

Those Fragile Flowers

The Ecology of Vermont's Alpine Summits

By Susan Shea

As you climb a mountain, if you look around, you will notice the forest changing. In Vermont the trail often begins in a northern hardwood forest, dominated by sugar maple, beech with its smooth, gray bark, and yellow birch with its golden bark curls. As you climb higher, evergreen red spruce and balsam fir intermix with the deciduous trees. At 2500 to 2800 feet in Vermont the forest becomes primarily spruce and fir. The ground is an emerald carpet of ferns, ground pines, and mosses, sprinkled with flowering plants such as bunchberry and Canada mayflower and the yellow Clintonia, or blue bead lily. An occasional mountain ash with its autumn clumps of bright red berries and heart-leaved paper birch are mixed in with the conifers.

It is not the elevation itself, but the changing climate that causes the change in the forest as you climb a mountain. Temperatures are colder here; thus the growing season is shorter. When air masses encounter a mountain range, they rise and cool rapidly, causing water vapor to condense into clouds. Fog is frequent and precipitation is at least double that in the valleys. The wetter soils of the mountains are more acidic and less fertile. Under these conditions the evergreen conifers have an advantage over most deciduous trees. By retaining their needles in the winter, they get a jumpstart on the growing season by photosynthesizing on sunny early spring days while still surrounded by snow. The conical shape of the spruce and firs also withstands snow loading and easily sheds snow.

Stunted Forests

If you climb higher in the Green Mountains, beyond 3500 feet the trees will become short and stunted, only a few inches to a few feet in size, and often growing as a dense thicket. This is known as *krummholz*, a German word that means "crooked wood". Here balsam fir and black spruce (replacing the red) grow very slowly, never reaching full size. These bonsai-like trees bend and twist in response to the wind and snow and ice loading. This subalpine *krummholz* forest is found only on the highest peaks of the Green Mountains, with good examples on Jay Peak, Mount Mansfield, Camel's Hump and Killington. Mixed in with the stunted trees are dwarf shrubs such as mountain blueberry, alpine bilberry, black crowberry and Labrador tea.

Beyond treeline, on rocky summits above 3500 feet, are alpine meadows. Extremely rare in Vermont, these natural communities are found only in three locations. Mount Mansfield (4393 ft.), Vermont's highest peak, has fifty-two acres of alpine vegetation; the distinctive Camel's Hump, ten acres; and Mount Abraham, a small site less than half an acre. It is believed that Jay Peak also supported an alpine community before its summit was dynamited in the 1950's to make room for a restaurant and ski lift housing; a few isolated alpine plants are still found there. Killington, Vermont's second highest mountain, may also have supported alpine plants prior to heavy hiker use and ski area development. More extensive alpine meadows are found in New Hampshire's White Mountains, the Adirondacks of New York State, and in the higher mountain ranges of Maine.

Mount Mansfield is also host to three small alpine bogs, or peatlands, the only known occurrence of this community in Vermont. These peatlands occur in shallow depressions in the bedrock where rainwater accumulates and is retained. These bogs, covered by sphagnum mosses, are very acidic and low in nutrients. The fluffy white clumps of cotton sedge are visible here during the summer.

Glacial Relics

These alpine communities are left over from the Pleistocene Epoch. When the glaciers melted in Vermont 13,000 years ago, the newly exposed rocky soil was first colonized by these plants, plants that now grow far to the north in the Canadian arctic. As the climate warmed, evergreen and then deciduous trees invaded the lowlands. Eventually the extreme conditions of mountain summits were the only places where arctic plants could out-compete other species.

In the alpine zone of the Green Mountains, exquisite flowers bloom during June and July. Sedges, grasses and rushes are also a major component of the alpine meadow. Bigelow's sedge, named for the early botanist Jacob Bigelow, is one of the most abundant. Many of these plants are rare and on the state threatened and endangered species list. According to the Vermont Nongame and Natural Heritage Program, Camel's Hump is home to eighteen rare plant species; Mount Mansfield hosts thirty-four – another reason to be careful where you step. Vermont's rare alpine plants include the globally imperiled Boott's rattlesnake-root, the miniature fern known as green spleenwort and the squashberry shrub with its orange fruit.

Amazing Adaptations

How do these plants manage to thrive in such a harsh environment? They are generally perennials, living for more than one season. Part of the plant overwinters, storing food for the next summer. The small size of alpine plants conserves energy and they grow close to the ground, where temperatures and wind velocities are less severe. Their common cushion-shaped growth form decreases wind exposure. The waxy, tightly packed leaves of the diapensia help prevent drying from the wind and sun. The dark green foliage absorbs sunlight, heating air and trapping it around the plant. If you put your fingers inside a diapensia cushion on a sunny day you will notice it is warmer inside than outside.

