13740

Acadian-Appalachian Montane Spruce-Fir Forest

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| **Modelers** |  | **Reviewers** |  |
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| None | None | None | None |
| None | None | None | None |

Vegetation Type

Forest and Woodland

Map Zones

64, 65, 66

Geographic Range

This system is found at higher elevations of northern New England and the Adirondacks, extending north along the mountains and higher hills into Canada and occurring southward in the Catskills (NatureServe 2007).

In New York, this system is found at high elevations in the Catskill and Adirondack mountains (Subsections 211I and 211D), usually at elevations ranging from 3000-4500ft (~900-1400m) (Edinger, et al. 2002).

Biophysical Site Description

This system occurs mostly upwards of 457m (1500ft) elevation and is restricted to progressively higher elevations southward. Northward, it is often contiguous with Acadian Low-Elevation Spruce-Fir-Hardwood Forest (CES201.565). (NatureServe 2007)

In map zone 64, this system is typically found on mountain slopes, at elevations from 900-1400m. Soils are strongly podzolized, and they tend to be highly organic. (Edinger, et al., 2002)

Vegetation Description

This system often forms a mosaic of strongly coniferous patches and mixed patches, with occasional smaller inclusions of northern hardwoods, but is overall more than 50% coniferous. *Picea rubens* and *Abies balsamea* are the dominant conifers. Common associates are mountain paper birch (*Betula cordifolia*) and yellow birch (*B. alleghaniensis*). At higher elevations and on more exposed slopes, the canopy may be almost entirely balsam fir, with only scattered red spruce and mountain paper birch (*Betula cordifolia*). (This is Edinger, et al. (2002) “Mountain fir forest.”)

Subcanopy trees thatare usually present at a low density include mountain ash (*Sorbus americana*), mountain maple (*Acer spicatum*), pin cherry (*Prunus pensylvanica*) and striped maple (*Acer pensylvanicum*). The shrub layer may consist primarily of seedlings and saplings of canopy trees; other shrubs that are present in some stands include red elderberry (*Sambucus racemosa)*, mountain holly (*Nemopanthus mucronatus*), American fly honeysuckle (*Lonicera canadensis*), and dwarf raspberry (*Rubus pubescens*). In the Catskills, hobblebush (Viburnum lantanoides) and mountain azalea (*Rhododendron prinophyllum*) are also common. At higher elevations and on more exposed slopes, the shrub layer may be dominated by balsam fir seedlings and saplings, with occasional individuals of green alder (*Alnus viridis* ssp. *crispa*) and Labrador tea (*Ledum groenlandicum*). (Edinger, et al. 2002).

Typically there is a dense layer of feather mosses and other bryophytes carpeting the forest floor; common bryophytes include *Pleurozium schreberi, Ptilium crista-castrensis, Bazzania trilobata, Brotherella recurvans, Dicranum scoparium, Hypnum pallescens,Hylocomium splendens*, and *Drepanocladus uncinatus*. Characteristic herbs are common wood-sorrel *(Oxalis acetosella*), mountain wood fern (*Dryopteris campyloptera*), bluebeads (*Clintonia borealis*), Canada

mayflower (*Maianthemum canadense*), mountain wood fern (*Dryopteris campyloptera*), bunchberry (*Cornus canadensis*), large-leaf goldenrod (*Solidago macrophylla*), mountain aster (*Aster acuminatus*), goldthread (*Coptis trifolia*), bristly clubmoss (*Lycopodium annotinum*), and shining clubmoss (*Lycopodium lucidulum*).

