



Spruce-Fir-Northern Hardwood Forest Formation

Forests of Vermont's Cooler Climate Areas

The Spruce-Fir-Northern Hardwood Forest Formation encompasses forest communities occurring where growing seasons are short, summers are cool, and winters are harsh. Forests in this formation blanket our highest peaks above 2,500 feet. They also occur in small, cold lowland pockets within large areas of Northern Hardwood Forest.

In the coldest areas, this formation is characterized by conifers, or softwoods. Red spruce and balsam fir are the most abundant trees, but white spruce, black spruce, northern white cedar, tamarack, and a scattering of hardwoods add to the texture. In some places, yellow birch can be dominant.

The severe winter conditions on mountains and in cold valleys are a serious challenge for plants. At high elevations, wind-driven ice particles pepper the trees like tiny bullets. Rime ice forms intricately beautiful but deadly ice sculptures on leaves and branches. Heavy snow breaks branches.

The conical shape of the evergreens is probably the most conspicuous adaptation to heavy snow loads; the spires shed snow like Vermont's steep-pitched roofs. Some evergreens also have chemical adaptations to deal with cold temperatures. The fragrant oil in balsam fir is a sort of "anti-freeze" that keeps water in the leaves from freezing and forming ice crystals, which would damage fragile cell walls. The shape of the leaves helps, too. The compact needles with their waxy coatings shed snow and protect the delicate cells inside.

The short growing season is perhaps one of the greatest difficulties in these cooler climate areas. The evergreen habit is a widely successful solution to this problem. A tree that can produce at least some food during warm spells in the winter has an advantage over trees that cannot, like maple and ash. But keeping leaves all winter means exposing them to snow loading, wind, ice, and other harsh winter conditions. The northern hardwoods shed their leaves each year to prevent this kind of damage. The cost of the deciduous habit is making new leaves each spring, but it seems to be a good tradeoff for the hardwoods. In the far north or at high elevations, though, with growing seasons under 90 days, the advantages to keeping leaves all year



The cold winters and heavy snows are severe challenges to the trees occurring in the Spruce-Fir-Northern Hardwood Forest Formation.

seem to outweigh the disadvantages. Red spruce, black spruce, balsam fir, and other evergreens begin photosynthesizing as early as mid-March on our mountains, long before herbaceous plants begin to grow. This early photosynthesis effectively extends their growing season by six or eight weeks. Some trees may even photosynthesize during warm spells in the middle of winter.

The evergreen habit is not the only strategy for extending the growing season, though. Aspens, tamaracks, and birches (all deciduous trees) have their own strategies for dealing with cold temperatures and short growing seasons. Quaking aspen, for example, lengthens the growing season by photosynthesizing throughout the year, using the chlorophyll in its noticeably green bark. Photosynthesis has been detected in the bark of tamarack, too, and scientists suspect that birches and other deciduous trees may use a similar strategy. In addition, some of the deciduous trees that grow in the north are remarkably well-adapted to the cold. Yellow birch can survive temperatures as low as -50°F , and balsam poplar, with a special mechanism to prevent sharp and damaging ice crystals from forming in its tissue, can survive to -112°F !

Soils in these cold northern forests are shallow, acidic, and infertile. Heavy precipitation passing through the rotting needles of evergreens creates acidity that leaches nutrients from the soil. The very pale gray color that is characteristic of the upper-soil profile in many conifer-dominated forests attests to the loss of iron and other soluble minerals. Decomposition is slow because of the cold and the acidity, so leaf litter accumulates as thick layers of organic matter.

Not only are the soils inhospitable for many temperate-climate plants, but where the conifer canopy is dense, it creates deep shade on the forest floor. There are few plants that can tolerate these conditions. Of those that can, several are evergreen like the trees that shade them.

Mosses and liverworts grow in lush abundance in this setting, staying green all winter and photosynthesizing whenever there is enough light. The forest floor, especially in conifer-dominated forests, may be a carpet of these primitive plants, with the shining Schreber's moss often most prominent. In fact, this one species may well constitute more of the biomass of the northern forest than any other single plant. Even so, there are many other species of moss, enough to occupy a lifetime of study. Some characteristic species are knight's plume, windswept moss, and stair-step moss.

Wildflowers, sedges, ferns, and clubmosses are scattered among the mosses, but they are not usually abundant. Shining clubmoss itself can form carpets, spreading along the ground by runners. Bluebead lily flowers in early summer. Common wood sorrel, bunchberry, and Canada mayflower are other common plants. These are all long-lived perennials, well-adapted to a stable but rigorous environment.

Patterns

There is great variety in the forests of the Spruce-Fir-Northern Hardwood Forest Formation, especially from mountain to lowland. Mountain forests are more profoundly influenced than lowland forests by wind, ice, and fog. Certain species, such as Bicknell's thrush and mountain wood fern, are restricted to these high elevations. Lowland forests within the Spruce-Fir-Northern Hardwood Forest Formation, on the other hand, are more likely to be associated with wetlands, since they often sit in basins. The lowland forests are also more likely to have been cleared for agriculture or logged heavily, activities that affect soils, vegetation, and fauna. For example, old fields in the Northeast-

ern Highlands may be dominated by white spruce or by northern white cedar, both of which are virtually absent from higher elevations.

The mountain forests themselves exhibit great variety. North-facing slopes are colder than south-facing slopes. Taconic Mountain peaks receive different weather systems than Northeast Kingdom peaks. Some slopes have been repeatedly logged and/or burned, whereas some inaccessible spots have been little touched by humans. Much of the variety, though, can be explained by elevation alone as it affects climate. Vermont's highest mountains show a full range of natural communities. The forest communities of the upper elevations range from Montane Yellow Birch-Red Spruce Forest to Montane Spruce-Fir Forest to the dwarf balsam fir and black spruce of Subalpine Krummholz.

Aside from elevation, some special conditions create more specialized communities. Beneath cliffs at high elevations, rockfall slopes have Boreal Talus Woodlands. At the bases of certain very open *talus* slopes, cold air collects and harsh conditions favor development of a Cold Air Talus Woodland.

Selected References and Further Reading

Marchand, Peter J. 1987. *North Woods: An Inside Look at the Nature of Forests in the Northeast*. AMC Press, Boston.

Marchand, Peter J. 1991. *Life in the Cold: An Introduction to Winter Ecology*. Second Edition. University Press of New England, Hanover.

▶ HOW TO IDENTIFY

Spruce-Fir-Northern Hardwood Forest Formation Communities

Read the short descriptions that follow and choose the community that fits best. Then go to the page indicated to confirm your decision.

Subalpine Krummholz: Low, dense thickets of balsam fir and black spruce at high elevations. Generally shallow to bedrock. Go to page 108.

Montane Spruce-Fir Forest: Dominated by red spruce and balsam fir, with occasional heartleaf birch, paper birch, and yellow birch. Higher elevations, generally above 2,500 feet. Go to page 111.

