13620

Laurentian-Acadian Northern Pine(-Oak) Forest

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

Forest and Woodland

Map Zones

51,63,64,65, 66

Geographic Range

Laurentian Acadian Northern Pine Oak Forest occurs in MB, ME, MI, MN, NB, NH, NS, NY, ON, PE?, QC, WI (NatureServe 2007).

Biophysical Site Description

Nothern 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 moderatley to extremely acidic with a surface layer or mor humus from accumulated pine needles (Cohen 2002).

Vegetation Description

Typically white pine and/or red pine form a supercanopy over a canopy of co-dominant trees such as red maple, paper birch, bigtooth aspen, trembling aspen, white oak, red oak, black oak, northern pin oak, and eastern hemlock. Portions of this type that occur on more mesic portions of the landscape may include sugar maple, yellow birch, and American beech.

The relative importance of pine and hardwood tree species in this system varies greatly across the map zone depending on local topography, soil, and landform. Presettlement forests of white pine, American beech, red maple and red oak were common on rolling, sandy moraines and moderately to well-drained sand plains. Mixed forests of white pine, red pine, black oak and white oak frequently occurred on rolling to steep gravelly landscapes throughout the northern Lower Peninsula. In the central Lower Peninsula and along the lake shore a forest co-dominated by white pine and white oak was characteristic of the dry sand plains. Assemblages dominated by hemlock and white pine were prevalent in the 1800s on moderately drained sand lake plains, ground moraines with fine till and outwash plains extending from Saginaw Bay through the Upper Peninsula. White pine and red pine were frequently co-dominants, concentrated in the northern Lower Peninsula on outwash plains and rolling moraines with sandy or gravelly soils and in the Upper Peninsula along

inland dune ridges (Comer et al. 1995).

BpS Dominant and Indicator Species

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| PIRE | Pinus resinosa | Red pine |
| PIST | Pinus strobus | Eastern white pine |
| POTR5 | Populus tremuloides | Quaking aspen |
| BEPA | Betula papyrifera | Paper birch |
| ACRU | Acer rubrum | Red maple |
| QUAL | Quercus alba | White oak |
| QURU | Quercus rubra | Northern red oak |
| QUVE | Quercus velutina | Black oak |

Disturbance Description

The natural disturbance regime in northern pine-oak forests is characterized by both infrequent catastrophic fire and frequent stand-perpetuating surface fires. This system fits into Fire Regime Group I, with fires occurring every 10 to 30yrs and low to moderate intensity (surface fires) most common. Severe wind events affect mature stands on an approximate 500yr rotation. Replacement fires occurred more frequently in barrens, young stands of mixed conifers, and mature closed conifers, whereas stands of mature, open conifers were primarily affected by surface fires.

Young white and red pines are killed by surface fires, becoming more resistant to fire disturbance when mature (age 50 to 100yrs). Once mature (approx 50yrs) both red pine and white pine are fire-adapted species and can withstand surface fire quite well. Mature stands are less susceptible to stand-replacing fires, due to tall crowns and the wide spacing of dominant trees that is maintained by surface fires. However, when catastrophic crown fires do occur, mortality is high in all structural layers, and survivorship depends on random variations in fire patterns resulting in unburned areas.

Fifty to 100yrs is required for red and white pine to produce adequate amounts of viable seed for self-replacement; thus crown-fire rotations of less than 50 to 100yrs favor early successional species capable of sprouting or invasion (e.g., aspen and birch), as well as species capable of producing seed in short periods (e.g., jack pine and black spruce). White pine is a mid-tolerant species capable of regenerating under full-light to shaded conditions. Red pine is less tolerant than white pine, and seedlings can only survive in approximately 35% or more full sunlight. This red pine-white pine community was predominantly even-aged due to frequent stand-replacing fires, with a relatively uniform structure in terms of tree height and diameter. During fire-free periods or periods with long surface fire rotation, mid-tolerant white pine gained dominance through gap-phase regeneration. During periods of repeated surface fires, red pine was favored over white pine.

Successional dynamics within this community were driven by interactions of disturbance regimes and neighborhood effects of nearby seed sources. Areas burning twice within short periods became temporary openlands and barrens, or early-successional aspen-birch.

