13620

Laurentian-Acadian Northern Pine(-Oak) Forest

BpS Model/Description Version: Aug. 2020

|  |  |  |  |
| --- | --- | --- | --- |
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Vegetation Type

Forest and Woodland

Map Zones

41, 50

Model Splits or Lumps

This Biophysical Setting (BpS) is split into multiple models:13620 and 13622(Pine Dominated).

Geographic Range

Northern and central Wisconsin, portions of Minnesota.

Biophysical Site Description

Outwash plains, ice-contact margins. Throughout the Great Lakes region, northern pine-oak forests occur principally on sandy glacial outwash, sandy glacial land plains, and less often on thin glacial drift over bedrock, inland dune ridges, and coarse-textured end moraines. Soils are typically coarse- to medium-textured sand or loamy sand and are moderately to extremely acidic with a surface layer or more humus from accumulated pine needles (Cohen 2002).

Vegetation Description

Upper canopy consists primarily of red pine (*Pinus resinosa*) and white pine (*Pinus strobus*). White pine was somewhat more abundant on more mesic, loamier soils, whereas red pine was more dominant on sandier soils (Schulte et al. 2002). Jack pine (*Pinus banksiana*) was generally restricted to sandier soils near established seed sources (Subsection 212Ka), where

stand-replacing fires were more frequent. Quaking aspen (*Populus tremuloides*), bigtooth aspen (*Populus grandidentata*), and paper birch (*Betula papyrifera*) were present and could be locally abundant in the early successional classes (Schulte et al. 2002). Northern red oak (*Quercus rubra*), northern pin oak (*Quercus ellipsoidalis*), red maple (*Acer rubrum*), and balsam fir (*Abies balsamea*) were present in the mid- to late successional classes; however, maple and fir were likely uncommon historically due to mortality from surface fires. Some evidence suggests that oak was a very minor component of this BpS historically (Dave Cleland, personal communication).

The ground layer in this BpS consists of 25-75% forbs and graminoids. The most common vascular plants are Canada mayflower (*Maianthemim canadense*), wild sarsparilla (*Aralia macrophyllus*), wintergreen (*Gaultheria procumbens*), and braken fern (*Pteridium aquilinum*).

The shrub layer is typically dominated by deciduous species such as lowbush blueberry (*Vaccinium angustifolium*), juneberries (*Amelanchier* spp.), oaks, and red maple seedlings (*Acer rubum*).

BpS Dominant and Indicator Species

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| PIBA2 | *Pinus banksiana* | Jack pine |
| PIRE | *Pinus resinosa* | Red pine |
| QURU | *Quercus rubra* | Northern red oak |
| POTR5 | *Populus tremuloides* | Quaking aspen |
| QUEL | *Quercus ellipsoidalis* | Northern pin oak |
| PIST | *Pinus strobus* | Eastern white pine |
| BEPA | *Betula papyrifera* | Paper birch |

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

Disturbance Description

This model pertains to those red and white pine systems that were historically maintained by relatively frequent surface fires (5-15yrs) and crown-fire rotations between 150-300yrs.

Fire return interval (FRI) is best exemplified by Fire Regime Group I, with surface fires occurring every 5-15yrs. High-intensity crown fires occur on ~300yr rotations.

Severe wind events affect mature stands on an ~500-1,000yr interval (see Schulte and Mladenoff 2005; Frelich 2002). Also see Schulte et al. (2005) for discussion of spatial pattering of wind impacts.

During fire-free periods or periods with long surface-fire rotation, mid-tolerant white pines gain dominance through gap-phase regeneration.

This description applies to red-white pine communities occurring within landscape ecosystems with properties resulting in long (150-300yrs) stand-replacing fire rotations. Surface and crown fire regimes historically interacted to regulate age, landscape, within-stand structure, and succession within this community. Natural fuel breaks imposed by high lake and wetland densities inhibited fire spread within the landscapes this community dominated, resulting in a relatively long fire rotation of 250yrs. In northwestern Quebec, Dansereau and Bergeron (1993) similarly found that a large, homogeneous landscape, devoid of lakes, had larger fires and fires of greater intensity compared with a landscape containing numerous water bodies and rough topography. Bergeron (1991) also documented similar traits for mainland versus islands in a large lake.

