrum* (red maple), *Betula papyrifera* (paper or white birch), *Pinus strobus* (white pine, which occasionally occurs in the supercanopy), *Populus grandidentata* (bigtooth aspen), *Populus tremuloides* (trembling aspen), *Prunus serotina* (black cherry) and *Quercus rubra* (red oak) (Cohen 2002). *Picea mariana* (black spruce) may also occur, particularly where the system occurs on dune ridges within peatlands. Many former areas of jack pine and red pine forests succeeded to open “stump prairies” or scrubby forests of *Populus grandidentata* (bigtooth aspen), *P. tremuloides* (quaking aspen), *Betula papyrifera* (paper birch), and *Prunus serotina* (black cherry) following widespread logging and slash fires in the mid-1800s to early 1900s (Cohen 2002; Epstein et al. 2002). *Vaccinium angustifolium* (low sweet blueberry), *V. myrtilloides* (Canada blueberry), and *Gaylussacia baccata* (huckleberry) are common low shrubs; characteristic dwarf shrubs include *Arctostaphylos uva-ursi* (bearberry), *Chimaphila umbellata* (pipsissewa), *Cornus canadensis* (bunchberry), *Epigaea repens* (trailing-arbutus), and *Gaultheria procumbens* (wintergreen) (Epstein et al. 2002; MNDNR 2003; Cohen et al. 2015). In openings, *Comptonia peregrina* (sweet-fern), *Prunus pumila* (sand cherry), *Salix humilis* (prairie willow) and *Corylus* spp. (hazelnuts) may be present. On paludified sand ridges, species typical of peatlands, such as *Chamaedaphne calyculata* (leatherleaf) and *Rhododendron groenlandicum* (Labrador-tea) may proliferate. Characteristic herbaceous species include *Pteridium aquilinum* (bracken fern), *Avenella flexuosa* (wiry hair grass), *Danthonia spicata* (poverty grass), *Carex pensylvanica* (Pennsylvania sedge), *Aralia nudicaulis* (sarsaparilla), *Maianthemum canadense* (Canada mayflower), *Trientalis borealis* (starflower), *Mitchella repens* (partridge-berry), *Apocynum androsaemifolium* (spreading dogbane), *Eurybia macrophylla* (large-leaved aster), *Melampyrum lineare* (cow-wheat), *Linnaea borealis* (twinflower), *Oryzopsis asperifolia* (rough-leaved rice-grass), and *Piptatheropsis pungens* (rice-grass) (Cohen 2002; Epstein et al. 2002; MNDNR 2003; Cohen et al. 2015). Mosses (e.g., *Dicranum* spp. and *Pleurozium schreberi*) and lichens (e.g., *Cladonia* and *Cladonia* spp.) often form a mat on the soil (Cohen 2002).

At Crex Meadows in western WI, Vogl (1961) studied pine barrens as described by original land survey records. He estimated that there were 20 trees greater than 15cm (6in) in diameter per hectare. This translates to an average distance between trees of 24m (65ft). The trees in this community had typical open-grown shapes. They had branches most of the way down their trunks with many needles. Many burned jack pine snags were encountered by land surveyors in Michigan. Zimmerman (1956) reported that the tallest tree in his 50 study sites was 16m (52ft). The average tree height was only 8m (26ft). This may be misleading because past logging may have eliminated the largest trees and there has not been enough time to regenerate the tallest pines. Vogl (1961), in his analysis of General Land Office surveys conducted in western WI, found that the average diameter of *Pinus banksiana* was 25cm (10in) and of *P. resinosa* was 50cm (20in). This indicates that taller trees may have existed before logging and the subsequent slash-fires that swept through most barrens.

BpS Dominant and Indicator Species

Symbol	Scientific Name	Common Name
PIBA2	<i>Pinus banksiana</i>	Jack pine
CAPE6	<i>Carex pensylvanica</i>	Pennsylvania sedge
QUEL	<i>Quercus ellipsoidalis</i>	Northern pin oak
GAPR2	<i>Gaultheria procumbens</i>	Eastern teaberry

VAAN	<i>Vaccinium angustifolium</i>	Lowbush blueberry
DEFLF	<i>Deschampsia (Avenella) flexuosa</i>	Wiry hair grass
PIRE	<i>Pinus resinosa</i>	Red pine
ARUV	<i>Arctostaphylos uva-ursi</i>	Kinnikinnick

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

Disturbance Description

Frequent fire and, in some places, frost and drought conditions, maintain open canopy conditions by limiting the development of woody vegetation and allowing the maintenance of a mixture of grasses and sedges. Pine barrens were found in the most fire-prone and driest areas of the landscape, often west of natural fire breaks. Barrens typically occur within long expanses capable of carrying wildfires with few natural fire breaks. In rolling topography, pine barrens are found in depressions that collect cold air, forming frost pockets (Comer 1996).

