# MASSACHUSETTS FOREST RESERVES
# LONG TERM ECOLOGICAL MONITORING PROGRAM
# MOUNT WASHINGTON FOREST RESERVE

A report on the baseline characteristics of the Forest Reserve Areas located within Mount Washington State Forest, Bash Bish Falls State Park, the Appalachian Trail Corridor, Mount Everett State Reservation, and Jug End State Reservation and Wildlife Management Area

Prepared for the
Massachusetts Executive Office of Energy and Environmental Affairs

June 2009

Avril de la Cretaz
Matthew Kelty
Lena Fletcher

Department of Natural Resources Conservation
University of Massachusetts Amherst

UMASS AMHERST

Cover:  Mount Washington State Forest, (photo courtesy of the Massachusetts Department of Conservation and Recreation).

## PREFACE

The Commonwealth of Massachusetts has established five Forest Reserve properties in the southwestern corner of the state, primarily in the town of Mount Washington with some areas extending into the adjacent towns of Egremont and Sheffield. Collectively, these properties constitute the Mount Washington Forest Reserve, one of eight large Forest Reserves in the Commonwealth (Fig. 1). The Forest Reserves were established by the Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA) to create areas where forest development is the product primarily of natural succession and natural disturbance. The Forest Reserve management goal is to increase the area of late seral forest and to protect and conserve species that depend on this habitat, while allowing the effects of natural disturbances to create variation in successional trends in some areas. Only passive management is used in the Forest Reserves, mainly focusing on restoring native habitat by removing invasive species. Sustainable forest management, including timber harvesting, will be implemented on state lands outside the Forest Reserve system (EOEEA 2009).

This report describes the physical features, disturbance history, land use history, and forest communities of the Mount Washington Forest Reserve. Following this, baseline data on tree density, size distribution, and species composition from Continuous Forest Inventory (CFI) data are summarized and discussed.

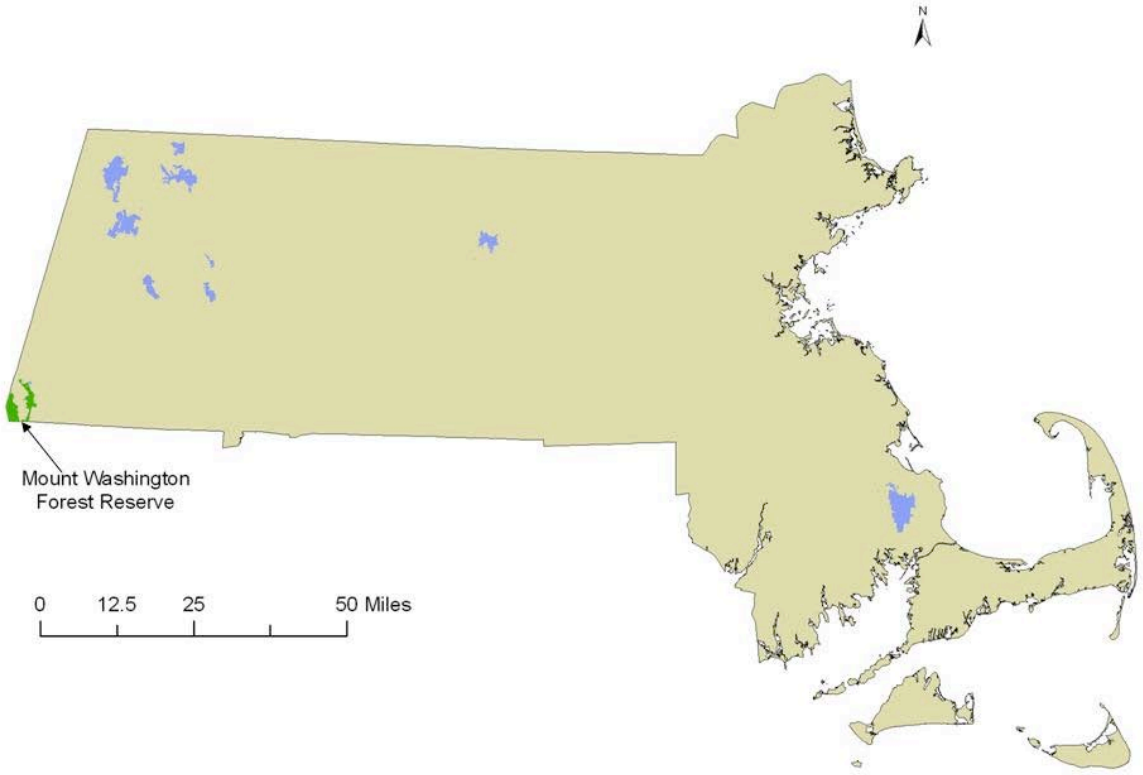



Fig. 1. Mount Washington Forest Reserve, Massachusetts (green). The other large Forest Reserves are shown in blue (DCR 2008). All GIS analyses were completed using ArcGIS 9.3 (ESRI 2008).

## THE MOUNT WASHINGTON FOREST RESERVE

## INTRODUCTION

The Mount Washington Forest Reserve consists of the entire southern portion of the Mount Washington State Forest, all of Bash Bish Falls State Park, a section of the Appalachian Trail Corridor, all of Mount Everett State Reservation, and a portion of the Jug End State Reservation and Wildlife Management Area (Fig. 2). The Forest Reserve properties are under the supervision of the Massachusetts Department of Conservation and Recreation-Division of Forests and Parks (DCR) and the Massachusetts Department of Fish and Game-Division of Fisheries and Wildlife (DFW). The greatest part of the Forest Reserve is located in the town of Mount Washington. "Mount Washington" refers to a no longer used name for the southern Massachusetts Taconic Mountains; there is no specific mountain in the area with that name. Sections of the Mount Everett State Reservation portion of the Forest Reserve extend into the town of Sheffield to the east and the Jug End Reservation is located in the town of Egremont to the north. The area of each Forest Reserve Parcel is shown in Table 1.

Table 1. Sites and areas, the Mount Washington Forest Reserve (area estimates based on GIS analysis).

| Site Name | Acres | Total State Forest Acres |
|---|---|---|
| Bash Bish Falls State Park | 410 | 410 |
| Mount Washington State Forest | 3,630 | 4,585 |
| Mount Everett State Reservation | 1,650 | 1,650 |
| Appalachian Trail Corridor | 350 | 435 |
| Jug End State Reservation and Wildlife Management Area | 780 | 1,190 |
| Total | 6,820 | 8,270 |

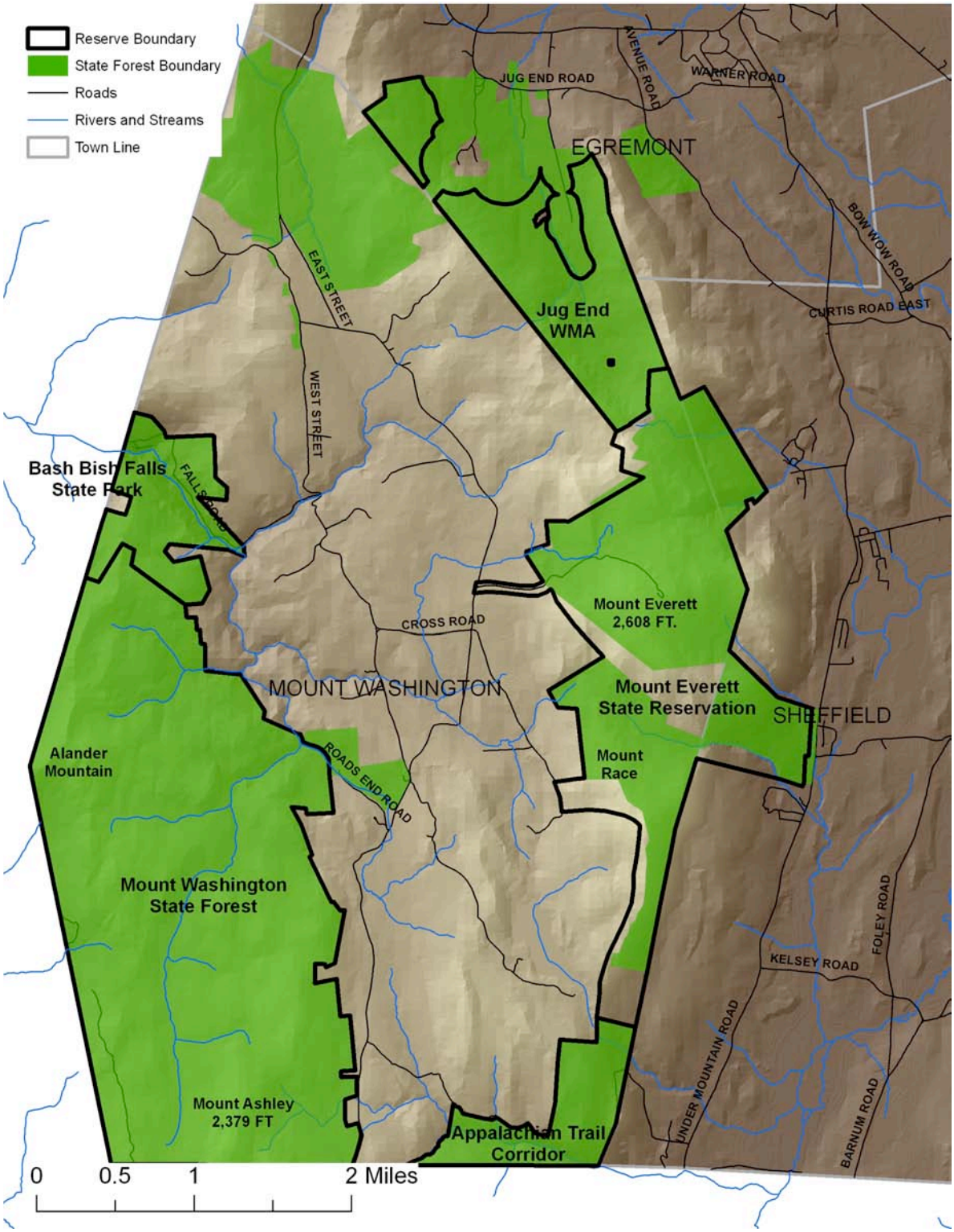



Fig. 2. Mount Washington Forest Reserve consisting of Bash Bish Falls State Park, the southern portion of the Mount Washington State Forest, a section of the Appalachian Trail Corridor, Mount Everett State Reservation and a portion of Jug End State Reservation and Wildlife Management Area (DCR 2008, DFW 2007).

Streams to the west of the Mount Everett Reservation ridgeline are part of the Bash Bish Watershed and flow to the north and west joining Bash Bish Brook that then flows to the Hudson River in New York State. On the east side of the Mount Everett ridgeline, streams flow east to the Housatonic River. Bash Bish Falls in Bash Bish State Park is Massachusetts' highest single-drop waterfall (Fig. 3) (MassGIS 2000). The stream tumbles through a series of gorges and a hemlock-hardwood ravine forest, and then drops about 60 feet to a pool below (DCR no date given).

Fig. 3. Bash Bish Falls at Bash Bish Falls State Park in the Mount Washington Forest Reserve, (photo courtesy of the Massachusetts DCR).