BpS Dominant and Indicator Species

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| PIRU | *Picea rubens* | Red spruce |
| ABBA | *Abies balsamea* | Balsam fir |
| BEAL2 | *Betula alleghaniensis* | Yellow birch |
| BEPAC2 | *Betula papyrifera var. cordifolia* | Mountain paper birch |
| POTR5 | *Populus tremuloides* | Quaking aspen |
| BEPA | *Betula papyrifera* | Paper birch |
| SOAM3 | *Sorbus americana* | American mountain ash |
| OXMO | *Oxalis montana* | Mountain woodsorrel |

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

Disturbance Description

The primary disturbance types impacting this system are insect damage, wind throw, ice damage and fire. Insects, wind and fire often act in concert, with budworm outbreaks increasing susceptibility to wind storms and either or both of these disturbances increasing dead fuel and thus predisposing the forest to catastrophic fire. Susceptibility to fire may be highest 5-8yrs after tree mortality. After that, flammability gradually decreases as fuel decomposes and new understory develops.

Estimates of mean fire return interval for this system range widely. In their comprehensive review, Lorimer and White suggest that 1200yrs may be the most likely estimate for the spruce-northern hardwood forest type as a whole, but they also present evidence that higher elevation forests of this type likely experienced more frequent fire. As with the lower elevation system (BpS 1373), fire disturbances would likely have been rare but severe and would have affected large patch sizes. Surface fires are extremely uncommon. Fire may occur in the spring or later in the growing season under drought conditions, with the former favoring a pathway to early successional aspen-birch and delaying spruce-fir regeneration. This pathway is modeled as Alternate Succession via classes C and D. Sustained crown fire runs covering several hundred acres can occur, with severe damage at the ground surface, depending on time of year. Drought spring conditions produce the most severe effects, whereas late summer or fall burns may temper effects due to presence of live fuel moisture. Large fires (10-100ac) and some wind events could extend class D to 130yrs before the paper birch finally senesces and the dense fir understory emerges. It is then a further 50-150yrs before the fir either senesces or is knocked back by budworm.

Wind events, insect attack and ice storms -- on a small patch to stand scale -- are more important than fire in this system. Stand replacing wind events (severe hurricane damage or microbursts) are expected to occur with a mean return interval of about 1000yrs (Lorimer and White, 2003). Severe hurricane damage is less common in this system’s range than in southern and central New England. Boose, et al.(2001) estimate the return interval for hurricanes capable of causing extensive blowdowns to be 380yrs for coastal Maine, and longer for the rest of this system’s range. In this montane system, susceptibility to severe wind damage varies widely with aspect and exposure. In this model, the younger classes and those dominated by hardwoods were assumed to be less susceptible to severe wind damage than the older classes dominated by fir and spruce (Boose and Foster, 2001).

Less damaging wind and ice storms that damage individual trees and small patches are more common than stand-replacing events. Ice storm damage can be moderately severe in hardwood canopies, especially older aspen and birch forests, but that damage is likely to be localized on those stands and mostly with canopy recovery. Wind disturbance often results in an abundance of mountain ash (*Sorbus decora* and *S. canadensis*) as well as elderberry (*Sambucus pubescens* and *S. canadensis*).

Spruce budworm sometimes destroys whole stands of spruce-fir forest. The preferred host plant of spruce budworm is balsam fir, but this native insect also attacks over-mature spruce. Minor spruce budworm outbreaks are also of considerable importance particularly in classes B and D where fir is at its peak of attractiveness to the budworm. One or two cycles of budworm over a 50-150yr period slowly decreases the dominance or co-dominance of fir and increases in waves the strong dominance of red and potentially some black spruce. Spruce beetle attacks trees >18in DBH. Over-mature or stressed spruce is susceptible to witch's broom, Armillaria, and in severe outbreaks the stand can collapse. In the relatively stable late-closed class, moderate disturbances from wind, spruce budworm, spruce bark beetle, Armillaria, and ice storm impact on this community but not to stand-replacing severity.

Though spruce budworm outbreaks today are on a 40-60yr cycle, the historic cycle is thought to be much longer. Before the late1800s, outbreaks appear to have been of smaller size and intensity, and with a greater interval between outbreaks.

