

*Conservation Assessment
for
Highland Rush
(Juncus trifidus) L.*



Foto: Anna-Lena Anderberg

Photo credit: Anna-Lena Anmderberg

USDA Forest Service, Eastern Region

May 6, 2004

**Melanie Schori, Botanical Consultant
Green Mountain National Forest of Vermont and
Monongahela National Forest of West Virginia**



This Conservation Assessment was prepared to compile the published and unpublished information on the subject taxon or community; or this document was prepared by another organization and provides information to serve as a Conservation Assessment for the Eastern Region of the Forest Service. It does not represent a management decision by the U.S. Forest Service. Though the best scientific information available was used and subject experts were consulted in preparation of this document, it is expected that new information will arise. In the spirit of continuous learning and adaptive management, if you have information that will assist in conserving the subject taxon, please contact the Eastern Region of the Forest Service - Threatened and Endangered Species Program at 626 East Wisconsin Avenue, Milwaukee, Wisconsin 53203.

Table of Contents

EXECUTIVE SUMMARY	4
ACKNOWLEDGEMENTS	5
INTRODUCTION	5
NOMENCLATURE AND TAXONOMY	6
DESCRIPTION OF SPECIES	6
LIFE HISTORY	6
HABITAT	7
DISTRIBUTION AND ABUNDANCE.....	12
Summary of Maine Occurrences	12
Summary of New Hampshire Occurrences.....	14
Summary of Vermont Occurrences	18
Summary of New York Occurrences.....	19
Summary of West Virginia Occurrences	21
STATUS	22
POPULATION BIOLOGY AND VIABILITY.....	23
POTENTIAL THREATS AND MONITORING	24
SUMMARY OF LAND OWNERSHIP AND EXISTING HABITAT PROTECTION.....	25
SUMMARY OF EXISTING MANAGEMENT ACTIVITIES	27
PAST AND CURRENT CONSERVATION ACTIVITIES	27
RESEARCH AND MONITORING	28
REFERENCES	29
LIST OF CONTACTS	32

EXECUTIVE SUMMARY

Juncus trifidus L., otherwise known as highland rush, is a perennial forb of the rush family. Plants reproduce asexually by forming tufts and sexually through flowers and fruit. The small brown flowers appear from April in the south and from June through September in the north. Fruit is set promptly, and the tiny seeds are probably dispersed by wind and water.

There are no taxonomic issues with *Juncus trifidus*, although there are several species that somewhat resemble it. Identification is not too difficult, though verification relies on a number of technical features, and people who are not familiar with rush keys and terminology may have difficulty when trying to identify plants.

The species is relatively common in the alpine and subalpine communities of Maine and New Hampshire, and is less common New York and Vermont. It occurs on a couple of high altitude cliffs in West Virginia, though these sites are not alpine. It is found on acidic substrates – histosols and granite gravels in the north and sandstone in the south.

Juncus trifidus is a circumboreal species, and is found in the United States in the Northeast and the Central Appalachians. It is ranked S3S4 and is known from at least 18 extant occurrences in New Hampshire, most of which lie within the White Mountain National Forest. The species is no longer tracked in New Hampshire. It is ranked S3S4 in Maine and is not tracked. In Vermont, it is ranked S1 and there are 6 extant occurrences, one of which is from the Green Mountain National Forest. It is on the Green Mountain National Forest's Regional Forester's Sensitive Species list. It is ranked S2 in New York and is known from 10 extant occurrences, most of which are within Adirondack Park. In West Virginia, it is ranked S1, with 2 extant occurrences, 1 of which is partly from Monongahela National Forest. It is on the Monongahela National Forest's Regional Forester's Sensitive Species list.

The main threat to *Juncus trifidus* is loss of individual plants and suitable habitat due to recreational activities. Direct trampling, soil compaction, and soil erosion all result from hiker foot traffic and off-trail wandering. Air pollution, acid rain, and global warming may have long-term effects on the viability of the species and its alpine habitats. Current regulations are not effective at controlling threats from recreational use or from environmental changes due to human activities.

Currently, only the populations on Vermont's alpine peaks are managed under active conservation programs. The Green Mountain Club, in co-operation with the Green Mountain National Forest, is responsible for summit stewardship programs and revegetation projects on a few mountains. Management plans are in place for some of the lands on which *Juncus trifidus* occurs, but there is little in the way of active conservation in Maine, New Hampshire, New York, and West Virginia. Since *Juncus trifidus* is widespread in alpine habitats, it may be a good indicator species that can reflect the overall health and integrity of the alpine system in the Northeast.

ACKNOWLEDGEMENTS

I owe many thanks to Lisa St. Hilaire, who wrote the initial literature review of *Juncus trifidus* for the White Mountain National Forest and Green Mountain National Forest. Her excellent writing and organization of information served as the basis for much of the following document. I reorganized and rewrote sections that were similar to those in the literature review, and cited the original sources, so I rarely cite Lisa's work directly, but I could not have written this document without her. Thanks are due to Diane Burbank of the Green Mountain National Forest; Sara Cairns, Bill Nichols, and Dan Sperduto at New Hampshire Natural Heritage Bureau; Heather Root for directing me to Pete Antos-Ketcham at the Green Mountain Club; Stacy Lemieux of the White Mountain National Forest; Bob Popp and Jodi Shippee at Vermont Nongame and Natural Heritage Program; Don Cameron and Emily Pinkham at Maine Natural Areas Program; Alice Schori at the Appalachian Trail Conference; Steve Young at New York Natural Heritage Program; the botanists at West Virginia Natural Heritage; Melissa Thomas-Van Gundy of Monongahela National Forest. Thanks especially to MaryBeth Deller, my contracting officer at the Green Mountain National Forest.

INTRODUCTION

Juncus trifidus is a perennial forb of the rush family. Plants reproduce sexually through flowers and fruit and asexually through tufted clonal growth. The species is relatively common in the alpine communities of Maine and New Hampshire, and is less common in New York and Vermont. It occurs in non-alpine habitat in West Virginia. There are no significant taxonomic issues with *Juncus trifidus*.

Juncus trifidus is a circumboreal species, and is found in the United States in the Northeast and Central Appalachians. It is ranked S3S4 in New Hampshire, S3S4 in Maine, S1 in Vermont, S2 in New York, and S1 in West Virginia. It is on the Green Mountain and Monongahela National Forests' Regional Forester's Sensitive Species lists. It is not tracked in New Hampshire and Maine.

This assessment includes sections on taxonomy, life history, and population biology. There is an extensive section that describes alpine and subalpine habitats in the Northeast, with a much smaller habitat overview for West Virginia. Occurrence information for Maine, New Hampshire, Vermont, New York, and West Virginia is included in the Distribution and Status section. The last sections cover threats to the species, conservation and management activities, land ownership and habitat protection, and research and monitoring activities.

This assessment is designed to concentrate on occurrences within the Green Mountain National Forest and Monongahela National Forest, National Forests in Region 9 with sensitive *Agrostis mertensii* populations. Since the alpine zone in the Northeast is found in New York, Maine, New Hampshire, and parts of Vermont and West Virginia that are not within the Forests, those areas are included as well. Similar assessments are being

written for *Agrostis mertensii*, *Vaccinium uliginosum*, and *Carex bigelowii* as well. These species share similar habitats in the Northeast and are widespread enough to serve as good indicators of the overall health of the alpine system.

NOMENCLATURE AND TAXONOMY

Juncus trifidus was named by Linnaeus in 1753. Plants in the southern parts of its United States range have been separated into subspecies *carolinianus* Hämet-Ahti on the basis of their fewer, larger flowers. Clemants (1990) says that Hämet-Ahti applied ssp. *carolinianus* to all North American plants since she considered them distinct from European plants, and that she based her distinctions on leaf characters. However, since American plants show more variation than Hämet-Ahti defined, Clemants advises that the ssp. *carolinianus* not be recognized. According to Gleason and Cronquist (1991), some authors have misapplied the varietal name *monanthos* to plants that should have been termed ssp. *carolinianus*.

DESCRIPTION OF SPECIES

Juncus trifidus is a member of the rush family (Juncaceae). It is a perennial that is densely caespitose from a short rhizome. Its stems are 5-30 cm high, sheathed at the base for about 3 cm, and have 2 or 3 filiform leaves near the apex. The sheaths are auriculate, with a short bristle-tip on the auricles. The leaves are 4-10 cm and very finely toothed. The inflorescences are borne at the top of the stem and consist of 1 or 2 groups of 1-4 flowers. The flowers have a pair of lacerate subtending bracteoles, 3 acuminate or aristate sepals that are 3-4 mm long, and 3 acuminate or acute tepals that are slightly shorter than the sepals. There are 6 anthers, and the fruit is an obovoid, three-chambered capsule with a beak of 1 mm. There are a few seeds per capsule (Gleason and Cronquist 1991). The stems tend to be dark green, and the leaves brown by midsummer, so from a distance the lower two-thirds of the plant is green, and the top third is tan.

LIFE HISTORY

Although *Juncus trifidus* is a perennial rush, the life span of an individual plant is not known. It can form dense tufts but has a limited ability to colonize areas through asexual reproduction. It roots at depth up to 80 cm (Bliss 1966). In the Northeast, it blooms from June through September (Bliss 1966), and sets seed in the same time period (Young 1992). In West Virginia, it may bloom as early as April and have fruit in June (West Virginia Natural Heritage Program 2004). Flowers are probably pollinated by small insects, since Gleason and Cronquist (1991) does not characterize the rush family as wind-pollinated. Seed is needed to colonize new areas. Seed germination requirements are not known, though it is likely that seeds germinate in the spring. *Juncus trifidus* is a diploid with $2n = 30$ (Gleason and Cronquist 1991).

HABITAT

Juncus trifidus is found in a wide variety of alpine habitats in New England and New York. It is considered an alpine species and is found on the higher peaks of the White Mountains, but may also be found on high elevation ledges and landslides in forested settings, cold-air talus slopes, and lower elevation rocky mountain stream or river banks (Sperduto and Cogbill 1999). It is also found in subalpine habitats, and may be a cliff dweller in the Central Appalachians, New York, and Vermont. It occurs in exposed rock crevices and cliff ledges at higher elevations in the mountains of Virginia, North Carolina, and Tennessee (Gleason and Cronquist 1963 and Radford *et al.* 1968 in Riefner 1981). In Vermont, it can be found in calcareous situations, while in New Hampshire, New York, and West Virginia, it is on acidic granite or sandstone. The Vermont occurrence in the Green Mountain National Forest is from a subalpine calcareous cliff, while the West Virginia occurrence from Monongahela National Forest is from a higher elevation sandstone cliff.

