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Ecological Inventory of Black Mountain State Forest

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A Quick Overview of the NH Natural Heritage Bureau's Purpose and Policies

The Natural Heritage Bureau is mandated by the Native Plant Protection Act of 1987 (NH RSA 217-A) to determine protective measures and requirements necessary for the survival of native plant species in the state, to investigate the condition and degree of rarity of plant species, and to distribute information regarding the condition and protection of these species and their habitats.

The Natural Heritage Bureau provides information to facilitate informed land-use decision-making. We are not a regulatory agency; instead, we work with landowners and land managers to help them protect the State's natural heritage and meet their land-use needs.

The Natural Heritage Bureau has three facets:

Inventory involves identifying new occurrences of sensitive species and classifying New Hampshire's biodiversity. We currently study more than 600 plant and animal species and 120 natural communities. Surveys for rarities on private lands are conducted only with landowner permission.

Tracking is the management of occurrence data. Our database currently contains information about more than 4,000 plant, animal, and natural community occurrences in New Hampshire.

Interpretation is the communication of Natural Heritage Bureau information. Our goal is to cooperate with public and private land managers to help them *protect* rare species populations and exemplary natural communities.

Cover: Red pine trunks in a portion of the exemplary red pine rocky ridge natural community at Black Mountain State Forest. Photograph by Ben Kimball, 2005.

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INTRODUCTION

The NH Natural Heritage Bureau, in the NH Division of Forests and Lands, facilitates the protection of New Hampshire's rare plants, exemplary natural communities (which are outstanding examples of different types of forests, wetlands, grasslands, etc.) and natural community systems. Our mission, as mandated by the Native Plant Protection Act of 1987 (RSA 217-A), is to determine protective measures and requirements necessary for the survival of native plant species in the state, to investigate the condition and degree of rarity of plant species, and to distribute information regarding the condition and protection of these species and their habitats.

During the summer of 2004 the NH Natural Heritage Bureau (NH Heritage) conducted an ecological inventory and assessment of **Black Mountain State Forest** (BMSF), a 729-acre property in the town of Haverhill, near the western edge of the White Mountains Region. This site was identified in *Ecological Analysis of NH State Lands* (Crowley and Sperduto 2001) as a Tier 1a property, a code assigned to state lands that were the highest priority for biological inventory. The state forest is adjacent to the White Mountain National Forest (WMNF), which comprises a vast area of publicly-owned forestland to the east of the property. The property sits on the western slopes of Black Mountain, a 2836 ft tall peak whose summit lies on WMNF.

Black Mountain, looking northeast from Haverhill.

METHODS

LANDSCAPE ANALYSIS

The landscape analysis process identified areas that were particularly likely to contain features of interest and allowed us to prioritize survey areas to increase the efficiency of field visits. Information sources we used during landscape analysis included National Wetland Inventory maps, surficial (Goldthwait 1950) and bedrock (Lyons *et al*. 1997) geological maps, soil surveys (NRCS 2001), land cover data (GRANIT 2001), and USGS topographic quadrangles. Digital coverages of some of these data layers, used with GIS computer mapping software (ArcView v.3.3a), improved our ability to conduct landscape analysis by allowing rapid comparison and integration of information from different sources. We queried the NH Heritage database to identify specific locations of known rare species and exemplary natural communities within potential study areas. We reviewed aerial photographs to determine vegetation patterns and conditions and assessed available information from DRED Division of Forests and Lands regarding stand type and condition (see Appendix 3).

FIELD SURVEY

Data were collected at specific locations called observation points (OPs) during field surveys. The following information was collected at most observation points:

1. natural community system type, following Sperduto (2004a, 2004b);
2. natural community type, following Sperduto and Nichols (2004);
3. identification of all native and non-native plant species;
4. percent coverage estimates for all plant species;
5. other descriptive notes, including soil descriptions and other physical site characteristics, evidence of human disturbance, size of the community, and wildlife evidence.

Most plants were identified in the field during the inventory; others were collected and keyed out using the resources available at NH Natural Heritage. Vascular plant nomenclature generally follows the Flora of North America Editorial Committee (1993a, 1993b, 1997, 2000, 2002a, 2002b, 2002c, 2003), then Gleason and Cronquist (1991), and occasionally Fernald (1950), with common names generally following George (1998).

A Global Positioning System (GPS) was used to determine both the location of observation points in each natural community type and the location of rare plant populations in the study area. A GPS unit was also used to determine the location of invasive plant populations. The accuracy of the data collected by the GPS was generally within 15 meters. Field data and site locations of exemplary natural communities and rare plant populations have been catalogued and incorporated into the NH Natural Heritage database.

A more detailed description of NH Heritage's ecological approach can be found in Appendix 1.

DATA ANALYSIS AND MANAGEMENT

Using standard Natural Heritage Program methodologies, NH Heritage compiled and analyzed data collected during the field inventory. We identified, mapped, and documented attributes of all significant biodiversity features, and assigned viability (or Element Occurrence) ranks based on size, condition, and landscape context (see Appendix 2). Rare plant and exemplary natural community data collected during the inventory have been entered into the NH Heritage database.

RESULTS

NATURAL SETTING OF BLACK MOUNTAIN STATE FOREST

Black Mountain State Forest is located in west central New Hampshire, on the boundary between the Northern Appalachian and Lower New England Ecoregions (see Figure 1)[1]. The Lower New England Ecoregion consists of an area extending from southwestern Maine to the northern New Jersey/Pennsylvania border, while the Northern Appalachian Ecoregion extends from the western Adirondacks in New York to northern and eastern Maine and adjacent portions of the Canadian Maritime Provinces. Both of these ecoregions are distinguished from their surrounding areas by particular climatic, geomorphological, and vegetative characteristics, and both have been further divided into "subsections" using finer-scale physical and biological criteria (Keys and Carpenter 1995). Although it is essentially part of the White Mountains, roughly half of BMSF is located in the Vermont Piedmont subsection of the Northern Appalachian Ecoregion. The other half is divided between the Sunapee Uplands and Northern Connecticut River Valley subsections of the Lower New England Ecoregion. Despite its location straddling the boundaries between Ecoregions and subsections, the vegetation of BMSF is primarily northern, although at lower elevations there is a transition to a community that is more similar to the forests of central and southern New Hampshire.

Although Black Mountain reaches 2836 ft., the summit is located on the adjacent White Mountain National Forest, with the highest elevations on BMSF at approximately 2320 ft and the lowest at 1220 ft. The majority of BMSF occupies the west-facing slopes of the mountain, although the property also includes Little Black Mountain, a 1782 ft. shoulder of Black Mountain, with the intervening saddle giving rise to at least three steep-sided stream drainages that form the North Branch, which eventually flows south to Oliverian Brook, a tributary of the Connecticut River. In New Hampshire, the transition between forests with a more southern character (typical of the Lower New England Ecoregion) and those with a more northern character (typical of the Northern Appalachian Ecoregion) is at approximately 1400 ft, just above the lowest elevations on the site.

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[1] **Ecoregions** are landscape divisions used by The Nature Conservancy and Natural Heritage programs nationwide that cover tens of thousands of square miles and have similar biological and physical characteristics – particularly climate, topography, and soils – and broad distribution patterns of plants and animals (Anderson *et al*. 1999). New Hampshire lies within three ecoregions: Northern Appalachian/Boreal Forest; Lower New England/Northern Piedmont; and North Atlantic Coast. Ecoregions consist of aggregations of finer-scale subsections (see below) that share numerous natural communities uncommon in or absent from adjacent ecoregions.