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Percent of All Fires** | **Min FI** | **Max FI** |
| Replacement | 584 | 100 |  |  |
| Moderate (Mixed) |  |  |  |  |
| Low (Surface) |  |  |  |  |
| All Fires | 584 | 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 was a matrix forest type at higher elevations in its core range; to the south it would have been a large patch system.

Adjacency or Identification Concerns

From NatureServe 2007: "This system can occupy an intermediate elevation position between Acadian Low-Elevation Spruce-Fir-Hardwood Forest (CES201.565) and Acadian-Appalachian Subalpine Woodland and Barrens (CES201.568), and it could arguably be combined with one of those, probably the former. However, in the southern part of its range, it often occurs without either of these other systems. It is distinguished, in concept, from Acadian Low-Elevation Spruce-Fir-Hardwood Forest (CES201.565) by the presence or greater abundance of montane species such as *Sorbus americana* or *Sorbus decora, Dryopteris campyloptera, Oxalis montana*, etc., and by occurring at higher positions in the toposequence. It is generally above northern hardwood forests, while Acadian Low-Elevation Spruce-Fir-Hardwood Forest (CES201.565) is generally below (or at similar elevations to) northern hardwood forests."

Issues or Problems

A significant disturbance that is currently affecting mountain spruce-fir forests in the eastern United States is spruce decline, a phenomenon that retards the growth of red spruce and eventually kills many trees. The causes of spruce decline have not been substantiated, but atmospheric deposition of pollutants (acid rain) is likely a contributing factor. (Edinger, et al. 2002)

Native Uncharacteristic Conditions

Spruce budworm outbreaks today are thought to be on a much shorter cycle (40-60yrs) than would have occurred under presettlement conditions. Before the late 1800s, outbreaks appear to have been of smaller size and intensity, and with a greater interval between outbreaks. Twentieth century harvesting created many large openings, which along with later century stand treatments favored extensive coniferous and in this case fir-dominated stands (Fraver 2007). This created abnormally large and mono-typic stands of nearly even-aged fir dominating large parts of the landscape, paving the way for run-away budworm epidemics whose impacts were much more intensive and wide ranging than we assume would occur under prior 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 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Herb | 0.5-1.0 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Herb | >1.0 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| 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 | A | A | A | A | A | A | A | A | A | A |
| Tree | 5-10 | A | A | A | A | A | A | A | A | A | A |
| Tree | 10-25 | UN | UN | UN | UN | C | C | C | C | B | B |
| Tree | 25-50 | UN | UN | UN | UN | UN | D | D | D | E | E |
| Tree | >50 | UN | UN | UN | UN | UN | D | 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 8 Early Development 1 - All Structures

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| POTR5 | Populus tremuloides | Quaking aspen | Upper |
| BEPAC2 | Betula papyrifera var. cordifolia | Mountain paper birch | Upper |
| BEPA | Betula papyrifera | Paper birch | Upper |
| ABBA | Abies balsamea | Balsam fir | Low-Mid |

Description

This class occupies an opening that followed stand replacement fire, microburst, or another major disturbance. Young stands characterized by birch (paper, gray) and aspen (trembling, big-tooth). Understory has spruce (red/white/black, but especially red) and balsam fir.

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

Class B 7 Mid Development 1 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| POTR5 | Populus tremuloides | Quaking aspen | Upper |
| BEPAC2 | Betula papyrifera var. cordifolia | Mountain paper birch | Upper |
| ABBA | Abies balsamea | Balsam fir | Low-Mid |
| PIRU | Picea rubens | Red spruce | Low-Mid |

Description

This class represents intermediate stands dominated by birch and aspen or sometimes fir, with spruce and fir in the understory, aged 30-69yrs.