Juncus trifidus is found in many kinds of alpine communities. It can occur in rock crevices on barren rocks, in open meadows of varying community types, and in heath communities and subalpine situations. It is found in all the alpine heath meadow types, in particular the dry-mesic heath meadow system, which is a group of communities that include dry-mesic heath alpine graminoid meadows, fell fields, and an array of *Carex* meadows, strong heaths, diapensia, and barren rock. This species tends to prefer more mesic sites and is similar to *Carex bigelowii* and *Vaccinium uliginosum* in preferences within these communities. It is occasionally found in subalpine heath krummholz and bare rock subalpine systems (SVE Panel 2002). Specific community types include: 1) Diapensia-azalea-rosebay dwarf shrubland, 2) Diapensia-bilberry heath (Sperduto and Cogbill 1999); 3) Diapensia alpine ridge (Gawler 2001); 4) alpine heath snowbank, 5) Bigelow's sedge meadow, 6) sedge-rush-heath meadow, 7) dwarf shrub-bilberry-rush barren (Sperduto and Cogbill 1999); 8) dwarf heath-graminoid alpine ridge (Gawler 2001); 9) alpine meadow (Thompson and Sorenson 2000); 10) Labrador tea heath/krummholz, and 11) sheep laurel-Labrador tea heath/krummholz (Sperduto and Cogbill 1999); and 12) alpine tundra and subalpine cliffs (calcareous and acidic) (Jenkins 1981). Many of these community types are ranked S1 or S2 in New England states (see St. Hilaire 2002 for more details on ranks). Alpine communities are significantly shaped by cold winter and cool spring and summer temperatures, a short growing season, almost constant and frequent high-speed winds, snow and ice scour, frost heaving, and desiccation. Soils tend to be thin and acidic, with low nutrient availability and dry to mesic conditions.

Alpine Habitat Descriptions:

1) The Diapensia-azalea-rosebay dwarf shrubland of New Hampshire is found on exposed wind blown situations with considerable bare ground where winter snow cover is slight or absent (4400-5500 feet elevation). Diapensia communities are characterized by the lowest percent plant cover of alpine communities (48-51%), a dominance of cushion

plants, and a limited cover of lichens and mosses. Freeze-thaw cycles are prevalent, as are active soil polygons (patterned soil movement due to freeze-thaw cycles) (Bliss 1963). Dominant species include *Diapensia lapponica*, *Juncus trifidus*, *Rhododendron lapponicum*, *Loiseleuria procumbens*, and *Vaccinium uliginosum*. Other species may include *Solidago cutleri*, *Salix uva-ursi*, *Agrostis mertensii*, and *Minuartia groenlandica*.

2) The Diapensia-bilberry heath community represents less diverse Diapensia heaths and is found at lower elevations (4000-4600 feet) (Sperduto and Cogbill 1999). Both Diapensia communities have soil pHs between 4.2 and 4.6 (Bliss 1963).

3) The Diapensia alpine ridge in Maine has patchy alpine vegetation in which matted evergreen shrubs and a few herbs are scattered among boulders or in bedrock pockets. Cushions of *Diapensia* are the dominant feature, but *Vaccinium uliginosum* is also common. The cover of herb species is usually less than 20%, and graminoids such as *Carex bigelowii* and *Juncus trifidus* are typically more abundant than forbs. This community is found in very exposed and windswept areas above treeline, with plants growing in gravelly substrate among fractured rocks (Gawler 2001).

4) The alpine heath snowbank community is located in the lee of rocks and ledges or just above continuous krummholz where snow accumulates and typically does not melt until May. Soils in this community tend to be well-drained, with a pH from 4.0 to 4.6 (Bliss 1963). The community is characterized by *Vaccinium uliginosum*, *Vaccinium angustifolium*, *Vaccinium vitis-idaea*, *Carex bigelowii*, and *Juncus trifidus*, supports *Ledum groenlandicum*, *Empetrum nigrum*, *Vaccinium cespitosum*, *Loiseleuria procumbens*, and occasionally *Arctostaphylos alpina* (Sperduto 1993). *Phyllodoce caerulea* and *Harrimanella hypnoides* can be found in this community (Sperduto and Cogbill 1999). Herbaceous associates include *Cornus canadensis*, *Maianthemum canadense*, and *Trientalis borealis*, and *Cetraria islandica* is frequently present. These communities form dense mats 4 to 12 inches deep, with 91-96% plant cover (Bliss 1963, 1966).

5) Bigelow's sedge meadow is generally the dominant but variable alpine meadow community of higher alpine peaks. Krummholz is sparse or absent. The community is dominated by *Carex bigelowii*, with small amounts of *Minuartia groenlandica* and dwarf heaths, and is found at 4300-6000 feet.

6) The sedge-rush-heath meadow is typically found on west and north exposures from 4800-5500 feet and is characterized by mixtures of *Carex bigelowii*, *Juncus trifidus*, dwarf heath and other shrubs (Sperduto 1993). *Minuartia groenlandica* and *Vaccinium vitis-idaea* are present, and total plant cover averages 72% (Bliss 1963). At lower elevations rush-heath mixtures with less sedge are a prominent variant (Sperduto and Cogbill 1999). *Carex bigelowii* is more prominent at higher elevations, while *Juncus trifidus* is more prominent at lower elevations. Other species present include *Potentilla tridentata* and *Cetraria islandica*. Some examples have much exposed rock and may grade into a fellfield community (Sperduto 1993). At elevations above 5600 feet on Mt. Washington, the community is characterized by *Juncus trifidus*, *Vaccinium vitis-idaea*,

and *Potentilla tridentata*, with *Carex bigelowii* and *Minuartia groenlandica* decreased in importance. In more exposed areas, *Diapensia lapponica* is common, while *Vaccinium uliginosum* is more prevalent in areas with greater snow cover (Bliss 1963). Soils in this habitat have pHs ranging from 4.1 to 4.7 (Bliss 1963).

7) The dwarf shrub-bilberry-rush barren is found in exposed situations, from 3400 to 4800 feet. It is the most common alpine community type in the Presidential Range of the White Mountains in New Hampshire, covering extensive areas. This community is usually located within a few hundred feet of timberline (Bliss 1963). Some winter snow may accumulate, but it melts early (Sperduto 1993). It is dominated by *Vaccinium uliginosum*, *Vaccinium vitis-idaea*, *Juncus trifidus*, with scattered dwarf shrubs, particularly *Empetrum atropurpureum*, *Potentilla tridentata*, and the occasional *Diapensia lapponica* and *Betula minor*. *Carex bigelowii* and *Juncus trifidus* have a lower abundance here than in sedge-rush-heath meadows (Sperduto and Cogbill 1999). This community type has local variations. On the upper solifluction terraces at higher elevations, like Mt. Washington's Alpine Garden, *Minuartia groenlandica*, *Scirpus cespitosus*, and *Agrostis mertensii* are important. On nearby Boott Spur and Bigelow Lawn, large stone rings with wind-exposed diapensia communities at their centers are surrounded with dwarf shrub heath-rush or sedge-rush-dwarf shrub heath on the more stable and protected flanks. In areas where the soils are moister in summer, there is an increase in the importance of *Carex bigelowii*, so that it dominates, or is co-dominant with *Juncus trifidus* (Bliss 1963). Soils in this community have pHs that range from 4.1 to 4.6 (Bliss 1963).

8) The dwarf heath-graminoid alpine ridge is the most common community type above treeline in Maine. It occurs on exposed windswept ridges, and ranges from dry in exposed areas to moist in protected patches. The vegetation is a mixture of dwarf evergreen shrubs and herbs, with total cover from 35-65%. The most abundant herbs are *Carex bigelowii* and *Juncus trifidus*. In one variant, *Carex bigelowii* forms carpets and is dominant, with sparse heath shrubs and herbaceous species (Gawler 2001).

9) Alpine meadows are found on open, exposed ridgetops at elevations above 3500 feet in Vermont. In these locations, high winds, frequent fog, abundant precipitation, low temperatures, and frequently intense solar radiation are prevalent. The soils are thin and primarily organic, in low pockets and in areas where the bedrock breaks into small fragments through freezing and thawing, allowing soil accumulation. The plant associations in this community are determined by environmental stresses, soil depth, and moisture. Sedge meadows form a mosaic with low shrub communities, areas of lichen-covered bedrock, and occasional trees in protected pockets. This community is characterized by many arctic species. *Vaccinium uliginosum*, *Empetrum nigrum*, and *Vaccinium boreale* are the dominant shrubs, with *Salix uva-ursi*, *Salix pyrifolia* also present. Herbaceous species may include *Agrostis mertensii*, *Asplenium viride*, *Carex atratiformis*, *Carex bigelowii*, *Deschampsia flexuosa*, *Diapensia lapponica*, *Dryopteris fragrans*, *Empetrum nigrum*, *Hierochloe alpina*, *Huperzia appalachiana*, *Juncus trifidus*, *Luzula parviflora*, *Maianthemum canadense*, *Minuartia groenlandica*, *Poa fernaldiana*,

Potentilla tridentata, *Prenanthes boottii*, *Smilacina trifoliata*, and *Solidago cutleri* (Thompson and Sorenson 2000).

Subalpine Habitat Descriptions:

10) In the Labrador tea heath/krummholz community, stunted *Abies balsamea* and *Betula papyrifera* var. *cordifolia* are common, with *Picea rubens* occasional near 3500 feet and *Picea mariana* near 4900 feet. Dwarf shrubs include *Ledum groenlandicum*, *Empetrum atropurpureum*, *Vaccinium uliginosum*, *Vaccinium vitis-idaea*, and occasionally *Vaccinium boreale*. *Cladina rangiferina*, *Cetraria islandica*, and *Cladina alpestris* are common and abundant. This krummholz community type ranges from nearly pure dwarf shrublands (<15 cm tall) to mixtures with up to 60% krummholz (<2 meter tall trees) (Sperduto and Cogbill 1999).