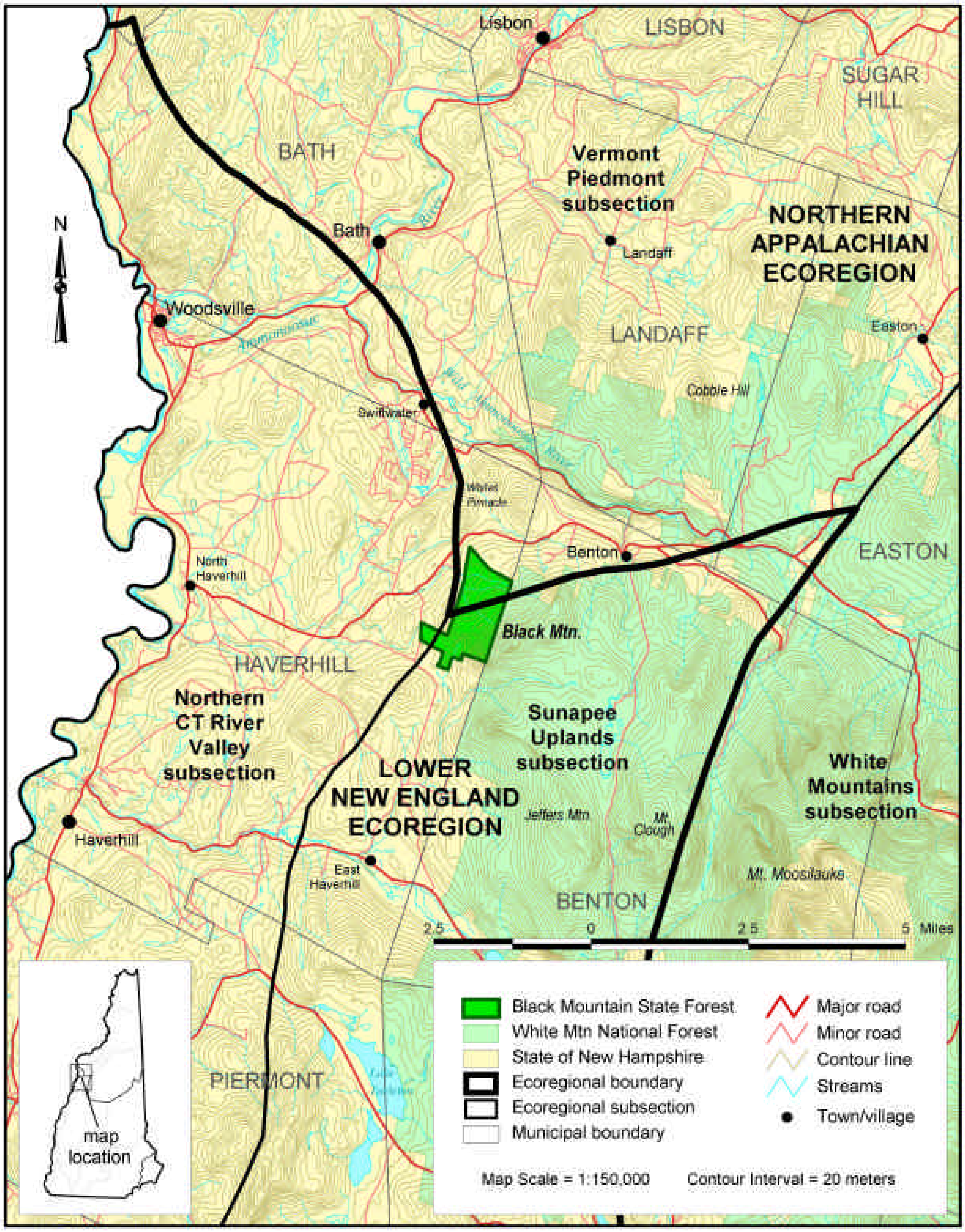

Figure 1. Location map of Black Mountain State Forest showing relative landscape position and ecoregional and ecoregional subsection contexts.

Geology and Soils

The bedrock of BMSF consists primarily of granodiorite, which is a type of felsic rock. Felsic rocks include granites, granodiorites, and quartzites. These rocks are high in silica content (>65%), and their weathering generally contributes to acidic soil conditions with low nutrient availability for plants.

In addition to the felsic bedrock, there is also a narrow band in the southern portion of BMSF that is underlain by the Fitch Formation (see Figure 2). This formation consists of metamorphosed sedimentary rocks, and is classified as carbonate-bearing. Carbonate-bearing rocks contain high concentrations of calcium carbonate ($CaCO_3$), which through weathering contributes to less acidic soil conditions and higher nutrient availability for plants (i.e., calcium and other base-cations). These conditions are often expressed by species-rich natural communities that frequently harbor rare plants. However, the occurrences of the Fitch Formation in New Hampshire are typically rather narrow, and this easily erodible rock does not appear to have a strong influence on the vegetation of BMSF. This may be due in part to the dominance of felsic till, which was likely transported in by glaciers from source areas to the north and west. This may also be partly a result of past limestone mining, which likely removed a substantial portion of the formation at this location as well as the original forest vegetation.

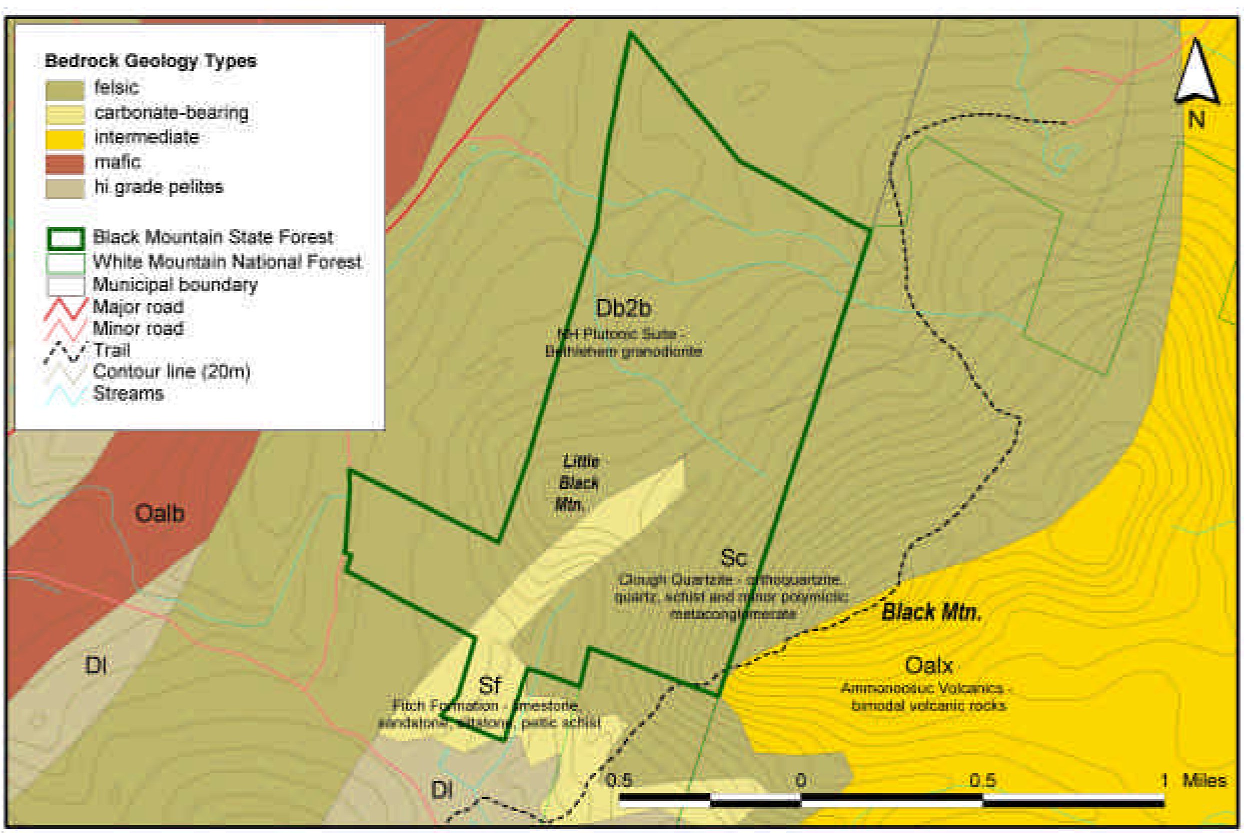

Figure 2. Bedrock geology at Black Mountain State Forest.

Soils at BMSF (see Figure 3) are predominantly sandy loams derived from glacial till and are very stony. They fall into soil series that are typical for the northern half of the state, and include Marlow fine sandy loam, Peru fine sandy loam, Berkshire loam, Pillsbury fine sandy loam, and Tunbridge-Lyman-Rock outcrop complex. For the most part, these series consist of moderately well drained to well drained soils on steep slopes. The Pillsbury series, which is a poorly drained soil on gently sloping topography, occurs along a stream drainage in the northern portion of the site.

