Alpine

Photo by Ben Kimball

Acres in NH:	4158
Percent of NH Area:	<1
Acres Protected:	4158
Percent Protected:	100

Habitat Distribution Map

Habitat Description

In New Hampshire, alpine habitat occurs above treeline (trees taller than 6 ft.) at approximately 4,900 ft., primarily within the Franconia and Presidential Ranges of the White Mountains. This region endures high winds, precipitation, cloud cover, and fog, resulting in low annual temperatures and a short growing season (Bliss 1963, Sperduto and Cogbill 1999). The interaction between severe climate and geologic features—such as bedrock, exposure, and aspect—determine the distribution and structure of alpine systems (Antevs 1932, Bliss 1963, Harries 1966, Sperduto and Cogbill 1999). Alpine habitat is comprised of low, treeless tundra communities embedded in a matrix of bedrock, stone, talus, or gravel, with or without thin organic soil layers, and interspersed with krummholz. Soils are well drained, highly acidic, nutrient poor, and weakly developed (Sperduto and Cogbill 1999).
Alpine vegetation is grouped into four natural community systems by NHNHB (Sperduto 2011): the alpine tundra, alpine ravine/snowbank, subalpine heath - krummholz/rocky bald, and alpine/subalpine bog systems. The alpine tundra is the primary system in the alpine zone, and occupies most of the summits, ridges, and slopes above treeline. The system is named for its resemblance to the tundra of the arctic zone, and is dominated by mat-forming shrubs like diapensia (*Diapensia lapponica*), alpine blueberry (*Vaccinium uliginosum*), bearberry willow (*Salix uvaursi*), and alpine-azalea (*Kalmia procumbens*), and graminoids such as Bigelow's sedge (*Carex bigelowii*) and highland rush (*Juncus trifidus*).

The alpine ravine/snowbank system is restricted to high-elevation ravines, particularly those with distinct cirque headwalls. This system occupies these settings where snow accumulates to significant depths and is late to melt in the spring. These conditions produce diverse vegetative communities with a mix of alpine and lowland species. The subalpine heath - krummholz/rocky bald system is found at elevations below the "true alpine" zone, primarily from 3,000 to 4,900 ft. "Krummholz" refers to wind-dwarfed thickets of trees, primarily black spruce (*Picea mariana*) or balsam fir (*Abies balsamea*). In heath – krummholz communities, patches of these stunted trees are mixed with various low shrubs, including Labrador-tea *(Rhododendron groenlandicum*), sheep laurel (*Kalmia angustifolia*), and crowberries (*Empetrum spp*.).
Alpine/subalpine bog systems are actually a type of peatland (see Peatland Habitat Profile), but are included in this profile because they are only found as small patches embedded within larger alpine or subalpine ecosystems. They are small (less than an acre to around five acres) and occur in concavities on ridges, and on moderate to steep slopes over bedrock where some combination of limited drainage, the damp subalpine climate, late melting snowpacks, and self-maintaining *Sphagnum* (peat moss) mats contribute to peat accumulation. Alpine/subalpine bogs are dominated primarily by lowland bog plants found in poor level fen/bog systems, but are distinguished from them by the presence of alpine and subalpine species.

Justification (Reason for Concern in NH)

Alpine habitat is a rare community throughout the Northeast, occurring mostly as isolated "islands" on high peaks. Unique alpine plant communities, extreme climatic conditions, and isolation lead to rare and endemic insect communities. White Mountain fritillary and artic butterflies are known to occur only on the Presidential Range, and their host plants may be sensitive to disturbance and climate change. Human impacts exist in almost every alpine zone, with the highest concentration occurring on ridges and summits (Harvey 2003). The impacts of human presence on alpine birds and mammals are not known. Alpine vegetation and soils are not well adapted to heavy recreational traffic.

Over the past 20 years, climate change has often been presumed to be the greatest threat to alpine habitats in New Hampshire, with the climatic treeline increasing in elevation with rising temperatures, displacing alpine-adapted vegetation (Halloy and Mark 2003, Lesica and McCune 2004). However, recent research suggests that alpine areas in the White Mountains may not be as vulnerable to climate change as originally believed, because encroachment by woody vegetation is controlled by mechanical degradation from wind and ice—phenomena that are unlikely to change significantly under climate change scenarios as they are currently understood (Seidel et al. 2009). Despite these revised predictions, alpine vegetation may still be vulnerable to atmospheric pollutants such as nitrogen and ozone.