Heinselman (1981) suggested there are two types of red-white pine systems, those maintained by frequent surface fires and a crown-fire rotation less than 150yrs, and those maintained by infrequent surface fires and crown-fire rotations between 150-300yrs. In the former, even-aged stands dominated, whereas in the latter systems, multi-aged white pine systems eventually developed. This description applies to red-white pine that occurred within landscape ecosystems where stand-replacing fires burned with 150yr rotations. Surface and crown fire regimes interacted to regulate age, landscape and within-stand structure,

and succession within this community. 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. Red-white pine forests were disturbed by large-scale, stand-replacing, crown fires in northern lower MI within rotations of 130 to 260yrs (Whitney 1986) and relatively frequent surface fires. In MI’s Upper Peninsula, Zhang et al. (1999) estimated that mixed red–jack–white pine communities burned on 160yr rotations, and red–white pine communities burned on 320yr rotations. Clark (1990), Heinselman (1981) and Frissel (1973) reported rotations of 135, 180, and 150yrs, respectively, for red-white pine communities in MN. Cleland et al. (2004a) estimated crown-fire rotations for the red–white pine community to be 164, 174, and 207yrs in northern Lower MI, MI’s Upper Peninsula, and northern WI, respectively. Longer rotations in WI are believed to be due to a higher density of lakes and wetlands resulting in a smaller surface area of upland landforms.

This community may have promoted surface fires by forming a deep, well-aerated litter layer of pine needles (McCune 1988). Relatively frequent surface fires (10 to 30yr cycles) reduced fuel loadings, eliminated living fuel ladders, and promoted widely-spaced trees that became increasingly resistant to crown fires over time (Frissell 1973). Surface fire regimes favored species with survival adaptations including thick bark and tall crowns, and maintained a landscape with a large proportion composed of widely-spaced, large pine. Surface fires also reduced competition and limited succession of more shade-tolerant species. Area maintained by surface fire was likely inversely related to area burned by crown fire, due to reduced fuel loadings and removal of shade-tolerant, coniferous fuel ladders. Fires burning in closed forests could be quite variable in intensity—from light surface fires to intense crown fires. Thus, each fire event represented a complex of fire types, with forest maintenance surface fires and forest-replacement crown fires interacting to form a single overall regime. Increased frequency of maintenance fires lengthened crown-fire rotations by reducing fuel loadings and eliminating the fuel ladders that promote crown fires.

VDDT Fire Frequency Results

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Min FI** | **Max FI** | **Percent of All Fires** |
| Replacement | 294 |  |  | 16 |
| Moderate (Mixed) | 454 |  |  | 11 |
| Low (Surface) | 66 |  |  | 73 |
| **All Fires** | **48** |  |  | **100** |

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 MN (Chippewa, Superior), MI (Ottawa, Hiawatha), and WI (Chequamegon, Nicolet), and the Menominee Reservation in WI.

Non-Fire Disturbances

Wind/Weather/Stress

Competition or lack of seed source

Adjacency or Identification Concerns

The natural range of red pine and white pine largely coincides with the extent of the Canadian shield. These pine forests were widespread in the past and included a diverse mixture of hardwood and conifer species including trembling aspen, bigtooth aspen, paper birch, white spruce, black spruce, balsam fir, red maple, sugar maple, and northern red oak. Bps 1301 - Boreal Aspen Birch Forest has been elimanted and lumped into several other BpSs in the Great Lakes. Trembling aspen - paper birch may have been a significant component of the early successional stages of this and other BpSs.

Historically this system was one of the most economically important species group in the lake states region. Extensive logging and subsequent slash fires that occurred throughout the Great Lakes in the mid to late 1800s greating reduced the extent of this system.

Issues or Problems

At the suggestion of the RA model (R6RPWff): The VDDT model was modified to increase the probability of wind storm events. Frelich has documented wind disturbance of catastrophic proportions as occurring on a 1000 to 2000yr interval. Granted that this may possibly be the landscape level mean, wind events are far more prevalent and occur randomly and with widespread regularity throughout the range of the red and white pine cover type. Thus, using local data, the wind event probability was increased to occur on an approximately 250yr average.

Native Uncharacteristic Conditions

Comments

**Model Parameters**

*Using Track Changes in Word you may suggest changes to any of the parameters indicated in the following tables. If you wish to see how those changes impact model results, go to the “Simulation Model Review Instructions” section on* <http://www.landfirereview.org/models.html>*. If you do not wish to edit and run the actual model, the TNC LANDFIRE will do so and if requested provide the reviewer with the results.*

**Succession Pathways**

|  |  |  |  |
| --- | --- | --- | --- |
| **From Class** | **Begins at (yr)** | **Succeeds to** | **After (years)** |
| Early1:ALL | 0 | Mid2:OPN | 30 |
| Late1:CLS | 151 | Late1:CLS | 999 |
| Mid1:CLS | 31 | Mid1:CLS | 150 |
| Mid2:OPN | 31 | Late1:CLS | 150 |

