13660

Laurentian-Acadian Pine-Hemlock-Hardwood Forest

BpS Model/Description Version: Aug. 2020

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

Forest and Woodland

Map Zones

51, 63, 64, 65, 66

Model Splits or Lumps

Geographic Range

Laurentian Acadian Pine Hemlock Hardwood Forest occurs the northeastern United States and maritime Canada west to Ontario, Wisconsin, and Michigan (Gawler & Faber-Langendoen 2015).

Within Hiawatha National Forest (Section 212R), Laurentian-Acadian pine-hemlock-hardwood forest is estimated to have covered ca. 70,000 ha (175,000 ac) at the time of the General Land Office (GLO) Surveys (Comer et al. 1995). The system was widespread in large patches in Mackinac, Chippewa, Alger, Scholcraft, and Delta Counties.

Biophysical Site Description

Presettlement forests of eastern hemlock, eastern white pine, and yellow birch commonly occurred on a variety of landforms, ranging from ravines, slopes, and summits in hilly or mountainous terrain to moist, moderately drained silty/clayey lake plains, moderate to poorly-drained till plains, outwash and lake plains and drumlin fields (Thompson and Sorenson 2005; Albert and Comer 2008; Sperduto and Kimball 2011). This assemblage was often found around lake and bog margins and in complex mosaics with (beech-)sugar maple-hemlock forest on the surrounding better-drained soils. Elevations are low to moderate, generally < 2000ft. Soil textures range from fine-textured sands to till and clay, and chemistry is acidic to circumneutral. The region has a cool snow-forest climate with warm summers. The daily maximum temperature in July ranges from 24 to 29 °C (75 to 85 °F) and the daily minimum temperature in January ranges from -21 to -9 °C (-5 to 15 °F). The mean length of freeze-free days is between 90 to 160 days and the average number of days per year with snow cover of 2.5cm or more is between 80 and 140 days. The normal annual total precipitation ranges from 610 to 1270 mm (Albert et al. 1986, Barnes 1991).

In the HNF, hemlock – white pine forests and hemlock – yellow birch forests occurred in small to large patches in landscape positions on lake plains and outwash plains between higher, better-drained beech – maple – hemlock forests (or, occasionally, drier pine forests) and a variety of wetlands (e.g., rich conifer swamp, muskeg, poor fen, patterned fen, bog, northern wet meadow), lakes, and streams. It also occurred less frequently on thin till over bedrock and in dune-and-swale complexes adjacent to Lake Michigan (Albert & Comer 2008).

Vegetation Description

Typical canopy dominants or codominants are Tsuga canadensis (eastern hemlock), Pinus strobus (white pine) and Betula alleghaniensis (yellow birch). Other components of the canopy can include Abies balsamea (balsam fir), Thuja occidentalis (white cedar), Picea rubens (red spruce), and several hardwoods, especially Acer rubrum (red maple), but also A. saccharum (sugar maple), Fagus grandifolia (beech), and Quercus rubra (red oak), although hardwoods comprise <75% of the canopy (Gawler & Faber-Langendoen 2015). Subcanopy, shrub, and ground layer cover and diversityare low due to the nutrient-poor and acidic mor humus as well as the low understory light intensity caused by the perpetually dense hemlock canopy (Curtis, 1959). Characteristic species of these substrata include conifer and hardwood seedlings and saplings, Viburnum acerifolium (maple-leaved viburnum), Hamamelis virginiana (witch-hazel), Lonicera canadensis (Canadian fly honeysuckle), Maianthemum canadense (Canada mayflower), Trientalis borealis (starflower), Medeola virginiana (Indian cucumber-root), Mitchella repens (partridge-berry), Aralia nudicaulis (wild sarsaparilla), Gaultheria procumbens (wintergreen). Coptis trifolia (goldthread), Oxalis acetosella (northern wood-sorrel), Dryopteris intermedia (intermediate wood fern), Spinulum annotinum (stiff clubmoss), Huperzia lucidula (shining clubmoss), and scattered bryophytes (Thompson & Sorenson 2005; Gawler & Cutko 2010; Reznicek et al. 2011; Sperduto & Kimball 2011).