11) The sheep laurel-Labrador tea heath/krummholz community is found primarily between 3000 and 3500 feet, and is characterized by a mixture of *Kalmia angustifolia* and *Ledum groenlandicum*, with *Vaccinium uliginosum* and *Vaccinium vitis-idaea*. Dwarfed *Betula papyrifera* var. *cordifolia* and *Abies balsamea* are common, and *Picea rubens* is more frequent than *Picea mariana*. Occasional species include *Rhododendron canadense* and *Nemopanthus mucronatus*, with *Vaccinium angustifolium* more common than at higher elevations. This krummholz community type ranges from nearly pure dwarf shrublands (<15 cm tall) to mixtures with up to 60% krummholz (<2 meter tall trees) (Sperduto and Cogbill 1999).

12) Boreal calcareous cliffs occur on limestones, marbles, and calcareous schists at elevations over 2000 feet in Vermont. They vary in origin and structure, but have a high availability of calcium and other nutrients. Boreal calcareous cliffs are generally sparsely vegetated, but plant cover and diversity increase in moister areas. Rare and uncommon species include *Sedum rosea*, *Arabis lyrata*, *Saxifraga oppositifolia*, *Saxifraga aizoides*, *Saxifraga paniculata* ssp. *neogaea*, *Artemisia campestris* ssp. *borealis*, *Dryopteris fragrans*, *Woodsia glabella*, *Primula mistassinica*, *Carex scirpoidea*, *Pinguicula vulgaris*, *Astragalus robbinsii* var. *minor*, *Erigeron hyssopifolius*, *Braya humilis*, *Eleocharis pauciflora*, *Rhynchospora capitellata*, and *Huperzia appalachiana* (Thompson and Sorenson 2000). In Vermont, *Juncus trifidus* is associated with both wet and dry rocks (Vermont Nongame and Natural Heritage Program 2001).

13) Boreal acidic cliffs occur on very steep slopes or vertical faces in the colder areas of Vermont, at high elevations or in cold valleys at lower elevations. They are usually granite or quartzite, which are acidic and do not weather easily. Shallow soils can accumulate in crevices and ledges, but are easily eroded. Boreal acidic cliffs are typically surrounded by spruce-fir forests and may support many species associated with those forests. Vegetation is sparse on the cliffs and diversity is low. Rare and uncommon species of this community include *Dryopteris fragrans*, *Carex scirpoidea*, and *Scirpus cespitosus* (Thompson and Sorenson 2000).

In New York, the Natural Heritage Program (2004) lists its habitat as alpine ridges, meadows, and openings in krummholz. The three community types that correspond to these descriptions according to Edinger et al. (2002) are alpine meadow, alpine krummholz, and spruce-fir rocky summit, and they are described below. *Juncus trifidus* is also known from a subalpine cliff community.

14) The alpine meadow is a meadow community that is similar to arctic tundra. Alpine meadows occur above timberline (about 4900 ft or 1620 m) on the higher mountain summits and exposed ledges of the Adirondacks. This community consists of a mosaic of small grassy meadows, dwarf shrublands, small boggy depressions, and exposed bedrock covered with lichens and mosses. The flora includes arctic-alpine species that are restricted (in New York) to these meadows, as well as boreal species that occur in forests and bogs at lower elevations. The soils are thin and organic, primarily composed of sphagnum peat or black muck. The soils are often thoroughly wet because they can be saturated by atmospheric moisture from fog. Characteristic species of the grassy meadows include *Scirpus cespitosus*, *Carex bigelowii*, *Calamagrostis canadensis*, *Hierochloa alpina*, *Deschampsia flexuosa*, *Luzula parviflora*, *Juncus trifidus*, *Potentilla tridentata*, *Cornus canadensis*, *Minuartia groenlandica*, and *Prenanthes nana*. Characteristic species of the low shrublands are *Vaccinium uliginosum*, *Chamaedaphne calyculata*, *Ledum groenlandicum*, *Betula glandulosa*, *Empetrum nigrum*, *Rhododendron lapponicum*, *Diapensia lapponica*, and *Salix uva-ursi*. On a few mountains there are distinctive patches of low shrublands consisting of dwarf birches including *Betula glandulosa*, *Betula minor*, and stunted *Betula cordifolia*. Characteristic species of the small boggy depressions include the peat mosses *Sphagnum nemoreum* and *Sphagnum fuscum*, *Eriophorum vaginatum* var. *spissum*, *Kalmia polifolia*, and *Vaccinium oxycoccus*. Rock outcrops that are relatively undisturbed by trampling are covered with arctic-alpine lichens such as map lichen (*Rhizocarpon geographicum*) and may have scattered cushions of diapensia. This community is very sensitive to trampling because of the thin, often saturated soils and the very slow growth rate of the vegetation in the stressful alpine environment.

15) The alpine krummholz community is a dwarf woodland dominated by *Abies balsamea* that occurs at or near the summits of the high peaks of the Adirondacks at elevations of 3500 to 4900 ft (1067 to 1494 m). Approximately 85% of the canopy consists of *Abies balsamea*; common associates include *Betula cordifolia* and *Picea mariana*. Less common are *Picea rubens*, *Juniperus communis*, *Larix laricina*, and *Thuja occidentalis*. The trees form dense stands of stunted trees; at the uppermost elevations below timberline the trees are under 5 ft (1.5 m) tall, with branches extending to the ground (i.e., there is no self-pruning of lower branches), and an average dbh of 3 in (7.6 cm). The groundlayer is densely shaded; the groundcover consists of a thick carpet of mosses, with scattered lichens and herbs. Characteristic herbs include *Cornus canadensis*, *Solidago macrophylla*, *Oxalis acetosella*, *Coptis trifolia*, and *Maianthemum canadense*.

16) The spruce-fir rocky summit is a community that occurs on cool, dry, rocky ridgetops and summits where the bedrock is non-calcareous (such as anorthosite, quartzite, or sandstone), and the soils are more or less acidic. The vegetation may be sparse or patchy,

with numerous rock outcrops and rock slides. The species have predominantly boreal distributions. Characteristic trees include *Picea rubens*, *Abies balsamea*, *Sorbus americana*, and *Betula cordifolia*. *Tsuga canadensis* may be an associate in examples in the Catskill Mountains. The shrub layer includes sapling canopy trees along with *Vaccinium angustifolium* and *Vaccinium myrtilloides*. Characteristic herbs include *Campanula rotundifolia*, *Potentilla tridentata*, *Solidago spathulata* ssp. *randii*, *Solidago macrophylla*, *Deschampsia flexuosa*, *Cornus canadensis*, *Aster acuminatus*, and *Oryzopsis pungens*. There are usually many mosses and crustose lichens growing on rock outcrops. This community type is not fully understood and more data are needed.

17) A cliff community occurs on vertical exposures of resistant, non-calcareous bedrock (such as quartzite, sandstone, or schist) or consolidated material; these cliffs often include ledges and small areas of talus. There is minimal soil development, and vegetation is sparse. Different types of cliffs may be distinguished based on exposure and moisture; these variations are not well-documented in New York, therefore the assemblages associated with these variations (sunny, shaded, moist, or dry areas) are combined in one community. Characteristic species include *Polypodium virginianum*, *Dryopteris marginalis*, *Deschampsia flexuosa*, *Kalmia latifolia*, and *Tsuga canadensis*.

In West Virginia, *Juncus trifidus* occurs on open cliffs on North Fork Mountain. North Fork Mountain is a long ridge (24 miles) that runs from northeast to southwest. It is composed of sedimentary rocks, including sandstone and conglomerates. Two populations have been reported, from 3700 and 4200 feet. The surrounding areas are forested, and associated species include *Potentilla tridentata*, *Pinus resinosa*, *Paronychia argyrocoma*, *Heuchera alba*, *Acer rubrum*, *Quercus rubra*, and *Quercus prinus*. This species assemblage indicates that the soil is likely to be acidic and well-drained.

The alpine and subalpine habitats in which *Juncus trifidus* occurs overlap with the habitats of *Agrostis mertensii*, *Carex bigelowii*, and *Vaccinium uliginosum*, for which conservation assessments have also been written. Surveys in the alpine zone should include these species as well, since they are likely to be found with *Juncus trifidus*.

DISTRIBUTION AND ABUNDANCE

Juncus trifidus is found in Europe, Asia, and eastern North America (Clemants 1990). In eastern North America, it is found south to the mountains of Virginia and North Carolina (Gleason and Cronquist 1991).

Summary of Maine Occurrences

Juncus trifidus is not tracked in Maine. It is found in suitable habitats on alpine and subalpine peaks. According to the checklist published by the Josselyn Botanical Society (1995), it occurs in Penobscot, Piscataquis, Somerset, Franklin, and Oxford Counties. All specimen information is from the University of Maine Herbarium database (2000) unless noted otherwise. Two occurrence records are based on Maine Natural Areas Program

(2001) Element Occurrence reports for other species where *Juncus trifidus* is mentioned as an associated species.

Elliotsville Township, Piscataquis County – A specimen was collected from Boarstone (Borestone) Mountain in 1895. Plants grew on ledges at 2000 feet.

T3 R10 WELS, Piscataquis County – Seymour (1997) reports a collection from Doubletop Mountain prior to 1970. This mountain is in Baxter State Park.

T3 R10 WELS, Piscataquis County – Plants were seen in 1984 on Mt. Coe. Plants occurred on an open slide with *Empetrum nigrum*, *Minuartia groenlandica*, *Agrostis mertensii*, and *Vaccinium uliginosum*. The elevation was 3260 feet. This location is in Baxter State Park. These are indirect data from the Maine Natural Areas Program (2004).

T3 R9 WELS, Piscataquis County – A specimen was collected from Hamlin Peak in 1953. Plants grew on open rocky ground. Hamlin Peak is in Baxter State Park.

T3 R9 WELS, Piscataquis County – Specimens were collected from Mt. Katahdin in 1856, 1892, 1898, 1923, and 1948. A specimen was collected at Pamola Peak in 1953, at the Saddle in 1954, at the Table Land in 1968, and from Baxter Peak in 1967. At Baxter Peak plants were noted as common and forming large tussocks at 5230 feet elevation. Mount Katahdin is in Baxter State Park.

T3 R9 WELS, Piscataquis County – A specimen was collected from South Turner Mountain in 1967. The elevation ranged from 3000 to 3110 feet. *Juncus trifidus* was common, forming large tussocks on the barren, open peak. This mountain is in Baxter State Park.