*Maximum Tree Size Class*  
Pole 5-9" DBH

Class C 7 Mid Development 2 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| BEPAC2 | Betula papyrifera var. cordifolia | Mountain paper birch | Upper |
| POTR5 | Populus tremuloides | Quaking aspen | Upper |
| ABBA | Abies balsamea | Balsam fir | Low-Mid |
| PIRU | Picea rubens | Red spruce | Low-Mid |

Description

This class reflects suppressed establishment of spruce-fir. The canopy will be dominated by birch and aspen. The understory initially lacks spruce and fir but the conifers establish later in the class, perhaps ~40yrs.

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

Class D 8 Late Development 1 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIRU | Picea rubens | Red spruce | Mid-Upper |
| ABBA | Abies balsamea | Balsam fir | Mid-Upper |
| BEPAC2 | Betula papyrifera var. cordifolia | Mountain paper birch | Upper |
| BEAL2 | Betula alleghaniensis | Yellow birch | Mid-Upper |

Description

This is the primary successional pathway from class C. This class represents closed stands dominated in the early years of the class by mature birch, with the aspen dying out. The understory fir and spruce are beginning to take over. By the end of this class (age range 80-119yrs), the early successional hardwoods have senesced, and the canopy is mostly fir and spruce, mixed with other hardwoods. Where this class has followed a budworm outbreak, the fir may be missing from the canopy. Occasional white pines present in this class may exceed 25m in height. In nature, cover overlaps with C, as trees have reached maximum height in C. Canopy cover could be >60%.

*Maximum Tree Size Class*  
Large 21-33"DBH

Class E 70 Late Development 2 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIRU | Picea rubens | Red spruce | Mid-Upper |
| ABBA | Abies balsamea | Balsam fir | Mid-Upper |
| BEAL2 | Betula alleghaniensis | Yellow birch | Mid-Upper |

Description

This is a closed spruce/fir stand (with a variable component of late successional hardwoods) from 70-175yrs+. Individual fir trees drop out after age 70-100yrs, but spruce and fir regenerate in gaps, eventually to spruce and secondarily to fir. Moderate disturbances from wind, spruce budworm, spruce bark beetle, Armillaria, and ice storms impact on this community but not to stand-replacing severity.

*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:CLS | 29 |
| Mid1:CLS | 30 | Late2:CLS | 69 |
| Mid2:CLS | 30 | Late1:CLS | 68 |
| Late1:CLS | 69 | Late1:CLS | 119 |
| Late2:CLS | 70 | Late2: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 | 0.001 | 1000 | Yes | 0 |
| Alternative Succession | Early1:ALL | Mid2:CLS | 0.015 | 67 | Yes | 0 |
| Wind or Weather or Stress | Mid1:CLS | Early1:ALL | 0.001 | 1000 | Yes | 0 |
| Replacement Fire | Mid1:CLS | Early1:ALL | 0.001 | 1000 | Yes | 0 |
| Wind or Weather or Stress | Mid1:CLS | Mid1:CLS | 0.004 | 250 | No | 0 |
| Insects or Disease | Mid1:CLS | Mid2:CLS | 0.005 | 200 | Yes | 0 |
| Wind or Weather or Stress | Mid2:CLS | Early1:ALL | 0.001 | 1000 | Yes | 0 |
| Replacement Fire | Mid2:CLS | Early1:ALL | 0.001 | 1000 | Yes | 0 |
| Wind or Weather or Stress | Late1:CLS | Early1:ALL | 0.001 | 1000 | Yes | 0 |
| Replacement Fire | Late1:CLS | Early1:ALL | 0.001 | 1000 | Yes | 0 |
| Insects or Disease | Late1:CLS | Mid2:CLS | 0.004 | 250 | Yes | 0 |
| Wind or Weather or Stress | Late1:CLS | Late1:CLS | 0.004 | 250 | No | 0 |
| Alternative Succession | Late1:CLS | Late2:CLS | 0.015 | 67 | Yes | 0 |
| Wind or Weather or Stress | Late2:CLS | Early1:ALL | 0.002 | 500 | Yes | 0 |
| Replacement Fire | Late2:CLS | Early1:ALL | 0.002 | 500 | Yes | 0 |

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