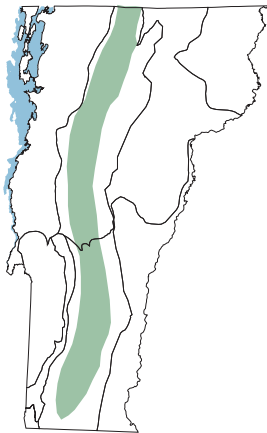
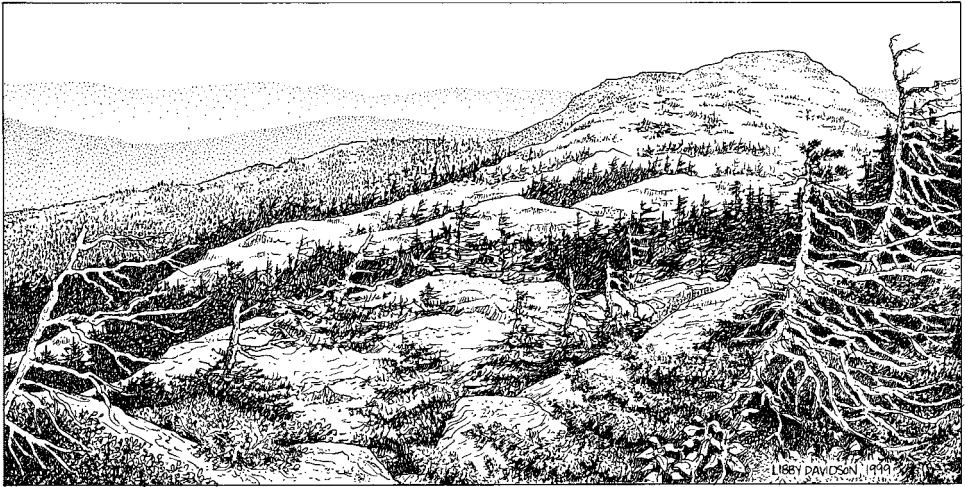
Lowland Spruce-Fir Forest: Dominated by red spruce and balsam fir, with occasional white spruce, black spruce, paper birch and yellow birch. Lowlands of Northeastern Highlands, and cold valleys elsewhere. Go to page 115.

Montane Yellow Birch-Red Spruce Forest: Mixed forest at high elevations (2,200-3,000 feet), dominated by yellow birch, and red spruce. Go to page 119.

Red Spruce-Northern Hardwood Forest: Mixed forest of red spruce, yellow birch, sugar maple, beech, balsam fir, white ash, and other species, not associated with mountain slopes, generally below 2,400 feet elevation, sometimes up to 2,700 feet. A variable community. Go to page 122.

Boreal Talus Woodland: Rockfall slopes dominated by heart-leaved paper birch with occasional red spruce. Appalachian polypody, skunk currant, and mountain maple are often abundant. Go to page 125.

Cold-Air Talus Woodland: Rare. Found where cold air drains at the bases of large talus areas. Characteristic plants are black spruce, abundant mosses and liverworts, foliose lichens, and Labrador tea. Go to page 127.



DISTRIBUTION/ABUNDANCE

Subalpine Krummholz is found only on the highest peaks in the Green Mountains, with well developed examples on Jay Peak, Mount Mansfield, Camel's Hump, and Killington. The total land area covered by this community is quite small in Vermont. Subalpine Krummholz is found throughout the northeastern United States, mostly above 3,500 feet, and well into Canada, with the upper elevational limit decreasing as one moves north.

ECOLOGY AND PHYSICAL SETTING

"Krummholz" is a German word meaning "crooked wood." At the highest elevations where trees can be found, above 3,500 feet in Vermont's mountains, harsh winds, ice, and snow put such stresses on trees that they never grow to full size. Precipitation at this elevation is high: over 70 inches per year as compared with less than 35 inches per year in the Champlain Valley. Average annual temperatures are low. Fog is commonplace in summer. Soils are mostly thin, undecomposed organic layers over bedrock and are near saturation most of the year.

VEGETATION

Subalpine Krummholz is transitional between Montane Spruce-Fir Forest below and Alpine Meadow above, so it shares species with both. Balsam fir and black spruce, the two dominants in Subalpine Krummholz, grow low to the ground, bending and twisting in response to wind and the damage caused by snow loading and ice. Growth rates are very slow under these conditions. The woody plants range in height from a few inches to a few feet and often grow so densely, and have such stiff branches, that they form an impenetrable thicket. Getting through such a thicket might require crawling on one's belly or scrambling over the tops of the matted trees.

Occasional showy mountain-ash and heart-leaved paper birch are mixed in with the softwoods. Several of the common boreal forest herbs grow beneath the stunted trees (Canada mayflower, bunchberry, brownish sedge, hoary sedge, and Bluebead lily, among others. Velvetleaf blueberry and other heath shrubs are scattered under or among the stunted spruce and fir. Mosses and lichens are abundant.

ANIMALS

Breeding birds of Subalpine Krummholz include dark-eyed junco, white-throated sparrow, blackpoll warbler, and Bicknell's thrush, a rare breeder in Vermont. The red-backed vole is a small mammal that may be found in Subalpine Krummholz.

SUCCESSIONAL TRENDS

When individual balsam fir or black spruce die in Subalpine Krummholz, either naturally or due to human influences, they are usually replaced by young seedlings of fir or spruce. In cases where large areas are laid bare and organic matter is scraped off the soil surface, hardwoods such as heart-leaved paper birch and mountain maple may become dominant for a time, perhaps persisting for several decades. Many high-elevation stands of heart-leaved paper birch are thought to have originated from fires that followed logging in the early-20th century.

VARIANTS

None recognized at this time.

RELATED COMMUNITIES

Alpine Meadow: This community is found above treeline, and therefore usually above Subalpine Krummholz, although the two communities interfinger. Alpine Meadow is generally open, with abundant bare rock, but has areas of low trees in sheltered areas. The two communities share many species in common. The more protected areas of Alpine Meadow are much like Subalpine Krummholz.

Montane Spruce-Fir Forest: This forest community is found below Subalpine Krummholz on our mountains, and grades into it. Trees are taller and straighter and alpine species like alpine bilberry are absent. Soils are deeper and have more mineral layers. As one goes down in elevation, black spruce disappears quickly and is replaced by red spruce.

PLACES TO VISIT

Mount Mansfield, Cambridge and Underhill,
Mount Mansfield State Forest, Vermont
Department of Forests, Parks, and
Recreation (VDFPR)
Killington Peak, Coolidge State Forest,
VDFPR
Camels Hump, Huntington and Duxbury,
Camels Hump State Park, VDFPR



Balsam fir is the dominant species in the most exposed portions of Subalpine Krummholz.