Fire probability often increased with stand age due to the general increase in fuel (Clark 1990; Heinselman 1973), but individual tree susceptibility to damage or mortality from fire often declined with tree size due to increasing bark thickness and a separation of foliage from the ground, which reduces crown-fire occurrence. This community may have promoted surface fires by forming a deep, well-aerated litter layer of pine needles (McCune 1988). Relatively infrequent surface fires (30-50yrs) reduced fuel loadings, eliminated living fuel ladders, and promoted widely spaced trees that became increasingly resistant to crown fires. Surface fires also reduced competition and succession to more shade-tolerant species.

More information needed to parameterize insects and disease for the pre-settlement era.

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Percent of All Fires** | **Min FI** | **Max FI** |
| Replacement | 349 | 3 |  |  |
| Moderate (Mixed) | 669 | 2 |  |  |
| Low (Surface) | 11 | 95 |  |  |
| All Fires | 11 | 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

Landscape must be adequate in size to contain natural variation in vegetation and disturbance regime. Though the virgin stands of red and white pine are greatly reduced from pre-settlement conditions, scattered stands and ecosystems still exist to represent this type. The Boundary Waters Canoe Area Wilderness (BWCAW) is an example, along with the national forests in Minnesota (Chippewa, Superior), Michigan (Ottawa, Hiawatha), and Wisconsin (Chequamegon, Nicolet) and Menominee Reservation in Wisconsin.

Historical fire size ranged from small acreages (<1,000ac) to extremely large events (>100,000ac or 40,000ha) (Heinselman 1978). To capture a range of ecologically significant fire events, the following values were used: minimum = 1,000ac, maximum = 100,000ac, with an average of 10,000ac.

Adjacency or Identification Concerns

Fire suppression, logging practices, and exotic invasives all have influenced the current landscape conditions. Historic natural disturbance (fire) has been removed, allowing for succession to late seral conditions. Harvesting practices have in some instances mimicked natural wind disturbance but not on the appropriate scale and frequency as historically. The exclusion of fire in this process is probably the key missing agent of successional change.

Issues or Problems

Much of this type was heavily altered during landscape-scale historical harvesting in the late 1800s and early 1900s (Mladenoff & Pastor 1993). Many stands were burned multiple times following harvest. Aspen and birch became especially prevalent immediately following this period. Fire suppression and high-grading of remaining pine stands has exacerbated the trend away from pine and toward mid- and later successional species such as red maple and balsam fir.

Plantations of red pine were established on this BpS in the 1930s by the CCC.

White pine blister rust, a potentially destructive fungal infection, was introduced to the United States in the early 1900s and caused relatively little white pine to be planted in this BpS throughout the latter half of the 20th century. Red pine was preferentially planted instead, even though white pine would have been more historically dominant for some sites.

Native Uncharacteristic Conditions

Due to fire suppression and other human activities, oaks and the other fire-dependent species within this BpS are declining and are being replaced by other less fire-adapted species such as red maple (*Acer rubrum*).

Stands heavily dominated by red maple or balsam fir in the canopy should be considered uncharacteristic in this BpS, as they would have been readily removed or reduced to lower canopy strata by relatively frequent surface fire.

Comments

In June 2020 TNC changed the code for this BpS from 13621 to 13620.

NOTE: 20 May 2008: As a result of final QC for LANDFIRE National by Jennifer Long, the upper-layer lifeform in Class A was changed from “Shrub” to “Tree” because 1) according to LANDFIRE National rules, the upper-layer lifeform should match the lifeform of height class which was “tree”; 2) the class description described a regeneration phase of aspen, paper birch, red pine, white pine, and oak; and 3) the box noting the “upper-layer lifeform was not dominant” was checked and the comment as follows, “dominant lifeform consists of low shrubs, ferns, and herbaceous species although any existing scattered trees would be the upper-level lifeform.”

Additional comments provided by Brendan Ward (bward@fs.fed.us).

During an s-class call, it was noted that for this and other systems, the fact that there is more aspen on the landscape today than in the reference condition may not be captured by LANDFIRE methods, leading to a reduction in FRCC.