T5 R9 WELS, Piscataquis County – A specimen was collected on Pinnacle Ridge of Traveler Mountain in 1953. This mountain is in Baxter State Park.

Bald Mountain Township (T4 R3 NBKP), Somerset County – A specimen was collected from the summit of Boundary Bald Mountain in 1983.

Dead River Township, Somerset County – A specimen was collected here in 1919 (University of Maine Herbarium 2000). Plants were seen on Bigelow Mountain in 2002. They were at 3899 feet on damp slides and on dry alpine ledges. Associated species included *Agrostis mertensii*, *Minuartia groenlandica*, *Sibbaldiopsis tridentata*, and *Vaccinium* sp. Plants are threatened by hiking. This site is owned by the Bureau of Parks and Land. These are indirect data from the Maine Natural Areas Program (2004).

Wyman Township, Franklin County – Seymour (1997) reports a collection from Bigelow Mountain prior to 1970. Bigelow Mountain is on land owned by the Bureau of Parks and Land. This may be the same 1919 collection cited above, except Seymour places his citation in Franklin County.

Sandy River Pkt., Franklin County – A specimen was collected on Saddleback Mountain, at 4116 feet, in 1964. Plants were common on exposed gravelly sites.

Redington Township, Franklin County – A specimen was collected from Saddleback Jr. in 1987.

Carrabassett Valley (T4 R2), Franklin County – A specimen was collected on Sugarloaf Mountain, at 4240 feet, in 1960. Associated species included *Vaccinium uliginosum* and *Ledum groenlandicum*. Plants grew in tight clumps on the rocky, barren summit.

Mount Abram Township, Franklin County – A specimen was collected on Mount Abraham in 1962. Plants were common on rocky barrens from 3800 to 4049 feet.

T6 North of Weld, Franklin County – A specimen was collected from exposed cliffs on Tumbledown Mountain in 1991. Associated species included *Potentilla tridentata* and *Vaccinium* sp.

Newry, Oxford County – Seymour (1997) reports a collection from Bald Mountain prior to 1970.

Bowmantown Township, Oxford County – A specimen was collected from cliffs at 2700 feet on Twin Peaks in 1975.

Grafton, Oxford County – A specimen was collected on the east peak of Baldpate Mountain in 1975. Baldpate is in the Appalachian Trail Corridor on land owned by the Bureau of Parks and Land.

Riley Township, Oxford County – A specimen was collected on Goose Eye in 1974. Plants were observed here in 1990 and 1997. Goose Eye is in the Appalachian Trail Corridor on land owned by the Bureau of Parks and Land.

Summary of New Hampshire Occurrences

Juncus trifidus is not tracked in New Hampshire. It is a very common plant in alpine habitat. There are at least 18 extant occurrences. Extensive populations are found within Thompson & Meserves and Sargents Purchase, in the alpine zone of the Presidential Range. These populations will probably be mapped as one metapopulation once the New Hampshire Natural Heritage Bureau implements its new mapping techniques. Occurrence data below come from Appalachian Trail Conference monitoring data (A. Schori, personal communication), New Hampshire Natural Heritage Bureau herbarium records and occurrence records (2001) on which *Juncus trifidus* is listed as an associate of a targeted species, and records from Pease's Flora of Northern New Hampshire (1964) and Seymour's Flora of New England (1997). It is uncertain whether these populations still exist.

Beans Grant, Coos County – A specimen was collected here in 1908. Appalachian Trail Conference data indicate that *Juncus trifidus* was present on Mt. Webster in 1990. It occurred on exposed overlooks with *Vaccinium uliginosum*, *Potentilla tridentata*, *Empetrum nigrum*, *Minuartia stricta*, *Solidago cutleri*, *Agrostis mertensii*, and *Vaccinium vitis-idaea*. The elevation was 3910 feet. This site is in the Presidential Range-Dry River Wilderness Area of the White Mountain National Forest.

Beans Grant, Coos County – A specimen was collected here in 1880. Appalachian Trail Conference data list *Juncus trifidus* as one of the dominant species on Mt. Clinton in 1990. Associated species included *Diapensia lapponica* and *Vaccinium uliginosum*. The elevation was 4185 feet. This site is in the White Mountain National Forest.

Beans Purchase, Coos County – Appalachian Trail Conference data list *Juncus trifidus* as present in Carter Notch in 1990. Plants grew in the cracks of large boulders along with *Paronychia argyrocoma*. The elevation of this occurrence is 3300 feet. This site is in the White Mountain National Forest. There is some hiker traffic in the area, and there is an Appalachian Mountain Club hut nearby.

Beans Purchase, Coos County – *Juncus trifidus* was seen on Imp Face on July 7, 1992. It grew on a coarse-grained mica schist cliff, along with *Vaccinium uliginosum*, *Vaccinium myrtilloides*, *Abies balsamea*, *Picea rubens*, *Betula cordifolia*, *Potentilla tridentata*, *Vaccinium vitis-idaea*, *Solidago randii*, *Danthonia spicata*, and *Deschampsia flexuosa*. This location is at 3000 feet and is in the White Mountain National Forest. Hiker traffic is a threat.

Benton, Grafton County – Specimens were collected from Mt. Moosilauke in 1898 and 1927. Appalachian Trail Conference data indicate that *Juncus trifidus* was present on Mt. Moosilauke in 1990. Associated species included *Vaccinium uliginosum*, *Carex bigelowii*, *Potentilla tridentata*, *Minuartia groenlandica*, *Vaccinium vitis-idaea*, *Deschampsia flexuosa*, and *Agrostis mertensii*. The elevation is 4800 feet. This site is partly owned by the White Mountain National Forest. There is an unprocessed report at New Hampshire Natural Heritage Bureau that mentions *Juncus trifidus* at this site.

Chandlers Purchase, Coos County – A specimen was collected here in 1916. Appalachian Trail Conference data indicate that in 1990, *Juncus trifidus* was a dominant species on Mt. Eisenhower, along with *Diapensia lapponica* and *Carex bigelowii*. The elevation was 4600 feet. This site is in the White Mountain National Forest. Hiker traffic is heavy and has caused erosion in some places.

Chatham, Carroll County – There is an unprocessed report at New Hampshire Natural Heritage Bureau that mentions *Juncus trifidus* from South Baldface. This mountain is in the White Mountain National Forest.

Dixville, Coos County – Specimens were collected in the Notch (1990 feet) in 1917 and 1961. This site is not in the White Mountain National Forest.

Dixville, Coos County – A specimen was collected from Table Rock in 1907. Table Rock is not in the White Mountain National Forest.

Franconia, Grafton County – There is an unprocessed report at New Hampshire Natural Heritage Bureau that mentions *Juncus trifidus* occurring on Mt. Lafayette. This site is in the Appalachian Trail Corridor and in the White Mountain National Forest. A specimen was collected on Mt. Lafayette in 1863.

Franconia, Grafton County – There is an unprocessed report at New Hampshire Natural Heritage Bureau that mentions *Juncus trifidus* from Mt. Lincoln. This mountain is in the Appalachian Trail Corridor and in the White Mountain National Forest.

Franconia, Grafton County – There is an unprocessed report at New Hampshire Natural Heritage Bureau that records *Juncus trifidus* as occurring on Mt. Truman. This peak is in the Appalachian Trail Corridor and in the White Mountain National Forest.

Franconia, Grafton County – There is an unprocessed report at New Hampshire Natural Heritage Bureau that lists *Juncus trifidus* as occurring on Cannon Mountain. This mountain is in the White Mountain National Forest.

Gorham, Coos County – A specimen was collected west of Mineral Spring in 1929.

Hadley Purchase, Coos County – A specimen was collected on Mt. Crawford in 1908. This location is in the White Mountain National Forest.

Harts Location, Carroll County – *Juncus trifidus* was collected on Mt. Willard in 1898. This location is in the White Mountain National Forest.

Jaffrey, Dublin, Cheshire County – Specimens were collected from Mt. Monandnock in 1883, 1890, 1891, 1897, 1968 and 1977. Plants grew in cracks in rocks and in gravel patches. The area is part of a reservation-state park-state forest complex.

Low & Burbanks, Coos County – *Juncus trifidus* was seen on Mt. Adams on June 30, 1997. It grew in a dwarf shrub heath-rush community with *Hierochloe alpina*, *Vaccinium uliginosum*, *Vaccinium vitis-idaea*, *Diapensia lapponica*, and *Deschampsia flexuosa*. The elevation was 5315. This location is in the White Mountain National Forest.

Low & Burbanks, Coos County – A specimen was collected in King Ravine in 1904. This site is in the White Mountain National Forest.

Randolph, Coos County – Specimen were collected at 1300 feet in 1919 and 1929.

Sargents Purchase, Coos County – Specimens were collected here in 1894 and 1926. Plants were seen on July 22, 1996, in the Alpine Garden on Mt. Washington. Associated

species included *Carex bigelowii*, *Potentilla tridentata*, *Diapensia lapponica*, and *Vaccinium uliginosum*. The elevation is 5250 feet. This location is in the White Mountain National Forest.

Sargents Purchase, Coos County – Specimens identified as from “Mt. Washington” are numerous: 1876, 1876, 1897, 1895, 1898, 1903, 1922, 1928, 1935, and 1972. One specimen was collected on the summit of Mt. Washington in 1903. The summit is in Mt. Washington State Park and the White Mountain National Forest. The elevation is 6280 feet.

Sargents Purchase, Coos County – A specimen was collected in Huntington Ravine in 1878. This location is in the White Mountain National Forest.

Sargents Purchase, Coos County – A specimen was collected in Tuckerman Ravine in 1902. This location is in the White Mountain National Forest.

Sargents Purchase, Coos County – A specimen was collected along the Crawford Path in 1893. This location is in the White Mountain National Forest.

Shelburne, Coos County – A specimen was collected from Mt. Ingalls in 1908. Mt. Ingalls is not in the White Mountain National Forest.

Stratford, Coos County – A specimen was collected at Percy Peaks in 1910. The peaks are in Nash Stream Forest. Plants were seen in 1988 and 1990. In 1988, the population was ranked D and was noted as subalpine on exposed bedrock, from 3220 to 3300 feet.