CHARACTERISTIC PLANTS

TREES

Abundant Species

Balsam fir – *Abies balsamea*

Black spruce – *Picea mariana*

Occasional to Locally Abundant Species

Red spruce – *Picea rubens*

American mountain-ash – *Sorbus americana*

Showy mountain-ash – *Sorbus decora*

Heart-leaved paper birch – *Betula papyrifera*
var. *cordifolia*

SHRUBS

Occasional to Locally Abundant Species

Mountain blueberry – *Vaccinium boreale*

Velvetleaf blueberry – *Vaccinium myrtilloides*

Alpine bilberry – *Vaccinium uliginosum*

Labrador tea – *Ledum groenlandicum*

Bartram's shadbush – *Amelanchier*
bartramiana

Mountain maple – *Acer spicatum*

Mountain cranberry – *Vaccinium vitis-idaea*

HERBS

Occasional to Locally Abundant Species

Canada mayflower – *Maianthemum canadense*

Bunchberry – *Cornus canadensis*

Brownish sedge – *Carex brunnescens*

Hoary sedge – *Carex canescens*

Bluebead lily – *Clintonia borealis*

Common wood sorrel – *Oxalis acetosella*

Goldthread – *Coptis trifolia*

Three-toothed cinquefoil – *Potentilla tridentata*

Mountain fir clubmoss – *Lycopodium*
appalachianum

RARE AND UNCOMMON PLANTS

Lesser pyrola – *Pyrola minor*

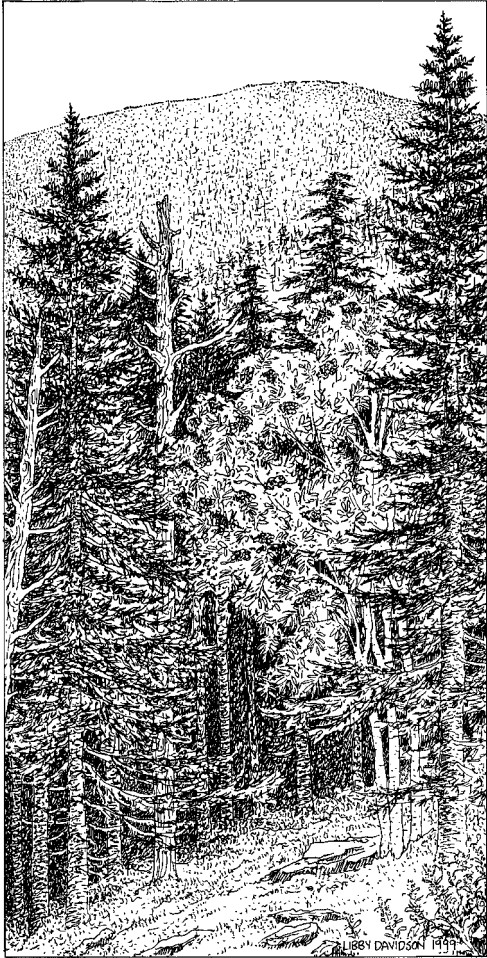
Squashberry – *Viburnum edule*

Alpine bilberry – *Vaccinium uliginosum*

Showy mountain-ash – *Sorbus decora*

Mountain blueberry – *Vaccinium boreale*

Mountain cranberry – *Vaccinium vitis-idaea*



ECOLOGY AND PHYSICAL SETTING

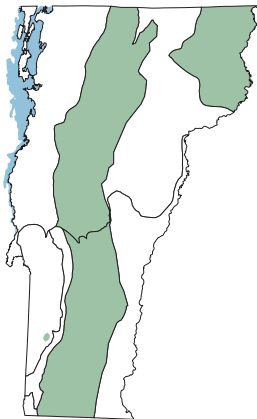
Along the spine of the Green Mountains, on mountains like Monadnock in Vermont's Northeastern Highlands, and on a few peaks in the Taconic Mountains, Montane Spruce-Fir Forest is dominant. In these places, we consider this forest the matrix-forming community. Montane Spruce-Fir Forests occur mostly above 2,800 feet elevation in the Southern Green Mountains and Taconic Mountains. In the Northern Green Mountains and Northeastern Highlands, the lower limit ranges from 2,500 feet to 2,700 feet. Below this elevation, Montane Yellow Birch-Red Spruce Forest is the dominant community.

The climate on these mountains is cold and severe. Summers are short and foggy; winters are cold and windy. Clouds are frequent and count as one of the main ecological influences on vegetation. Mountaintop clouds form when moist air rises and condenses as it cools. Often, on a still day, the only clouds in sight are those that cap the mountaintops. One of the effects of all this excess moisture is a constant supply of water to the forests. Foliage intercepts water droplets, which then fall to the ground as fog drip. This fog drip can be a significant and important source of moisture for plants. Continually wet, spongy conditions on upper mountain trails testify to the quantity of water captured in this way. The down side of all the fog, however, is that it limits light infiltration and therefore cuts down on photosynthetic activity, even when the temperatures are quite warm. Considering the influence of clouds on Montane Spruce-Fir Forests, it may well be, as has been proposed by one scientist, that the lower elevational limit of this community on New England mountains corresponds to the prevailing lower limit of clouds.

Soils in Montane Spruce-Fir Forests are *spodosols* – acidic, leached soils that are low in fertility. A typical soil profile shows dramatic color differences between layers, evidence of the leaching. The soils are vulnerable to disturbance

DISTRIBUTION/ ABUNDANCE

Montane Spruce-Fir Forest is common in Vermont at elevations above 2,500 feet (or higher in the southern part of the state). This community can be found throughout the mountains of northern New England and into Canada and in the mountains as far south as Tennessee.



from downslope movement and wind-throw, which are common on Montane Spruce-Fir Forests. Downslope movement can be dramatic when soils become super-saturated. In very steep valleys like Smugglers Notch, landslides are commonplace. Other processes that affect these forests are ice and snow, which can damage plant tissues and also break tree limbs, and natural fires. Some of the fires that have occurred in these forests in the last 200 years were caused, either directly or indirectly, by humans.

Montane Spruce-Fir Forests dot the upper elevations of the Appalachians as far south as the North Carolina-Tennessee border. Moving southward, however, one has to look higher and higher to find the dark green of the spruce and fir. In the Great Smokies, for example, it doesn't begin until about 5,000 feet elevation.

VEGETATION

In this cloudy, cold environment, mosses thrive and are sometimes the dominant vegetation on the forest floor. Dense carpets of sphagnum moss, which are usually associated with bogs, are common throughout the forest on moist sites, for example on cliffs where dripping groundwater and fog provide a constant supply of moisture. Schreber's moss is abundant on drier sites. Lichens do well in these forests, too, hanging from trees and clinging to bark, taking moisture from the air. Herbs are sparse in these dark forests, but those that do thrive are mountain wood fern, brownish sedge, Bluebead lily, whorled aster, common wood sorrel, and shining clubmoss. American mountain-ash and striped maple (moosewood) are scattered shrubs. Hobblebush, a low shrub that makes a tangle with its reclining branches, is abundant.

Above the forest floor the canopy is dense with red spruce and balsam fir, though in places it is broken by hardwood species like heart-leaved paper birch or American mountain-ash. Birch can be abundant where the soil has been disturbed by downslope movement or by fire and can persist for long periods of time where the disturbance recurs with frequency.

Balsam fir is the more common softwood species at higher elevations. At the very highest elevations of Montane Spruce-Fir Forest, just below Subalpine Krummholz, black spruce begins to mix in with balsam fir, and red spruce is completely gone.

ANIMALS

Some characteristic birds that nest in Montane Spruce-Fir Forests are blackpoll warbler, yellow-rumped warbler, red-breasted nuthatch, ruby-crowned kinglet, and olive-sided flycatcher. Bicknell's thrush and bay-breasted warbler are rare inhabitants of these forests. Most of these birds migrate to the south in winter. The yellow-rumped warbler may not go far; many winter in southern New England. The ruby-crowned kinglet goes to the Carolinas or perhaps the Gulf Coast. The blackpoll warbler migrates to South America, more than 5,600 miles from its Vermont breeding grounds. Not surprisingly, it is one of the last warblers to return in spring.

Porcupines live in the mountain forests as well as in lowland forests, feeding on mountain shelters and other unexpected foods. Red squirrels are abundant in spruce-fir forests, since red spruce and balsam fir seeds are among their preferred foods. Red squirrels prefer to nest in tree cavities where they are protected in winter. When there are no tree cavities, they build tight globular nests in treetops.

