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Acadian-Appalachian Subalpine Woodland and Heath-Krummholz

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Modelers		Reviewers	
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None	None	None	None
None	None	None	None

Vegetation Type

Shrubland

Map Zones

64, 66

Geographic Range

This system is found on the higher summits of the northern Appalachian Mountains, from northern New England and the Adirondacks into the Canadian Gaspé, extending south in scattered locations into southern New England.

Biophysical Site Description

This system encompasses vegetation of varying physiognomy at upper elevations, near and slightly above treeline, in the northeastern United States and adjacent Canada. It may be a zone between montane spruce-fir forest and alpine systems or may cover the ridgelines and summits of lower mountains. In the Appalachians it occurs mostly above 915m (3000ft) elevation but can be at much lower elevations near the Atlantic Coast.

Vegetative cover in these systems consists of stunted spruce trees (i.e., krummholz), dwarf-shrubland, lichen or sparse vegetation. Islands of taller shrubs and trees may occur in protected spots. This system includes wetland depressions, small alpine bogs, within the surrounding upland matrix. More specifically, subalpine fens, which are rare and restricted to the White Mountains, are included here. These are heath-dominated and graminoid-dominated fens, often occurring in a mosaic surrounded by other subalpine vegetation. They are on gentle slopes (usually ~10%), usually at 732-915m (2400-3000ft) elevation. Peat accumulation is in the 10-50cm range. Occurrences are usually about 5ac in size but range up to about 20ac.

The vegetation is exposed to high winds, a short growing season, low temperatures, heavy cloud cover, and snow accumulation, high precipitation and fog interception, and well drained soils with, low nutrient availability and high organic matter content (Sperduto and Cogbill 1999).

Vegetation Description

Overall plant composition in these systems relates well to elevation range, area, and range of soil moisture conditions (Sperduto and Cogbill 1999, Bliss 1963). Vegetation structure ranges from woodland to shrubland to sparsely vegetated dwarf-shrubs and herbs. Woodlands may be locally extensive, and patches of open rock support areas of shrub, dwarf-shrub or sparse vegetation. Shrublands may be extensive on the upper slopes, forming krummholz or, in somewhat more protected spots, deciduous shrub thickets. Trees become progressively stunted as exposure

increases, with *Picea rubens* replaced by *Picea mariana* in a stunted form. Ericads, including *Kalmia angustifolia*, *Ledum groenlandicum*, and *Vaccinium uliginosum*, are the most characteristic shrubs; *Empetrum nigrum* and *Empetrum eamesii* ssp. *atropurpureum* (= *Empetrum atropurpureum*) are indicative of the subalpine zone.

In the graminoid fens, *Calamagrostis pickeringii* is dominant and characteristic, with northern sedges such as *Carex michauxiana*, *Carex wiegandii*, *Carex exilis*, etc. The montane heath fens contain *Alnus viridis* ssp. *crispa* (= *Alnus crispa*), *Nemopanthus mucronatus*, and ericads.

BpS Dominant and Indicator Species

Symbol	Scientific Name	Common Name
KAAN	<i>Kalmia angustifolia</i>	Sheep laurel
LEGR	<i>Ledum groenlandicum</i>	Bog labrador tea
VAUL	<i>Vaccinium uliginosum</i>	Bog blueberry
EMNI	<i>Empetrum nigrum</i>	Black crowberry
EMEAA	<i>Empetrum eamesii</i> ssp. <i>atropurpureum</i>	Purple crowberry

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

Disturbance Description

Weather factors (wind/precipitation) are the primary agents of stress and disturbance to these systems. These factors are year-round, persistent, and chronic. In particular, permafrost and frost phenomena characterize parts of the Presidential Range, the largest and most diverse of the region's alpine areas (Sperduto and Cogbill 1999). As a result of the limiting fuel sources, most fires that occur in either system are likely in the "low" (surface) category.

While little research is available on fire frequency in these systems, natural fire is likely rare because of perennially moist conditions, sparse vegetation, and lack of soil and fuel. Fire may rarely occur, either from direct lightning strikes or, more likely, from upslope migration from adjacent forest types.