Stratford, Coos County – There is an unprocessed report of *Juncus trifidus* from GoBack Mountain. This mountain is in the Vickie Bunnell Tract and is owned by The Nature Conservancy.

Success, Coos County – A specimen was collected from Lary Flume in 1928. This location is not in the White Mountain National Forest.

Success, Coos County – A specimen was collected on Mt. Success in 1908. Appalachian Trail Conference records list *Juncus trifidus* as present on Mt. Success in 1990. This mountain is in the Appalachian Trail Corridor.

Thompson & Meserves, Low & Burbanks, Coos County – A specimen was collected at this location in 1893. *Juncus trifidus* was observed on July 17, 1990, at Star Lake. The habitat is an alpine bog and associated boulder strewn heaths. Associated species included *Vaccinium uliginosum*, *Geum peckii*, *Ledum groenlandicum*, *Picea mariana*, and *Carex bigelowii*. There is also an unprocessed report at New Hampshire Natural Heritage Bureau that mentions *Juncus trifidus* at this location. This site is in the White Mountain National Forest.

Thompson & Meserves, Coos County – A specimen was collected at 4500 feet in 1973. *Juncus trifidus* was seen at Mt. Jefferson on July 17, 1990. It grew on a large outcropping with *Loiseleuria procumbens*, *Cassiope hypnoides*, *Phyllodoce caerulea*, *Vaccinium cespitosum*, *Vaccinium boreale*, *Cornus canadensis*, *Coptis groenlandica*, and *Vaccinium vitis-idaea*. The elevation was 5010 feet. This location is in the White Mountain National Forest.

Thompson & Meserves, Coos County – A specimen was collected from a trail in the gulf in 1909. It was seen in Great Gulf on August 11, 1994. It grew on mossy boulders and outcrops along with *Deschampsia flexuosa*, *Thelypteris phegopteris*, *Streptopus amplexifolius*, *Agrostis mertensii*, *Solidago macrophylla*, *Carex brunnescens*, *Luzula parviflora*, and *Geum peckii*. The elevation was 3690 feet. This location is in the White Mountain National Forest.

Thompson & Meserves, Low & Burbanks, Coos County – Specimens were collected along the Presidential Mountains that run across the border of these two towns in 1889, 1902, 1903, 1906, 1907, and 1931. Plants are undoubtedly still present at these locations in the White Mountain National Forest.

Summary of Vermont Occurrences

In Vermont, there are four occurrences that have been seen since 1990, two that were last seen in the 1980s but are still considered extant, and one historical occurrence (Vermont Nongame and Natural Heritage Inventory 2001). One occurrence is on land owned by the Green Mountain National Forest.

VT .001 (Rochester, Windsor County) – This occurrence was first seen in 1907 and is represented by an herbarium specimen at University of Vermont. It was last seen on October 3, 1994. About 6 small clumps were observed at the base of a wall of cliffs, and were assumed to have seeded in from plants further up the cliffs. The plants were growing in cracks of otherwise bare rocks, in both wet and dry sites. Three larger clumps were found in a blueberry-moss patch on a small open overlook above the east wall of the cliffs, growing with *Vaccinium angustifolium*, *Potentilla tridentata*, *Solidago spathulata*, *Danthonia spicata*, *Lycopodium obscurum*, and *Cladonia rangiferina*. The cliffs are part of a Northern New England calcareous cliff community, at an elevation of 2500 feet. This occurrence is on land owned by the Green Mountain National Forest.

VT .002 (Duxbury, Washington County) – This occurrence was first seen in 1980. It was last seen in 1984. No details on the size of the population are available. Plants were in a Northern New England acidic cliff community on open schist cliffs. The elevation was 2900 feet. The area is owned by the Vermont Department of Forests, Parks, and Recreation and is in Camels Hump State Forest.

VT .003 (Cambridge, Lamoille County) – In 1978, plants were found on dry exposed schist ledges on the west side of the notch, at 2700 feet. This occurrence was last seen on

July 16, 1980. Information is based on a specimen collected on dry ledges in a steep ravine on the west side of the notch. The elevation was 3200 feet. Plants were also noted on the east side of the notch, on a cliff-face at 2800 feet. The area is owned by the Mt. Mansfield Co. and the Vermont Department of Forests, Parks, and Recreation.

VT .004 (Orleans County, Jay) – This historical occurrence is known from a collection on June 25, 1965. It is from the base of the summit of a peak in Jay State Forest.

VT .005 (Underhill, Chittenden County) – In 1987, plants were prevalent on a bald, and less abundant or absent on the summit. In 1989, they were noted as scattered on the ridge top and a different knob. This occurrence was last observed in 1994, when four long-term study transects were established on this mountain. Ten one-meter quadrats were surveyed at each site. The second site had *Juncus trifidus* present in five quadrats, the third site had it in 5 quadrats, and the fourth site had it in 3 quadrats. In 1990, plants were observed on a ridge and knob. The habitat is a New England Alpine Community, at 4000 feet, and the site is owned by the Vermont Department of Forests, Parks, and Recreation and by University of Vermont.

VT .006 (Duxbury, Washington County) – Plants were first seen on August 17, 1987, when they were noted as common in places with less hiker traffic and as doing well on a smaller summit north of the trail. This occurrence was last observed on August 9, 2001. Plants were scattered in clumps in the more sheltered areas on the summit and ledges of the mountain. The habitat is a New England Alpine Community at 4000 feet elevation. The occurrence is ranked E and is on land owned by the Vermont Department of Forests, Parks, and Recreation. Trampling by hikers is considered a threat.

VT .007 (Bolton, Chittenden County) – This occurrence was last seen in 1996. Approximately 50 plants were seen growing on a south-facing cliff at 2900 feet elevation with *Vaccinium uliginosum*. Another 2 clumps occur at a slightly lower elevation (2600-2700 feet) on an east-facing cliff roughly one-quarter of a mile to the northwest. The habitat is a boreal acidic cliff community with dense thickets of red spruce, mountain paper birch, and mountain holly along the tops of the cliffs. Very stunted black spruce occur sparingly on the brow of the east-most face. This occurrence is ranked D because of its small size, and the area is owned by the United States Army.

Summary of New York Occurrences

In New York, there are 10 extant occurrences and one historical occurrence (New York Natural Heritage Program 2004). Eight occurrences are within Adirondack Park. Occurrences may be ranked from A to D (A being best) based on population size, available habitat size, population quality, and population defensibility.

NY .001 (Wawarsing, Shawangunk, Ulster County) – This occurrence was first surveyed on September 30, 1989, and was last seen on September 30, 1996. Plants are on Shawangunk conglomerate outcrops, cliffs, and in vertical cracks in the cliffs. The

elevation is 2240 feet. There are thousands of plants and they are inaccessible. The occurrence is ranked B and is on land owned by The Nature Conservancy.

NY .002 (Keene, Essex County) – This occurrence was last seen on June 20, 1981. Approximately 100 plants grew on the summit of a mountain in an alpine meadow on granite outcrops. An associated species was *Carex bigelowii*. The elevation is 4920 feet. The occurrence is in the High Peaks Wilderness Area of Adirondack Park and is ranked BC.

NY .003 (Keene, Essex County) – This occurrence was last observed on September 15, 2002. Plants are widespread in the alpine area and on the summit of a mountain. Several hundred plants grow on anorthosite in an open rocky alpine area. Associated species include *Carex bigelowii* and *Trichophorum cespitosus*. The elevation is 5200 feet. The occurrence is ranked BC because a hiking trail runs through the population and trampling is a problem. The occurrence is in the High Peaks Wilderness Area of Adirondack Park.

NY .004 (Wilmington, Essex County) – This occurrence was first surveyed on July 21, 1999, and was last seen on July 20, 2000. It is characterized as a large vigorous occurrence in a slightly disturbed habitat. Plants were found on ledges south of the summit above timberline, at three places along the trail near the summit, at the edge of the parking lot, and below Wilmington turn. The habitat is ledges, alpine meadows on thin soil over rocks, and alpine krummholz community. Associated species include *Minuartia groenlandica*, *Salix uva-ursi*, and *Carex bigelowii*. The elevation is 4860 feet, the occurrence is ranked A, and the area is in Adirondack Park.

NY .005 (Keene, Essex County) – This occurrence was last seen and surveyed on July 9, 1989. Two plants were found on dry cliffs at an elevation of 3250 feet. The occurrence is in the Dix Mountain Wilderness Area and is ranked CD because of the small size and marginal habitat.

NY .006 (North Elba, Essex County) – This occurrence was first surveyed on September 5, 1989, and was last observed on July 2, 1997. A medium-sized population grows on top of a cliff on a mountain. The habitat is a vast anorthosite cliff with scattered intrusives and seeps. Associated species include *Deschampsia flexuosa*, *Minuartia groenlandica*, and *Solidago randii*. There are 10 acres of habitat, and the elevation is 3500 feet. This occurrence is ranked BC and is in the High Peaks Wilderness Area of Adirondack Park.

NY .007 (Marbletown, Ulster County) – This occurrence was last observed and surveyed on July 29, 1999. Ten plants were found at the top of a crevice within cracks along a cliff face. The habitat is dry and exposed vertical conglomerate cliffs with vertical and horizontal cracks. Associated species include *Danthonia* sp., *Amelanchier arborea*, *Betula populifolia*, *Fagus grandifolia*, *Pinus rigida*, *Gaylussacia baccata*, *Kalmia latifolia*, *Vaccinium angustifolium*, and various lichens. The elevation is 1300 feet. The area is in the Mohonk Preserve, which is owned by the Mohonk Mountain House. The occurrence is ranked CD because hikers on a trail by the cliff pick plants.

NY .008 (Keene, Essex County) – This occurrence was last seen and surveyed on July 24, 1998. Plants occur in two locations, one on a small peak southwest of the summit, the other at the intersection of two trails that lead to the summit. The elevation is 4700 feet. The occurrence is ranked C and is in the High Peaks Wilderness Area and is owned by the New York State Department of Environmental Conservation.

NY .009 (Keene, Essex County) – This occurrence was last observed on July 14, 1998. The population is at the bottom of a cliff slightly below a mountain summit. Associated species include *Potentilla tridentata*, *Vaccinium uliginosum*, and alpine goldenrod. The elevation is 4330 feet. The occurrence is ranked Extant. The area is in the High Peaks Wilderness Area of Adirondack Park and is owned by the New York State Department of Environmental Conservation.