SUCCESSIONAL TRENDS

Where Montane Spruce-Fir Forests are disturbed and where mineral soil is laid bare, either through natural processes like landslides or through human activities like logging and burning, paper birch or heart-leaved paper birch most commonly replace the softwoods. Pin cherry and mountain maple are prevalent in these situations as well. These hardwood species, especially paper birch, can persist for a long time following a disturbance, but where soils are stable, spruce and fir ultimately dominate.

MONTANE SPRUCE-FIR FOREST

The natural death and replacement of fir trees can create striking vegetation patterns at the highest elevations in these forests. Where they are dramatically displayed, for example in New Hampshire's White Mountains, these patterns are very regular and are known as "fir waves."

VARIANTS

Montane Fir Forest: At upper elevations, where balsam fir dominates and the height of the trees is generally lower.

Montane Spruce Forest: At lower elevations, where balsam fir is nearly absent, trees are taller, and hardwoods are more commonly mixed in.

RELATED

COMMUNITIES

Lowland Spruce-Fir Forest: This community tends to be less stressed by wind and ice. It occurs in low, cold pockets in a variety of situations. The herbs and shrubs that characterize high elevation forests (mountain wood fern, for example) are absent, and white spruce may be present in the canopy.

Montane Yellow Birch-Red Spruce Forest: Found at lower elevations, generally 2,000 to 3,000 feet, this community has deeper soils, less severe climate, and more hardwood species in the canopy.

Subalpine Krummbolz: Found above Montane Spruce-Fir Forest, this community has low, stunted trees, red spruce is nearly absent, and black spruce is common.

CONSERVATION STATUS AND MANAGEMENT CONSIDERATIONS

Many of Vermont's Montane Spruce-Fir Forests have been logged, had roads and ski trails built through them, or have been otherwise disturbed by humans. During the late-19th century and early-20th century, heavy logging took place in high-elevation forests, with spruce in especially high demand. In very steep areas, trees were moved downslope using natural slides and cliff faces. This period of heavy logging and major soil disturbance was followed by frequent fires, some caused by lightning

and some directly by humans. Many of today's high-elevation paper birch forests originated at this time. In spite of modern intrusions, these forests are probably in better shape overall than they were 100 years ago.

There are large areas of this community (notably in

Camels Hump State Forest) that are virtually undisturbed because of inaccessibility, and many mountains have isolated pockets of undisturbed Montane Spruce-Fir Forest.

Although fine examples of this community occur at high elevations, they are threatened by acidic deposition, which comes as rain or as fog. Acidification of the soil affects nutrient uptake among other things, and may have dramatic long-term effects on these forests.

Any activities in Montane Spruce-Fir Forest should be conducted with great care because of steep slopes and fragile soils. Logging is generally not recommended above 2,500 feet.



Bicknell's thrush is a rare species that nests in Montane Spruce-Fir Forest and Subalpine Krummbolz.

PLACES TO VISIT

Camels Hump, Duxbury and Huntington,
Camels Hump State Park, Vermont
Department of Forests, Parks, and
Recreation (VDFPR)
Glastenbury Mountain, Glastenbury, Green
Mountain National Forest
Mount Mansfield, Cambridge and Underhill,
Mount Mansfield State Forest, VDFPR

SELECTED REFERENCES AND FURTHER READING

Cogbill, Charles V. 1987. The boreal forests
of New England. *Wild Flower Notes*
2:27-36.
Cogbill, Charles V. and Peter S. White. 1991.
The latitude-elevation relationship for
spruce-fir forest and treeline along
the Appalachian mountain chain.
Vegetatio 94:153-175.

CHARACTERISTIC PLANTS

TREES

Abundant Species

Red spruce – *Picea rubens*
Balsam fir – *Abies balsamea*
Occasional to Locally Abundant Species
Yellow birch – *Betula alleghaniensis*
Heart-leaved paper birch – *Betula papyrifera*
var. *cordifolia*
Black spruce – *Picea mariana*

SHRUBS

Occasional to Locally Abundant Species

Mountain maple – *Acer spicatum*
Striped maple – *Acer pennsylvanicum*
Hobblebush – *Viburnum alnifolium*
Showy mountain-ash – *Sorbus decora*
American mountain-ash – *Sorbus americana*
Bartram's shadbush – *Amelanchier*
bartramiana

HERBS

Occasional to Locally Abundant Species

Whorled aster – *Aster acuminatus*
Common wood sorrel – *Oxalis acetosella*
Bluebead lily – *Clintonia borealis*
Bunchberry – *Cornus canadensis*
Shining clubmoss – *Lycopodium lucidulum*
Mountain wood fern – *Dryopteris campyloptera*
Ground cedar – *Lycopodium digitatum*

BRYOPHYTES

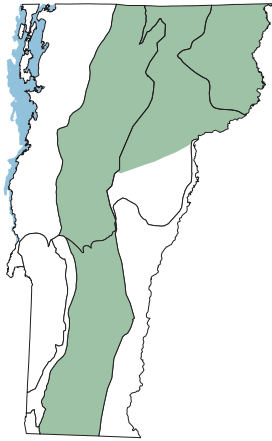
Abundant Species

Schreber's moss – *Pleurozium schreberi*
Stair-step moss – *Hylocomium splendens*
Knight's plume moss – *Ptilium crista-castrensis*
Common fern moss – *Thuidium delicatulum*
Occasional to Locally Abundant Species
Pin-cushion moss – *Leucobryum glaucum*
Windswept moss – *Dicranum* spp.
Moss – *Sphagnum russowii*
Liverwort – *Bazzania trilobata*

RARE AND UNCOMMON PLANTS

Lesser pyrola – *Pyrola minor*
Showy mountain-ash – *Sorbus decora*
Mountain sweet-cicely – *Osmorbiza chilensis*
Northern sweet-cicely – *Osmorbiza*
depauperata
Squashberry – *Viburnum edule*

LOWLAND SPRUCE-FIR FOREST



DISTRIBUTION/ABUNDANCE

Lowland Spruce-Fir Forests are common in the lowlands of the Northeastern Highlands, lowlands within the Northern Green Mountains, the plateau area of the Southern Green Mountains, and scattered locations in the Northern Vermont Piedmont. The community is common in northern Maine and in the Adirondacks, as well as in New Brunswick, Nova Scotia, and parts of Québec. Related communities are found in a broad band of boreal forest extending across Canada.

ECOLOGY AND PHYSICAL SETTING

Lowland Spruce-Fir Forests are found in the colder regions of the state, particularly in the Northeastern Highlands, Northern Green Mountains, and Southern Green Mountains. In these three biophysical regions, they can be matrix-forming communities. They are found in cold pockets, where cool air settles and creates a cold microclimate and where soils are especially moist. Thus, in an area where mountains and cold lowland pockets occur side by side, as in the Northeastern Highlands, one sees hardwood forests sandwiched between areas of softwood: spruce and fir will dominate at both the highest and lowest elevations, and hardwoods will dominate on the middle slopes between. Lowland Spruce-Fir Forests are often found adjacent to and grading into wetlands such as Black Spruce Swamps. Where extensive areas of Lowland Spruce-Fir Forest occur, as in Maine and Canada, they are known as Spruce-Fir Flats.

Lowland Spruce-Fir Forest can be a confusing name for these forests because they are also common at fairly high elevations in the plateau area of the Southern Green Mountains. Although the elevation is high (2,000 feet or more), these forests are tucked into cold pockets and depressions, where the high winds and frequent fog of mountain summits are not felt. In species composition, soil characteristics, and ecological processes, they are distinct from Montane Spruce-Fir Forests and need a distinguishing name.