According to Sperduto and Cogbill (1999) and Forbes (1953), some subalpine ridgelines may have been originally opened by fires of natural or human origin, pushing the ecosystem over the "resiliency threshold" (Bormann and Likens 1979) where recovery to original forest could take centuries due to loss of soil. Other subalpine sites appear to have been open for at least many centuries based on the earliest accounts, although fire may have altered the proportion of forest versus open and woodland area (Whitney and Moeller 1982). Consequently, while fires have modified the extent of open habitat on some subalpine peaks, most were likely open to some extent prior to European settlement (Sperduto and Cogbill 1999). Numerous examples of sites with human fire history include mid-elevation ridgelines and summits in New Hampshire (e.g. the Baldface range, Mt. Cardigan, Mt. Chocorua, Moat Mountain, Mt. Kearsarge, and Mt. Monadnock) that burned long ago, and which have had limited vegetation recovery. In fact, the fires on Mt. Kearsarge (ca.1800), Mt. Chocorua (1815) and Moat Mountain (1854) initiated a loss of soil and vegetation that remains evident today and will likely take centuries to recover (Forbes 1953).

The unknown origin of many historical fires confounds the assessment of natural fire regimes. Many fires in the region, including some in these systems, likely occurred as a result of train

activity coupled with logging debris in the 1800s and early 1900s. In fact, Forbes (1953) noted that, “The denudation of these mountains has been due primarily to Man and his misuse of fire.”

Fire plays a more significant role in the Northern Appalachian-Acadian Rocky Heath system, which is similar in physiognomy but occurs in coastal and more southern locations. In the locations fires are at least partly responsible for the numerous “Bald” mountains from 1000--3000ft elevation throughout the Northeast.

In some cases, birch-alder communities within the Acadian-Appalachian Subalpine Woodland and Heath-Krummholz are a result of past landslides or snowslides, which create a suitable environment for these pioneering species (Flaccus 1959). Depending on the frequency of these disturbances, the birch-alder community may be a transient, successional montane community, or it may be a more permanent subalpine plant community lacking tall vegetative growth (Kimball and Weinrauch 2000).

Fire Frequency

Severity	Avg FI	Percent of All Fires	Min FI	Max FI
Replacement	3360	27		
Moderate (Mixed)	1805	52		
Low (Surface)	4310	21		
All Fires	923	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

Due to the patchiness of vegetation in these systems, fires are likely mostly small patch occurrences, with larger fires possible in areas where vegetation is more developed and more fuels have accumulated.

Adjacency or Identification Concerns

This system is distinguished from Acadian-Appalachian Montane Spruce-Fir-Hardwood Forest (CES201.566) by the shift to woodland and patchy barrens from the forested character of the montane forest, including the decreased importance of *Picea rubens*. They are often contiguous on the ground. It is also related to Northern Appalachian-Acadian Rocky Heath Outcrop (CES201.571) but occurs at higher elevations, and the heath outcrop system lacks *Vaccinium uliginosum*, *Empetrum* and other subalpine plant species. Patches of *Picea rubens*/*Vaccinium angustifolium* / *Sibbaldiopsis tridentata* Woodland (CEGL006053) might occur in this system, but only incidentally; that association is more central to the concept of Northern Appalachian-Acadian Rocky Heath Outcrop (CES201.571).

Subalpine fens are considered a distinct system by New Hampshire Natural Heritage Program, the only state where they are currently known to occur, but because there is little information currently available on them and the alpine system includes alpine wetlands as well as uplands, they are included within this system. This could be reconsidered as more information on their landscape distribution, extent and pattern becomes available. (NatureServe 2007)

Issues or Problems

Coupled with the slow rate of succession in this system, a presumed history of anthropogenic fires in this system makes the assessment of natural disturbance regimes very challenging.

Alpine and sub-alpine communities are among the most sensitive systems to climate change. In fact, regional projections of future greenhouse-gas-induced climatic warming indicate that alpine tundra systems may be lost between 440N and 570N (Delacourt and Delacourt 1998).