NY .010 (Marbletown, Rochester, Ulster County) – This historical occurrence is based on a specimen collected in 1885. It was collected near a lake. Plants presumably occurred on both sides of the town line.

NY .011 (Newcomb, Essex County) – This occurrence was last seen and surveyed on September 22, 2002. Plants grow in a flat area at the base of a ledge below the summit of a mountain. The elevation is 4822 feet. The occurrence is ranked C. The area is in the High Peaks Wilderness Area of Adirondack Park and is owned by the New York State Department of Environmental Conservation.

Summary of West Virginia Occurrences

There are two extant occurrences in West Virginia (West Virginia Natural Heritage Program 2004). One occurrence is partly on land owned by Monongahela National Forest. Ownership of the other site is not clear, but The Nature Conservancy may be the owner.

Land in West Virginia is delimited with the metes and bounds system, rather than the township and range system used in northern states such as Maine. Therefore, West Virginia locations refer to county and quad rather than county and township, since township names were not available for the following locations.

WV .001 (Circleville Quad, Pendleton County) – This occurrence was first observed on July 28, 1987. There were 50-100 plants in several dozen clumps, and they were in flower or had immature fruit. The population area was between 100 square yards and 2 acres. It was ranked B due to the population size. In 1995, the occurrence was described as a moderately large population in pristine condition, with excellent viability and defensibility. The plants were last observed on April 6, 2002. Three clumps were observed in 2002, but conditions were too slippery to safely inventory the plants in more detail. *Juncus trifidus* occurs on a dry conglomerate cliff at 4200 feet elevation. The cliffs are in a forested area but are open due to their steepness. Associated species

include *Pinus resinosa*, *Pinus virginiana*, *Potentilla tridentata*, *Paronychia argyrocoma*, and *Heuchera alba*. According to West Virginia Heritage data, this site is now threatened by a potential vacation home development. Monongahela National Forest tracks this location in their databases, but it appears to be outside the Forest boundaries (M. Thomas-Van Gundy, personal communication). The Nature Conservancy owns thousands of acres around a knob not too far south of this location, so it is possible that the site is owned by The Nature Conservancy.

WV .002 (Upper Tract Quad, Pendleton County) – On June 3, 1994, hundreds of plants were seen in clumps on the cliffs. They were in flower and fruit, over a 2+ acre area. This occurrence was last observed on April 11, 2002. At that time, there were 63 clumps of plants in fruit. The location is the upper ledges of cliffs on a mountain. The cliffs are Tuscarora sandstone, and are open and dry. The elevation is 3700 feet. The occurrence is ranked A, though there are threats from introduced weeds, hiker traffic, and a nearby horse hitching locale. Part of the occurrence is on land that lies within the Monongahela National Forest boundary. The area is managed as a Nature Conservancy bioserve in cooperation with the USDA Forest Service and private landowners. The area is primarily managed for recreation purposes.

STATUS

Juncus trifidus has a global rank of G5, indicating that it is secure. It is ranked S1 in Vermont and West Virginia, S2 in New York, and S3S4 in Maine and New Hampshire. Ranks for states and provinces in North America are presented in Table 1 below.

Table 1. Status of *Juncus trifidus* in North America (NatureServe 2001).

RANKED AS S1, S2 or LISTED as T or E by State	RANKED AS S3-S5 OR S?	RANKED as SR or SRF	RANKED as SH or SX
Vermont (S1): 6 extant and 1 historical occurrences	Maine (S3S4): reported from 5 counties	South Carolina (SR)	Tennessee (SH)
Maryland (S1)	New Hampshire (S3S4): reported from 4 counties	Labrador, Newfoundland Island (SR)	
New York (S2): 10 extant and 1 historical occurrences		Nunavut (SR)	
North Carolina (S1)		Quebec (SR)	
Virginia (S1)			
West Virginia (S1): 2 extant occurrences			
New Brunswick (S1)			
Nova Scotia (S2)			

Juncus trifidus is not tracked in Maine and New Hampshire. In Vermont, it is known from seven occurrences, one of which is historical. One occurrence is on land owned by the Green Mountain National Forest, and the species is on the Green Mountain National Forest Regional Forester’s Sensitive Species list. It is a New England Plant Conservation Program Division 3 plant, which indicates that it is a locally rare taxon, not considered regionally rare, but potentially with one or more occurrences of biological, ecological, or possible genetic significance (Brumback and Mehrhoff *et al.* 1996). In New York, it is known from eleven occurrences, one of which is historical. In West Virginia, it is known from two extant occurrences, and is on the Eastern Region’s Regional Forester’s Sensitive Species list.

POPULATION BIOLOGY AND VIABILITY

Juncus trifidus can form dense tufts but has a limited ability to colonize areas through asexual reproduction (Marchand and Roach 1980). It tends to occur as scattered plants, though it can reach very high densities in some of the alpine sedge-rush-heath communities. The life span of an individual plant is not known, but it seems to be able to spread readily by seed and colonize available habitat. Seeds may be spread by birds (SVE Panel 2002), though they are very small and could be dispersed by wind and water.

In the dry/mesic heath meadow system, which forms a large and widespread patch to matrix scale system in the Presidential Mountains of New Hampshire, *Juncus trifidus* probably forms a metapopulation (SVE Panel 2002). If areas are disturbed, it is likely that they could be easily recolonized (Marchand and Roach 1980). On lesser summits, which have these systems in small patches, *Juncus trifidus* is probably at a greater risk of extirpation. It is not known how well this species can persist in small or degraded habitats (SVE Panel 2002).

POTENTIAL THREATS AND MONITORING

Present or Potential Risks to Habitat or Range

Hiker traffic is a threat to a number of alpine areas, especially those that are small and on heavily visited peaks. Hikers can trample plants to death, causing them to lose their soil-retaining capabilities. Foot traffic can also loosen soil, which is then washed or blown away. Soils do not recover quickly in the alpine zone, and habitat can decrease at a rapid rate. Some habitats are more sensitive than others. The dry/mesic heath meadow system is threatened by trampling along trails and on ridges and peaks where hikers wander in search of a good view. The system is widespread, but trampling where habitat patches are smaller may put *Juncus trifidus* and associated species at risk (SVE Panel 2002).

Heavy recreational use also threatens alpine plants on Camel's Hump (Zika 1993). During the peak season, there can be so many visitors on Camel's Hump and Mt. Mansfield that there are not enough unvegetated surfaces for everyone to stand on (Pete Ketcham, Green Mountain Club, personal communication). Likewise, hiker traffic has severely degraded habitat on Mt. Marcy (Ketchledge and Leonard 1984).

Global warming and acid deposition may be a threat to the dry/mesic heath meadow system, though the ultimate effects on the success of this species and others of the dry/mesic alpine heath meadow community are uncertain, and some effects may not be negative. Acid rain deposition is not likely to be a big issue since alpine soils are already quite acidic (SVE Panel 2002). Air pollution, including ground-level ozone, may damage plants in the alpine zone. In Newfoundland, *Juncus trifidus* is limited by high summer temperatures (Damman 1965).

In the Southern Appalachians, trampling, rock climbing, recreational and residential development, and invasive species are potential threats to the exposed granitic outcrop community where *Juncus trifidus* is found (Murdock 1992 in Johnson 1996). Another threat is woody plant succession. Trampling typically begins in open, central areas of the outcrops, and succession usually begins at the margins of the community, squeezing rare plants out of their habitat (Johnson 1996).

Commercial, Recreational, Scientific or Educational Over-utilization

Juncus trifidus is not used for commercial, scientific, or educational activities. Its habitat and individual plants are threatened by recreational use, though it is not a target of recreational use.

Disease or Predation

There are no documented threats from disease or predation. *Juncus trifidus* probably provides food and nesting material for a number of animals, but no information pertaining to North American populations was found.

Inadequacy of Existing Regulatory Mechanisms

Juncus trifidus is not a protected species in Maine or New Hampshire. Populations could easily be lost due to recreational impacts. There are no regulations that restrict recreational impacts, except in Maine's Baxter State Park, where access is somewhat restricted. In Vermont, species that are state listed as Threatened or Endangered are protected from "taking" (picking, digging up, etc.) without a permit (B. Popp, Vermont Nongame and Natural Heritage Program, personal communication). However, *Juncus trifidus* is not state listed, and the protection from taking does not include protection from trampling by hikers. On peaks in the Green Mountain National Forest, there are no regulations that prohibit fires and camping above treeline, activities which could negatively impact plants and habitat. In New York, plants on the state list are protected from "taking" without the landowner's permission (New York Natural Heritage Program 2004). In West Virginia, both occurrences are along a heavily used trail. One occurrence is in an area that is designated for recreational use, including hiking, horseback riding, and mountain biking. Both occurrences may be on land that is owned or managed by The Nature Conservancy, but they are not protected from recreational pressures.

In addition, there are no regulatory mechanisms that protect habitat. Efforts are being made in the White and Green Mountains to educate hikers and limit hiker impacts, but there are very few regulations that are effective at preventing habitat loss. Federal regulations governing air pollution and air quality are also not effective at preventing damage to alpine plants and ecosystems from ozone and other pollutants.

Other Natural or Human Factors Affecting Continued Existence of Species

Non-native weeds have been identified as a problem at one West Virginia occurrence. It is not known what kinds of weeds are present, or if they directly threaten the *Juncus trifidus* population. There is some concern over the impact of dogs on alpine vegetation in Vermont.

SUMMARY OF LAND OWNERSHIP AND EXISTING HABITAT PROTECTION

In Maine, occurrences are known from lands owned by Baxter State Park, the Bureau of Parks and Land, and private individuals or companies. Habitat in Baxter State Park and in the Appalachian Trail Corridor is protected from development, though not from recreational impacts. Land owned by the Bureau of Parks and Land is managed for multiple uses, including recreation, wildlife, and timber. Their dominant use system is designed to keep intensive management activities away from areas with rare species and backcountry recreational usage (Maine Bureau of Parks and Land 2004). Land owned by private individuals and companies is assumed to be without protection.

Most of the occurrences in New Hampshire lie within the White Mountain National Forest. The White Mountain National Forest is managed for multiple uses, including timber harvesting. Populations that are within the Appalachian Trail Corridor are afforded protection from non-recreational uses. Since *Juncus trifidus* grows above treeline in many locations, in areas where the primary use is recreational, it is relatively protected from non-recreational pressures. Occurrences that are on privately owned lands can be assumed to have no protection.