Lowland Spruce-Fir Forest is a variable community. We recognize two phases: one with wetter soils and one with better-drained soils. Here we describe the moist-soil phase; the other is described under "Variants."

LOWLAND SPRUCE-FIR FOREST

Parent materials in these forests are basal till or lacustrine sediments. Soils are spodosols — acidic, leached soils which are low in fertility. They are moderately well drained to somewhat poorly drained. The depth of the basal till is typically less than 20 inches. Large boulders are a common sight in this community.

Natural disturbance regimes vary with soil moisture and texture. In wetter areas, shallow rooting contributes to windthrow, leaving single tree gaps and a microtopography of hummocks and hollows. In rare cases where storms are very severe, large areas of blowdown can occur. Ice damage can influence these forests. In drier areas, fire can be an important natural process. Other natural disturbances include flooding and felling of trees by beaver and infestations of spruce budworm and spruce bark beetle.

VEGETATION

In most places, red spruce and balsam fir are the late-successional dominants. Given the variability of soils within this forest type, however, species composition can vary considerably. Black spruce is common where soils are wetter. White pine can be a component of the canopy in well-drained soils. Hardwoods such as red maple, yellow birch, and paper birch can be mixed in as well. White spruce is absent from southern Vermont but is common as a

mid-successional tree in the Northeastern Highlands and to the north in Maine and Canada.

Shrubs such as mountain holly and wild raisin are scattered in the understory. The ground layer is often dominated by mosses and liverworts. Herbs such as common wood sorrel, bluebead lily, and shining clubmoss are scattered about, but the dense shade makes them scarce. Overall plant diversity is low in comparison with other forest types.

ANIMALS

Characteristic mammals are red squirrel, deer mouse, southern red-backed vole, porcupine, red fox, fisher, moose, and white-tailed deer. Characteristic birds in Lowland Spruce-Fir Forests are yellow-bellied flycatcher, yellow-rumped warbler, blackpoll warbler, Swainson's thrush, red-breasted nuthatch, and ruby-crowned kinglet.

Several rare birds breed in these forests: black-backed woodpecker, gray jay, bay-breasted warbler, and boreal chickadee.

SUCCESSIONAL TRENDS

Succession in Lowland Spruce-Fir Forests can take several paths, creating confusion for the ecologist or forester trying to understand the natural vegetation of a site.

On better drained sites repeated harvest of softwoods for pulp can create a forest that resembles a Mesic Northern Hardwood Forest, as spruce and fir are removed. Softwoods will eventually come into the understory and may ultimately return to a place of dominance, but this process can take a long time. In the interim it can be difficult to determine whether a hardwood forest is “natural” or a result of past logging practices.



Knight's plume is one of the common boreal mosses found in Lowland Spruce-Fir Forest.

On the other hand, softwood species such as red and white spruce, which are normally thought of as late-successional species, can be quite successful as pioneers in old fields, as can balsam fir and northern white cedar. These species do well where mineral soil has not been exposed. The heavy seeds make their way into the sod, and the large seedlings are able to compete with field grasses. Thus a site that was originally softwood may return directly to softwood domination, with no intermediate successional step. Or, a site that was originally dominated by hardwoods may be converted to softwoods, at least temporarily.

Where natural processes have prevailed, succession in Lowland Spruce-Fir Forests is perhaps a bit more predictable. On riverbanks, steep slopes, and sites where soil disturbance accompanies the natural removal of trees, shade-intolerant hardwoods such as paper birch, aspen and pin cherry tend to come in first, growing quickly and creating a forest canopy in only a few years. Later, these will be replaced by spruce and fir, with yellow birch and red maple mixed in. Eventually, in the absence of disturbance, red spruce, black spruce, and white pine will dominate, depending on the nature of the substrate.

VARIANTS

Lowland Spruce-Fir Forest, well-drained phase: These forests are found on benches, plateaus, shorelines, and glacial outwash. Soils are moderately well drained to excessively drained sands or gravels. White pine can be a late-successional dominant in these areas; black spruce is generally absent. Fire may play a role in natural forests of this type, few of which remain.

RELATED COMMUNITIES

Montane Spruce-Fir Forest: Found at high elevations on mountain tops where fog and wind are important ecological factors. Soils are cold and acid-leached.

Black Spruce Swamp: Often adjacent to the wetter phases of this community and intergrading with it, these wetlands have very poorly drained organic soils.

CONSERVATION STATUS AND MANAGEMENT CONSIDERATIONS

Most Lowland Spruce-Fir Forests in Vermont have been logged in the past, some quite heavily. No old growth examples are known. Some of the finest examples, however, are on newly protected lands within the Nulhegan Basin of the Northeastern Highlands. Management of these forests is a complex issue; there is a diversity of opinions on how to manage them correctly. If the protection of natural biological diversity is an objective, management must recognize and mimic natural ecological processes. Hardwoods and softwoods should be removed in the same proportion as they would be removed by nature. Silvicultural techniques might include single tree harvest or small strip cuts. Soil disturbance should be minimized, especially in wet areas, by harvesting in winter or by using mechanized equipment.

PLACES TO VISIT

Nulhegan Basin, Lewis, U.S. Fish and Wildlife Service

Victory Basin, Victory, Victory Basin Wildlife Management Area, Vermont Department of Fish and Wildlife

SELECTED REFERENCES AND FURTHER READING

Cogbill, Charles V. 1987. The boreal forests of New England. *Wild Flower Notes* 2:27-36.

Siccama, Thomas G. 1974. Vegetation, soil and climate on the Green Mountains of Vermont. *Ecological Monographs* 44:325-349.

CHARACTERISTIC PLANTS

TREES

Abundant Species

Red spruce – *Picea rubens*

Balsam fir – *Abies balsamea*

Occasional to Locally Abundant Species

White pine – *Pinus strobus*

Yellow birch – *Betula alleghaniensis*

Paper birch – *Betula papyrifera*

Black spruce – *Picea mariana*

White spruce – *Picea glauca*

Northern white cedar – *Thuja occidentalis*

Red maple – *Acer rubrum*

Tamarack – *Larix laricina*

Early-successional Species

Pin cherry – *Prunus pensylvanica*

Quaking aspen – *Populus tremuloides*

Balsam poplar – *Populus balsamifera*

SHRUBS

Abundant Species

Striped maple – *Acer pensylvanicum*

Hobblebush – *Viburnum alnifolium*

Mountain holly – *Nemopanthus mucronatus*

Wild raisin – *Viburnum nudum* var.
cassinoides

Sheep laurel – *Kalmia angustifolia*

Occasional to Locally Abundant Species

Labrador tea – *Ledum groenlandicum*

Speckled alder – *Alnus incana*

Leatherleaf – *Chamaedaphne calyculata*

Mountain maple – *Acer spicatum*

American mountain-ash – *Sorbus americana*

Bartram's shadbush – *Amelanchier*
bartramiana

Velvetleaf blueberry – *Vaccinium myrtilloides*

HERBS

Abundant Species

Common wood sorrel – *Oxalis acetosella*

Bluebead lily – *Clintonia borealis*

Bunchberry – *Cornus canadensis*

Shining clubmoss – *Lycopodium lucidulum*

Intermediate wood fern – *Dryopteris intermedia*

Whorled aster – *Aster acuminatus*

Occasional to Locally Abundant Species

Twinflower – *Linnaea borealis*

Goldthread – *Coptis trifolia*

Canada mayflower – *Maianthemum canadense*

Pink lady's slipper – *Cypripedium acaule*

BRYOPHYTES AND LICHENS

Schreber's moss – *Pleurozium schreberi*

Stair-step moss – *Hylocomnium splendens*

Knight's plume moss – *Ptilium crista-castrensis*

Common fern moss – *Thuidium delicatulum*

Pin-cushion moss – *Leucobryum glaucum*

Windswept moss – *Dicranum* spp.