This model was adapted from 501362-2 by Jeremy Bennet and Ron Waukau to capture Minneosta. 501362-2 was adapted from LANDFIRE Model 5113620 Laurentian-Acadian Northern Pine-(Oak) Forest by Becky Schillo (schillor@michigan.gov), Brad Slaughter (slaughterb@michigan.gov), and Doug Cox (mteecology@frontiernet.net). LANDFIRE Model 511362 built upon Rapid Assessment model R6RPWff -- Red Pine White Pine with Frequent Fire by Tim Hepola (Tim\_Hepola@fws.gov), Dave Cleland (dcleland@fs.fed.us), and Jim Merzenich (jmerzenich@fs.fed.us). The model was further refined to incorporate local data collected on the Menominee Reservation (Jeremy Bennett, 21 March 2007)

Comment related to Disturbance Description: A current fire history study being conducted on the Menominee Reservation has demonstrated that young pines (white and red pines as young as 10-15yrs of age) did survive surface fires that occurred in the mid-1800s. This contradicts the understanding that young pines will not survive surface fires until they reach a more mature age (50yrs+). This might suggest that these historic fires were very low intensity and burned in light flashy fuels. This suggests that the types of surface fire and the vegetation structure were very complex and variable. Much more information is needed to truly understand how to model these historic disturbances and reference conditions.

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 | A | A | A | A | A | A | A | A | A | A |
| Shrub | 0.5-1.0 | A | A | A | A | A | A | A | A | A | A |
| Shrub | 1.0-3.0 | A | A | A | A | A | A | A | A | A | A |
| Shrub | >3.0 | A | A | A | A | A | A | A | A | A | A |
| Tree | 0-5 | A | A | A | A | A | A | A | A | A | A |
| Tree | 5-10 | C con | C con | C con | C con | C con | C con | C con | C con | C con | C con |
| Tree | 5-10 | B brdlf | B brdlf | B brdlf | B brdlf | B brdlf | B brdlf | B brdlf | B brdlf | B brdlf | B brdlf |
| Tree | 5-10 | B mix | B mix | B mix | B mix | B mix | B mix | B mix | B mix | B mix | B mix |
| Tree | 10-25 | C con | C con | C con | C con | C con | C con | C con | C con | C con | C con |
| Tree | 10-25 | B brdlf | B brdlf | B brdlf | B brdlf | B brdlf | B brdlf | B brdlf | B brdlf | B brdlf | B brdlf |
| Tree | 10-25 | B mix | B mix | B mix | B mix | B mix | B mix | B mix | B mix | B mix | B mix |
| Tree | 25-50 | D | D | D | D | D | D | D | D | D | D |
| Tree | >50 | D | D | D | D | D | D | D | D | 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 14 Early Development 1 - All Structures

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| POTR5 | Populus tremuloides | Quaking aspen | Lower |
| BEPA | Betula papyrifera | Paper birch | Lower |
| QURU | Quercus rubra | Northern red oak | Lower/mid |
| PIST | Pinus strobus | Eastern white pine | Lower |
| PIBA2 | Pinus banksiana | Jack pine | Lower |
| PIRE | Pinus resinosa | Red pine | Lower |

Description

This class is a regeneration phase from either fire or wind. It consists mainly of aspen, paper birch, red pine, jack pine, white pine, and oak. It is typically a mixture of two to three pine species and three or more deciduous species. Scattered overstory relict red and white pines are common. Where there is a lack of seeds or potential sucker trees, these areas can be initially colonized by blackberry (*Rubus* spp.), blueberry, sweet fern, bracken fern, red maple, cherry, or other shrubs.

Upper-layer lifeform is not the dominant lifeform. Dominant lifeform consists of low shrubs, ferns, and herbaceous species although any existing scattered trees would be the upper-level lifeform.

*Maximum Tree Size Class*  
seeds/saps <5" DBH

Class B 10 Mid Development 1 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIST | Pinus strobus | Eastern white pine | Upper |
| PIRE | Pinus resinosa | Red pine | Upper |
| QURU | Quercus rubra | Northern red oak | Lower |
| PIBA2 | Pinus banksiana | Jack pine | Upper |
| POTR5 | Populus tremuloides | Quaking aspen | Upper |

Description

This class is a transition class marked by declines in jack pine, paper birch, and aspen. Dominated by red pine and white pine. Northern red oak would persist as an understory component.