**Disturbance Pathways**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **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** |
| ReplacementFire | Early1:ALL | Early1:ALL | 0.0100 | 100 | No |   |
| AltSuccession | Early1:ALL | Mid1:CLS | 0.0010 | 1,000 | Yes |   |
| ReplacementFire | Late1:CLS | Early1:ALL | 0.0030 | 333 | Yes |   |
| Wind/Weather/Stress | Late1:CLS | Early1:ALL | 0.0020 | 500 | Yes |   |
| SurfaceFire | Late1:CLS | Late1:CLS | 0.0130 | 77 | No |   |
| MixedFire | Late1:CLS | Mid1:CLS | 0.0050 | 200 | Yes |   |
| Wind/Weather/Stress | Late1:CLS | Mid1:CLS | 0.0020 | 500 | Yes |   |
| ReplacementFire | Mid1:CLS | Early1:ALL | 0.0020 | 500 | Yes |   |
| Wind/Weather/Stress | Mid1:CLS | Early1:ALL | 0.0020 | 500 | Yes |   |
| AltSuccession | Mid1:CLS | Late1:CLS | 1.0000 | 1 | Yes | 100 |
| Wind/Weather/Stress | Mid1:CLS | Mid1:CLS | 0.0020 | 500 | No |   |
| Competition/Maint | Mid1:CLS | Mid2:OPN | 0.0200 | 50 | Yes |   |
| ReplacementFire | Mid2:OPN | Early1:ALL | 0.0020 | 500 | Yes |   |
| Wind/Weather/Stress | Mid2:OPN | Early1:ALL | 0.0020 | 500 | Yes |   |
| MixedFire | Mid2:OPN | Mid1:CLS | 0.0020 | 500 | Yes |   |
| Wind/Weather/Stress | Mid2:OPN | Mid1:CLS | 0.0020 | 500 | Yes |   |
| SurfaceFire | Mid2:OPN | Mid2:OPN | 0.0250 | 40 | No |   |

Succession Classes

Class A 13 Early Development 1 - All Structures

Structural Information

Upper Layer Lifeform: Tree

Upper Layer Canopy Cover: 11 - 100%

Upper Layer Canopy Height: Tree 0m - Tree 5m

Tree Size Class: Pole 5-9" DBH

Upper Layer Lifeform is not the dominant lifeform

Dominant life form consists of low shrubs, ferns, and herbaceous species although any exisitng scattered trees would be the upper level life form.

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIRE | Pinus resinosa | Red pine | Upper |
| PIST | Pinus strobus | Eastern white pine | Upper |
| PIBA2 | Pinus banksiana | Jack pine | Low-Mid |

Description

Class A (0-30yrs) is typified by barrens and open lands dominated by shrubs, sweet fern, bracken fern, blueberry, sedges, grasses, and other herbaceous plants. This stage represents 0-30yrs in time. At the start of this class trees comprise less than 10% canopy cover, including those that survived a castostrophic fire event. After 5-10yrs pine and oak seedlings and saplings will establish. Depending on local site conditions (soil, climate, landforms, and proximity of pine-oak seed sources) class A can succeed to either B or C. If a replacement fire occurs in class A this stage will consist of scrubby oak grubs and young jack pines.

Class B 13 Mid Development 1 - Closed

Structural Information

Upper Layer Lifeform: Tree

Upper Layer Canopy Cover: 41 - 100%

Upper Layer Canopy Height: Tree 5.1m - Tree 25m

Tree Size Class: Medium 9-21"DBH

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIRE | Pinus resinosa | Red pine | Upper |
| PIBA2 | Pinus banksiana | Jack pine | Upper |
| POTR5 | Populus tremuloides | Quaking aspen | Mid-Upper |
| BEPA | Betula papyrifera | Paper birch | Mid-Upper |

Description

Class B (31-150yrs) is comprised of mixed red pine-jack pine-oak stands with a bigtooth and trembling aspen-birch component that has established following a major disturbance event. This stage could establish in the absense of a nearby pine and oak seed source. This stage may include a significant component of aspens, paper birch with young pines and oaks in the understory of these pioneer species. After 30-50yrs, pine and hardwoods may begin to compete with pioneer aspens and birch and obtain canopy dominance. By 75-100yrs aspens and birch will begin to senesce and pine and oak species reach canopy dominance. This class will succeed to class D (through alt succession in the VDDT model).

Class C 48 Mid Development 2 - Open

Structural Information

Upper Layer Lifeform: Tree

Upper Layer Canopy Cover: 0 - 40%

Upper Layer Canopy Height: Tree 5.1m - Tree 25m

Tree Size Class: Medium 9-21"DBH

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIRE | Pinus resinosa | Red pine | Upper |
| PIST | Pinus strobus | Eastern white pine | Upper |
| PIBA2 | Pinus banksiana | Jack pine | Upper |

Description

Class C is a mid-seral stage comprised of young red pine-white pine stands 30-150 years old. Jack pine could be a significant component of this mid-seral stages, especially following replacement or frequent fire events. This stage would occur on drier, more barren sites where aspen and birch are not a major component or where seed producing pines seeded in after a fire event. Also these drier sites would be more fire-prone and therefore frequent surface fires would help maintain the open conditions of this class. This class succeeds to class D.