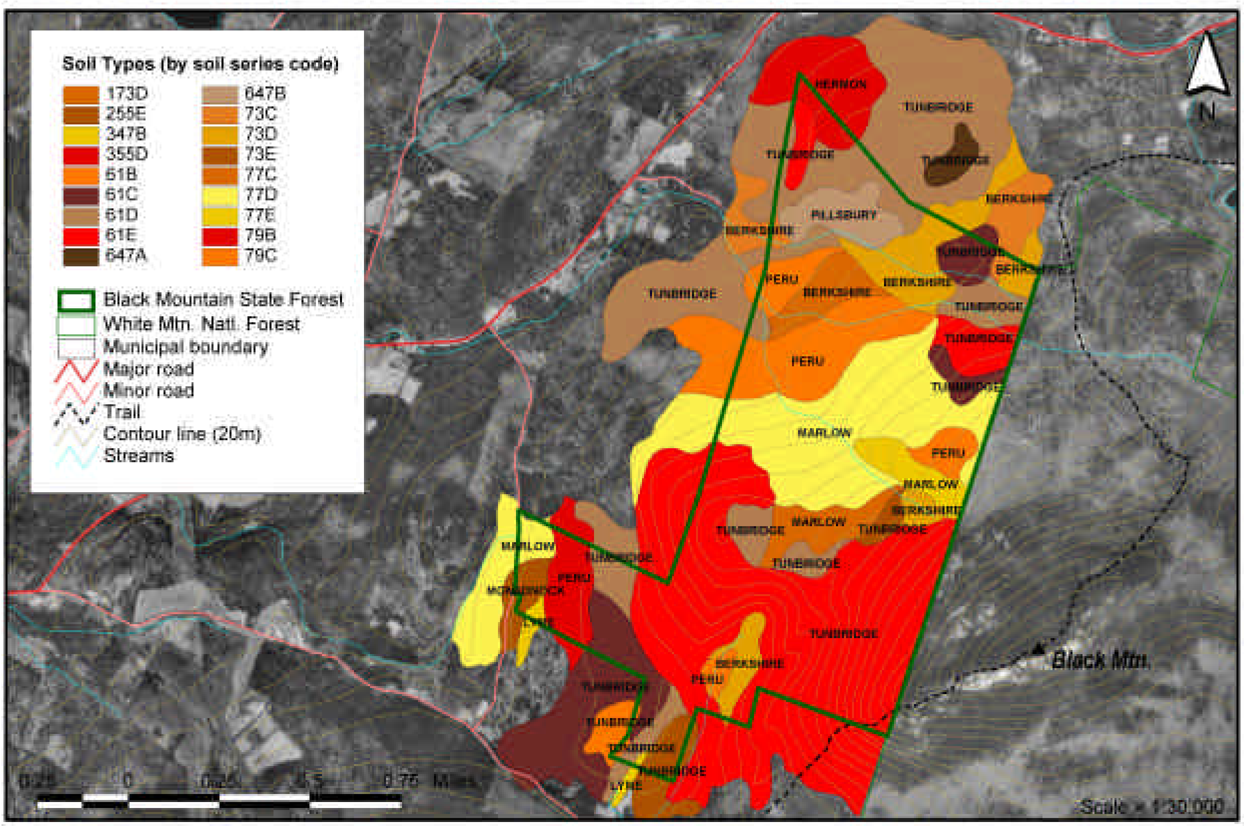

Figure 3. Soil types at Black Mountain State Forest.

Vegetation

Black Mountain State Forest can be divided informally into northern and southern sections, with the boundary being two clearcuts near the center of the property, totaling roughly 40 acres in area (see Figure 4). Although the vegetation on both halves of the study area is typical of the surrounding region, there are enough differences to distinguish between the two halves.

The vegetation throughout BMSF is comprised principally of upland forest communities. On the northern portions of the property, the dominant forest type is *sugar maple – beech – yellow birch forest*, which is often referred to simply as "northern hardwood forest." This common forest type is generally found at elevations of 1400-2500 ft throughout the state, but particularly in the White Mountains and North Country. In a mature example of this community type, *Acer saccharum* (sugar maple), *Fagus grandifolia* (American beech) and *Betula alleghaniensis* (yellow birch) are the dominant canopy species. However, at BMSF, much of the forest is early to mid-successional, and *Acer rubrum* (red maple) has become one of the dominant trees. At lower elevations, there is a transition zone in which more southern species, more common in the adjacent Connecticut River Lowlands and Vermont Piedmont subsections, mix with the northern hardwoods, including *Quercus rubra* (red oak) and *Tsuga canadensis* (hemlock).

In addition to the northern hardwoods, there are patches of *high-elevation spruce – fir forest*. Although it is called "high-elevation," and found mostly above 2500 ft in the White Mountains, it is not uncommon for this community to occur at lower elevations on poor soils, particularly as one moves further north. At BMSF this forest type occurs at elevations as low as 1500 ft, due to a combination of factors, particularly soil type and land use history. Most of the area covered by this community on the northern half of the state land is early- to mid-successional, and is characterized by a canopy of *Picea rubens* (red spruce), *Abies balsamea* (balsam fir) and *Betula papyrifera* (paper birch). In some areas, paper birch is the dominant tree, which indicates a past disturbance of either fire or logging. In the southern portion of the property, at higher elevations, this community is found in a somewhat more mature condition, often mixing with *Pinus resinosa* (red pine) from the adjacent community (see below).

In areas where the soils have some nutrient enrichment resulting from some combination of topographic position (i.e., lower slopes and coves) or the composition of underlying bedrock or till, *semi-rich mesic sugar maple forests* can occur. Ranked S3S4 by NH Natural Heritage, this forest type is found throughout the state on somewhat enriched soils, which are the result of either enriched bedrock or alluvial deposition. Small (<1 acre) patches of this community are found throughout the study area, but one larger example is described below under Features of Local Significance.

Running through all these forest communities are small streams, along which occur *subacid forest seeps* (S3S4), that reflect slight enrichment from the underlying soils. These seeps are found within forested settings throughout the state, and occurrences at BMSF are also described below under Features of Local Significance.

In addition to these tiny wetlands, at the southern end of the property is a *northern hardwood – black ash – conifer swamp* (S2). This rare community is found primarily north of the White Mountains. The example at BMSF is near the southern end of the community's range in New Hampshire. This noteworthy occurrence is described below under Exemplary Natural Communities.

Also described below under Exemplary Natural Communities is the *red pine rocky ridge* community, which occupies many of the dry slopes and ridgetops in the southern half of BMSF. This community type is found at elevations from 750-2700 ft in central and northern New Hampshire, with the best occurrences between 1400-2400 ft in the White Mountains.