BpS Dominant and Indicator Species

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| TSCA | *Tsuga canadensis* | Eastern hemlock |
| BEAL2 | *Betula alleghaniensis* | Yellow birch |
| PIST | *Pinus strobus* | Eastern white pine |

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

Disturbance Description

Disturbance and successional dynamics in the hemlock-birch-pine type are driven by wind events. Tree falls and crown removal are the primary results from the wind disturbance in conjunction with the shallow root systems of the hemlock and white pine. The wind events that can occur are downbursts and microbursts from thunderstorms, tornados, and general circulation winds around severe low-pressure systems. Data for long-term events is estimated from current conditions and sparse historical data. Heavy, catastrophic windstorms and tornados are estimated to have occurred at >1000yr intervals. Estimates of rotation periods for wind events range from 1200-2400yrs (Whitney 1986). Insect attacks follow wind or ice storm damage, and contribute to the break-up of the stands, generating large amounts of coarse, woody debris.

There is limited data for wind event disturbances. The wind events generated large amounts of coarse woody debris. Rare broad-scale catastrophic storm and fire interactions resulted in fire rotations of more than a thousand years (Cleland et al. 2004, Ziegler 2002, Woods 2000, Canham and Loucks 1984, Frelich and Lorimer 1991, Grimm 1984, Runkle 1982, Whitney 1986). Most of these fires were severe surface fires that occurred only after prolonged drought and insect/disease events. The fire cycle for such forests must have been erratic, with intervals of 200-300yrs plausible. Concomitant with surface fires, ground fires that consume organic horizons can also occur under unusually dry conditions (VanDeMark 2006). These may be especially important in high-moisture sites where considerable depth of organic deposits accumulate under predominantly hemlock canopies. Fire Regime V applies to this system.

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Percent of All Fires** | **Min FI** | **Max FI** |
| Replacement | 485 | 32 |  |  |
| Moderate (Mixed) | 1000 | 15 |  |  |
| Low (Surface) | 291 | 53 |  |  |
| All Fires | 154 | 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. Replacement fires at 400-500yrs may be in the thousands of acres. Surface and mixed fires could be less than 10ac.

Adjacency or Identification Concerns

This system is distinguished from other similar systems by a strong pine and/or hemlock component and the potential to succeed to hemlock-dominated stands; this would have been possible under the natural disturbance regime and given natural densities of seed sources. Historical harvesting and subsequent repeated fires in the late 1800s and early 1900s have allowed some expansion of BpS 1302 (Laurentian-Acadian Northern Hardwood Forest) and BpS 1362-2 (Laurentian-Acadian Northern Pine-Oak Forest) onto sites formerly occupied by this type, particularly due to dramatic decreases in available hemlock seed sources. Expansion and comingling of 1302 would generally be restricted to more loamy and nutrient rich soils. Comingling with 1362-2 would occur primarily near sites with historically more frequent fire. Lack of hemlock seed sources and hemlock recruitment on the landscape would effectively convert this to 1362-2 during the later successional stages. Historical data sources will be required to correctly depict the historic distribution of this type.

Decline of hemlock due to infestation by hemlock woolly adelgid (Adelges tsugae) may result in conversion of this type to Laurentian-Acadian Hardwood Forest with expansions of hardwoods such as beech and yellow birch into areas formerly dominated by hemlock, although this decline may take decades or longer in areas infested with HWA, and may be impacted by coincident infestation of stands by pests of competing hardwoods such as beech scale (Cryptococcus fagisuga) (Jenkins et al. 2000; Morin & Liebhold 2015).

Issues or Problems

Much of this type was heavily altered during landscape-scale historical harvesting in the late 1800’s and early 1900’s (Mladenoff and Pastor 1993), primarily resulting in a drastic reduction of hemlock seed sources on the landscape. Current recruitment of hemlock may be limited not only by this reduced distribution of seed sources, but also from significant rates of browsing by white-tailed deer (Carey 1993).