The Mount Washington Forest Reserve lies within the Taconic Mountains Subsection. Subsections are an ecoregional classification of the U.S. Forest Service and the basis for Massachusetts state ecoregions (Fig. 4). Land Type Associations (LTAs) represent a finer scale of ecological classification within subsections or ecoregions. The Mount Washington Forest Reserve lies almost entirely within the Taconic Mountains Low/mid elevation LTA (Fig. 4). This land type association is characterized by acidic bedrock and

soils and by the absence of red spruce, even on the mountain peaks. The Low/mid-elevation LTA is found at elevations between 1,150 and 2, 610 ft. A small portion of the Jug End Forest Reserve is located in the southern Marble Valley – Rolling Lowlands LTA. This LTA is characterized by marble and limestone bedrock with calcareous soils derived from glacial till, and is generally found at elevations below 1,650 ft. Pockets of calcareous bedrock and soils are present within the larger higher elevation LTA as well (Keys and Carpenter 1995, de la Cretaz and Kelty 2008).

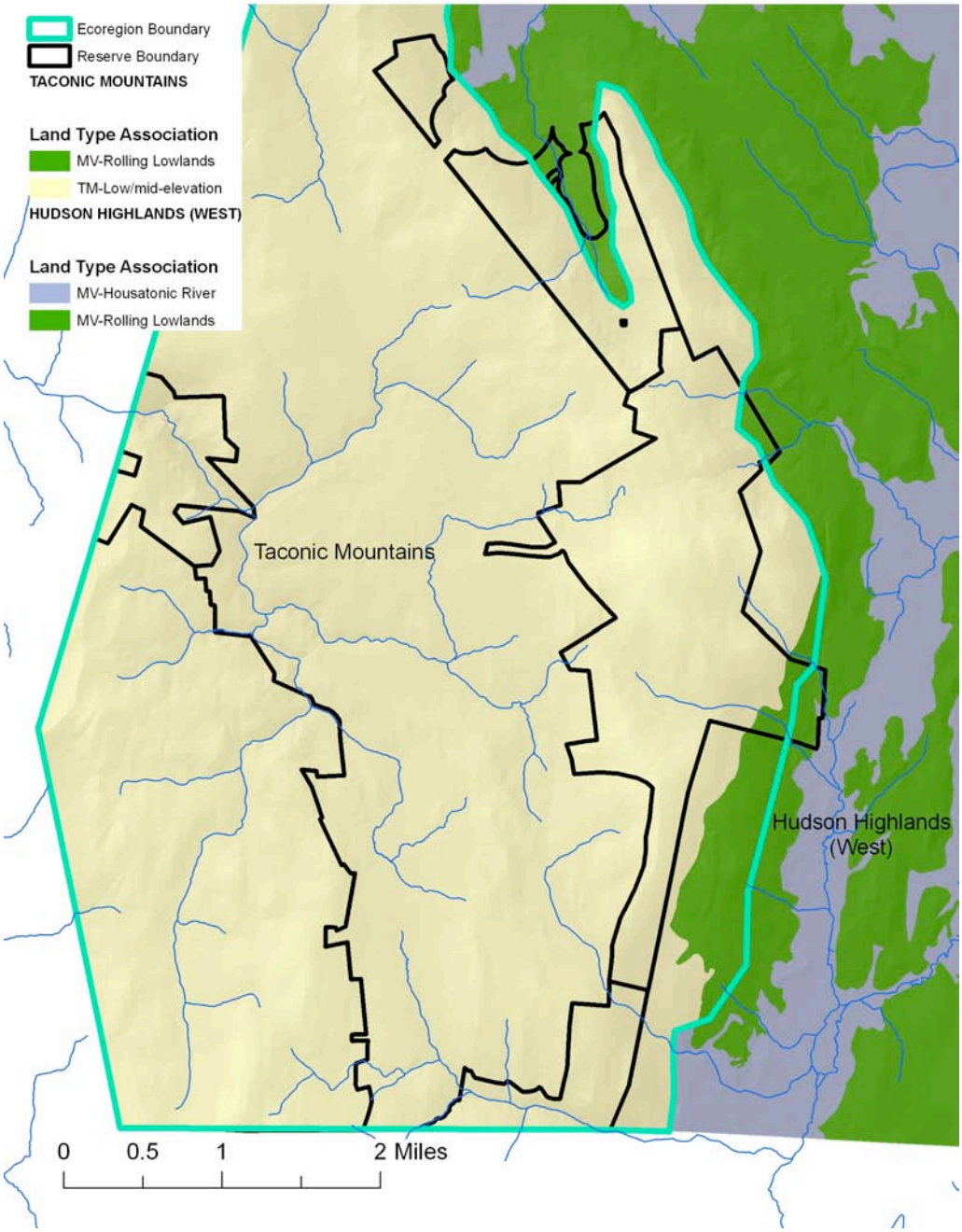



Fig. 4. Land Type Associations of the Mount Washington Forest Reserve (de la Cretaz and Kelty 2008).

### *Associated Open Space*

Within a 2-mile buffer extending from the Forest Reserve Boundary in the State of Massachusetts, there are approximately 8,200 acres of permanently protected open space (Fig. 5). The DCR and DFW manage 1,700 acres, parts of the Mount Washington State Forest and Jug End WMA that are outside the Forest Reserve boundaries. The 520 acres of the Appalachian Trail Corridor, outside the State Forest properties are under the supervision of the National Park Service. The Nature Conservancy (TNC) protects 2,520 acres in the region. The remaining protected areas are owned by a variety of NGOs, land trusts and private individuals (MassGIS 2009 (a)).

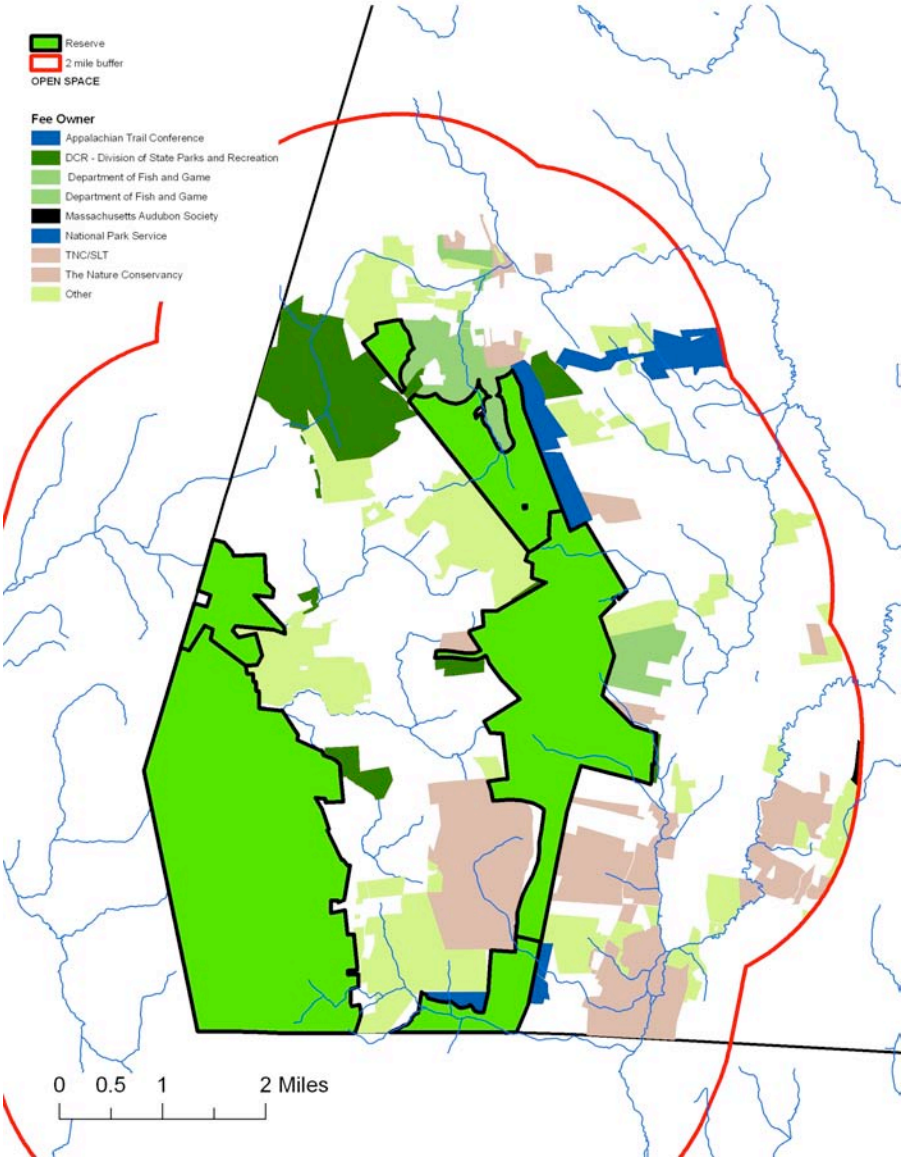



Fig. 5. Permanently protected open space within a buffer extending 2 miles from the Forest Reserve boundary (Massachusetts only) (MassGIS 2009 (a)). TNC/SLT = The Nature Conservancy and the Sheffield Land Trust.

## PHYSICAL FEATURES

### *Topography*

Elevations in the Mount Washington Forest Reserve range from about 780 ft. on the eastern border of the Mount Everett State Reservation, near the Sheffield town line, to 2,608 ft., at the summit of Mount Everett (Fig. 2, Fig. 6). Mount Ashley, at 2,379 ft. is the highest point within the Mount Washington State Forest portion of the Forest Reserve (Fig.2). There are steep slopes (45% to more than 60%) with an east-southeast aspect on the eastern edge of the Mount Everett State Reservation portion of the Forest Reserve. Along the Massachusetts/New York border, there are steep slopes with a northwest aspect (Fig.7). Within the Jug End State Reservation and Wildlife Management Area there is a central valley bordered by upland ridges to the northeast and southwest (Figs.7, Fig.8).

Fig. 6. Mount Everett summit (elevation 2, 608 ft.), (photo by Avril de la Cretaz).

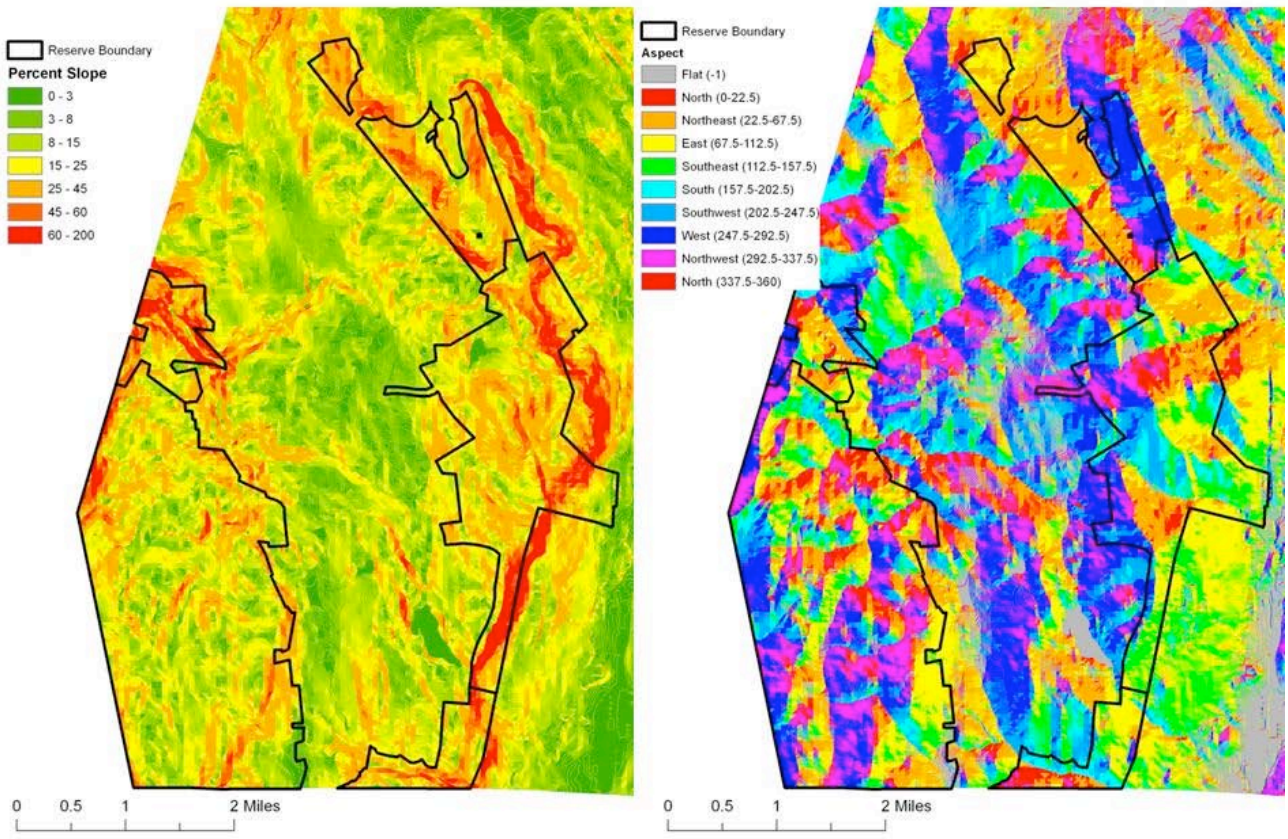



Fig. 7. Percent slopes (left) and aspect (right), Mount Washington Forest Reserve.