Protection and Regulatory Status

The majority of New Hampshire alpine habitat is within the boundaries of the WMNF. The WMNF is part of the National Wilderness Preservation System (16 U.S.C. 1131-1136, 78 Stat. 890). This system is comprised of federally owned areas designated by Congress as "Wilderness Areas." Three Wilderness Areas in the WMNF (Great Gulf, Presidential-Dry River, Pemigewasset) contain alpine habitat.

Distribution and Research

In New Hampshire, alpine habitat occupies 0.13% (7,717 acres) of the state, with the highest concentration occurring in the Presidential Range. The Presidential Range distribution includes Alpine Garden (5,175 to 5,575 ft.), Bigelow's Lawn (5,500 ft.), Great Gulf (4,228 to 5,828 ft.), Huntington Ravine (4,075 to 5,475 ft.), Tuckerman's Ravine (4,525 to 5,125 ft.), Monroe Flats (5,075 ft.), Oakes Gulf (4,400 to 5,000 ft.), Washington Summit (6,288 ft.), and Lakes of the Clouds (5,012 ft.) on Mt. Washington; Edmunds Col (4,938 to 5,100 ft.) on Mt. Madison (5,367 ft.); Bumpus Brook (5,799 ft.) on Mt. Adams; Monticello Lawn (5,390 ft.); Mt. Clay (5,533 ft.); King's Ravine (3,825-5,000 ft.) on Mt. Jefferson; Mt. Franklin (5,001 ft.); Mt. Monroe (5,384 ft.); and Mt. Eisenhower (4,760 ft.) (Harvey 2003). The remaining New Hampshire alpine habitat includes: North Baldface, South Baldface, Mt. Davis (3,819 ft.), Mt. Bond (4,690 ft.), Mt. Bondcliff (4,265 ft.), Mt.Guyot (4,580 ft.), South Twin (4,902 ft.), Mt. Lafayette (5,260 ft.), Mt Lincoln (5,089 ft.), and Mt Moosilauke (4,802 ft.) (Harvey 2003).

Current distribution, historic distribution, and status of alpine habitat is synthesized from expert review and consultation, management plans, technical field reports, scientific journals, and plant and community records in the New Hampshire Heritage Biological and Conservation Data System (BCD). Habitat maps were generated utilizing Hale and Rock (2003) landcover analysis for the WMNF, AMC alpine habitat polygons for the Presidential Range and Franconia Ridge, and NHNHB exemplary alpine natural communities. Alpine invertebrate distributions need study.

Relative Health of Populations

New Hampshire's largest expanse of alpine habitat occurs in the Presidential Range (6,931 ac), followed by Franconia Ridge (379 ac) and Baldface (247 ac). The remaining alpine habitat units comprise 160 ac.

Habitat Condition

Biological Condition:
Species richness of rare animals within their dispersal distances from the polygon
Species richness of rare animals within polygon
Species richness of rare plants in polygon
Richness of rare and exemplary natural communities in polygon

Landscape Condition:
Area (hectares) Landscape Complexity
Local Connectedness

Human Condition:
Index of Ecological Integrity scaled to State
Density of hiking trails in the unit (km/km^2)

Habitat Management Status:

The Wilderness Areas in the WMNF containing alpine habitat (Pemigewasset, Presidential-Dry River, and Great Gulf Wilderness Areas) are managed according to the guidelines and standards delineated

in the Land and Resource Management Plan for the White Mountain National Forest. Natural processes are allowed to continue with minimal impediment, effects and impacts of human use will be minimized, primitive recreation opportunities will be provided, appreciation of the qualities of wilderness landscapes will be fostered, and utilization for educational and scientific purpose will be continued (USDA Forest Service 2004).

Threats to this Habitat in NH

Threat rankings were calculated by groups of taxonomic or habitat experts using a multistep process (details in Chapter 4). Each threat was ranked for these factors: Spatial Extent, Severity, Immediacy, Certainty, and Reversibility (ability to address the threat). These combined scores produced one overall threat score. Only threats that received a "medium" or "high" score have accompanying text in this profile. Threats that have a low spatial extent, are unlikely to occur in the next ten years, or there is uncertainty in the data will be ranked lower due to these factors.

Habitat degradation from ozone (Threat Rank: Medium)

Nitrogen oxides (Nox) and volatile organic compounds (VOC) are emissions produced in the burning of fossils fuels in power plants and gasoline engines. Ozone is a secondary pollutant produced by photochemical reactions between Nox and VOC. These reactions are fueled by UV radiation, resulting in higher ozone production in summer and at higher elevations (Finco et al. 2013).