Fire return intervals for stands in Minnesota are estimated at 30-50 years for moderate surface fires to 120-170 years for catastrophic fires (MNDNR 2003).

There are numerous estimates of fire return interval for upland jack pine systems depending on scale and geographic location of study. Whitney (1986) estimated average return time for canopy replacement fire in jack pine forests of northern lower MI to be about 80yrs. Similar return times (50-100yrs) have been estimated by Heinselman (1981) in MN. Whitney (1986) also estimated that surface fires occurred every 25yrs, while Heinselman (1981) suggested that on drier sites light to moderate surface fires may have occurred every 20-40yrs. Simard & Blank (1982) calculated presettlement fire frequency in the Mack Lake area of Oscoda County, MI to have averaged in the range of 13-41yrs. Historical reports document near-annual fires in barrens (Curtis 1959). In a synthesis of the fire literature for historic fire return intervals for the Great Lakes Region Dickman and Cleland (2002) report that the fire return interval for jack pine barrens ranged from 15-60yrs and fires may have even occurred on an annual basis. It is likely that the frequency of fires depended in part to indigenous burning.

Insect infestations in jack pine are also an important disturbance factor, often followed by canopy fire. Currently, jack pine budworm infestations can lead to stand-level mortality, but it is unclear how the insect behaved in presettlement. GLO data indicate that fire and windthrow were important in some barrens landscapes (Comer et al. 1995, Comer and Albert 1999). This system falls within Fire Regimes I and II.

Fire Frequency

Severity	Avg FI	Percent of All Fires	Min FI	Max FI
Replacement	25	34	10	80
Moderate (Mixed)	46	18	10	80
Low (Surface)	18	48	1	20
All Fires	8	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

This is matrix system that included prairie/barrens, savanna, and closed canopy forests. The patterning of these patch types was influenced by variation in the size, intensity and frequency of

fires. Fire size, frequency and intensity was dependent on natural features, soil types, topography, climatic factors and the concentration of indigenous people.

Adjacency or Identification Concerns

Jack pine barrens often occurred on extensive areas of outwash plain intermixed with dry sand prairie and closed-canopy jack pine systems. The system grades into oak barrens and savannas in the south and into northern pine (oak) forests along to the north. It may be confused with Laurentian Pine-Oak Barrens (BpS 1407).

Many areas that once supported pine barrens and closed jack pine forests have been planted to red pine plantations. Also, current logging practices, clear cutting of jack pine without fire or reforestation practices, these sites have converted to aspen and birch stands.

Other classifications: Michigan Natural Features Inventory (MNFI) natural community classification: dry northern forest. The Nature Conservancy National Classification: CODE: (III.A.4a.SW20.00). International Vegetation Classification (IVC) Alliance: Pinus banksiana - Pinus resinosa - Quercus ellipsoidalis Forest & Woodland Alliance; Pinus banksiana - Pinus resinosa / Arctostaphylos uva-ursi Sand Woodland Alliance. Association: Pinus banksiana - (Pinus resinosa) - Quercus ellipsoidalis / Carex pensylvanica Forest; Pinus banksiana / Vaccinium spp. / Pleurozium schreberi Woodland; Pinus banksiana - Pinus resinosa - Pinus strobus Dune Forest; Pinus banksiana - (Pinus resinosa) / Corylus cornuta Forest; Pinus banksiana - Picea mariana / Vaccinium spp. / Pleurozium schreberi Forest. Kotar habitat type Group 1.

Issues or Problems

Need to acquire more detailed information about distribution of pine barrens in MN. Need more research on frequency of historical surface fire. This model constitutes all jack pine dominated systems in MZ50. We incorporated dry sand prairie, jack pine barrens and jack pine forest into one model with each vegetation type representing a seral stage in the model. The amount of the landscape in each of these seral stages (dry sand prairie, jack pine barrens and jack pine forest) depended on temporal and spatial scales and was closely linked with fire return intervals. This differs from how the modelers in MZ51 (MI) chose to model jack pine systems. In MZ51 there are separate models for jack pine forests and jack pine barrens.

Native Uncharacteristic Conditions

Comments

Prior to LANDFIRE Remap this BpS was named Laurentian-Acadian Jack Pine Barrens and Forest.