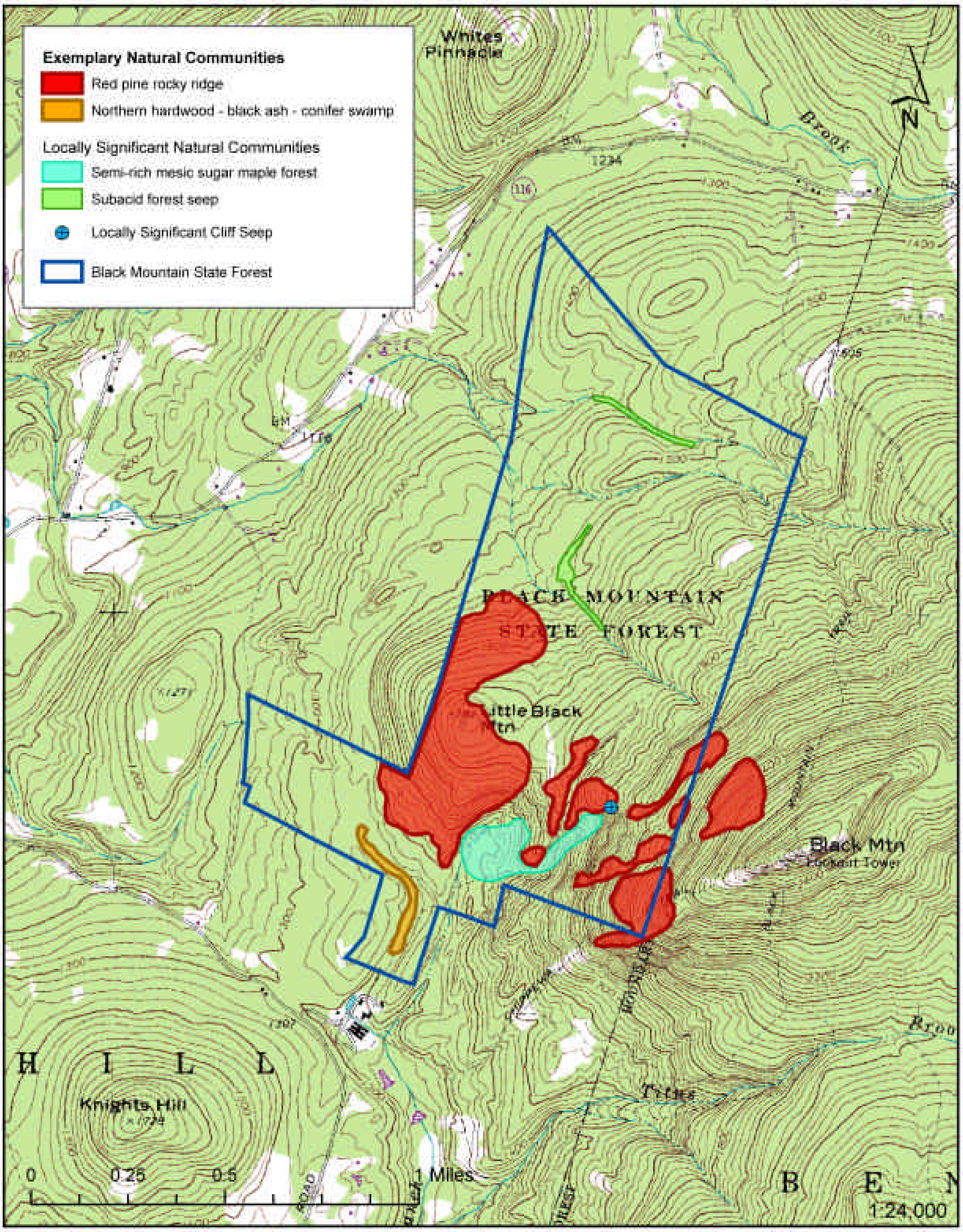

Figure 4. Exemplary and locally significant ecological features at Black Mountain State Forest.

Table 1: Features of Ecological Significance at Black Mountain State Forest.

Feature	Last Seen	Size (ac)	State Rank	Rank	Conservation Significance
NATURAL COMMUNITY					
Cliff seep	08/04	<0.1	S3S4		Local
Northern hardwood – black ash – conifer swamp	**08/04**	**5**	**S2**	**C**	**Exemplary**
Red pine rocky ridge	**10/04**	**164**	**S3S4**	**AB**	**Exemplary**
Semi-rich mesic sugar maple forest	08/04	18	S3S4		Local
Subacid forest seep	09/04	6	S3S4		Local

Exemplary Natural Communities

Red pine rocky ridge (S3S4)

This community occupies dry south- and west-facing slopes, as well as open rocky ridges, on both Black Mountain and Little Black Mountain. The structure and composition of this example is variable, although *Pinus resinosa* (red pine) is present as a dominant or codominant throughout. The structure varies from semi-open woodlands (50-70% canopy cover) to ridge top ledges with as much as 50% of the ground as bare rock. In some of the more wooded areas at BMSF, it is found in almost monotypic stands, but it more frequently occurs as part of mixed stands, along with *Picea rubens* (red spruce), *Quercus rubra* (red oak), and *Acer rubrum* (red maple), and occasionally *Pinus strobus* (white pine) and *Abies balsamea* (balsam fir). On the ridge top ledges, tree cover is sparse, but always includes red pine, and often red spruce and white pine.

The sparse or scattered shrub layer includes *Acer pensylvanicum* (striped maple), *Vaccinium myrtilloides* (velvet-leaf blueberry), *Vaccinium angustifolium* (lowbush blueberry) and *Kalmia angustifolia* (sheep laurel). The herbaceous layer is often sparse, but can be denser in more open settings, and includes such species as *Pteridium aquilinum* var. *latiusculum* (bracken), *Aralia nudicaulis* (wild sarsaparilla), *Cypripedium acaule* (pink lady's-slipper), *Melampyrum lineare* (linear-leaved cow-wheat), *Gaultheria procumbens* (wintergreen), *Oryzopsis asperifolia* (rough-leaved rice-grass), and *Carex debilis* (Rudge's sedge).

Red pine is a fire-dependent species, and red pine communities require regular fires to control competing species and allow for the regeneration of red pine seedlings. At BMSF, some charcoal particles were found in the soil within 5 cm of the surface, indicating a past fire event. Several cores were taken of red pines in this area, and all were between 85 and 100 years of age at breast height, which indicates that they were probably all established after a single disturbance event. Portions of this red pine rocky ridge community with a high percentage of hardwoods in the canopy may reflect a longer period of time since the last fire.

Red pine rocky ridge community (open ridge top ledge expression) from upper elevations of the property.

Red pine rocky ridge community (woodland expression). (B. Kimball photo)

Northern hardwood – black ash – conifer swamp (S2)

This community occurs as a narrow swamp bordering a small stream near the southern edge of BMSF. The hydrology is influenced by seepage from surrounding uplands, and reflects some degree of nutrient enrichment. Soils are organic, with a thin layer of moderately-well decomposed organic material over well-decomposed muck. Tree canopy cover is variable, with numerous wet openings, and is characterized by a mix of hardwood and conifer species. Dominant tree species include *Thuja occidentalis* (northern white cedar), *Acer rubrum* (red maple), *Abies balsamea* (balsam fir), *Fraxinus nigra* (black ash), *Fraxinus americana* (white ash), and *Betula alleghaniensis* (yellow birch). At the upper end of the stream, the soils become more acidic, and northern white cedar is replaced by *Picea rubens* (red spruce).

Shrubs are sparse or absent, but the herbaceous layer is lush (70-80% cover). Herb species include *Onoclea sensibilis* (sensitive fern), *Matteuccia struthiopteris* var. *pensylvanica* (ostrich fern), *Osmunda claytoniana* (interrupted fern), *Tiarella cordifolia* (foamflower), *Solidago rugosa* (rough goldenrod), *Athyrium filix-femina* var. *angustum* (northern lady fern), *Coptis trifolia* var. *groenlandica* (goldthread), *Impatiens capensis* (spotted touch-me-not), *Carex gynandra* (perfect-awned sedge), *Carex pedunculata* (long-stalked sedge), and *Rubus pubescens* (dwarf raspberry).

Features of Local Significance

Semi-rich mesic sugar maple forest (S3S4)

This community is distinguished by having more enriched soils than the surrounding uplands at BMSF, but does not have the high diversity and rarer species components found in rich mesic forests elsewhere in the state. At BMSF, it occupies the slopes and stream bottoms along the headwaters of North Branch, below the ridge between Black Mt. and Little Black Mt. The canopy is dominated by *Acer saccharum* (sugar maple), along with *Fagus grandifolia* (American beech), and *Fraxinus americana* (white ash). The herbaceous layer is moderately diverse, and includes *Polystichum acrostichoides* (Christmas fern), *Uvularia sessilifolia* (sessile-leaved bellwort), *Solidago flexicaulis* (zigzag goldenrod), *Viola rotundifolia* (round-leaved violet), *Viola canadensis* (Canada violet), *Botrychium virginianum* (rattlesnake-fern), *Osmorhiza claytonii* (Clayton's sweet-cicely), *Actaea pachypoda* (white baneberry), and *Aralia racemosa* (spikenard). At the head of one of the small perennial headwater streams is the cliff seep (described below).

Semi-rich mesic sugar maple forest community at Black Mountain State Forest.

Cliff seep (S3S4)

This feature is the product of a small perennial stream trickling over a 6-8 ft. rock overhang and seepage emerging through fractures on the cliff face. It is noteworthy primarily due to the presence of two species which would not generally be expected to occur together: *Thuja occidentalis* (northern white cedar) and *Rhododendron prinophyllum* (early azalea). *Thuja occidentalis* (northern white cedar), which occurs on and around the cliff seep, is a strong indicator of circumneutral soil conditions, which was confirmed by pH measurements between 6.7 and 6.9. It is also present in the *northern hardwood – black ash – conifer swamp* described above, and both of these occurrences are unusual for this species this far south in the state. The other noteworthy species at the seep is *Rhododendron prinophyllum* (early azalea), a shrub which is more frequent in southwestern New Hampshire, and is generally found on dry slopes. Its state rank in New Hampshire is considered "indeterminate," indicating the need for more data needed to assess its status accurately. We are unaware of other places in New Hampshire where these two species occur together.