Fig. 8. Forest Reserve, Jug End State Reservation and Wildlife Management Area, (photo courtesy of the DCR).

***Bedrock Geology***

The Mount Washington Forest Reserve area is part of the Taconic Mountain Range, which runs along the eastern border of New York State from northwest Connecticut to western Massachusetts and then north to west-central Vermont. The Taconic Mountains (including the Mount Greylock ridge) were created during the Taconic mountain building event (orogeny), which occurred between 485 and 440 million years ago during the Ordovician era. During this time, the Shelburne Falls and Bronson Hill volcanic island chains slowly moved towards and finally collided with the eastern margin of the core North American continent known as Laurentia. This collision shoved sedimentary rocks of the island chains, ocean bottom, and continental margin up and over the rocks of the continental shelf. The Taconic Mountains are the eroded remnants of these thrust sheets (Skehan 2001).

The uplands of the Mount Washington State Forest and Mount Everett Reservation and Jug End WMA are located on the Everett formation (Fig. 9). The Everett formation is composed of acidic meta-sedimentary phyllite and schist. This is described as "pale green to greenish gray phyllite with tiny crystals of albite feldspar and chlorotoid, a platy mineral that superficially resembles chlorite (Fig. 9, Fig. 10, Table 2). The valley between these upland formations is covered by the limey mudstone of the Walloomsac Formation. The Walloomsac Formation consists of orangish, weathering marble, phyllite, quartz, shaley limestone and limey shale. It is the youngest formation in the region and was deposited on top of the Stockbridge Marble, in valley lowlands and on the lower slopes of the mountain ridges. To the east of the Mount Everett Reservation/Jug End WMA portions of the Forest Reserve, the marble bedrock of the Stockbridge Formation underlies the Housatonic River Valley and extends up the slopes of the eastern face of the Mount Everett Ridge (Zen et al. 1983, Skehan 2001). Upland marble and limestone deposits have created calcareous cliff habitat and rare mesic, species-rich natural communities, (NHESP 2004, Appendix C).

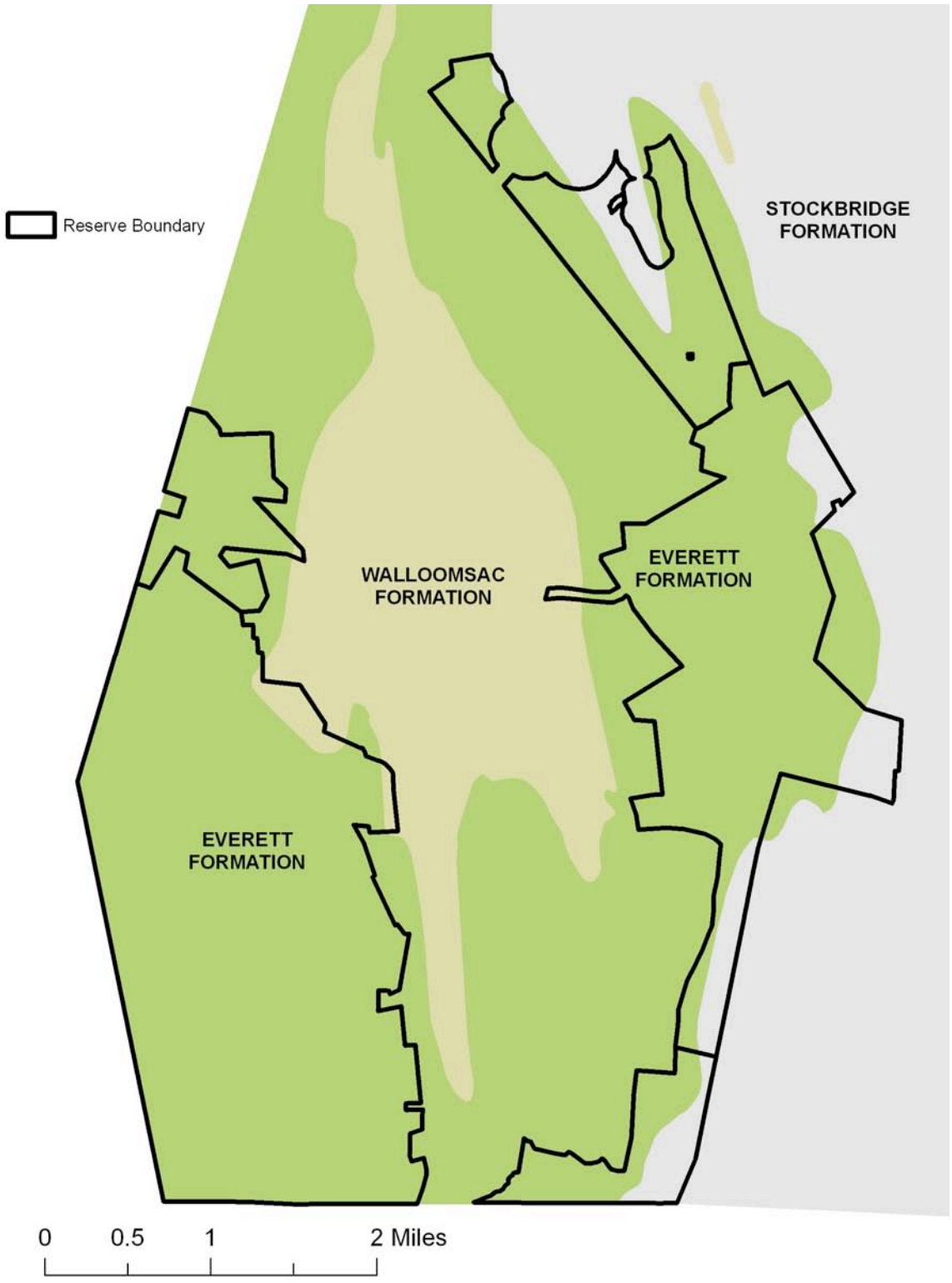



Fig. 9. Bedrock formations in the Mount Washington Forest Reserve area (Zen et al. 1983).

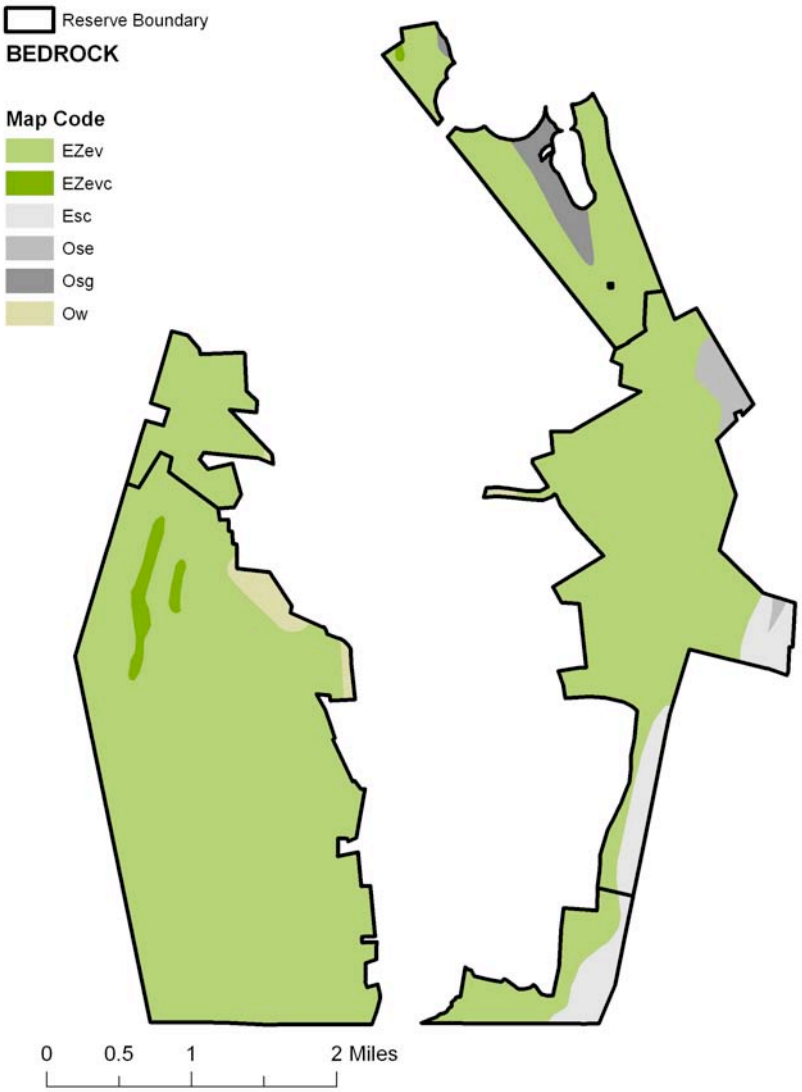



Fig. 10. Bedrock, Mount Washington Forest Reserve (Zen et al. 1983).

Table 2. Bedrock description, Mount Washington Forest Reserve (Zen et al. 1983).

| Map Code | Description | Area (%) | Formation | Rock Type |
|---|---|---|---|---|
| EZev | Phyllite and schist | 90 | Everett | Sedimentary |
| EZevc | Meta-argillite (metagraywacke) and quartzite | 1 | Everett | Sedimentary |
| Esc | Calcitic dolomite marble with white quartz nodules | 4 | Stockbridge | Metamorphic |
| Ose | Calcite marble | 1 | Stockbridge | Metamorphic |
| Osg | Limestone, marble, and dolostone | 2 | Stockbridge | Sedimentary |
| Ow | Phyllite, schist, and limestone | 1 | Walloomsac | Sedimentary |

### *Surficial Geology and Soils*

There have been repeated episodes of glaciation in New England during the past one million years. Mountains of ice, thousands of feet high have advanced from the north, scraping away existing material and retreated, leaving massive amounts of debris, known as glacial drift, behind. The last glacial maximum occurred about 18,000 years ago. The recession of the glaciers, which continued until about 12,000 years ago, exposed a landscape covered with thick deposits of glacial drift consisting primarily of till and outwash. Glacial till, created by the grinding movement of the glaciers over bedrock, consists of poorly-sorted material, particles of many different sizes, including larger rocks and boulders. Glacial outwash is deposited by meltwaters and consists of well-sorted sand and gravel. Glacial till deposits cover most of the Mount Washington Forest Reserve Area with a few small areas of glacial outwash in some lowland areas (MassGIS 1999, Skehan 2001).