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	B	B	B	B	A	A	A	A	A	A

Herb	0.5-1.0	B	B	B	B	A	A	A	A	A	A
Herb	>1.0	B	B	B	B	A	A	A	A	A	A
Shrub	0-0.5	C	C	C	C	A	A	A	A	A	A
Shrub	0.5-1.0	C	C	C	C	A	A	A	A	A	A
Shrub	1.0-3.0	C	C	C	C	A	A	A	A	A	A
Shrub	>3.0	C	C	C	C	A	A	A	A	A	A
Tree	0-5	B	B	B	B	B	B	B	B	B	B
Tree	5-10	C	C	C	C	C	C	C	D	D	D
Tree	10-25	C	C	C	C	C	C	C	C	C	C
Tree	25-50	C	C	C	C	C	C	C	C	C	C
Tree	>50	C	C	C	C	C	C	C	C	C	C

Succession class letters A-E are described in the Succession Class Description section. Some classes use a leaf form 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 14 Early Development 1 - All Structures

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
CAPE6	Carex pensylvanica	Pennsylvania sedge	Lower
SCSC	Schizachyrium scoparium	Little bluestem	Lower
PIBA2	Pinus banksiana	Jack pine	Lower
VAAN	Vaccinium angustifolium	Lowbush blueberry	Lower

Description

Sedges and grasses are dominant, with scattered jack pine/pine regeneration and low shrubs.

Upper Layer Lifeform is not the dominant lifeform. Grasses and sedges are dominant lifeforms. Typically, herbaceous species are less than a meter in height. Minimum cover for herbaceous species is approximately 40% while maximum coverage is 90%.

Maximum Tree Size Class

None

Class B 23 Mid Development 1 - Open

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
PIBA2	Pinus banksiana	Jack pine	Low-Mid
PIRE	Pinus resinosa	Red pine	Low-Mid
QUEL	Quercus ellipsoidalis	Northern pin oak	Low-Mid
CAPE6	Carex pensylvanica	Pennsylvania sedge	Lower

Description

Dominated by jack pine regeneration (seedlings or saplings), with scattered red pine and northern pin oak, isolated cases of birch and aspen. A patchwork of clumps of regenerating trees with areas of grass.

Upper Layer Lifeform is not the dominant lifeform. The upper layer lifeform varies depending on the spatial scale. Jack pine and other trees form clumps interspersed within a matrix of grasses and sedges.

Maximum Tree Size Class

Sapling >4.5ft; <5"DBH

Class C	49	Late Development 1 - Open
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Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
CAPE6	Carex pensylvanica	Pennsylvania sedge	Lower
PIBA2	Pinus banksiana	Jack pine	Upper
VAAN	Vaccinium angustifolium	Lowbush blueberry	Lower
QUEL	Quercus ellipsoidalis	Northern pin oak	Middle

Description

Sedges and grasses are dominant, with scattered jack, red, and white pine trees and low shrubs.

Upper Layer Lifeform is not the dominant lifeform. The upper layer lifeform varies on spatial scales in some areas grasses and sedges are dominant lifeform. Typically, herbaceous species are less than a meter in height. Minimum cover for herbaceous species is approximately 40%, while maximum coverage is 70%. In other areas the dominant life will be jack pine growing in patches.

Maximum Tree Size Class

Medium 9-21"DBH

Class D	14	Late Development 1 - Closed
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Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
PIBA2	Pinus banksiana	Jack pine	Upper
QUEL	Quercus ellipsoidalis	Northern pin oak	Mid-Upper
GAPR2	Gaultheria procumbens	Eastern teaberry	Lower
PIRE	Pinus resinosa	Red pine	Upper

Description

Closed-canopy jack pine forest that results after prolonged periods (25yrs) of fire suppression or microtopography that protects forest from fires.

Maximum Tree Size Class

Medium 9-21"DBH

Model Parameters

Deterministic Transitions

From Class	Begins at (yr)	Succeeds to	After (years)
Early1:ALL	0	Mid1:OPN	5
Mid1:OPN	6	Late1:OPN	15
Late1:OPN	16	Late1:CLS	200
Late1:CLS	201	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
Replacement Fire	Early1:ALL	Early1:ALL	0.2	5	Yes	0
Replacement Fire	Mid1:OPN	Early1:ALL	0.017	59	Yes	0
Surface Fire	Mid1:OPN	Mid1:OPN	0.02	50	No	0
Mixed Fire	Mid1:OPN	Mid1:OPN	0.04	25	No	0
Insects or Disease	Late1:OPN	Mid1:OPN	0.002	500	Yes	0
Optional 1	Late1:OPN	Early1:ALL	0.002	500	Yes	0
Replacement Fire	Late1:OPN	Early1:ALL	0.017	59	Yes	0
Mixed Fire	Late1:OPN	Mid1:OPN	0.025	40	Yes	0
Surface Fire	Late1:OPN	Late1:OPN	0.1	10	No	0
Replacement Fire	Late1:CLS	Early1:ALL	0.001	1000	Yes	0
Surface Fire	Late1:CLS	Late1:CLS	0.02	50	No	0

Optional Disturbances

Optional 1: Optional 1 (wind followed by fire)

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