Class D 26 Late Development 1 - Closed

Structural Information

Upper Layer Lifeform: Tree

Upper Layer Canopy Cover: 51 - 90%

Upper Layer Canopy Height: Tree 25.1m - Tree 50m

Tree Size Class: Very Large >33"DBH

Indicator Species

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

Description

Class D is comprised of mature red pine-white pine stands (>151 yrs). There may be a subcanopy of hardwood species such oaks and red maple. There may also be a low to mid shrub layer of shrubs such as of witch hazel and maple-leaved viburnum. Groundlayer species may include wintergreen, wild sarsaparilla.

References

Bergeron, Y. 1991. The influence of island and mainland lakeshore landscapes on boreal forest fire regimes. Ecology 72:1980–1992.

Bergeron, Y. and J. Brisson. 1990. Fire regime in red pine stands at the northern limit of the species range. Ecology 17:1352-1364.

Braun, E.L. 1950. Deciduous Forests of Eastern North America. Blackburn Press. Caldwell, NJ. 596 pp.

Clark, James S. 1990. Fire and climate change during the last 750 years in northwestern Minnesota. Ecological Monographs 60(2):135-159.

Cleland, D.T., S.C. Saunders, T.R. Crow, D.I. Dickmann, A.L. Maclean, J.K. Jordan, R.L. Watson and A.M. Sloan. 2004. Characterizing historical and modern fire regimes in the Lake States: A landscape ecosystem approach. Landscape Ecology 19:311-325. 2004.

Cleland, D.T., S.C. Saunders, K.M. Brosofske, A.L. Maclean, J.K. Jordan, R.L. Watson, A.M. Sloan, T.M. Scupien, T.R. Crow and D.I. Dickmann. 2003. Ongoing project to determine historical and modern wind and fire regimes, fire risk and historical landscape and community composition and structure in the Lake States and R-9 National Forests.

Cohen, J. G. 2002. Natural Community abstract for dry-mesic northern forest. Michigan Natural Features Inventory, Lansing, MI. 12 pp.

Comer, P.J., D.A. Albert, H.A. Wells, B.L. Hart, J.B. Raab, D.L. Price, D.M. Kashian, R.A. Cornerand 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.

Dansereau, P.R.and Bergeron, Y. 1993. Fire history in the southern boreal forest of

northwestern Quebec. Can. J. For. Research 23:25-32.

Frissell, S.S. Jr. 1973. The importance of fire as a natural ecological factor in Itasca State Park, Minnesota. Quat. Research 3:397-407.

Heinselman, M.L. 1981. Fire and succession in the conifer forests of North America. In forest succession: concepts and applications. West, D.C, H.H. Shugart and D.B. Botkin, eds. Springer-Verlag, New York. 374-406.

Heinselman, M.L. 1978. Fire Intensity and Frequency as Factors In The Distribution and Structure of Northern Ecosystems. USDA, GTO, WO-26.

Heinselman, M.L. 1973. Fire in the virgin forests of the Boundary Waters Canoe Area, Minnesota. University of Michigannnesota. Quat. Research 3:329-382.

Holla, Teresa A. and Peggy I. Knowles. 1988. Age structure analysis of a virgin white pine, Pinus strobus, population. Canadian Field-Naturalist 102(2):221-226.

McCune, Bruce. 1988. Ecological diversity in North American pines. Amer. J. Boany. 75(3):353-368.

Motzkin, G., P. Wilson, D.R. Foster and A. Allen. 1999. Vegetation patterns in heterogeneous landscapes: the importance of history and environment. Journal of Vegetation Science.

NatureServe. 2007. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA, USA. Data current as of 15 April 2007.

Quinby, P.A. 1991. Self-replacement in old-growth white pine forests of Temagami, Ontario. For. Ecol. Management 41:95-109.

Turner, M.G., R.H. Gardner, V.H. Dale and R.V. O'Neill. 1989. Predicting the spread of

disturbance across heterogeneous landscapes. Oikos 55:121-129.

USDA Forest Service, Final Environmental Impact Statement for the Forest Plan Revision for the Chippewa and Superior National Forests, 2004.

Whitney, G.G. 1986. Relation of Michigan's presettlement pine forests to substrate and

disturbance history. Ecology 67(6):1548-1559.

Zhang, Q., K.S. Pregitzer and D.D. Reed. 1999. Catastrophic disturbance in the presettlement forests of the Upper Peninsula of MI. Canadian Journal of Forest Research 29:106-114.