Soils in the Mount Washington Forest Reserve are all inceptisols, new soils showing little evidence of soil forming processes (Brady and Weil 2002). Soils formed in acidic glacial till cover 97% of the Forest Reserve area (Fig. 11). The Taconic soil series is the most common, covering 90% of the area. Taconic soils are shallow (10 to 20 inches to bedrock), somewhat excessively drained soils that formed in acidic glacial till derived mainly from strongly folded phyllite, schist, quartzite and slate (NCSS 2005). Other acidic till soils include the Lanesboro, Fullam, and Brayton series described in Table 3 below. In addition, there are small areas where soils are derived from calcareous till and outwash material derived partially from limestone and dolomite. Although they represent less than 4% of the Forest Reserve area, these soils are important because they are high in nutrients and give rise to natural communities with high biodiversity.

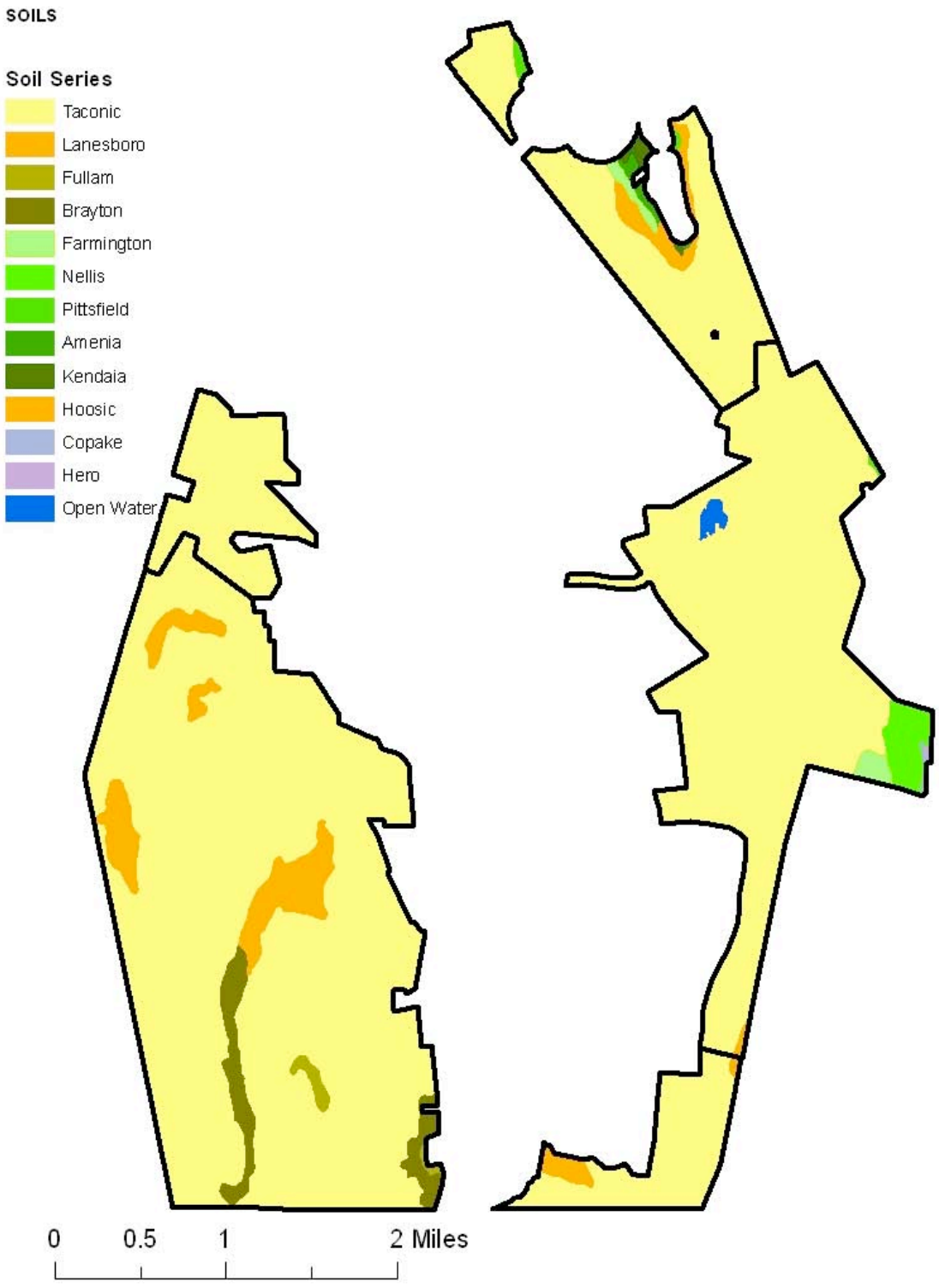



Fig. 11. Soil types in the Mount Washington Forest Reserve (Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture 1999).

Table 3. Soil Series, Mount Washington Forest Reserve (NRCS 2005, 2005, 2008, 2005, 2007, 2006, 2007, 2006, 2007, 2002, 2001, 2000).

| Series Name | Soil Characteristics | Area (%) |
|---|---|---|
| **Soils formed in acidic till** | | |
| Taconic | Shallow, somewhat excessively drained | 91 |
| Lanesboro | Moderately deep to a dense substratum, well drained | 4 |
| Fullam | Moderately deep to a dense substratum, moderately well drained | |
| Brayton | Very deep, poorly drained | 1 |
| **Soils formed in calcareous till** | | |
| Farmington | Shallow, well drained and somewhat excessively drained | <1 |
| Nellis | Very deep, well drained | <1 |
| Pittsfield | Very deep, well drained | <1 |
| Amenia | Very deep, well drained | <1 |
| Kendaia | Very deep, somewhat poorly drained | <1 |
| **Soils formed in acidic outwash** | | |
| Hoosic | Very deep, excessively drained | <1 |
| **Soils formed in calcareous outwash** | | |
| Copake | Moderately deep to stratified sand and gravel, very deep to bedrock, well drained | <1 |
| Hero | Very deep, moderately well drained | <1 |

### *Climate*

The nearest weather station is located in Great Barrington (elevation 728 ft.), 5 – 10 miles northeast of the Forest Reserve. The mean yearly temperature at this site is 45.1˚F and the mean annual precipitations is 48.8 inches (Table 4). As elevations within the Forest Reserve exceed 2,000 feet on several mountain peaks, mean temperatures at various locations within the Forest Reserve would be lower and yearly precipitation somewhat greater than that recorded for Great Barrington (Daley and Taylor 1998) (Fig. 12).

Table 4. Mean 24-hour temperature and mean precipitation by month, Great Barrington MA (World Climate 1996).

| | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [1]Temp.˚F | 20.1 | 22.3 | 32.5 | 44.1 | 54.9 | 63.5 | 68.0 | 66.2 | 58.3 | 47.7 | 37.9 | 26.1 | 45.1 |
| [2]Precip. Inches | 3.7 | 3.0 | 3.8 | 4.0 | 4.9 | 3.4 | 4.2 | 5.2 | 4.2 | 4.6 | 4.6 | 3.4 | 48.8 |

[1] Temperature data derived from NCDC TD 9641 Clim 81 1961-1990 Normals. 30 years between 1961 and 1990.
[2]Precipitation data derived from NCDC Cooperative Stations. 15 complete years between 1973 and 1995.

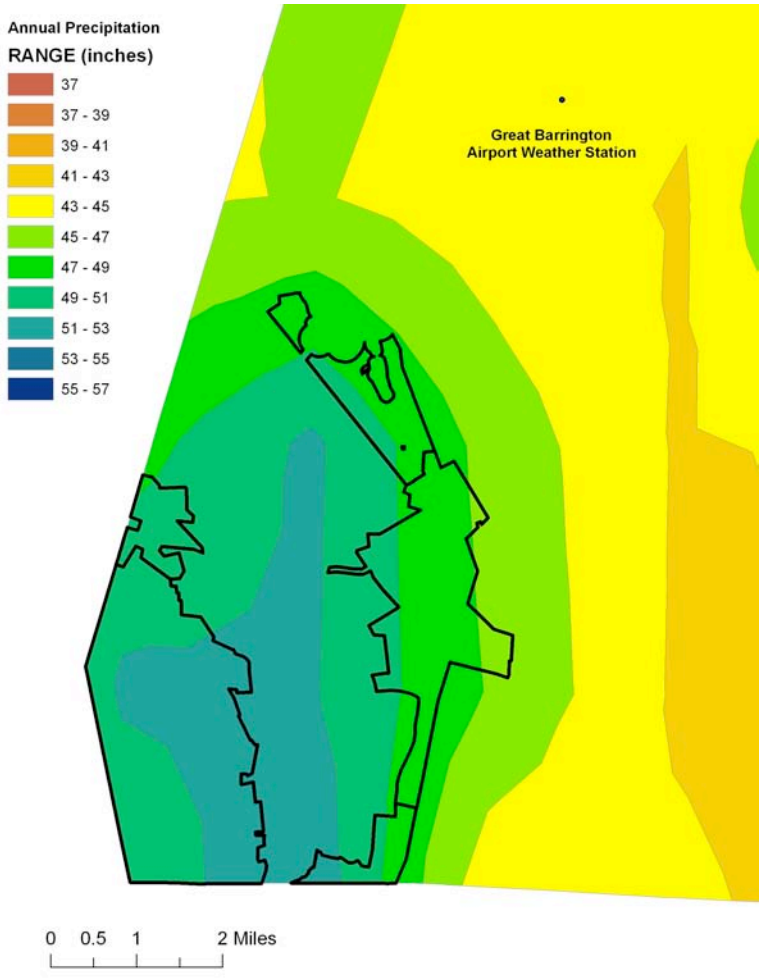



Fig. 12. Estimated Massachusetts annual precipitation, 1961-1990 (Daly and Taylor 1998).

***Disturbance History***

The most common natural disturbances in this area are windstorms (hurricanes), snow and ice, insects, and disease. State foresters have recorded evidence of tree damage from fire (1938), snow and ice (1958, 1977, 1996), insects (1980), and disease (1988) (DCR 2000). Although there is no record of wind damage from Continuous Forest Inventory (CFI) records, a study of old growth stands in the area found evidence of repeated damage correlating to 33 hurricanes documented in historical records from 1716 to 1985 (D'Amato 2007). State foresters have recorded damage to individual trees caused by a variety of biological agents (DCR 2000). These include beaver, porcupines, birds, fungi, and insects: cherry black knot, beech bark disease, nectria, various species of fomes, white pine weevil, sawflies, ants, bark beetles, and borers. Aerial photo surveys (MassGIS 1997) indicate defoliation by canker in 1962 (>2,000 acres), fire in 1968 (123 acres on the western side of the Mount Everett ridge), oakleaf tier in 1978 (1800 acres in the southeast corner of the Mount Washington State Forest) and again in 1984 (84 acres), Gypsy moth defoliation affected the entire southwest corner of Massachusetts between 1980 -1983. A small area defoliated by pear thrips (180 acres) was noted in 1988. . Hemlock woolly adelgid has not yet been reported in this area, but poses a potential threat to hemlocks. Damage from a recent ice storm (December 2008) has yet to be documented; however, initial reports would suggest that this damage may be extensive

**Pest and Pathogen Information**

Cherry black knot (*Apiosporina morbosa*) is a fungal disease affecting black cherry that causes the development of warty black galls ranging in length from ½ inch to more than 1 ft. The infected trees decline and become more symptomatic with each growing season. The infection stresses the entire tree causing it to weaken, decline, and possibly die. The stress placed on the tree may also make it susceptible to infections by other pathogens. Occasionally knots grow large enough to girdle a branch and kill it. Trees with multiple infections become dwarfed and misshapen (Cornell Plant Diagnostic Clinic 2007).