Liverwort – *Bazzania trilobata*

Reindeer lichen – *Cladina rangiferina*

RARE AND UNCOMMON PLANTS

Mountain cranberry – *Vaccinium vitis-idaea*

Moose dung moss – *Splachnum ampullaceum*

MONTANE YELLOW BIRCH-RED SPRUCE FOREST



ECOLOGY AND PHYSICAL SETTING

On mountain slopes and low summits, this forest type characterizes the transition from Northern Hardwood Forest to Montane Spruce-Fir Forest. It ranges from 2,000 feet to 2,900 feet elevation, but the actual elevation at which it occurs varies from north to south in the mountains. In the Northern Green Mountains, 2,500 feet is the upper limit, whereas it may reach 2,900 feet in the Taconics.

In general, soils are well drained to moderately well drained, and bedrock is often close to the surface or even exposed. Parent material is basal till or ablation till over bedrock. Restricting layers sometimes limit the downward movement of water. There is great variability within this community; locally wet sites are common, and coves and benches can support more nutrient-demanding species.

Natural ecological processes influencing these forests include wind, ice loading, landslides, and smaller scale downslope movement of soil and nutrients.

VEGETATION

At higher elevations, yellow birch and red spruce are codominant in mid- to late-successional Montane Yellow Birch-Red Spruce Forests. At lower elevations, sugar maple, red maple, and American beech join the mix. Paper birch, pin cherry, and yellow birch are common in early-successional examples. Balsam fir can be present in early-successional stands at high elevations. The understory vegetation varies depending upon the composition of the canopy and the local soil conditions. In spruce dominated areas, the understory vegetation is quite sparse due to the dense shade created by the canopy.

Characteristic shrubs are hobblebush, striped maple, and mountain maple. Hobblebush can form nearly impenetrable thickets with its arching stems that root at the nodes. Characteristic herbs are mountain wood fern, common

DISTRIBUTION/ ABUNDANCE

This community is common on upper mountain slopes in Vermont, in the Northern Green Mountains, Southern Green Mountains, Taconic Mountains, Northern Vermont Piedmont, and Northeastern Highlands.

This community is also common throughout the mountainous areas of the northeastern United States and southeastern Canada.



MONTANE YELLOW BIRCH-RED SPRUCE FOREST

wood sorrel, twinflower, bluebead lily, Canada mayflower, intermediate wood fern, whorled aster, and sarsaparilla. In some places, mountain wood fern can be extremely abundant, seeming almost to exclude other species.

ANIMALS

Some typical birds of Montane Yellow Birch-Red Spruce Forests are winter wren, blackburnian warbler, Swainson's thrush, Canada warbler, and solitary vireo.

SUCCESSIONAL TRENDS

Succession in Montane Yellow Birch-Red Spruce Forests can be set back by landslides, by treefall due to wind, or by human activities such as logging or road building. Early-successional species can include balsam fir (especially at the highest elevations), yellow or paper birch and where organic matter has been scraped or burned off the soil, pin cherry and aspen. Over time red spruce is likely to become more prominent than yellow birch in these forests, but slope instability may contribute to the prominence of yellow birch. In some places, yellow birch can remain dominant for long periods.

VARIANTS

Montane Yellow Birch-Sugar Maple-Red Spruce Forest: This variant is found at lower elevations (below 2,500 feet), where sugar maple, red maple, and beech become common in the canopy. Pockets of additional moisture favor sugar maple and may account for some of these specialized pockets, which are sometimes adjacent to seeps. The hardwood trees tend to be low in stature and gnarly. Typical herbs are swollen sedge, drooping woodreed, wood millet, and, in moister places, pale touch-me-not and wood nettle.



Yellow birch seedlings often become established on old stumps or logs, resulting in elevated roots as the tree matures and the stump rots away.

RELATED COMMUNITIES

Montane Spruce-Fir Forest: Red spruce and balsam fir are more abundant in these forests, which generally occur over 2,500 feet.

Northern Hardwood Forest: This community is found at lower elevations than Montane Yellow Birch-Red Spruce Forest and has a higher overall species diversity. Some Northern Hardwood Forests resemble Montane Yellow Birch-Red Spruce Forests because they are locally dominated by yellow birch or red spruce. They differ,

MONTANE YELLOW BIRCH-RED SPRUCE FOREST

however, in having a species composition that is more characteristic of lower elevations, including hemlock, a tree that does not reach elevations above 2,000 feet.

CONSERVATION STATUS AND MANAGEMENT CONSIDERATIONS

Most examples of this community have been selectively logged for yellow birch and red spruce. Historically, these areas were heavily logged in winter. Present threats include ski area development and highgrading.

PLACES TO VISIT

Camels Hump, Duxbury and Huntington, Camels Hump State Park, Vermont Department of Forests, Parks, and Recreation (VDFPR)
Mount Mansfield, Cambridge and Underhill, Mount Mansfield State Forest, VDFPR
Equinox Highlands (Mount Equinox and Mother Myrick Mountain), Manchester and Dorset, Equinox Preservation Trust and The Nature Conservancy

CHARACTERISTIC PLANTS

TREES

Abundant Species

Red spruce – *Picea rubens*
Yellow birch – *Betula alleghaniensis*

Occasional to Locally Abundant Species

Sugar maple – *Acer saccharum*
American beech – *Fagus grandifolia*
Red maple – *Acer rubrum*

Balsam fir – *Abies balsamea*

Successional Species

Paper birch – *Betula papyrifera*
Pin cherry – *Prunus pensylvanica*
Quaking aspen – *Populus tremuloides*

SHRUBS

Abundant Species

Hobblebush – *Viburnum alnifolium*
Striped maple – *Acer pensylvanicum*
Mountain maple – *Acer spicatum*

HERBS

Abundant Species

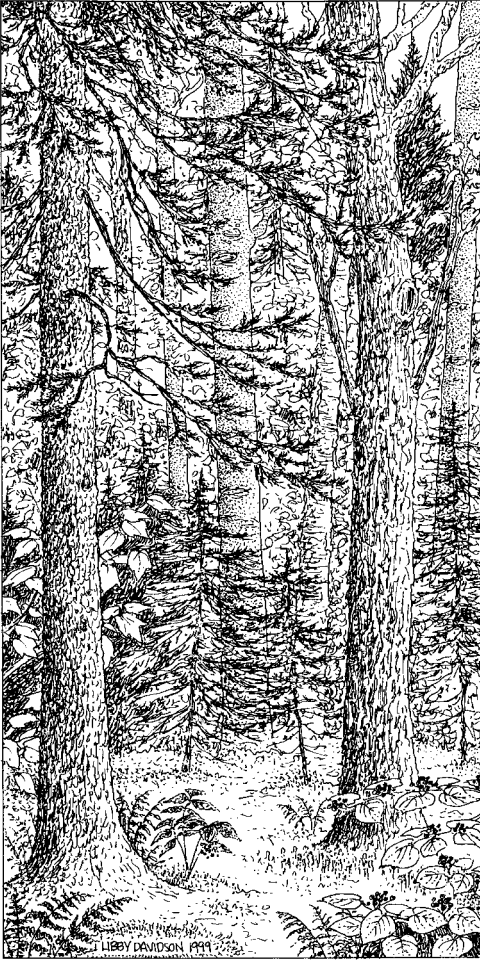
Mountain wood fern – *Dryopteris campyloptera*
Common wood sorrel – *Oxalis acetosella*
Bluebead lily – *Clintonia borealis*
Canada mayflower – *Maianthemum canadense*
Sarsaparilla – *Aralia nudicaulis*
Whorled aster – *Aster acuminatus*