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 | 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 | B mix | B mix | B mix | B mix | B mix | B mix | B mix | B mix | B mix | B mix |
| 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 | 10-25 | D | D | D | D | D | D | D | D | D | D |
| 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 3 Early Development 1 - All Structures

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| BEPA | Betula papyrifera | Paper birch | Upper |
| POTR5 | Populus tremuloides | Quaking aspen | Upper |

Description

Openings. 0-10yrs following a replacement event in classes A, B and C. May be characterized by other species including Acer saccharum (sugar maple), Betula alleghaniensis (yellow birch), Ostrya virginiana (ironwood), Populus grandidentata (bigtooth aspen), and Pinus strobus (white pine) depending on surrounding unburned forest types.

*Maximum Tree Size Class*
Seedling <4.5ft

Class B 16 Early Development 2 - Closed

Upper Layer Lifeform: Tree

Upper Layer Canopy Cover: 71 - 90%

Upper Layer Canopy Height: Tree 5.1m - Tree 10m

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| QURU | Quercus rubra | Northern red oak | Upper |
| BEPA | Betula papyrifera | Paper birch | Upper |
| POTR5 | Populus tremuloides | Quaking aspen | Upper |
| ACRU | Acer rubrum | Red maple | Upper |
| POGR4 | Populus Grandidentata | Bigtooth aspen | Upper |

Description

Post replacement regeneration with early seral species.

Balsam fir could occasionally become established during this class, but would have been primarily limited to the understory and midstory strata.

*Maximum Tree Size Class*
Sapling >4.5ft; <5"DBH

Class C 39 Mid Development 1 - Closed

Upper Layer Lifeform: Tree

Upper Layer Canopy Cover: 51 - 90%

Upper Layer Canopy Height: Tree 5.1m - Tree 10m

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIST | Pinus strobus | Eastern white pine | Upper |
| PIRE | Pinus resinosa | Red pine | Upper |
| TSCA | Tsuga canadensis | Eastern hemlock | Upper |
| BEAL2 | Betula alleghaniensis | Yellow birch | Upper |

Description

Stands consist of red pine, white pine, eastern hemlock and yellow birch.

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

Class D 42 Late Development 1 - Closed

Upper Layer Lifeform: Tree

Upper Layer Canopy Cover: 51 - 100%

Upper Layer Canopy Height: Tree 10.1m - Tree 50m

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIST | Pinus strobus | Eastern white pine | Upper |
| TSCA | Tsuga canadensis | Eastern hemlock | Upper |
| BEAL2 | Betula alleghaniensis | Yellow birch | Mid-Upper |

Description

Stands consist of mature and old growth hemlock, occasionally mixed with white pine, yellow birch, and potentially several other associates.

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

Model Parameters

Deterministic Transitions

|  |  |  |  |
| --- | --- | --- | --- |
| **From Class** | **Begins at (yr)** | **Succeeds to** | **After (years)** |
| Early1:ALL | 0 | Early2:CLS | 10 |
| Early2:CLS | 11 | Mid1:CLS | 80 |
| Mid1:CLS | 81 | Late1:CLS | 300 |
| Late1:CLS | 301 | 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 | 0.005 | 200 | Yes | 0 |
| Wind or Weather or Stress | Early2:CLS | Early1:ALL | 0.001 | 1000 | Yes | 0 |
| Replacement Fire | Early2:CLS | Early1:ALL | 0.002 | 500 | Yes | 0 |
| Surface Fire | Early2:CLS | Early2:CLS | 0.005 | 200 | No | 0 |
| Wind or Weather or Stress | Mid1:CLS | Early1:ALL | 0.001 | 1000 | Yes | 0 |
| Replacement Fire | Mid1:CLS | Early1:ALL | 0.002 | 500 | Yes | 0 |
| Mixed Fire | Mid1:CLS | Mid1:CLS | 0.0025 | 400 | No | 0 |
| Surface Fire | Mid1:CLS | Mid1:CLS | 0.004 | 250 | No | 0 |
| Wind or Weather or Stress | Late1:CLS | Mid1:CLS | 0.001 | 1000 | Yes | 0 |
| Replacement Fire | Late1:CLS | Early1:ALL | 0.002 | 500 | Yes | 0 |
| Surface Fire | Late1:CLS | Late1:CLS | 0.0025 | 400 | No | 0 |

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