Fomes species observed within the Mount Washington Forest Reserve include *Fomes annosus* and *Fomes pini*. *Fomes annosus* is a fungus that attacks many conifer species and some hardwoods, causing root and butt rot. Fruiting bodies generally occur underground or below forest floor material where moisture is high. Infected trees become susceptible to windthrow (Mook and Eno 1961). *Fomes pini* infects the heartwood of mature and overmature pines of all species, causing a condition known as redheart. The perennial conks are often hoofshaped. Infected trees can survive indefinitely but are structurally unsound (www.forestpests.org 2008).

Nectria canker is the most common canker of hardwood trees. There are several species of Nectria fungus including *Nectria galligena* (the most widespread) *N. magnoliae*, which attacks tulip trees, and *N. coccinea* (see beech bark disease below). The fungus is found on red and sugar maple, black, yellow, and white birch, and beech trees. Hickory, and ash species are generally not affected. Nectria fungus infections often are not fatal to the host tree; birch species are the most susceptible to death by girdling (Brandt 1964).

Beech bark disease results when bark, attacked and altered by the beech scale insect (*Cryptococcus fagisuga*), is invaded and killed by fungi, primarily *Nectria coccinea* and sometimes *Nectria galligena*. Beech bark disease causes significant mortality (Houston and O'Brien 1983).

Sawflies are a group of insects related to wasps and bees. There are a number of sawfly species, each preferring specific plants or groups of plants. White pine is frequently a preferred host. Their name is derived from the saw-like ovipositor the adult female uses to lay eggs. Adult sawflies are inconspicuous wasp-like insects that do not sting. Sawfly larvae look like hairless caterpillars. The larvae often feed in groups and can quickly defoliate portions of trees (Wawrzynski 2009)**.**

Pear Thrips (*Taeniothrips inconsequens*) were first identified as agricultural pests that attacked fruit trees. They have been considered a serious forest pest since 1979. Adult pear thrips emerge from the soil in the spring. They feed on the buds and emerging leaves of sugar maple, birch, ash, black cherry, and beech, and then lay their eggs in the veins and petioles of the leaf epidermis leaving brown scars. Symptoms can include fallen green leaves, leaves that are smaller than normal, and cholorotic and tattered leaves. The leaf margins are frequently browned or wilted. Trees generally recover once the pear thrip population crashes. Growth decline and crown dieback can occur during especially long-lasting outbreaks (O'Brien and Snowden 1989).

White pine weevil (*Pissodes strobi*) is a native insect that attacks eastern white pine. Adults hibernate in the duff underneath host trees, emerge in early spring, and crawl up the trunk of the host tree, where males and females begin feeding just below the terminal bud cluster. Females lay their eggs in egg cavities starting just below the terminal bud cluster and extending down the upper half of the terminal shoot. After the eggs hatch, larvae burrow under the bark of the terminal shoot where they continue feeding. Following metamorphosis, the adult beetles emerge from the pupae and continue feeding on the buds and bark tissue of stems and branches. Weevil attacks result in growth reduction (each weevil attack reduces tree height growth by 40 to 60% in that year), stem deformation, increased susceptibility to wood decay organisms, and tree mortality, although mortality is rare and usually occurs only in small trees (less than 4 ft tall) (Hamid et al. 1995).

Gypsy Moth (*Lymantria dispar*) caterpillars have caused widespread forest defoliation throughout Massachusetts. The most severe recent outbreak occurred from 1980-1982. Gypsy moth caterpillars prefer hardwoods, especially oaks, basswood, gray and white birch, and poplar. Older larvae feed on several species of hardwoods plus hemlock, pines and spruces. They tend to avoid ash, butternut, balsam fir and mountain laurel, but will feed on almost anything during a population outbreak. Outbreak populations return to low levels that do not visibly affect the forest canopy after 2 to 3 years. Wasps, flies, ground beetles, and ants; many species of spiders, birds, and many small woodland mammals (mice, shrews, chipmunks, squirrels, and raccoons) all prey on gypsy moth larvae when population density is low, but this predation does not prevent outbreaks (McManus et al. 1989, Elkinton et al. 2004). Population outbreaks are eventually controlled by density-dependent mortality. A virus (*Nucleopolyhedrovirus*) usually causes outbreak population collapse. Recently an

entomopathogenic fungus species (*Entomophaga maimaiga*) has prevented population outbreaks. The fungus has spread rapidly since it was first observed in 1989, partially the result of intentional introduction into gypsy moth infested areas as a biological control (Hajek et al. 1996, Liebhold 2003).

The oak leaf tier (*Croesia semipurpurana*) is a pest of oaks throughout the Northeastern United States and Canada. The overwintering moth eggs occur individually on the bark of smaller branches and hatch in early May. The newly hatched larvae, which are yellowish-brown with a shiny black head, first feed on developing buds and later on expanding leaves. Much of the defoliation is a result of bud destruction by early larval feeding. Caterpillars frequently feed simultaneously with other oak feeders (i.e., sawfly and gypsy moth caterpillars). When mature, the caterpillars may be seen hanging on silk threads from the oaks as they drop to the ground to pupate in the litter. Normally trees defoliated by this insect can survive 2 and possibly 3 years of successive defoliation before twig and branch mortality begin to appear. In most areas it is rare to have more than 2 successive years of heavy defoliation by this pest before populations collapse. Most trees refoliate, however, the second crop of leaves is usually yellower and somewhat stunted (Maine Department of Conservation Maine Forest Service - Forest Health and Monitoring Division 2000).

Hemlock Woolly Adelgid (*Adelges tsugae*) is a small aphid-like insect native to Japan that has caused considerable mortality to eastern hemlock trees from North Carolina to Connecticut. The woolly adelgid is now present in southern Berkshire County and poses a potential threat to the hemlocks in the Otis Forest Reserve (Orwig et al. 2002).

## LAND USE HISTORY

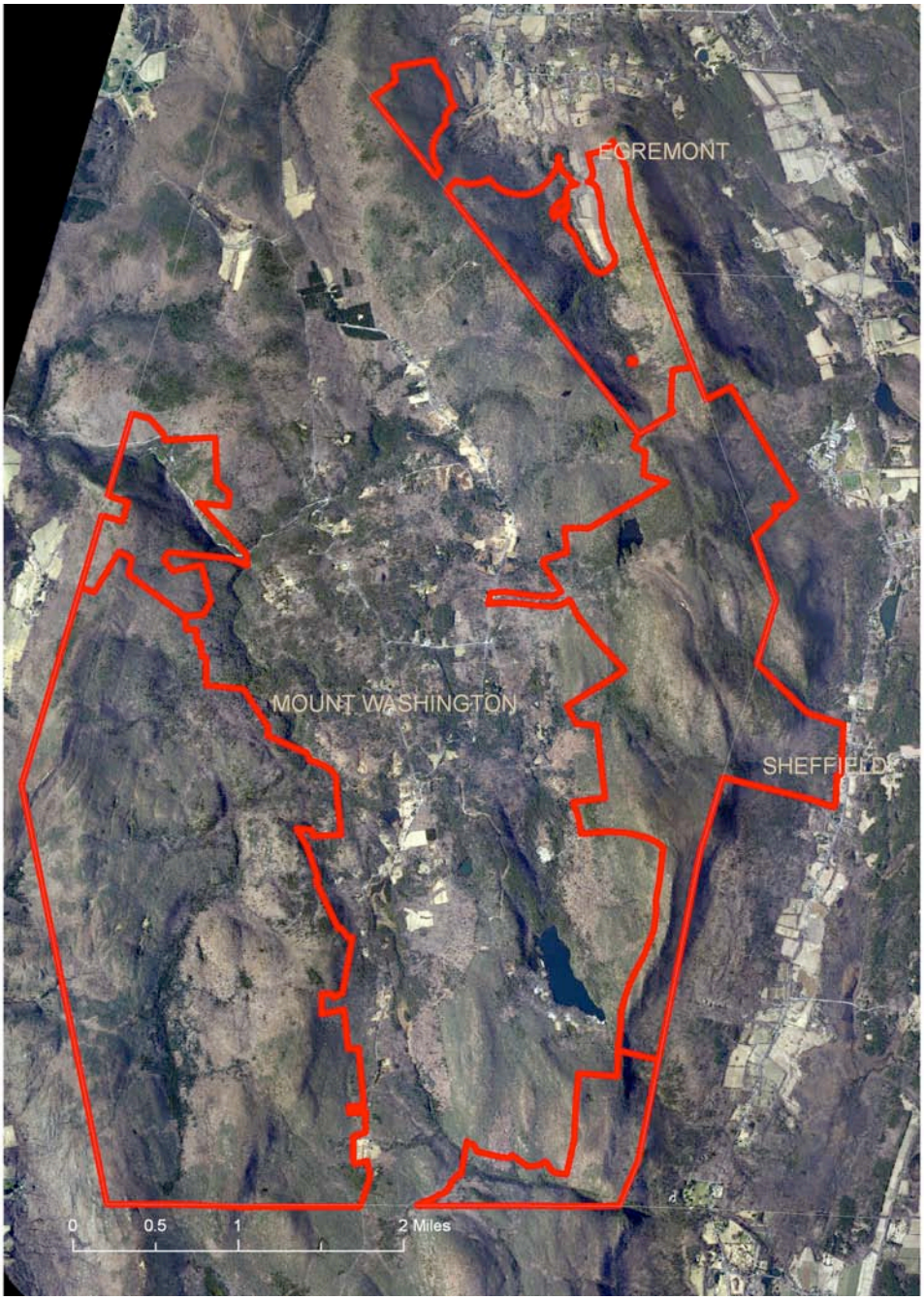



Fig. 13. Orthophotos of Mount Washington, Egremont and Sheffield with Forest Reserve Boundaries shown in red (MassGIS 2005).

The southwestern corner of Massachusetts was originally inhabited by the Mahican people, a group of Algonquian tribes that occupied lands from the western banks of the Hudson east to the Connecticut River Valley and from the southern Catskills north to Lake Champlain (Fig. 14). Henry Hudson, sailing for the Dutch first made contact with the

Mahicans in 1609. The Dutch established a lucrative fur trade with the Iroquois, Mohawks, and Mahicans with trading centered at Fort Orange (present day Albany). This site was at the northern end of New Netherlands, the name given to Dutch holdings along the Hudson River that began, to the south, at New Amsterdam (New York City). Dutch traders were replaced by the English in 1664, following the loss of New Netherlands to the English (NPS, no date given). Conflict with Mohawk tribes to the west over control of the fur trade pushed the Mahicans eastward where they settled in the village of Westenhuck (now Stockbridge) in Massachusetts. As pressure from European settlements increased, the Mahicans (also known as Housatonic or Stockbridge Indians) sold their lands piecemeal. Contact with Europeans also brought epidemics that decimated native populations. With their land lost and their population greatly reduced, the Mahicans eventually migrated westward, settling in western New York and later Wisconsin, where descendents of the Stockbridge tribe remain today (Massachusetts Foundation for the Humanities, no date given).