Native Uncharacteristic Conditions

As discussed above, it is thought that this system has been altered by anthropogenic fires in many locations.

Because of the high scenic value of these systems, human activities (i.e., hiking trails) are a localized source of persistent stress and disturbance. Most systems retain significant areas of natural vegetation with localized trampling of vegetation, soil erosion, and unofficial trail development. Some areas have been heavily trampled or reduced to gravel or bedrock with little hope of recovery at current recreational levels (Sperduo and Cogbill 1999).

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	B	B	B	B	B	B	B	B
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	C	C	C	C	C	C	UN	UN
Shrub	0.5-1.0	UN	UN	C	C	C	C	C	C	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	UN	UN	D	D	D	D	D	UN	UN	UN
Tree	5-10	UN	UN	UN	UN	UN	UN	UN	UN	UN	UN
Tree	10-25	UN	UN	UN	UN	UN	UN	UN	UN	UN	UN
Tree	25-50	UN	UN	UN	UN	UN	UN	UN	UN	UN	UN
Tree	>50	UN	UN	UN	UN	UN	UN	UN	UN	UN	UN

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	11	Early Development 1 - Open
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Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
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Description

This class represents the first 150yrs following a catastrophic disturbance such as a severe fire or possibly a landslide or avalanche. Little to no soil development has occurred. Beginning with bare rock, lichens gradually colonize the site.

Upper Layer Lifeform is not the dominant lifeform. This class will be dominated by lichens most often. Towards the end of the class, mosses and scattered sedges will begin to invade.

Maximum Tree Size Class

None

Class B	10	Early Development 2 - Open
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Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
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Description

In this class, soil development has begun, and vascular plants are beginning to dominate. Vegetation is a mixture of lichens, sedges and moss, with some patches of bare rock usually still present. There is still not enough vegetation to make fire possible. Stand-replacing disturbance such as a landslide or avalanche (modeled as Optional 1) is very unlikely (mean fire return interval=2000yrs).

Maximum Tree Size Class

None

Class C	23	Mid Development 1 - Open
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Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
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Description

This class represents a shrub-dominated community, with patches of herbaceous vegetation, mosses, lichen, and bare rock still likely.

Fire is possible but unlikely in this class, which still has very limited fuels. Any fire would be a surface fire that would keep the system in this class. Other stand-replacing disturbance such as landslide or avalanche (modeled as Optional 1) is very unlikely.

Upper Layer Lifeform is not the dominant lifeform. Shrubs become more dominant as this class progresses in age. At the beginning of the class, they may represent <25% cover.

Maximum Tree Size Class

None

Class D 56 Late Development 1 - Open

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
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Description

This class represents krummholz, with stunted spruce (and fir?) and patches of dense shrubs. Areas of denser and taller vegetation in this class provide an opportunity for fire to be carried across small to large patches of this class, most likely as a result of severe fires at lower elevations travelling upslope.

Maximum Tree Size Class

Pole 5-9" DBH

Model Parameters

Deterministic Transitions

From Class	Begins at (yr)	Succeeds to	After (years)
Early1:OPN	0	Early2:OPN	149
Early2:OPN	150	Mid1:OPN	299
Mid1:OPN	300	Late1:OPN	499
Late1:OPN	500	Late1:OPN	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
Optional 1	Early1:OPN	Early1:OPN	0.0005	2000	Yes	0
Optional 1	Early2:OPN	Early1:OPN	0.0005	2000	Yes	0
Optional 1	Mid1:OPN	Early1:OPN	0.0005	2000	Yes	0
Surface Fire	Mid1:OPN	Mid1:OPN	0.001	1000	No	0
Replacement Fire	Late1:OPN	Early1:OPN	0.0005	2000	Yes	0
Optional 1	Late1:OPN	Early1:OPN	0.0005	2000	Yes	0
Mixed Fire	Late1:OPN	Mid1:OPN	0.001	1000	Yes	0

Optional Disturbances

Optional 1: Landslide/snowslide

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