Some plants such as Labrador tea, with its tawny wool, grow hairs on the undersides of leaves to protect the stomata, or leaf openings through which gases are exchanged. Many alpiners put food reserves into their roots first, waiting several years before producing flowers. These plants often form flower buds by the end of the summer so they'll be ready to bloom the following spring as soon as conditions permit. Asexual reproduction – spreading by runners or underground stems, is more common in alpine plants than in others, which avoids the challenges of seedling establishment.

Much of the area above timberline is exposed rock, most of which is covered by lichens and mosses. These pioneer plants are able to colonize bare rock by gathering nutrients from rain, dust and decayed fragments of their own tissue. Lichens, symbiotic associations between algae and fungi, also secrete acids that dissolve substances from the rocks. They grow very slowly, but can live a long time. Some individual alpine lichens may be several thousand years old. These pioneer plants create soil that enables other plants to grow.

Alpine Fauna

Vermont's high mountain summits do not support as great a diversity of animals as do the lowlands, but there are some species which make their home here, particularly in the summer. The croak of the raven and the plaintive call of the white-throated sparrow, "Old Sam Peabody, Peabody" are often heard in the Green Mountains. Dark-eyed juncos, blackpoll warblers and the rare Bicknell's thrush breed in the subalpine forest. The Bicknell's thrush is the subject of a research study by the Vermont Institute of Natural Science; GMC volunteers are helping to monitor mountain summits for the bird. The Bicknell's thrush, cousin to the hermit thrush, Vermont's state bird, is the only songbird that breeds exclusively in high-elevation forests of the Northeast.

Red squirrels, which feed primarily on seeds from the cones of coniferous trees, are at home in the montane spruce-fir forest. Snowshoe hares are one of the few mammals common above treeline. They are brown in summer and turn white in winter for camouflage against the snow. The hares' large feet serve as snowshoes for winter travel. Browsing snowshoe hares create another challenge for alpine plants. Shrews, mice and voles also live on mountain summits. Other mammals such as bobcats, fishers, weasels and even moose may visit the alpine zone.

Threats to the Mountain Ecosystem

Vermont's fragile alpine and subalpine ecosystems face multiple threats. Rick Paradis, Director of the University of Vermont's Natural Areas Center, which owns and manages 400 acres on the summit of Mount Mansfield, notes "These ecosystems are resilient to natural forces, but not as resistant to human intrusion." Though most are publicly-owned, these high-elevation lands are attractive for ski area expansion and the development of wind turbines and telecommunications facilities.

Air pollutants transported long distances from urban areas and fossil fuel sources to the south and west create acid rain and fog. Acidification of the soil by precipitation affects nutrient uptake and may have dramatic long-term effects on mountain forests. Research studies by University of Vermont professor Hub Vogelmann on the red spruce forest on Camel's Hump beginning in the 1960's were the first in the nation to document this effect. Acidity causes aluminum, usually a harmless component in rocks and soil, to become soluble in water, where it is toxic to plants and fish. Calcium and other nutrients essential for plant growth are leached out of the soil. Continuing studies on Camel's Hump have also shown that prolonged exposure to acid cloud mist impairs the ability of spruce needles to survive cold stress. As a result, in some years winter injury to this forest is severe.

If global climate change takes place as predicted, and the climate warms, plant communities will likely shift their ranges. Species now growing in the valleys will move upslope. The spruce-fir forests currently below the alpine summits may be able to grow at higher elevations, crowding and shading out alpine plants.

Hikers are another threat to alpine vegetation. Besides trampling plants, hiking boots can harm the shallow, peaty turf. Once this mat is cut, water erodes it quickly. Organic matter that has taken thousands of years to accumulate is washed away. The Green Mountain Club started its ranger-naturalist (now summit caretaker) program in 1969 to address this problem. Seasonal staff and trail signs educate hikers to walk with care (see sidebar). GMC has also erected cairns, string and brush fences, puncheon, and low scree walls from loose rock to keep hikers on the trail and off vegetation, other successful methods. "I believe the alpine vegetation on Mount Mansfield and Camel's Hump is recovering as a result of our program over the past thirty-five years," says Rick Paradis. "Photos taken in the past decade on Mount Mansfield have documented the trend of colonizing species such as moss, sedges and mountain sandwort moving into areas outside treadways that were previously trampled."

A relatively new issue is the impact of winter use of the summits on alpine vegetation. In winter, high winds often blow off the snow cover, exposing the plants. Trampling by snowshoers, climbers wearing crampons, and backcountry skiers and snowboarders on their way to descents is a serious danger to plants during a vulnerable season.

Through education and the continuing careful stewardship of Vermont's mountain summits, visited by so many hikers each year, the Green Mountain Club and its partners hope that future generations will be able to enjoy the white blooms of diapensia and hear the call of the Bicknell's thrush in the krummholz forest.

How You Can Help Protect the Alpine Zone (put in box or sidebar)

- Do not pick any plants or flowers
- Stay on the trails
- Walk on rock whenever possible
- Do not take rocks; doing so can disturb plant and animals habitats
- Leash your dog and keep pets off vegetation
- In winter, remove snowshoes and crampons on exposed summits and keep to rock
- Spread the word; educate your friends