*Mahican chief Etow Oh Koam, known as Nicholas, the only known portrait of an 18th century Mahican chief (Print Collection, Miriam & Ira D. Wallach Division of Art, Prints & Photographs, The New York Public Library, Astor, Lenox and Tilden Foundations)*

Fig. 14. www.peekskillmuseum.org/origin_of_peekskill.htm

The effect of native populations on the forest is general considered to have been minimal; however, there is some speculation that burning by native peoples may have created conditions that, along with dry soils, favored the growth of chestnut, oak, and hickory in pre-settlement forests in the Mount Washington area (Cogbill et al. 2002).

The first European settlers in the Mount Washington area were Dutch. In 1683, Robert Livingston,the Elder, a Scot who had married into the wealthy Dutch Van Rensselaer family, purchased 2,000 acres of land from the native people along the Hudson with an additional 300 acres of meadowland in Taghkanic NY purchased in 1685. In 1686, Governor Thomas Dongan of New York granted all the "remaining and adjoining lands" a total of 160,240 acres to Livingston. The land was settled by tenants who held lifetime leases to the property, but, in a quasi-feudal system, were not allowed to own it. In 1715, the royal government of New York confirmed the grants and established the whole property as a "lordship", named the Manor of Livingston (Ellis 1878) with Robert Livingston as Lord of the Manor. Livingston Manor was passed on first to Robert's son Phillip and then to his grandson Robert who held his position until his death in 1790. Livingston Manor included parts of the Taconic Range and southern Berkshire Mountains.

In 1722, the Massachusetts General Court granted petitions of Joseph Parsons and 115 others, and of Thomas Nash and 60 others for two townships in the Housatonic Valley, each seven miles square. It was stipulated that the lands must be settled in a "compact, regular, and defensible manner." On April 25, 1724, a group of Westfield, Konkapot, and other Housatonic Indians sold the land extending from four miles east of the Housatonic River west to the New York boundary and from the Connecticut boundary north to Stockbridge for £460, 3 barrels of cider, and 30 quarts of rum. This area included the present towns of Sheffield, Great Barrington, Egremont, Mount Washington, Lee, and part of Stockbridge (Eaton 1948). When the English settlers arrived, they found six Dutch families living in the area, one of whom had been farming there since 1692, as tenants of the Livingston Manor (Eaton 1948, Resch and Katz 1976).

The disputed area along the New York/Massachusetts boundary was a source of conflict for many years. The Livingstons persisted in charging many of the English settlers rent for use of lands that were granted as free towns by the Massachusetts Colonial Legislature. Both English and Dutch settlers petitioned the General Court of Massachusetts for aid, which was initially denied. In 1755, Robert Livingston's agents murdered one of the English settlers, William Race, for whom Mount Race is probably named. In 1757, a group of 40 proprietors (representing a total population of about 200) purchased a plantation on Taghconic Mountain in an effort to establish legal title to the land and independence from Livingston. Livingston's agents retaliated by burning six farms. By the time of the Revolutionary War, the area had been resettled and the conflict was close to resolution. The town of Mount Washington, now part of the Massachusetts Commonwealth, was incorporated in 1779 (Federal Writers' Project 1939).

During the 18$^{th}$ century land was cleared for subsistence farming and trees were cut to provide fuel and construction materials for local purposes, but the overall impact on the forest was small. Forest clearing accelerated in the 19$^{th}$ century. This was in large part due to the development of the mining industry in the surrounding area. Iron deposits were discovered in the 1720s in Salisbury, Connecticut, just to the south of Mount Washington. Mineral deposits throughout the Housatonic/Taconic region were located near the contact line between the Stockbridge marble and the Walloomsac bedrock formations. The first blast furnace in Salisbury began producing pig iron in 1762. At the peak of production, the

Salisbury Iron industry was the largest iron producer in the United States. Iron ore was also discovered in Lenox, Massachusetts to the north of Mount Washington. The blast furnace in Lenox Dale went into production in 1765 and operated for 116 years (Kirby 1995). An iron furnace was also operating in Copake, New York (Federal Writers' Project 1939). The production of iron required iron ore, lime, water, and charcoal, all of which were found in abundance in this region. The hillsides were stripped of trees to supply these blast furnaces with charcoal. Iron production in the Housatonic Valley was at its height in the 1840s and 1850s. The iron industry declined in the second half of the 19th century as the timber supply was depleted and technological changes supported the development of new centers of production. Iron and steel smelters built in cities such as Pittsburgh, Cleveland, and Chicago used coal for fuel (Miller, no date given). They processed huge volumes of hematite iron ore that came from open pit mines in the Mesabi Range of northern Minnesota and were then transported first by rail, then shipped across the Great Lakes. The iron industry in the Housatonic River Valley was essentially gone by the turn of the century. The last of the blast furnaces ceased production in 1923 (Kirby 1995).

Agricultural activity increased after 1860, as the iron industry declined. In the latter part of the 19th century Mount Washington became widely known for potato farming. "The soil was fertile along the plateau and not a potato bug disturbed production" (Federal Writers' Project 1939). Over time however, with increased competition from other agricultural areas, farming declined as well. At the beginning of the 20th century, few people made their living off the land. The area became known as an attractive location for summer tourists and some families rented out rooms or opened tea houses. Local residents also earned money collecting rattlesnakes in the rugged hills for University research laboratories and for medicinal purposes – the oil was sold as remedy for deafness (Federal Writers' Project 1939, Tillinghast 2000).

The forest grew back as industry and agriculture declined. The State began purchasing forestland in 1909. The earliest purchases, between 1908 and 1933 established the Mount Everett State Reservation. Bash Bish Falls State Park was acquired in 1924. Ovsay Lipetz donated 2,850 acres of forestland in Mount Washington in 1966, a major portion of Mount Washington State Forest. The Appalachian Trail properties were acquired between 1979 and 1984, a collection of nine parcels ranging in size from 12 to 300 acres. The Jug End State Reservation properties were acquired between 1994 and 2003 (DCR Deed Database, 2008).

The Mount Washington Forest Reserve is located in one of the more sparsely populated areas of Massachusetts (Fig 13). Mount Washington as always been a small town. At the time of the first United States census in 1790, the population of Mount Washington was 328. In 1810, the population had increased to 474. It diminished to 205 in 1870 and fell further to 82 in 1907 (Lamson 1908). The three towns in which the Forest Reserve is located, Mount Washington, Egremont, and Sheffield, have populations of 130, 1,345, and 3,335 respectively. The largest town in the region is Great Barrington with a population of 7,527 (MassGIS 2009 (b), U.S. Census 2000).

There was one timber harvest recorded in the Mount Washington Forest Reserve between 1984 and 2003. An area of 60 acres on the eastern border of the Mount Washington State Forest portion of the Forest Reserve was harvested in 1990 (McDonald et al. 2006).

## FOREST TYPES

In 2003, the DCR completed the "Land Cover Classification Project", including forest type mapping of all Massachusetts State Forests. GIS digital forest-type data were derived from 1:12,000 scale, leaves-on color infrared aerial photographs. The digital data and aerial photography were provided by the James W. Sewall Company of Old Town, Maine (DCR 2003). Forest cover for the Mount Washington Forest Reserve is shown in Figure 15 and summarized by area in Table 5.

Nearly 60% of the Mount Washington Forest Reserve overstory is dominated by oak-hardwoods, mixed oak, and red oak. In addition to red oak, oak species found in the Mount Washington Forest Reserve include black oak, white oak, and chestnut oak. Hemlock, hemlock-hardwood, and northern hardwood stands occupy an additional 36% of the Forest Reserve area. Hemlocks are commonly found in the riparian areas of forest streams (Fig. 16). A five acre sugar maple stand is located on rich mesic calcareous till soils in the Jug End WMA. The eastern slopes of the Mount Everett Reservation are primarily covered with white pine, mixed white pine-hemlock, white pine-hardwood and white pine-oak stands. The predominance of oak in much of the Forest Reserve may be explained by the dry Taconic soils as oaks tend to grow well dry sites compared to other hardwoods, a slightly warmer climate due to the location of the Forest Reserve near the Connecticut border, and historic land use (Cogbill et al., 2002).

The Mount Washington Forest Reserve also is the site of a rare dwarf pitch pine forest community, found at only a few sites in the Northeast. The Mount Everett summit is covered by approximately 20 acres of dwarf pitch pine, a forest community that supports numerous rare species. Ridgetop dwarf pitch pine communities are also present on Race Mountain within the Forest Reserve and on Bear Mountain to the north. These pitch pine communities are unique, in part because the trees are so small. Heights vary from prostrate mats 1 ft. tall to single stems between 9 and 10 ft. tall. The stems are highly contorted. At lower elevations, pitch pine forests develop on sandy outwash plains with high fire frequency. On the Mount Everett summit, there is little evidence of past fires. It appears that rugged weather conditions (wind, snow, and ice) in combination with thin rocky soils, maintain the extreme dwarfism of these pitch pines. The open summits of Mount Everett are thought by many to be a natural phenomenon that has persisted for hundreds of years (Motzkin et al. 2002).

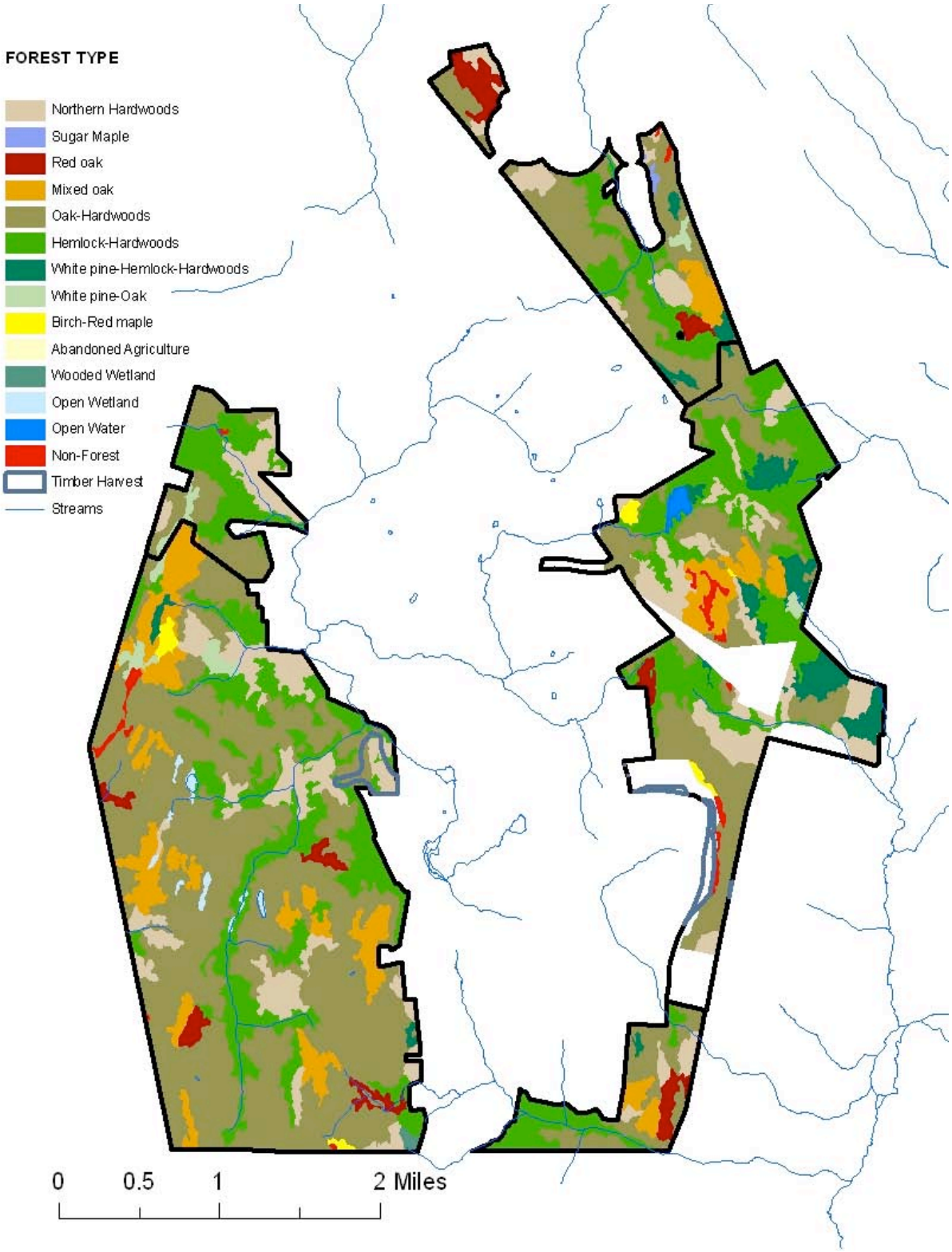



Fig. 15. Forest types, Mount Washington Forest Reserves and timber harvests 1984-2003(DCR 2003, (McDonald et al. 2006).