*Maximum Tree Size Class*  
Medium 9-21" DBH

Class C 7 Mid Development 2 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIST | Pinus strobus | Eastern white pine | Upper |
| PIRE | Pinus resinosa | Red pine | Upper |
| QURU | Quercus rubra | Northern red oak | Lower |
| PIST | Pinus strobus | Eastern white pine | Lower |

Description

This class is mature woodlands dominated by red pine and white pine. Oaks persist in the understory. White pine and red pine understory developing in the understory, density dependent on surface FRI.

*Maximum Tree Size Class*  
Medium 9-21" DBH

Class D 8 Late Development 1 - Closed

Indicator Species

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | | | **Common Name** | **Canopy Position** | | |
| PIST | Pinus strobus | | | Eastern white pine | Upper | | |
| PIRE | Pinus resinosa | | | Red pine | Upper | | |
| QURU | | Quercus rubra | Northern red oak | | | Under/mid |
| PIST | Pinus strobus | | | Eastern white pine | Under | | |
| VIAC | Viburnum acerifolium | | | Mapleleaf viburnum | Lower | | |

Description

This class is mature woodlands dominated by red pine and white pine with some white pines in understory and red pines in the understory of more open stands. Oaks present in the understory.

*Maximum Tree Size Class*  
Very Large >22" DBH

Class E 61 Late Development 2 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIST | Pinus strobus | Eastern white pine | Upper |
| PIRE | Pinus resinosa | Red pine | Upper |
| QURU | Quercus rubra | Northern red oak | Under/mid |
| PIRE | Pinus resinosa | Red pine | Under |
| PIST | Pinus strobus | Eastern white pine | Under |
| VIAC | Viburnum acerifolium | Mapleleaf viburnum | Lower |

Description

This class is a mature woodland typified by the maintenance of open, large-diameter stands of mixed red and white pines. Depending on surface fire frequency and locations, new cohorts of red and white pines may appear in the understory. The overstory is dominated by red pine with white pine as an associate.

*Maximum Tree Size Class*  
Medium >22" DBH

Model Parameters

Deterministic Transitions

|  |  |  |  |
| --- | --- | --- | --- |
| **From Class** | **Begins at (yr)** | **Succeeds to** | **After (years)** |
| Early1:ALL | 0 | Mid1:OPN | 30 |
| Mid1:OPN | 31 | Late2:OPN | 75 |
| Mid2:CLS | 76 | Late1:CLS | 115 |
| Late2:OPN | 76 | Late2:OPN | 999 |
| Late1:CLS | 116 | 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** |
| Alternative Succession | Mid1:OPN | Mid2:CLS | 1 | 1 | No | 40 |
| Wind or Weather or Stress | Mid1:OPN | Early1:ALL | 0.002 | 500 | Yes | 0 |
| Replacement Fire | Mid1:OPN | Early1:ALL | 0.0033 | 303 | Yes | 0 |
| Surface Fire | Mid1:OPN | Mid1:OPN | 0.1 | 10 | No | 0 |
| Wind or Weather or Stress | Mid2:CLS | Early1:ALL | 0.002 | 500 | Yes | 0 |
| Replacement Fire | Mid2:CLS | Early1:ALL | 0.0033 | 303 | Yes | 0 |
| Mixed Fire | Mid2:CLS | Mid1:OPN | 0.01 | 100 | No | 0 |
| Surface Fire | Mid2:CLS | Mid2:CLS | 0.1 | 10 | No | 0 |
| Wind or Weather or Stress | Late1:CLS | Early1:ALL | 0.002 | 500 | Yes | 0 |
| Replacement Fire | Late1:CLS | Early1:ALL | 0.0033 | 303 | Yes | 0 |
| Mixed Fire | Late1:CLS | Late2:OPN | 0.01 | 100 | No | 0 |
| Surface Fire | Late1:CLS | Late1:CLS | 0.1 | 10 | No | 0 |
| Alternative Succession | Late2:OPN | Late1:CLS | 1 | 1 | No | 100 |
| Wind or Weather or Stress | Late2:OPN | Early1:ALL | 0.002 | 500 | Yes | 0 |
| Replacement Fire | Late2:OPN | Early1:ALL | 0.0033 | 303 | Yes | 0 |
| Surface Fire | Late2:OPN | Late2:OPN | 0.1 | 10 | No | 0 |

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