Ozone is a highly phytotoxic pollutant, interfering with both photosynthesis and cellular metabolism. These impacts are reflected in a decrease in the numbers of flowers and fruits a plant will produce, as well as impaired water use efficiency and other functions. Plants weakened by ozone may be more susceptible to pests, disease, and drought (Allen 2002).

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Habitat degradation from mercury deposition (Threat Rank: Medium)

Exposure of wildlife to mercury may result in mortality, developmental effects, and reduced reproductive success.

Studies have documented significant concentrations of mercury in the blood of songbirds, particularly high-elevation species such as Bicknell's thrush (Rimmer et al. 2005). While the toxic effects of bioaccumulation in animals have been documented, plants do not appear to be sensitive to mercury (Lovett et al. 2009).

Habitat degradation from acid deposition (Threat Rank: Medium)

Acid deposition may result in plant mortality, alteration of soil/water chemistry, and loss of nutrients.

Acid deposition has declined significantly as a result of decreased emissions from fossil fuel-burning power plants (Burns et al. 2011). However, it is unlikely that sensitive habitats that have already experienced significant acidification will recover without further reductions in acid deposition.

Habitat degradation from contamination around railway tracks (Cog railway) (Threat Rank: Medium)

The engines from the cog railway have historically caused contamination of the area surrounding the tracks, as a result of the coal-fired engines. Additionally, the installation of buried cable and fiber-optic

lines adjacent to the tracks disturbed alpine vegetation and created an unvegetated zone several meters wide.

Four years after the installation of the buried cable lines along the cog railway, recovery of alpine vegetation has been extremely slow (Capers & Taylor 2014). This same study observed frequent cinders produced by coal-fired trains throughout the study area, although their effects on vegetation are unknown. The cog railway has replaced most of their coal-fired engines with biodiesel engines, eliminating the generation of new cinders, although other chemical contamination may still occur.

List of Lower Ranking Threats:

Habitat degradation from snow compaction related to recreational activity

Habitat degradation from recreation infrastructure that concentrates visitor impacts around facilities (AMC huts and Mt. Washington summit buildings)

Habitat degradation from hikers that trample vegetation and cause soil erosion

Mortality from the collection of individuals from the wild

Habitat conversion and impacts from roads

Habitat conversion and degradation from wind tower and turbine development or communication towers, potential for ongoing wildlife impacts through direct mortality and disturbance to behavior.

Habitat degradation from changes in temperature or weather patterns that can change species composition

Actions to benefit this Habitat in NH

Monitor vegetation to assess habitat changes across space and time

Primary Threat Addressed: Habitat degradation from changes in temperature or weather patterns that can change species composition

Specific Threat (IUCN Threat Levels): Climate change & severe weather

Objective:
To assess changes in habitat resulting from various aspects of climate change and atmospheric pollution.

General Strategy:
The Appalachian Mountain Club and Mount Washington Observatory have been conducting long-term monitoring on alpine vegetation to document changes in species composition and structure resulting from the effects of atmospheric pollution and climate change. NHFG should provide support to these ongoing efforts.

Political Location:
Coos County

Watershed Location:
Androscoggin-Saco Watershed

Advise land managers on mitigating trail impacts.

Primary Threat Addressed: Habitat degradation from hikers that trample vegetation and cause soil erosion

Specific Threat (IUCN Threat Levels): Human intrusions & disturbance

Objective:
Eliminate the co-occurrence of trail impacts with delineated S1-ranked natural communities and rare alpine lepidopteran habitats.

General Strategy:
NHFG will delineate sensitive areas and provide trail advisories to all managing agencies to mitigate trail impacts to wildlife and wildlife habitats. NHFG will become a recognized participant of the Appalachian Trail Conference (ATC) Cooperative Management System. Participants include AMC, DOC, NHDES, and WMNF formalized through a series of Cooperative Agreements at both the state-level and local level (New Hampshire is one of the only states that does not have a wildlife agency as a partner). NHFG will be involved in the development, review, and approval of the Appalachian Trail Local Management Plan. NHFG will enter a MOA with DRED to maintain and manage trails in accordance with the health of wildlife and wildlife habitats.

Political Location:
Coos County

Watershed Location:

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Peter Bowman, NHNHB

2005 Authors:
Celine T. Goulet, NHFG; Steven G. Fuller, NHFG

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