The remainder of the vegetation at the seep is a mix of enriched-site species and plants more typical of the surrounding uplands. *Fraxinus americana* (white ash) and *Cornus rugosa* (round-leaved dogwood) are both indicators of somewhat enriched conditions, while *Picea rubens* (red spruce), *Dennstaedtia punctilobula* (hay-scented fern), *Aster macrophyllus* (large-leaved aster), *Epigaea repens* (trailing arbutus), and *Brachyelytrum erectum* var. *glabratum* (northern short husk grass) would be expected in the adjacent *red pine rocky ridge* community.

Overhanging cliff with cedar and azalea.

Subacid forest seep (S3S4)

This community occurs as very small wetlands near or adjacent to small perennial streams. They form as a result of groundwater discharge at or near the soil surface, typically resulting in saturated, mucky soil conditions. Although most are too small to map individually (<0.1 acres), they are numerous enough along two streams in the northern half of the site that they can be represented with a 20m wide buffer along the streams with which they are associated. In addition to these buffered streams, seepage occurs more extensively across a flat area associated with the more southern stream.

Although there are few woody plants growing directly within the seepage area, seeps are small enough that they are usually completely shaded by trees in the surrounding uplands. At BMSF, these include *Acer rubrum* (red maple), *Fraxinus americana* (white ash), *Betula alleghaniensis* (yellow birch), and *Acer saccharum* (sugar maple). Within the seep itself, a fairly lush herbaceous layer includes *Laportea canadensis* (wood nettle), *Onoclea sensibilis* (sensitive fern), *Carex scabrata* (rough sedge), *Circaea alpina* (small enchanter's nightshade), *Rubus pubescens* (dwarf raspberry), *Tiarella cordifolia* (foamflower), *Thalictrum pubescens* (tall meadow-rue), *Matteuccia struthiopteris* var. *pensylvanica* (ostrich fern), *Polystichum acrostichoides* (Christmas fern), *Cinna latifolia* (drooping woodreed), *Oxalis acetosella* (northern wood sorrel), *Athyrium filix-femina* var. *angustum* (northern lady fern), *Dryopteris intermedia* (intermediate wood fern), *Veratrum viride* (false hellebore), and *Chrysosplenium americanum* (golden saxifrage).

Subacid forest seep along stream at Black Mountain State Forest.

MANAGEMENT CONSIDERATIONS

Black Mountain State Forest is actively managed for multiple uses including commercial forest products, wildlife habitat, recreation, plant conservation and diversity, clean water and climate mitigation (RSA 227-G). From an ecological perspective, recommended management of the BMSF would include the reservation of exemplary natural communities as natural areas (i.e., maintained in a natural condition by allowing physical and biological processes to operate, with management actions limited to ecological restoration or to preserve natural communities and rare species at risk). Tree removal in exemplary and otherwise significant natural communities can have an immediate and lasting negative impact to biological legacies and intrinsic ecological conditions that characterize these communities (e.g., vegetation structure, species composition, coarse woody debris, soil structure). While some exemplary communities may require management to compensate for altered disturbance regimes, most have the best opportunity to persist when they are insulated from human activities (for a more detailed discussion of impacts to natural communities, see Nichols 2005). Ideally, locally significant communities would also be protected in the same manner as exemplary natural communities, and would thereby contribute to the overall biodiversity value of the local landscape, but their level of importance is somewhat lower because protection opportunities are not as limited in a statewide context.

Timber harvesting is a particular concern for the wetland communities on BMSF, specifically the *northern hardwood – black ash – conifer swamp* and the *subacid forest seeps*. The recommended riparian and wetland guidelines described in "Good Forestry in the Granite State" (New Hampshire Forest Sustainability Standards Work Team 1997) and Buffers for Wetlands and Surface Waters: A Guidebook for New Hampshire Municipalities (Chase 1995) recommend a buffer of 100 ft. for wetlands and waterways, which should mitigate much of the potential impact to the exemplary and locally significant natural communities. However, there are indications in the literature that such narrow buffer strips do not protect against all impacts such as degradation in water and sediment quality (Houlahan and Findlay 2004). Because the *northern hardwood – black ash – conifer swamp* is a high-quality example of a community that is rare state-wide, a more conservative approach (i.e., a 300 ft. buffer) to mitigating effects of cutting in the forest surrounding the exemplary swamp community may be warranted, simply because the limited distribution of the type in the state means that more is "at stake" biologically. In addition to being an exemplary community, the swamp contains *Thuja occidentalis* (northern white cedar) as a canopy component, which is rare this far south in New Hampshire.

Although the *subacid forest seeps* are very small, their significance for local biodiversity is far greater than the proportion of the landscape they occupy would suggest. In addition to supporting a number of plant species that do not occur elsewhere in the surrounding habitats, they provide vital breeding habitat for a number of amphibian and invertebrate species. However, their typically saturated, mucky soils are susceptible to compaction and are easily damaged by foot or vehicular traffic. Because they are so small, the best way to protect these communities is to maintain a 100 ft. minimum buffer around the streams with which the seeps are associated, for the same reasons described above.

At over 160 acres, the *red pine rocky ridge* at BMSF is one of the largest known occurrences of this natural community type in New Hampshire. However, in the long term, this community can disappear through natural successional processes:

> Fire plays an important role in the formation and maintenance of this community, and controlled burns or wildfire may be required for substantial regeneration of red pine, whether or not harvesting is performed. Red pine can exceed 200 years of age, and its thick, platy bark affords mature trees some protection from fire when trees reach about 70 years of age. Younger trees have thinner bark and may not survive an intense fire (Sperduto and Nichols 2004).

Without this sort of regular disturbance, the forest will likely eventually succeed to dominance exclusively by species that do not require open conditions and exposed mineral soil, most likely a mixture of *Quercus rubra* (red oak), *Picea rubens* (red spruce), *Fagus grandifolia* (American beech), and *Acer rubrum* (red maple). The use of prescribed fire, or a "let burn" policy regarding natural wildfires, is the best way to ensure the maintenance of this natural community.

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Appendix 1. NH Heritage Ecological Approach.

NATURAL COMMUNITIES

NH Heritage classifies the landscape with "natural communities," which are recurring assemblages of species found in particular physical environments. Each natural community type is distinguished by three characteristics: (1) a definite plant species composition; (2) a consistent physical structure (such as forest, shrubland, or grassland); and (3) a specific set of physical conditions (such as different combinations of nutrients, drainage, and climate conditions). Natural communities include both wetland types (e.g., red maple basin swamp) and uplands such as woodlands (e.g., rich red oak-sugar maple/ironwood talus woodland) and forests (e.g., hemlock-beech-oak-pine forest).

Across the landscape, natural communities form a mosaic of patches of different sizes. Some tend to be small (such as forest seeps) while others may cover large areas (such as montane spruce - fir forests). Further, boundaries between natural community types can be either discrete (and therefore easily identified in the field) or gradual (thus making some areas difficult to map). Below we describe how and why natural communities are classified and explain the concept of "exemplary" natural communities and their importance to conservation.

NATURAL COMMUNITY CLASSIFICATION

Classifying natural communities enables ecologists, land managers, and others to communicate effectively and to make management decisions regarding ecological systems. Community classification is a powerful tool because it provides a framework for evaluating the ecological significance of pieces of the landscape in both state and regional contexts. Understanding both the rarity of a community within the state and region and the quality of each example is critical to informed conservation planning. As landscape units that share physical and biological characteristics important to many species, natural communities help focus management and conservation attention in an efficient manner, particularly since our knowledge of the individual species in a particular community is often incomplete. In addition, use of a natural community classification can help us understand how ecological processes in one community may affect neighboring communities. For example, knowing that the surrounding upland forest soils are a primary source of nutrients flowing into a poor fen community is important information for land managers to consider when planning management activities.