Occasional to Locally Abundant Species

White mandarin – *Streptopus amplexifolius*
Pale touch-me-not – *Impatiens pallida*
Twinflower – *Linnaea borealis*
Intermediate wood fern – *Dryopteris intermedia*
Swollen sedge – *Carex intumescens*
Drooping woodreed – *Cinna latifolia*
Whorled aster – *Aster acuminatus*
Painted trillium – *Trillium undulatum*
False hellebore – *Veratrum viride*

RARE AND UNCOMMON PLANTS

Wood millet – *Milium effusum*
Lesser pyrola – *Pyrola minor*
Showy mountain-ash – *Sorbus decora*
Mountain sweet-cicely – *Osmorbiza chilensis*
Northern sweet-cicely – *Osmorbiza depauperata*



ECOLOGY AND PHYSICAL SETTING

This is a variable community that describes situations where softwoods and hardwoods occur in mixed stands and persist that way over time. They may result from locally shallow soils where bedrock is close to the surface, or from especially moist soils. Parent materials are basal tills, and soils generally have a restricting layer or pan at 18-24 inches below the surface – the explanation for the additional soil moisture. Depending on the situation, soils are well drained (on knolls) to moderately well drained (where a pan is present). Slopes are gentle; these forests are generally found on benches and plateaus, although occasionally they can be found on steeper slopes.

This community is often surrounded by Northern Hardwood Forest, and is in many ways related to that community, but its species composition places it here in the Spruce-Fir-Northern Hardwood Forest Formation.

VEGETATION

The canopy in these forests is a mix of red spruce, yellow birch, beech, and sugar maple in varying proportions, with white ash present in richer sites and with balsam fir and red maple common in younger stands. The shrub layer is sometimes well developed, with hobblebush a common component, and the herb layer is comprised of typical boreal herbs such as bluebead lily and shining clubmoss.

ANIMALS

Animal communities are probably similar to those found in Northern Hardwood Forests.

DISTRIBUTION/ ABUNDANCE

Since much of Vermont is in an area of transition between northern hardwood forests and spruce-fir forests, this community is common here. It reaches its best expression on the plateau of the Southern Green Mountains. Similar communities are found throughout New England.



SUCCESSIONAL TRENDS

In many forests of this type, red spruce, hemlock, and yellow birch may become dominant over time, depending on the physical setting. Red Spruce-Northern Hardwood Forest may, in many cases, be a successional stage of what will ultimately become softwood forest. Early to mid-successional species include balsam fir, paper birch, white pine, red maple, aspen, pin cherry, and gray birch.

VARIANTS

None recognized at this time.

RELATED COMMUNITIES

Montane Yellow Birch-Red Spruce Forest: In their extreme expressions, these two communities are quite different and easily distinguishable, but there is surely some overlap between them as well. The relationships between them need further study. In general, Montane Yellow Birch-Red Spruce Forest has less tree diversity, especially in its higher elevation settings where sugar maple and beech drop out.

Northern Hardwood Forest: Red Spruce-Northern Hardwood Forest can be considered a variant of Northern Hardwood Forest, and often occurs adjacent to it. Northern Hardwood Forest can have a component of red spruce in its canopy, making it somewhat similar to this community, but it generally lacks the dominance of boreal herbs.

Lowland Spruce-Fir Forest: This can be very similar to Red Spruce-Northern Hardwood Forest, but it has only a minor component of hardwood species.

Montane Spruce-Fir Forest: This can be very similar to Red Spruce-Northern Hardwood Forest, but it has only a minor component of hardwood species, is colder, and has higher rainfall.

CONSERVATION STATUS AND MANAGEMENT CONSIDERATIONS

This is a common community in Vermont, but its occurrence is not well documented. It is quite likely that good examples are found within wilderness areas of the Green Mountain National Forest. Management of these forests should consider successional tendencies, favoring species that would naturally occur on the site in question.

PLACES TO VISIT

Groton State Forest, Vermont Department of Forests, Parks and Recreation
Lye Brook Wilderness, Green Mountain National Forest



The late May or June flowers of hobblebush are a common sight in Red Spruce-Northern Hardwood Forest.

CHARACTERISTIC PLANTS

TREES

Abundant Species

Red spruce – *Picea rubens*
Yellow birch – *Betula alleghaniensis*
American beech – *Fagus grandifolia*

Occasional to Locally Abundant Species

Sugar maple – *Acer saccharum*
Eastern hemlock – *Tsuga canadensis*
Balsam fir – *Abies balsamea*
Red maple – *Acer rubrum*

Successional Species

Paper birch – *Betula papyrifera*
Pin cherry – *Prunus pensylvanica*
Quaking aspen – *Populus tremuloides*

SHRUBS

Abundant Species

Hobblebush – *Viburnum alnifolium*
Striped maple – *Acer pensylvanicum*
Mountain maple – *Acer spicatum*
American mountain-ash – *Sorbus americana*

HERBS

Common wood sorrel – *Oxalis acetosella*
Bluebead lily – *Clintonia borealis*
Starflower – *Trientalis borealis*
Canada mayflower – *Maianthemum canadense*
Sarsaparilla – *Aralia nudicaulis*
Twinflower – *Linnaea borealis*
Intermediate wood fern – *Dryopteris intermedia*
Swollen sedge – *Carex intumescens*
Drooping woodreed – *Cinna latifolia*
Whorled aster – *Aster acuminatus*

RARE AND UNCOMMON PLANTS

Wood millet – *Milium effusum*



DISTRIBUTION/ ABUNDANCE

Boreal Talus Woodlands are found as small areas in the Southern Green Mountains, Northern Green Mountains, and Northeastern Highlands and possibly in the Taconic Mountains and Northern Vermont Piedmont. They are found throughout the northeastern United States, New Brunswick, Nova Scotia, and parts of Québec.



ECOLOGY AND PHYSICAL SETTING

Boreal Talus Woodlands are wooded areas of rockfall, or talus. They occur in the colder areas of the state, such as at high elevations, in cold valleys, and in the Northeastern Highlands. Trees are the dominant vegetation, but they are scattered and are never dense enough to form a closed canopy.

The formation of talus is discussed in the section on Open Upland Communities. Most large talus areas have some open talus and some talus woodland. Talus woodlands generally occur at the bases of open talus areas, where soil has accumulated in crevices between rocks, allowing trees to root and grow. Trees can also grow in the small amount of soil material that has accumulated on the rocks and boulders themselves. In these situations trees do not grow tall, straight, or fast, but instead are short and often twisted. High winds, ice damage, and occasional rockfall are natural processes that add to the stress on plants, causing treefall and limb damage. Boreal Talus Woodlands can burn, but natural fires are rare. Many areas did burn along with adjacent forests, when human-caused fires swept through Vermont in the late-19th and early-20th centuries after heavy logging.

