

13740

Acadian-Appalachian Montane Spruce-Fir Forest

BpS Model/Description Version: Aug. 2020

Update: 4/19/2018

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 that are 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 (*Nemopanthis mucronatus*), American fly honeysuckle (*Lonicera canadensis*), and dwarf raspberry (*Rubus pubescens*). In the Catskills, hobblebush (*Viburnum*

lantanoïdes) 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	<i>Picea rubens</i>	Red spruce
ABBA	<i>Abies balsamea</i>	Balsam fir
BEAL2	<i>Betula alleghaniensis</i>	Yellow birch
BEPAC2	<i>Betula papyrifera</i> var. <i>cordifolia</i>	Mountain paper birch
POTR5	<i>Populus tremuloides</i>	Quaking aspen
BEPA	<i>Betula papyrifera</i>	Paper birch
SOAM3	<i>Sorbus americana</i>	American mountain ash
OXMO	<i>Oxalis montana</i>	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 late 1800s, 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

[illegible]

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	<i>Populus tremuloides</i>	Quaking aspen	Upper
BEPAC2	<i>Betula papyrifera</i> var. <i>cordifolia</i>	Mountain paper birch	Upper
BEPA	<i>Betula papyrifera</i>	Paper birch	Upper
ABBA	<i>Abies balsamea</i>	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	<i>Populus tremuloides</i>	Quaking aspen	Upper
BEPAC2	<i>Betula papyrifera</i> var. <i>cordifolia</i>	Mountain paper birch	Upper
ABBA	<i>Abies balsamea</i>	Balsam fir	Low-Mid
PIRU	<i>Picea rubens</i>	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

7

Mid Development 2 - Closed

Indicator Species

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

8

Late Development 1 - Closed

Indicator Species

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

70

Late Development 2 - Closed

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
PIRU	<i>Picea rubens</i>	Red spruce	Mid-Upper
ABBA	<i>Abies balsamea</i>	Balsam fir	Mid-Upper

BEAL2	Betula alleghaniensis	Yellow birch	Mid-Upper
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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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