The classification of natural communities in New Hampshire is based on data from more than 10 years of ecological research by ecologists with NH Heritage and The Nature Conservancy, plus extensive reviews of scientific literature (Sperduto and Nichols 2004). These data have been compiled and used to define natural community types in part through the application of ordination and classification techniques. Most state natural heritage programs continually update their classifications and cooperate with The Nature Conservancy's regional and national ecologists to ensure that natural community types are comparable across state lines.

The names of natural community types generally begin with the dominant or most characteristic plant species, and may include the name of a landscape feature or vegetative structure that is typical of that community. For example, the community type "black gum-red maple basin swamp" refers to a basin swamp (a specific landscape feature, as opposed to a streamside swamp) with black gum *and* red maple in the canopy. In addition, like all Society of American Foresters (SAF) forest cover types, forested natural communities may have many overlapping species and other characteristics, but they are defined by distinct and diagnostic combinations of species and physical characteristics. For example, the red spruce - northern hardwood natural community has considerably more red spruce in the overstory, and is generally higher in elevation, than the standard northern hardwood forest (sugar maple-beech-yellow birch forest natural community) despite many species that occur in both.

NATURAL COMMUNITIES COMPARED TO OTHER CLASSIFICATION SYSTEMS

Many classification schemes are used to define vegetation types or other land units. While many of them have utility for certain purposes, most differ from the natural community classification in terms of their founding principles, attributes, and goals. In the following paragraphs, several of these classification schemes are contrasted with the natural community classification used by NH Heritage.

SAF COVER TYPES

While natural community names can be similar to the names of SAF forest cover types, natural communities are defined using a broader range of considerations. SAF forest cover types are primarily based on dominant tree species, while natural communities are based on all plant species, the structure of these species, and the specific physical environment. Trees are often subtle indicators of their environments. A number of natural communities can be distinguished based largely on trees, and in some cases a difference in tree composition is the main difference between two community types. However, some trees are so broadly adapted that their presence does not precisely indicate site conditions (e.g., white pine or red maple). Differences in tree canopy composition may also primarily relate to cutting or other disturbances.

For example, there are four SAF spruce - fir cover types that correspond to the "montane spruce - fir forest" natural community type. These different cover types primarily relate to stand disturbance history or the successional stage rather than to major environmental differences. The four cover types also do not differentiate between upland spruce - fir forests and spruce - fir swamps. When one considers understory species and soils, upland spruce - fir forests are markedly different from the red spruce/*Sphagnum* basin swamp natural community. In fact, the differences between these two natural communities are more dramatic than the internal differences among the four SAF spruce - fir cover types. SAF cover types are useful, however, for timber management purposes.

National Vegetation Classification System

At a national level, The Nature Conservancy has published a National Vegetation Classification System (NVC; Grossman *et al*. 1998; Anderson *et al*. 1998) that uses a formal classification hierarchy emphasizing differences in both vegetation structure and floristic composition. This system is periodically updated to include new information from more specific natural community classifications developed at the state level, such as the New Hampshire natural community classification. The Federal Geographic Data Committee has adopted a vegetation classification standard derived from the NVC for use by federal agencies, and future development of the classification is expected to be a collaborative effort (Grossman *et al*. 1998). Natural communities are synonymous in scale and in concept to the "association" level of the NVC. The primary difference between the two classifications is that the New Hampshire classification uses environmental characteristics directly in the organizational hierarchy (*e.g.*, floodplain forests and talus slopes), whereas the NVC hierarchy is based primarily on vegetation characteristics alone.

USFWS Wetland Classification

A classification scheme frequently used in wetland and aquatic systems was produced by Cowardin *et al.* (1979) for the U.S. Fish and Wildlife Service (USFWS). In the USFWS system, wetlands and deepwater habitats are defined by their vegetation, substrate, and frequency of flooding in a hierarchy that emphasizes flooding regimes and attributes of vegetation at a coarse scale (e.g., vegetation structure, life-form, persistence, etc.). This classification system is useful because of its applicability to broad geographical regions and because it can be readily applied in conjunction with aerial photograph interpretation. It was the basis for wetland typing in the National Wetland Inventory mapping effort.

Natural community types can typically nest within the hierarchical structure of the USFWS system. In addition to the flooding regimes and coarse vegetation characteristics used to distinguish USFWS types, however, the natural community classification considers factors such as nutrient regime, water source, and geomorphic setting, as indicated by specific differences in floristic composition. For example, under the USFWS system, red maple/*Sphagnum* saturated basin swamps and red maple-black ash/swamp saxifrage seepage swamps would both be considered saturated, palustrine broad-leaved deciduous forested wetlands. This grouping does not reflect important differences between the two communities, including differences in species composition (ground cover by *Sphagnum* versus forb species), nutrient levels (species indicative of nutrient-poor versus minerotrophic conditions), water sources (upland runoff versus groundwater seepage), geomorphic settings (basin depression versus headwater seepage area), and soils (deep peat versus shallow peat over silt). The natural community classification provides additional detail regarding ecological conditions and processes that helps clarify the distribution of biological diversity across the landscape.

Ecological Land Types

Defined to date only for national forest lands in New Hampshire, the U.S. Forest Service's Ecological Land Types (ELTs) emphasize particular soil features, including depositional environment, soil texture, and soil depth. Although some ELTs correspond reasonably well to groups of communities, they are not easily compared to natural communities for five primary reasons. First, ELTs in New Hampshire are limited to uplands. Second, they are mapped as units of 100 or more acres, so natural communities that occur as smaller patches are not detected and often occur within many ELT types. Third, ELTs can be related to general tree species composition, but the composition of other plant species is not considered directly. Fourth, ELTs do not directly reflect the mineral composition of soil and bedrock, whereas natural communities do. Finally, ELTs describe some fine-scale soil characteristics that may have silvicultural significance but sometimes have no known corresponding floristic expression.

EXEMPLARY NATURAL COMMUNITIES

NH Heritage places particular emphasis on and gives conservation priority to "exemplary" natural communities. Exemplary natural communities include all examples of rare types (such as a rich mesic forest) and high-quality examples of common types. High-quality natural communities are identified as having relatively little human impact. These areas have greater potential to contain or achieve natural dynamics that are characteristic of the original community types. A forested natural community need not be "old growth" to obtain exemplary status. Typical exemplary forested natural communities have a variety of characteristic species, natural regeneration within forest gaps, multiple age classes, diverse structural characteristics, abundant standing and fallen woody debris, intact soil processes, and little direct evidence of human disturbance. Such characteristics can only be studied, preserved, and understood by having appropriate reference sites. Further, exemplary natural communities represent the best remaining examples of New Hampshire's flora, fauna, and underlying ecological processes.

The effects of natural disturbances, such as the 1998 ice storm, do not preclude any natural community from being designated exemplary. Damages caused by natural disturbances, including ice storms, blowdowns, and fire, are part of the suite of natural processes influencing natural community dynamics. We take disturbance such as heavy ice damage into account when assessing natural communities, but if a community also displays exemplary attributes, including minimal human influence, then we are likely to classify it as such.

NATURAL COMMUNITY SYSTEMS

Natural community systems are repeating associations of natural communities. Systems can be useful for the following reasons: (1) they can be used as a tool to track locations and compare entire sites without having to refer to all communities at a site, particularly when these communities may intergrade and be difficult to map; (2) they allow general classification of a system when detailed information is not available or detailed surveys are not feasible; (3) systems can provide a more practical scale for conservation planning and site comparisons; and (4) systems may be more suitable mapping units than communities for integrating wildlife occurrence data and habitat needs with plant information. The classification and mapping of exemplary natural community systems can therefore be effective at identifying conservation targets of the highest priority.

RARITY

NH Heritage considers the rarity of a natural community or a species both within New Hampshire and across its total range. We identify the degree of rarity within New Hampshire with a state rank and throughout its range with a global rank. Ranks are on a scale of 1 to 5, with a 1 indicating critical imperilment, a 3 indicating that the species or natural community is uncommon, and a 5 indicating that the species or natural community is common and demonstrably secure. Species and natural communities considered to be globally rare or state rare are those designated G1-G3 or S1-S3, respectively. Some species are rare both globally and in New Hampshire (e.g., G2 S1), while others are common elsewhere but rare in New Hampshire (e.g., G5 S1). Many communities have not been assigned global ranks at this time, pending a comprehensive review of their status and distribution range-wide.