In Vermont, one occurrence is on land owned by the Green Mountain National Forest. Since *Juncus trifidus* is on the Green Mountain National Forest Regional Forester's Sensitive Species list, any activities near the occurrence should maintain protection for the plants. One occurrence is owned by the United States Army and is assumed to not have any protection. All other occurrences are on land owned or managed by the Vermont Department of Forests, Parks & Recreation. These lands are protected from development. Land classified as natural areas are managed for protection of rare species and habitats and for recreational purposes (Vermont Department of Forests, Parks, and Recreation 2004). Two occurrences are partly on land owned by University of Vermont and a ski company. The University of Vermont allows multiple uses of its land but cooperates with state agencies to protect the alpine habitat. The ski company does not offer any habitat protection on its land.

Most New York occurrences are in Adirondack Park. Adirondack Park is a combination of public and private lands that is managed for multiple uses, including water conservation and timber management. Some areas are designated as wilderness or as for outdoor recreation. All public lands are managed by the state, and there is a management plan for the whole Park. The Adirondack Park Agency is responsible for managing the Park (Adirondack Park Agency 2004). It is not clear which occurrences in Adirondack Park are on public lands, and it is not clear what the management strategy for the alpine areas is. Several occurrences are on land owned by the New York State Department of Environmental Conservation. Since the Department of Environmental Conservation is responsible for setting and enforcing environmental laws, including New York's protected plants legislation, it is assumed that populations of *Juncus trifidus* on Department of Environmental Conservation lands are afforded protection. One occurrence is on land owned by The Nature Conservancy. The Nature Conservancy generally affords habitat protection to the lands it owns. One occurrence is on land owned by the Mohonk Mountain House, which is a privately owned resort. Although the

resort owners are proud of their natural areas and maintain trails for their guests' recreation pleasure, it is assumed that there is no habitat protection for this occurrence.

One West Virginia occurrence is partly on land owned by Monongahela National Forest. Since *Juncus trifidus* is on the Eastern Region's Regional Forester's Sensitive Species list, any activities around the occurrence would be managed to maintain protection for the plants. It is not clear who owns the land on the other side of the Forest boundary, but according to West Virginia Natural Heritage, the entire area is managed by The Nature Conservancy as a biopreserve. Despite the habitat protection that might be afforded by Monongahela National Forest and The Nature Conservancy, the area is primarily used for recreational purposes, including hiking and mountain bike riding. The other occurrence is on land that might be owned by The Nature Conservancy. The area is used for recreation and housing development was identified as a threat, so even if the land is owned by The Nature Conservancy, there does not appear to be substantial habitat protection.

SUMMARY OF EXISTING MANAGEMENT ACTIVITIES

There are no existing management activities in Maine, New Hampshire, the White Mountain National Forest, the Green Mountain National Forest, or Monongahela National Forest. The National Forests have management plans in place or are in the process of developing them. The Appalachian Trail Conference monitors rare plants within its corridor and tries to protect rare plants during trail work, though *Juncus trifidus* is not considered too important in New Hampshire. There may be management activities in Adirondack Park, on lands owned by the New York Department of Environmental Conservation, and on lands owned by Vermont Forests, Parks, and Recreation. There are management plans in place for their lands, but no information on management activities was available through those agencies' websites or through data provided by Natural Heritage Programs. Current management activities in Vermont appear to be restricted to the conservation activities of the Green Mountain Club. See below for details.

PAST AND CURRENT CONSERVATION ACTIVITIES

In Vermont, New York, and West Virginia, *Juncus trifidus* is tracked by state Natural Heritage Programs. Signs aimed at educating visitors about the fragility of the alpine zone are present on various peaks in Maine, New Hampshire, Vermont, and New York. Alpine revegetation projects have been carried out at a small scale in the Adirondacks (Ketchledge *et al.* 1985), but did not necessarily target *Juncus trifidus*.

The Green Mountain Club is responsible for a number of conservation activities. Summit caretakers are present on Mt. Mansfield, Camel's Hump, and Mt. Abraham from the end of May to mid-October to educate visitors about alpine habitats and plants. Trail crews work to keep trails well-defined with blazes and cairns, and construct scree walls to protect vegetation. Summit caretakers also use string to mark off areas that are being

revegetated, and position wooden signs that ask people to stay off revegetated areas at ground level, where they can be easily seen. Illegal trails and areas used repeatedly for picnicking or view seeking are revegetated. The Green Mountain Club's conservation activities are limited by a lack of funds to pay caretakers and varying regulations for lands owned by different agencies.

RESEARCH AND MONITORING

Existing Surveys, Monitoring and Research

Juncus trifidus is not actively surveyed or monitored in Maine or New Hampshire, including the White Mountain National Forest. The Appalachian Mountain Club monitors vegetation and rare species around its huts, but *Juncus trifidus* is not a targeted species. In New Hampshire, other surveys in the alpine area are carried out by New England Plant Conservation Program task force members, although those surveys only target the rarest alpine species, and by Plant Conservation Volunteers, who are overseen by the New England Wild Flower Society. Again, *Juncus trifidus* is not a targeted species. The Appalachian Trail Conference last conducted surveys within its trail corridor in 1990, and *Juncus trifidus* was noted as present in some areas (A. Schori, Appalachian Trail Conference, personal communication). The species is no longer tracked by New Hampshire Natural Heritage Bureau, and they did not have any current information readily available.

In Vermont, monitoring and surveys are conducted by Vermont Nongame and Natural Heritage Program botanists and by Plant Conservation Volunteers. There is no regular scheduling for surveying activities (B. Popp, Vermont Nongame and Natural Heritage Program, personal communication). There are several long-term study transects that have been set up on Mt. Mansfield to monitor vegetation changes.

In New York, monitoring and surveys are conducted by New York Natural Heritage Program botanists. There have previously been revegetation studies in the alpine zone of the Adirondacks, but there may not be any current studies.

In West Virginia, the state Heritage Program surveys the *Juncus trifidus* populations. Monongahela National Forest is not currently monitoring its population, and it has not received any requests for research permission.

Survey Protocol

Each state's Natural Heritage Program has its own form for surveys, but all the forms are designed to gather the same basic information. Location, population size, habitat, and threats are all important. New Hampshire's old form asked for detailed information on habitat (community type, associated species, slope, aspect, position, soil hydrology), population data (number of ramets or genets if countable, occurrence area, plant health, population structure, phenology, reproductive evidence), and a map, but the newer form

is less complex. West Virginia uses two different field forms. Both collect information on location, population size and structure, habitat features, and include an area for a map. One form asks more questions about population structure and rates four aspects of the element occurrence – quality, condition, viability, and defensibility.

In New Hampshire and Vermont, Plant Conservation Volunteers, as well as state botanists, may survey plants. Plant Conservation Volunteers are trained to identify plants and are then assigned certain occurrences to survey. They may also send in information about new populations that they discover. New Hampshire occurrences within the Appalachian Trail corridor were surveyed by members of New Hampshire Natural Heritage Bureau. Maine relies on state botanists, as does New York, but both will accept occurrence data from what Maine terms “rogue botanists.” Reporting forms are available on-line. Ideally, each field report would contain comprehensive data, but detailed observations are frequently lacking. Thoroughly surveying a population is time-consuming and may not be feasible for large populations. Sometimes a botanist does not realize that a species is of particular interest, and so it is only noted in passing. *Juncus trifidus* is too common in Maine and New Hampshire to be the target of surveys.

Research Priorities

Information is needed on the disturbance dynamics of the alpine dry-mesic heath meadow system, especially for lower elevation peaks because the recreation impacts may be more on these areas. The White Mountain National Forest should review the Cogbill and Sperduto summary of work done for the Pemigewasset district (Franconia Ridge management report). Susan Wisner at the University of North Carolina has written a PhD dissertation on Outliers in the southern Appalachians, including *Geum peckii*, *Scirpus cespitosus*, *Juncus*, etc., which would be a good reference for White Mountain National Forest library (SVE Panel 2002). On a broader scale, research is needed to track changes in alpine community health and species composition.

REFERENCES

- Adirondack Park Agency. 2004. Available at:
http://www.apa.state.ny.us/About_Park/more_park.html (Accessed May 5, 2004).
- Bliss, L. C. 1963. Alpine plant communities of the Presidential Range, New Hampshire. *Ecology* 44: 678-697.
- Bliss, L. C. 1966. Plant productivity in alpine microenvironments on Mt. Washington, New Hampshire. *Ecological Monographs* 36: 125-155.
- Brumback W. E., L. J. Mehrhoff, R. W. Enser, S. C. Gawler, R. G. Popp, P. Somers, D. D. Sperduto, W. D. Countryman, and C. B. Hellquist. 1996. Flora Conservanda: New England. The New England Plant Conservation Program list of plants in need of conservation. *Rhodora* 98: 233-361.

Clemants, S. E. 1990. Juncaceae (Rush Family) of New York State. Contributions to a flora of New York State VII. R. S. Mitchell, editor. Bulletin Number 475, New York State Museum. University of the State of New York, State Education Department, Albany, New York, USA.

Damman, A. W. H. 1965. The distribution patterns of northern and southern elements in the flora of Newfoundland. *Rhodora* 67: 363-392.

Edinger, G. J., D. J. Evans, S. Gebauer, T. G. Howard, D. M. Hunt, and A. M. Olivero (editors). 2002. Ecological Communities of New York State. Second Edition. A revised and expanded edition of Carol Reschke's Ecological Communities of New York State. (Draft for review). New York Natural Heritage Program, New York State Department of Environmental Conservation, Albany, New York. Found online at: http://www.dec.state.ny.us/website/dfwmr/heritage/Draft_ECNY2002.htm

Gawler, S. C. 2001. Natural landscapes of Maine: a classification of vegetated natural communities and ecosystems. Maine Natural Areas Program, Department of Conservation, Augusta, Maine, USA.

Gleason, H. A. and A. Cronquist. 1991. Manual of vascular plants of northeastern United States and adjacent Canada, 2nd edition. The New York Botanical Garden, Bronx, New York.