Table 5. Forest types, Mount Washington Forest Reserve (DCR 2003).

| Forest Type | Area (%) |
|---|---|
| Northern Hardwoods | 12 |
| Sugar maple | <1 |
| Red oak | 2 |
| Mixed oak | 8 |
| Oak-Hardwoods | 48 |
| Hemlock-Hardwoods | 24 |
| White pine-Hemlock-Hardwoods | 3 |
| White pine-Oak | 1 |
| Birch-Red maple | <1 |
| Abandoned Agriculture | <1 |
| Wooded Wetland | <1 |
| Open Wetland | <1 |
| Open Water | <1 |
| Non-Forest (cliffs/steep slopes) | 1 |

Fig. 16. Hemlocks and northern hardwood species bordering Ashley Hill Brook in the Mount Washington State Forest portion of the Mount Washington Forest Reserve.

***Old-Growth in the Mount Washington Forest Reserve***

A recent study (D'Amato et al. 2006, D'Amato 2007) identified six old-growth forest stands in the Mount Washington Forest Reserve varying in size from two to fifteen acres with a median area of four acres (Fig. 17). One of these stands is located in Bash Bish Falls State Park, one in the Mount Washington State Forest at Mount Race, three in the Mount Everett State Reservation at Glen Brook, Guilder Pond, and Mount Race and one in the Appalachian Trail Corridor at Sages Ravine-Bear Rock Falls. Old-growth was defined as "forests lacking any evidence of past land use and containing five canopy trees >225 years old per hectare (2.47 acres), which indicates establishment prior to European settlement." These forests are usually found on steep slopes that were relatively inaccessible to nineteenth century logging. Analysis of these stands showed that old-growth in this area exhibited a much higher degree of structural complexity than was found in second-growth forests nearby. In particular, old-growth stands had larger overstory trees, a wider range of diameter distributions and greater volumes of snags and downed coarse woody debris (D'Amato et al. 2008). An additional analysis (D'Amato and Orwig 2008) documented the disturbance history of these stands. The natural disturbance regime of these old-growth stands was "dominated by frequent, relatively low-intensity disturbances operating somewhat randomly on the landscape." There was no evidence of stand-replacing disturbances. Data from these studies provide a basis for comparing the condition of the Forest Reserves to true old-growth forest, at the present time and in the future, as the Forest Reserves develop through forest succession subject to the effects of natural disturbances.

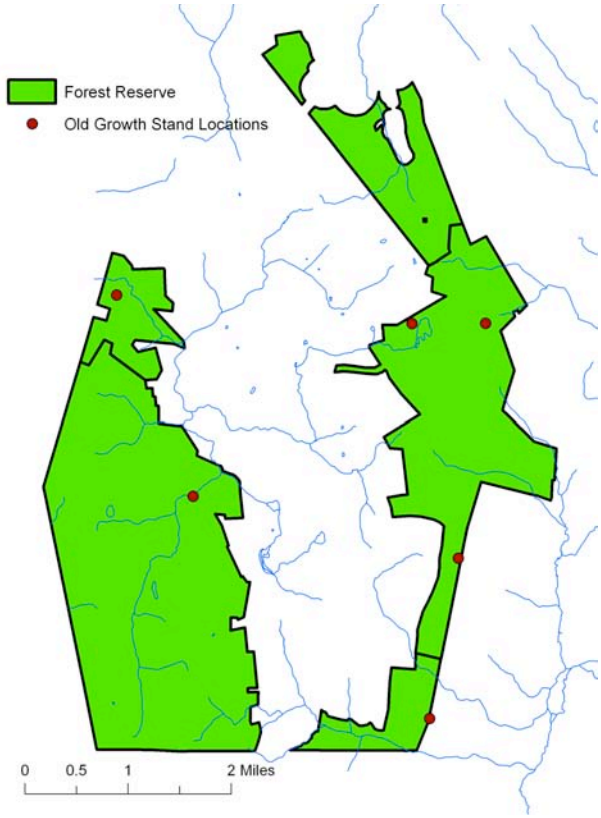



Fig. 17. Old-Growth stand locations in the Mount Washington Forest Reserve (D'Amato et al. 2006).

## CONTINUOUS FOREST INVENTORY (CFI) DATA

The Continuous Forest Inventory (CFI) plots were established by Massachusetts state forestry agencies in the late 1950s. These are permanent 0.20-acre plots, laid out on a 0.5-mile square grid on all state forests and most state watershed protection land (Rivers 1998) (Fig. 18). Plot measurements were completed in 1960, 1965, 1980, and 2000. Data include plot descriptors and measurements of all trees ≥5.0 inches dbh (diameter at breast height). Deadwood and understory sampling were added in 2000 (Rivers 1998). Future sampling is planned at 10-year intervals. All analyses are based on the 2000 CFI dataset. The CFI data were analyzed using SAS 9.1.3 Statistical Software (2004).

There are 40 CFI plots shown on the digital maps for the Mount Washington Forest Reserve; however, there is no plot or tree data for plot # 5301, which presumably lies outside the state forest boundary. All analyses are based on data from 39 plots. Two of these plots are categorized as "upland brush". No tree data exists for these plots. Plot 0666 is noted to have soil limitations with shrub species (mountain laurel and "other oak", presumably scrub oak) listed as regeneration interference. Plot 0669 is noted as having shrub species and "other oak" as regeneration interference and difficult accessibility.

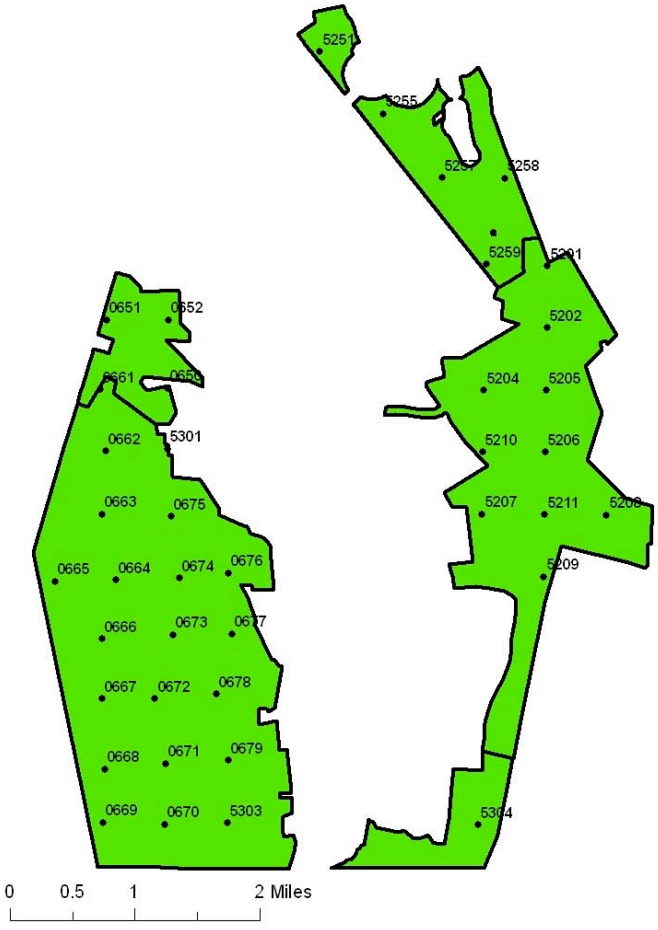



Fig. 18. Continuous Forest Inventory (CFI) plots, Mount Washington Forest Reserve.

### *Forest Age and Disturbance History*

CFI plot ages are determined by coring 1-3 overstory trees located just outside the boundaries of each plot (Table 6). CFI plots in the Mount Washington Forest Reserve are between 47 and 116 years old.

Table 6. Plot age, Mount Washington Forest Reserve.

| **CFI Plot Age** | |
|---|---|
| **Age (years)** | **# Plots** |
| 41-50 | 1 |
| 51-60 | 3 |
| 61-70 | 8 |
| 71-80 | 6 |
| 81-90 | 2 |
| 91-100 | 13 |
| 101-110 | 0 |
| 111-120 | 2 |
| 121-130 | 0 |
| Listed as 0 | 4 |
| Total Plots | 39 |
| Age Range* | 47-116 |
| * Excluding 0 | |

The CFI methods allow only one disturbance to be entered for each plot at each measurement date. The disturbance recorded may be the most recent disturbance or the most important disturbance to have affected the plot (e.g., if a plot was damaged by a windstorm in 1970 and then harvested in 1990, the recorded disturbance would have been changed from "wind" to "harvest cut" in the 2000 sampling). Therefore, the data do not represent a complete disturbance history of the plot. Four plots in the Mountain Washington Forest Reserve were damaged by fire by disease in 1998 and 1 plot was damage by snow and ice in 1996 (Table 7). A completely disturbance record by plot can be found in Appendix B.

Table 7. Summary of disturbances, Mount Washington Forest Reserve.

| **CFI Plot Disturbance** | | |
|---|---|---|
| **Disturbance Type** | | |
| **Code** | **Description** | **# Plots** |
| 0 | None | 19 |
| 1 | Fire | 4 |
| 2 | Wind | 0 |
| 3 | Snow & Ice | 10 |
| 4 | Other use, cleared | 0 |
| 5 | Other use, pastured | 0 |
| 6 | Insects | 1 |
| 7 | Disease | 1 |
| 8 | Timber stand improvement | 1 |
| 9 | Harvest cut | 3 |
| | Total | 39 |

***Live Trees***

Size distribution in the Mount Washington Forest Reserve follows a typical inverse J-curve with larger numbers of trees in the smaller size classes (Fig. 19). The number of trees/acre declines progressively as dbh increases. Mean stand density based on data from 39 plots for the Mount Washington Forest Reserve for trees ≥ 5 inches dbh is 184.9 ± 16.3 stems/acre (95% confidence interval). Mean stand density for large trees ( ≥ 20 inches dbh) is 2.6 ± 2.6 stems/acre.