QUALITY RANKS

In addition to considering the rarity of a natural community or species as a whole, NH Heritage ranks the quality of individual natural community occurrences and rare plant populations. These "Quality Ranks" give a more detailed picture of significance and conservation value. Quality ranks are based on the *size, condition,* and *landscape context* of a natural community or rare species population. These terms collectively refer to the integrity of natural processes or the degree of human disturbances that may sustain or threaten long-term survival. There are four quality ranks:

Rank	Description
A	**Excellent Occurrence:** An A-ranked natural community is a large example nearly undisturbed by humans or which has nearly recovered from early human disturbance and will continue to remain viable if protected. An A-ranked rare species occurrence is large in both area and number of individuals, is stable, exhibits good reproduction, exists in a natural habitat, and is not subject to unmanageable threats.
B	**Good Occurrence:** A B-ranked community is still recovering from early disturbance or recent light disturbance by humans and/or may be too small in size to be an A-ranked occurrence. A B-ranked population of a rare species occurrence is at least stable, grows in a minimally human-disturbed habitat, and is of moderate size and number.
C	**Fair Occurrence:** A C-ranked natural community is in an early stage of recovery from disturbance by humans and/or a small sized representative of the particular type of community. A C-ranked population of a rare species is in a clearly human-disturbed habitat and/or small in size and/or number, and possibly declining.
D	**Poor Occurrence:** A D-ranked natural community is severely disturbed by humans, its structure and composition are greatly altered, and recovery is unlikely. A D-ranked

occurrence of a rare species is very small, has a high likelihood of dying out or being destroyed, and exists in a highly human-disturbed and vulnerable habitat.

For example, consider a population of a rare orchid growing in a bog that has a highway running along one border. The population may be large and apparently healthy (large *size* and intact *condition*), but the long-term threats posed by disturbance at the bog's edge – its low-quality *landscape context* (pollution from cars and roads, road-fill, garbage, altered hydrology, reduced seed dispersal, etc.) – may reduce the population's long-term viability. Such a population of orchids would receive a lower rank than a population of equal *size* and *condition* in a bog completely surrounded by a forest (i.e., with a higher quality *landscape context*).

NH Heritage, in collaboration with other state heritage programs and The Nature Conservancy, is working to develop quality rank specifications for all of New Hampshire's natural communities and rare plant species. Unfortunately, limited time and incomplete knowledge, both on local and global scales, have prevented the development of thoroughly tested and peer reviewed quality rank specifications for most of New Hampshire's natural communities and rare species.

In the absence of rank specifications for each natural community, NH Heritage uses broad guidelines for assigning preliminary quality ranks. The guidelines for assessing the size, condition, and landscape context for natural communities are described below.

SIZE

Occurrence size is a quantitative measure of area occupied by a species or natural community and accounts for such factors as population abundance, fluctuation, density, and area of occupancy for species. All else being equal, the larger a natural community is, the more viable it will be. Large size is correlated with increased heterogeneity of internal environmental conditions, integrity of ecological processes, species richness and size of constituent species populations and their respective viability, potential resistance to change, resilience against perturbations, and ability to absorb disturbances. Size is used in a relative sense with respect to the range of sizes exhibited by the particular natural community type.

CONDITION

Condition is a combined measure of the quality of reproduction (for species), development/maturity (for communities), degree of integrity of ecological processes, species composition, biological and physical structure, and abiotic physical factors within the occurrence. For example, old growth forests with little anthropogenic disturbance and intact biotic and abiotic factors, structures, and processes, would warrant an "A" rank for condition regardless of size.

Excellent Condition: Old growth or minimally disturbed by human impacts with recovery essentially complete, or in the case of disturbance-maintained communities (e.g., pitch pine/scrub oak barrens), the natural disturbance regime has prevailed continuously with no significant or irreversible alterations by humans; ecological processes, species composition, and structural features are intact.

Good Condition: Mature examples with only minor human impacts or good potential for recovery from relatively minor past human impacts; ecological processes, species composition, and structural features are largely intact.

Fair Condition: Immature examples or those with significant human impacts with questionable recovery potential or in need of significant management and/or time to recover from present condition; ecological processes, species composition, and structural features have been altered considerably but not to the extent that the occurrence is no longer viable if managed and protected appropriately.

Poor Condition: Little long term viability potential.

LANDSCAPE CONTEXT

Landscape context is a combined measure of (a) the quality of landscape structure, (b) the extent (including genetic connectivity), and (c) the condition of the surrounding landscape that influences the occurrence's condition and viability. Dynamic natural community occurrences have a better long-term viability when they are associated with large areas of diverse habitat that support dynamic ecosystem processes. Potential factors to be considered include: (a) the degree of landscape fragmentation; (b) the relationship of a natural community to contiguous wetland or upland natural communities; (c) the influence of the surrounding landscape on susceptibility to disturbance; (d) the relative position in a watershed; (e) susceptibility of the occurrence to pollutants and hydrologic change (Chase *et al*. 1995); and (f) the functional relationship of the natural community to surrounding natural landscape features and larger-scale biotic and abiotic factors. For example, open peatlands are extremely sensitive to nutrient input, basin swamps are moderately sensitive, and streamside/riverside communities and seepage swamps are less sensitive.

In general, landscape condition is weighted towards the immediate 30-300 m (100-1000') buffer area around the natural community where direct impacts of land use may be most significant. The adjacent 1.6-3.2 km^2 (1-2 mi^2) area or relevant watershed area around the natural community is considered to a lesser degree. In turn, the larger area beyond the relevant watershed receives the least consideration. The actual size applied for a natural community varies according to the characteristics of the particular natural community and the specific context of the occurrence in the landscape.

Excellent Landscape Context: Natural community is embedded in a matrix of undisturbed, unfragmented surrounding natural communities that have functional connectivity to the occurrence; past human disturbances that potentially influence the community are minimal or negligible.

Good Landscape Context: Surrounding landscape is largely intact and minimally fragmented, or human disturbance/fragmentation is of a configuration and magnitude that is consistent with maintaining the current condition of the occurrence, or disturbances can be managed to achieve viability.

Fair Landscape Context: Significant human impacts, development, fragmentation, and other disturbances characterize the landscape around the natural community and may affect the long term viability and condition of the occurrence.

Poor Landscape Context: Functional human impacts, fragmentation and loss of natural communities dominate the surrounding landscape; the occurrence is probably not viable, even with management.

PROTECTING NEW HAMPSHIRE'S BIODIVERSITY

WHAT IS AND WHY SHOULD WE PROTECT BIODIVERSITY?

WHAT IS BIODIVERSITY?

Biodiversity can be defined as the variety and variability of all living organisms (Taylor *et al*., eds. 1996). Biodiversity includes the entire combination of organisms, their genes, the natural communities in which they live, and the complex interactions among and between organisms and their physical environment. Natural levels of biodiversity may be very high, as in tropical regions with favorable growing conditions and high species counts per unit area. Natural levels of biodiversity can also be very low, where conditions are harsh and few species can survive (such as in deserts and arctic regions). The biodiversity in a given area decreases when species suffer local extinctions, when invasive species form a monoculture that displaces a variety of native species, and when natural habitats (which support the local species) are fragmented or destroyed. On a landscape scale, unique components of biodiversity (such as species or natural communities that only occur within a limited area) are a focal point for conservation efforts.

WHY SHOULD WE PROTECT BIODIVERSITY?

Reasons for biodiversity protection include the following:

- **Direct benefits:** Both individual species and functioning natural communities provide a large array of direct economic and other benefits. These include, but are not limited to: flood prevention, water quality improvement, fire prevention, food, medicines and herbal remedies, genetic resources, recreation, crop pollination, and pest control.

Due to the extensive interactions among all species, even species with no obvious direct benefits to humans may play a critical role in the survival of beneficial species or in the suppression of harmful ones. The loss of a single species, or the disturbance of a natural community, can have extensive and unpredictable consequences.

- **Scientific knowledge:** To understand how ecosystems work, and how human activities impact them, scientists need to be able to study undisturbed systems and the full array of naturally occurring species.
- **Ethics:** Many people believe that all life has an intrinsic right to exist, and humans have a moral obligation to uphold that right.

- **Aesthetics:** Many people value species and their habitats simply for the opportunity to look at them. For these people, quality of life is diminished by the loss of a favorite species or natural area.