With their huge boulders, hidden crevices, and twisted trees, Boreal Talus Woodlands are difficult places to walk through.

VEGETATION

Trees are scattered, small and poorly formed. Heart-leaved paper birch, yellow birch, and red spruce are characteristic species that make up the low, open canopy. Shrubs, especially mountain maple, are common, making up a significant portion of the vegetation in these communities. Herb diversity is low. A few species, like Appalachian polypody, can persist on the rocks themselves, but most vascular plants are found between boulders where soil has accumulated. Lichens are well adapted to the open rock in Boreal Talus Woodlands, and they are often abundant.

ANIMALS

Long-tailed shrew and rock vole are two small mammals found in Boreal Talus Woodlands. Both species are rare in Vermont.

SUCCESSIONAL TRENDS

Boreal Talus Woodlands, in a sense, are in a perpetual state of early succession since treefall in the unstable soils is common. It may also be true that some Boreal Talus Woodlands are still recovering from the massive fires of 100 years ago, some of which were caused indirectly by human disturbance of the forests. In any case, early-successional species include pin cherry, yellow birch, and heart-leaved paper birch. Late-successional Boreal Talus Woodlands are likely to have more red spruce and less heart-leaved paper birch.

VARIANTS

None recognized at this time.

RELATED COMMUNITIES

Cold Air Talus: This community is found at the base of open talus areas where consistent cold temperatures occur, resulting from cold air drainage. It is distinguished by the presence of labrador tea, black spruce, and mosses that indicate cold conditions.

Open Talus: This is an open community, often devoid of vascular vegetation and often adjacent to Boreal Talus Woodland.

Northern Hardwood Talus Woodland: These woodlands are found at lower elevations and in areas where sugar maple, beech, and yellow birch are the dominant forest species.

CONSERVATION STATUS AND MANAGEMENT CONSIDERATIONS

This is an uncommon community in Vermont and all examples are small. Most examples, however, are relatively undisturbed by humans, since logging, road building, and other activities are difficult on these steep, rocky slopes.

PLACES TO VISIT

Mount Horrid, Rochester and Goshen,
Green Mountain National Forest

CHARACTERISTIC PLANTS

TREES

Abundant Species

Heart-leaved paper birch – *Betula papyrifera*
var. *cordifolia*

American mountain-ash – *Sorbus americana*

Red spruce – *Picea rubens*

Yellow birch – *Betula alleghaniensis*

Occasional to Locally Abundant Species

Balsam fir – *Abies balsamea*

SHRUBS AND VINES

Occasional to Locally Abundant Species

Mountain maple – *Acer spicatum*

Skunk currant – *Ribes glandulosum*

Striped maple – *Acer pennsylvanicum*

Red-berried elder – *Sambucus racemosa*

Virginia creeper – *Parthenocissus quinquefolia*

HERBS

Occasional to Locally Abundant Species

Appalachian polypody – *Polypodium*
appalachianum

White wood aster – *Aster divaricatus*

Fringed bindweed – *Polygonum cilinode*

Hairgrass – *Deschampsia flexuosa*

Marginal wood fern – *Dryopteris marginalis*

BRYOPHYTES AND LICHENS

Moss – *Grimmia apocarpa*

Rock tripe – *Umbilicaria* spp.



ECOLOGY AND PHYSICAL SETTING

The dramatic views from a Cold Air Talus Woodland may make the arduous and even dangerous trek there worthwhile. These woodlands are often perched above surrounding forest and landscape. Large blocks of Open Talus may tower above the woodland for hundreds of feet.

Cold Air Talus Woodland is found where steep slopes or deep valleys allow cold air to drain and settle, and where talus blocks have collected over millennia. On large areas of open talus, heating of the rocks on a sunny day causes local temperatures to rise significantly, just as sun on a parking lot makes it intensely hot. The hot air is less dense than the cooler surrounding air and so rises above it. This creates a dramatic temperature stratification, with cool air settling to the base of the steep slope. Deep spaces between the rocks enhance this effect by providing a place for the cool air to stay and be protected from stirring winds. "Ice caves" are the result. Some of these caves have ice until June or early July.

Because of the constantly cold temperatures, Cold Air Talus Woodlands harbor plants that are normally found much further north or much higher in elevation.

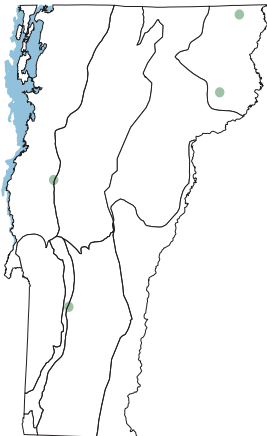
As is true of other talus woodlands, soil is hard to come by, accumulating in spaces between the rocks, or in small crevices on the rocks themselves. Trees are low and slow growing, and shrubs and herbs are sparse.

VEGETATION

Cold Air Talus Woodlands have open canopies of scattered trees, including black spruce, red spruce, and birches, with low shrubs of the heath family, a group of plants that is especially well adapted to infertile soils. Where there is adequate soil, Appalachian polypody, and a few other vascular plants may be present. Mosses and lichens are abundant.

DISTRIBUTION/ ABUNDANCE

This is a rare community in Vermont. Small examples are known from the Southern Green Mountains and Northeastern Highlands. More extensive examples are documented in New Hampshire's White Mountains. The community likely occurs in New York, Maine, and south-eastern Canada as well.



ANIMALS

The fauna of this community are not well known.

VARIANTS

None recognized at this time.

RELATED COMMUNITIES

Open Talus: Open Talus is often associated with this community and is adjacent to it upslope. This community is sparsely vegetated and lacks the most northern elements, such as black spruce and Labrador tea.

Boreal Talus Woodland: This community is often adjacent to Cold Air Talus Woodland and is related to it, but lacks the most northern elements.

PLACES TO VISIT

White Rocks National Recreation Area,
Wallingford, GMNF
Brousseau Mountain, Averill, Kingdom State
Forest, Vermont Department of Forests,
Parks, and Recreation (VDFPR)
Umpire Mountain, Victory, Victory State
Forest, VDFPR

CHARACTERISTIC PLANTS

TREES

Abundant Species

Black spruce – *Picea mariana*

Red spruce – *Picea rubens*

Heart-leaved paper birch – *Betula papyrifera*
var. *cordifolia*

Paper birch – *Betula papyrifera*

Occasional to Locally Abundant Species

Balsam fir – *Abies balsamea*

American mountain-ash – *Sorbus americana*

SHRUBS

Occasional to Locally Abundant Species

Labrador tea – *Ledum groenlandicum*

Low sweet blueberry – *Vaccinium*
angustifolium

Velvetleaf blueberry – *Vaccinium myrtilloides*

HERBS

Occasional to Locally Abundant Species

Appalachian polypody – *Polypodium*
appalachianum

Creeping snowberry – *Gaultheria bispidula*

BRYOPHYTES AND LICHENS

Abundant Species

Moss – *Sphagnum capillifolium*

Schreber's moss – *Pleurozium schreberi*

Windswept moss – *Dicranum polysetum*

Moss – *Polytrichum strictum*

Occasional to Locally Abundant Species

Pin-cushion moss – *Leucobryum glaucum*

Windswept moss – *Dicranum ontariense*

Windswept moss – *Dicranum flagellare*

Liverwort – *Ptilidium pulcherrimum*

Lichen – *Umbilicaria mammulata*

Lichen – *Cladonia uncialis*

Lichen – *Cladina* sp.