Josselyn Botanical Society. 1995. Checklist of the vascular plants of Maine, third edition. Bulletin 844, June 1995, Maine Agricultural and Forest Experiment Station, University of Maine. Orono, Maine, USA.

Jenkins, J. 1981. The rare plants of the Green Mountain National Forest and their potential habitats. A research report prepared for the Supervisor's Office of the Green Mountain National Forest, Rutland, Vermont, USA.

Johnson, B. R. 1996. Southern Appalachian rare plant reintroductions on granite outcrops. Pages 433-443 in D. A. Falk, C. I. Millar and M. Olwell, eds., Restoring diversity, strategies for reintroduction of endangered plants. Washington, D.C.: Island Press.

Ketchledge, E. H. and R. E. Leonard. 1984. A 24-year comparison of the vegetation of an Adirondack mountain summit. *Rhodora* 86: 439-444.

Ketchledge, E. H., R. E. Leonard, N. A. Richards, P. F. Craul, and A. R. Eschner. 1985. Rehabilitation of alpine vegetation in the Adirondack Mountains of New York State. USDA Forest Service, Northeastern Forest Experiment Station, Research Paper NE-553.

Maine Bureau of Parks and Land. 2004. Available at: <http://www.state.me.us/doc/parks/programs/prl.html> (Accessed May 5, 2004).

Maine Natural Areas Program (MNAP). 2001. Element Occurrence Summary. Maine Department of Conservation, Augusta, Maine, USA.

Marchand, P. J. and D. A. 1980. Reproductive strategies of pioneering alpine species: seed production, dispersal, and germination. *Arctic and Alpine Research* 12: 137-146. Abstract only.

NatureServe: An online encyclopedia of life [web application]. 2001. Version 1.5. Arlington, Virginia. The Association for Biodiversity Information. Available at: <http://www.natureserve.org/>

New Hampshire Natural Heritage Inventory (NHNHI). 2001. Element occurrence summaries. DRED-Division of Forests and Lands, Concord, New Hampshire, USA.

New York Natural Heritage Program. 2004. New York State Department of Environmental Conservation. Albany, New York, USA.

Pease, A. S. 1964. A flora of northern New Hampshire. New England Botanical Club, Inc., Boston, Massachusetts, USA.

Riefner, R. E., Jr. 1981. Studies on the Maryland flora VII: Addition of *Cyperus houghtonii* Torr. and *Juncus trifidus* var. *monanthos* (Jacq.) Bluff & Fing. to the state flora. *Phytologia* 48: 146-150.

Seymour, F.C. 1997. The flora of New England. Second edition, fifth printing with supplement. Privately printed, USA.

Sperduto, D. 1993. Alpine/subalpine tundra formation of New Hampshire, DRAFT 3/24/93. New Hampshire Natural Heritage Inventory, Concord, New Hampshire, USA.

Sperduto, D. D. and C. V. Cogbill. 1999. Alpine and subalpine vegetation of the White Mountains, New Hampshire. New Hampshire Natural Heritage Inventory, Concord, New Hampshire. Submitted to the USDA Forest Service, White Mountain National Forest, Laconia, New Hampshire, USA.

St. Hilaire, L. 2002. Literature review of *Juncus trifidus*. Prepared for the White and Green Mountain National Forests.

SVE Panel. 2002. Green Mountain National Forest/White Mountain National Forest species viability evaluation expert panel notes on alpine plants. Panel held: May 13-15, 2002, Rutland, Vermont, USA.

Thompson, E. H. and E. R. Sorenson. 2000. Wetland, woodland, wildland; a guide to the natural communities of Vermont. University Press of New England, Hanover, New Hampshire, USA.

University of Maine Herbarium. 2000. Available at:
www.umesci.maine.edu/biology/herbarium/vascular-plants.html (Accessed April 24, 2004).

Vermont Department of Forests, Parks & Recreation (Vermont Forests, Parks, and Recreation). 2004. Available at: <http://www.state.vt.us/anr/fpr/> (Accessed May 5, 2004).

Vermont Nongame and Natural Heritage Program. 2001. Element Occurrence Summary. Department of Fish and Wildlife, Waterbury, Vermont, USA.

West Virginia Natural Heritage Program. 2004. Elkins, West Virginia, USA.

Young, S. M., editor. 1992. New York rare plant status list. New York Natural Heritage Program, New York State Department of Environmental Conservation, Latham, New York.

Zika, P. F. 1993. Historical species loss in the alpine zone of Camels Hump, Vermont. Bulletin of the Torrey Botanical Club 120: 73-75. Hard copy w/ *Hierochloe alpina*.

LIST OF CONTACTS

Information Requests

Diane Burbank, Ecologist. Green Mountain & Finger Lakes National Forest
dburbank@fs.fed.us (802) 388-4362 x116 fax: (802) 388-3842

Sara Cairns, Data Manager/Biologist. New Hampshire Natural Heritage Bureau
SARAC@dred.state.nh.us (603) 271-3623

Don Cameron, Botanist/Ecologist. Maine Natural Areas Program. State House Station 93, Augusta, Maine 04333-0093 (207) 287-8041 fax: (207) 287-8040
don.s.cameron@maine.gov

MaryBeth Deller, Botanist. Green Mountain National Forest, Rochester Ranger District, 99 Ranger Road, Rochester, Vermont 05767.
mdeller@fs.fed.us (802) 767-4261 ext. 524

Pete Antos-Ketcham. Green Mountain Club
Pete@greenmountainclub.org (802) 244-7037 ext. 17

Stacy Lemieux, Forest Plan Revision Biologist. White Mountain National Forest
slemieux@fs.fed.us (603) 528-9536

Emily Pinkham, Database Manager. Maine Natural Areas Program. State House Station 93, Augusta, Maine 04333-0093 (207) 287-8046

emily.pinkham@maine.gov

Bob Popp, Program Botanist. Nongame & Natural Heritage Program, Vermont.
Dept. of Fish & Wildlife, 5 Perry Street, Suite 40, Barre, Vermont. 05641-4266
bob.popp@anr.state.vt.us (802) 476-0127

Heather Root. Essex Jct., Vermont.
hr26@cornell.edu

Alice Schori. Appalachian Trail Conference, New England Regional Office,
P. O. Box 312, Lyme, New Hampshire 03768-0312
aschori@atconf.org (603) 795-4935 fax: (603) 795-4936

Jodi Shippee, Database Assistant. Vermont Nongame and Natural Heritage
Program. Vermont Department of Fish and Wildlife, 103 South Main St, 10
South Waterbury, Vermont 05671-0501.
jodi.shippee@anr.state.vt.us (802) 241- 4230 fax: (802) 241- 3295

Melissa Thomas-Van Gundy, Forest Botanist. Monongahela National Forest.
mthomasvangundy@fs.fed.us (304) 636-1800 ext. 286

Steve Young, Program Botanist. New York Natural Heritage Program, 625
Broadway, 5th Floor, Albany, New York 12233-4757
smyoung@gw.dec.state.ny.us (518) 402-8935

Doug Weihrauch. Appalachian Mountain Club.
dweihrauch@outdoors.org

West Virginia Natural Heritage Program. P.O. Box 67, Elkins, West Virginia
26241
(304) 637-0245 fax: (304) 637-0250

Appendix I:

An Explanation of Conservation Ranks Used by The Nature Conservancy and Natureserve

The conservation rank of an element known or assumed to exist within a jurisdiction is designated by a whole number from 1 to 5, preceded by a G (Global), N (National), or S (Subnational) as appropriate. The numbers have the following meaning:

- 1 = critically imperiled
- 2 = imperiled
- 3 = vulnerable to extirpation or extinction
- 4 = apparently secure
- 5 = demonstrably widespread, abundant, and secure.

G1, for example, indicates critical imperilment on a range-wide basis — that is, a great risk of extinction. S1 indicates critical imperilment within a particular state, province, or other subnational jurisdiction — i.e., a great risk of extirpation of the element from that subnation, regardless of its status elsewhere. Species known in an area only from historical records are ranked as either H (possibly extirpated/possibly extinct) or X (presumed extirpated/presumed extinct). Certain other codes, rank variants, and qualifiers are also allowed in order to add information about the element or indicate uncertainty.

Elements that are imperiled or vulnerable everywhere they occur will have a global rank of G1, G2, or G3 and equally high or higher national and subnational ranks (the lower the number, the "higher" the rank, and therefore the conservation priority). On the other hand, it is possible for an element to be rarer or more vulnerable in a given nation or subnation than it is range-wide. In that case, it might be ranked N1, N2, or N3, or S1, S2, or S3 even though its global rank is G4 or G5. The three levels of the ranking system give a more complete picture of the conservation status of a species or community than either a range-wide or local rank by itself. They also make it easier to set appropriate conservation priorities in different places and at different geographic levels. In an effort to balance global and local conservation concerns, global as well as national and subnational (provincial or state) ranks are used to select the elements that should receive priority for research and conservation in a jurisdiction.

Use of standard ranking criteria and definitions makes Natural Heritage ranks comparable across element groups; thus, G1 has the same basic meaning whether applied to a salamander, a moss, or a forest community. Standardization also makes ranks comparable across jurisdictions, which in turn allows scientists to use the national and subnational ranks assigned by local data centers to determine and refine or reaffirm global ranks.

Ranking is a qualitative process: it takes into account several factors, including total number, range, and condition of element occurrences, population size, range extent and area of occupancy, short- and long-term trends in the foregoing factors, threats, environmental specificity, and fragility. These factors function as guidelines rather than arithmetic rules, and the relative weight given to the factors may differ among taxa. In

some states, the taxon may receive a rank of SR (where the element is reported but has not yet been reviewed locally) or SRF (where a false, erroneous report exists and persists in the literature). A rank of S? denotes an uncertain or inexact numeric rank for the taxon at the state level.

Within states, individual occurrences of a taxon are sometimes assigned element occurrence ranks. Element occurrence (EO) ranks, which are an average of four separate evaluations of quality (size and productivity), condition, viability, and defensibility, are included in site descriptions to provide a general indication of site quality. Ranks range from: A (excellent) to D (poor); a rank of E is provided for element occurrences that are extant, but for which information is inadequate to provide a qualitative score. An EO rank of H is provided for sites for which no observations have been made for more than 20 years. An X rank is utilized for sites that are known to be extirpated. Not all EOs have received such ranks in all states, and ranks are not necessarily consistent among states as yet.