WHY FOCUS BIODIVERSITY PROTECTION ON NATURAL COMMUNITIES?

Since communities by definition are assemblages of multiple species (animal and plant), protecting a community provides protection for many individual species. Therefore, if we protect an adequate number of viable examples of each natural community type, we can protect the majority of New Hampshire's species. This is sometimes referred to as a “coarse-filter” approach to protecting biodiversity.

Because the coarse filter can miss some important species, however, it needs to be augmented with a finer filter. The “fine-filter” approach generally focuses on specific rare species whose habitats have not been included in “coarse-filter” areas. By locating populations of these species, and then protecting the natural community examples where they are found, we can successfully protect the full range of biodiversity.

In addition to the living species in a community, “biological legacies” are important elements of natural systems. Biological legacies are organic materials that accumulate over time, such as seed banks, coarse woody debris, and soil nutrients. Topsoil, the layer of mineral earth that contains a large quantity of organic material from the growth, death, and decomposition of plants, is an example of a biological legacy. These legacies take years to develop, yet can be rapidly lost if natural communities are disturbed or natural processes are interrupted. Successful protection of a natural community will usually protect these important landscape features, which would otherwise take many years to replace.

In many cases, protection of one natural community may require protection of groups of adjacent communities within a larger landscape. With the possible exception of large matrix communities, no community is completely self-sufficient. Processes such as erosion, windfalls, fire frequency, and nutrient accumulation are all strongly affected by what happens in adjacent communities. In addition, animal species typically depend on having access to a combination of communities, usually in close proximity: different natural communities provide critical shelter and food at different times of the year.

Even when intact adjacent communities are not required to protect a particular example of a natural community, overall biodiversity protection is greatly enhanced when protected areas include a variety of adjacent and connected communities. In general, long-term community viability increases with the size of protected areas, and certain wide-ranging animals can be supported that would not occur in smaller areas. Edge effects (such as infiltration by invasive species) are also reduced. The importance of scale to effective biodiversity protection is discussed in more depth in Sperduto *et al*. (2001) (see “Protecting Biodiversity on IP Lands in Northern New Hampshire”).

PROTECTING NEW HAMPSHIRE'S BIODIVERSITY

In 1994, the Northern Forest Lands Council (1994) concluded that "maintaining the region's biodiversity is important in and of itself, but also as a component of stable forest-related economies, forest health, land stewardship, and public understanding." In response to recommendations by the Northern Forest Lands Council, the NH Division of Forests and Lands and the NH Fish and Game Department established the Ecological Reserves System Project. One of the project's primary objectives was to "assess the status of biodiversity in New Hampshire and the extent to which it is protected under the current system of public and private conservation lands" (NH Ecological Reserve System Project 1998a). This question was then explored by a 28-member Scientific Advisory Group, who took the question beyond the northern forest and considered it in a statewide context. The conclusions of the group indicated that there was a serious need for continued biodiversity conservation in New Hampshire (NH Ecological Reserve System Project 1998b):

> Though conservation lands comprise approximately 20% of the land area in New Hampshire, the current system of conservation lands in New Hampshire does not appear to provide comprehensive, long-term protection of biodiversity at the species, natural community, or landscape levels.

NH Heritage strives to facilitate protection of the state's biodiversity through the protection of key areas that support rare species, rare types of natural communities, and high quality examples of common natural community types. Exemplary natural communities are particularly important because we assume that, if we protect an adequate number of viable examples of each natural community type, we can protect the majority of New Hampshire's species. This is sometimes referred to as a "coarse-filter" approach to protecting biodiversity.

The coarse filter can miss important species, however, so it needs to be augmented with a finer filter. The "fine-filter" approach generally focuses on specific rare species. For example, the rare, federally threatened *Isotria medeoloides* (small whorled pogonia) occurs in a variety of second-growth hardwood forests in southern New Hampshire. This orchid's habitat may not be captured by the coarse-filter approach, so we need to employ a fine-filter approach (i.e., survey for the plant itself) to ensure that the species is protected.

Long-term protection of New Hampshire's species, natural communities, and ecological processes requires a variety of conservation approaches. The goal of NH Heritage's coarse- and fine-filter approaches is to inform management decisions by identifying those sites that have a relatively greater potential for maintaining the natural diversity within the state.

The foundation for successful biodiversity protection is a series of representative, high-quality examples of all the state's natural community types, with their constituent species and their underlying ecological processes. The best option for this kind of protection would be a series of connected, high-quality natural community types; this series would ensure that ecological processes that connect natural communities remain functionally intact within a broader landscape context. In short, there is a need for reserve areas with natural communities protected within a diverse landscape, not just in isolation.

NH Natural Areas

The Department of Resources and Economic Development (DRED) places the lands it manages into four principal categories based on general land use: agricultural lands, conservation easements, forestry lands, and recreation lands. Within DRED, the Division of Forests and Lands (NH DFL) actively manages and classifies forestry lands, and occasionally recreation lands, into resource areas according to recognized resource values or dominant natural features. During forest inventory and forest management work when this zoning is established, NH DFL may designate particular sections of a property as belonging to a natural preserve area.

A natural preserve area, or natural area, is defined as an area that "has retained its natural character, although not necessarily completely undisturbed, and/or which contains floral, faunal, ecological, or geological features of global, national, regional, and/or statewide significance of scientific and/or educational interest" (NH DRED 1996). Beyond this definition, formal specifications have not yet been developed for the establishment of natural preserves on DRED lands. Proposed criteria to govern these designations include the following (NH DRED 1995):

A. Sites which provide habitat for rare or endangered species;

B. Sites that contain a rare natural community or high quality representative of a common natural community, or larger landscape units containing important combinations of communities and/or species;

C. Sites largely undisturbed by humans or largely recovered from human disturbance;

D. Sites which provide habitat for large numbers or uncommon associations of native plant and animal species; and

E. Sites with special geological or paleontological significance.

Appendix 2. Explanation of global and state rank codes.

Ranks describe rarity both throughout a species' range (globally, or "G" rank) and within New Hampshire (statewide, or "S" rank). The rarity of sub-species and varieties is indicated with a taxon ("T") rank. For example, a G5T1 rank shows that the species is globally secure (G5) but the sub-species is critically imperiled (T1).

Code	*Examples*		*Description*
1	G1	S1	Critically imperiled because extreme rarity (generally one to five occurrences) or some factor of its biology makes it particularly vulnerable to extinction.
2	G2	S2	Imperiled because rarity (generally six to 20 occurrences) or other factors demonstrably make it very vulnerable to extinction.
3	G3	S3	Either very rare and local throughout its range (generally 21 to 100 occurrences), or found locally (even abundantly at some of its locations) in a restricted range, or vulnerable to extinction because of other factors.
4	G4	S4	Widespread and apparently secure, although the species may be quite rare in parts of its range, especially at the periphery.
5	G5	S5	Demonstrably widespread and secure, although the species may be quite rare in parts of its range, particularly at the periphery.
U	GU	SU	Status uncertain, but possibly in peril. More information needed.
H	GH	SH	Known only from historical records, but may be rediscovered. A G5 SH species is widespread throughout its range (G5), but considered historical in New Hampshire (SH).
X	GX	SX	Believed to be extinct. May be rediscovered, but evidence indicates that this is less likely than for historical species. A G5 SX species is widespread throughout its range (G5), but extirpated from New Hampshire (SX).

Modifiers are used as follows.

Code	*Examples*		*Description*
Q	G5Q	GHQ	Questions or problems may exist with the species' or sub-species' taxonomy, so more information is needed.
?	G3?	3?	The rank is uncertain due to insufficient information at the state or global level, so more inventories are needed. When no rank has been proposed the global rank may be "G?" or "G5T?"

When ranks are somewhat uncertain or the species' status appears to fall between two ranks, the ranks may be combined. For example:

G4G5	The species may be globally secure (G5), but appears to be at some risk (G4).
G5T2T3	The species is globally secure (G5), but the sub-species is somewhat imperiled (T2T3).
G4?Q	The species appears to be relatively secure (G4), but more information is needed to confirm this (?). Further, there are questions or problems with the species' taxonomy (Q).
G3G4Q S1S2	The species is globally uncommon (G3G4), and there are questions about its taxonomy (Q). In New Hampshire, the species is very imperiled (S1S2).

Appendix 3. Cover Types at Black Mountain State Forest.