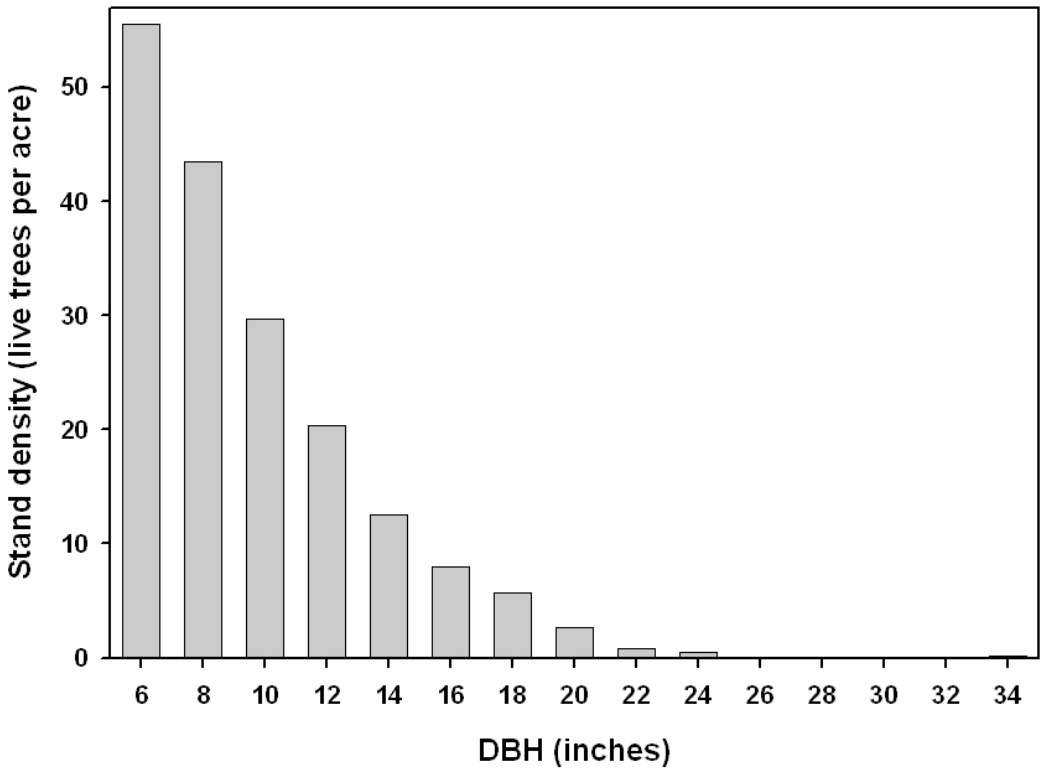



Fig. 19. Mean stand density (trees/acre) by 2-inch dbh classes (DCR 2000), Mount Washington Forest Reserve.

Based on analysis of 2000 CFI data (DCR 2000), the primary species in the Mount Washington Forest Reserve are red oak, hemlock, and red maple (Fig. 20). Red oak accounts for 40% of the total basal area. Eighteen percent of the basal area is hemlock and 13% is red maple. Northern hardwoods and northern hardwood associates (white ash and black cherry) account for 10% of the total basal area. Live-tree biomass in 2000 was 71.9 ± 3.4 tons/acre (N = 39 plots).

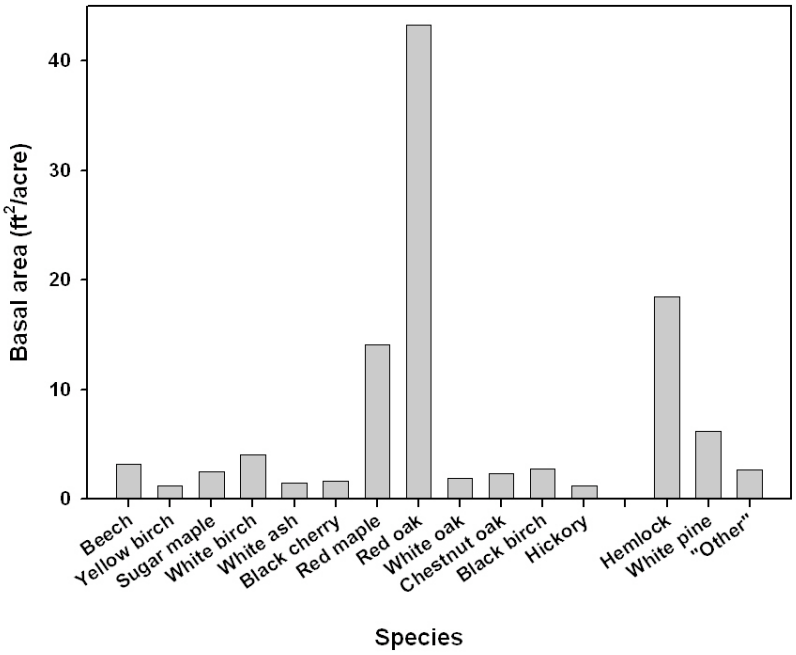



Fig. 20. Mean basal area ($ft^2$/acre) by species (2000 CFI data), Mount Washington Forest Reserve (N=39 plots). "Other" includes all species less than 1.0 $ft^2$/acre. This includes (in descending order): pitch pine, black oak, unidentified species, chestnut, misidentified species, and other spruce.

***Deadwood***

Biomass of standing deadwood (snags) and down deadwood (coarse woody debris) was estimated from volume calculations using specific gravity estimates by species, reduced for stages of decay (Tyrrell and Crow 1994, Chojnacky and Heath 2002, Woodall and Williams 2007). N=39 plots for all statistical analyses. The biomass estimate for standing deadwood was 3.8 ± 2.5 tons/acre. The down deadwood biomass estimate was 2.8 ± 2.0 tons/acre. Standing deadwood was primarily composed of red oak (40%) and red maple (15%) with 6% chestnut oak (Fig. 21). Forty-five percent of the down deadwood was composed of red oak, with northern hardwoods (10%), red maple (13%), hemlock (11%), and chestnut oak (5%) in lesser amounts.

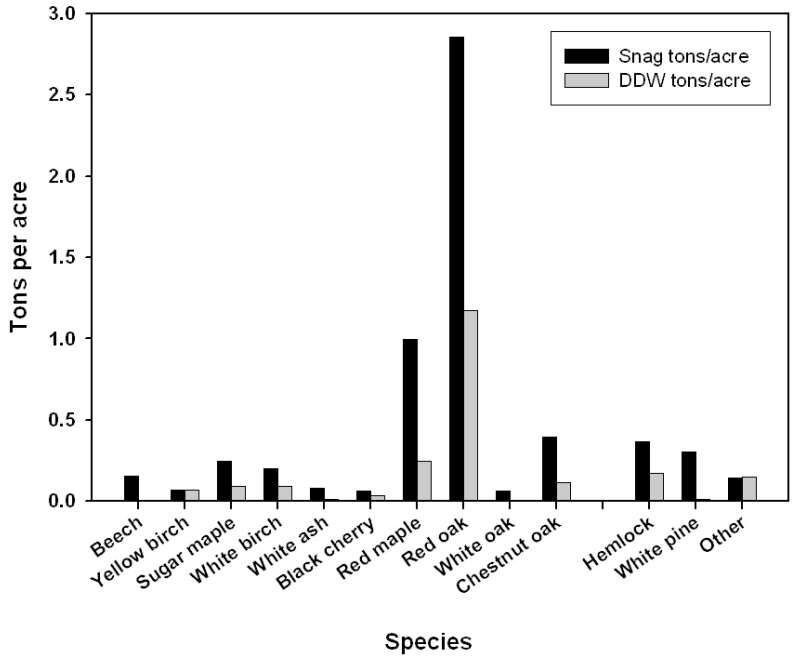



Fig. 21. Species composition of standing and down deadwood (2000 CFI data), Mount Washington Forest Reserve, (N=39 plots). "Other" includes black birch, chestnut, pitch pine, red spruce, and unidentified species.

***References***


Access Genealogy Indian Tribal Records. No date given. Mahican Tribal History. http://www.accessgenealogy.com/native/tribes/algonquian/mahicanhist.htm

Brady, N.C., and R.R. Weil. 2002. *The Nature and Property of Soils.* 13th Edition. Prentice Hall, Upper Saddle River, NJ.

Brandt, R.W. 1964. Nectria canker of hardwoods. USDA Forest Pest Leaflet 84, Forest Service.

Chojnacky, D.C., and L.S. Heath. 2002. Estimating deadwood from FIA forest inventory variables in Maine. *Environmental Pollution* 116:S25-S30.

Cogbill, C.V., J. Burk, and G. Motzkin. 2002. The forests of presettlement New England, USA: spatial and compositional patterns based on town proprietor surveys. *Journal of Biogeography* 29:1279-1304.

Cornell Plant Diagnostic Clinic. 2007. Black Knot (*Apiosporina morbosa*) Factsheet, http://plantclinic.cornell.edu/FactSheets/black_knot/blacknot.htm (accessed February 2009).

Daly C. and G. Taylor. 1998. Massachusetts Average Monthly or Annual Precipitation, 1961-90. Water and Climate Center of the Natural Resources Conservation Service. Portland Oregon, http://www.ocs.orst.edu/prism/state_products/maps.phtml?id=MA (Accessed, April, 2009).

D'Amato, A.W., D.A. Orwig, and D.R. Foster. 2006. New estimates of Massachusetts old-growth forests: useful data for regional conservation and forest reserve planning. *Northeastern Naturalist* 13(4):495-506.

D'Amato, A.W. 2007. *Structural Attributes, Disturbance Dynamics, and Ecosystem Properties of Old-Growth Forests in Western Massachusetts.* Ph.D. Dissertation, Department of Natural Resources Conservation, University of Massachusetts, Amherst, MA.

D'Amato, A.W., and D.A. Orwig. 2008. Stand and landscape-level disturbance dynamics in old-growth forests in western Massachusetts. *Ecological Monographs* 78(4):507-522.

D'Amato, A.W., D.A. Orwig, and D.R. Foster. 2008. The influence of successional processes and disturbance on the structure of *Tsuga canadensis* forests. *Ecological Applications* 18(5):1182-1199.

DCR (Massachusetts Department of Conservation and Recreation). 2000. Continuous Forest Inventory (CFI) Data. (Unpublished dataset).

DCR (Massachusetts Department of Conservation and Recreation). 2003. Massachusetts Department of Conservation and Recreation, Bureau of Forestry, "Land Cover Classification Project" from data provided by the James W. Sewall Company, Old Town, Maine.

DCR (Massachusetts Department of Conservation and Recreation). 2008. Deed Data Base, compiled by Conrad Ohman, Management Forester, Western Region, Pittsfield, MA.

DCR (Massachusetts Department of Conservation and Recreation). 2008. Forest Reserve boundaries.

DCR (Massachusetts Department of Conservation and Recreation). Bash Bish Falls State Parkhttp://www.mass.gov/dcr/parks/western/bash.htm (accessed June 2009).

de la Crétaz, A.L., and M.J. Kelty. 2008. Land Type Associations of Western Massachusetts, Unpublished Report. USDA Forest Service, Northeastern Area State and Private Forestry, Durham, NH.

DFW (Massachusetts Department of Fish and Game-Division of Fisheries and Wildlife). 2007. Matrix Reserve Boundaries.

Eaton, W.P. 1948. Two hundred and fifty years of history, *In* R. Peattie (editor) *The Berkshires, The Purple Hills*, Vanguard Press, New York.

Elkinton JS, A.M. Liebhold, R.M. Muzika. 2004. Effects of alternative prey on predation by small mammals on gypsy moth pupae. *Population Ecology* 46(2):171-178.

Ellis, F. 1878. *General History of Columbia County, New York 1871*, Everts & Ensign, Philadelphia, PA, *1878.* http://www.usgennet.org/usa/ny/county/columbia/livstn/patents_early_settlers.htm (accessed April 2009).

EOEEA (Executive Office of Environmental and Energy Affairs). 2009. Forest Reserves. Boston, MA. February 2, 2009. http://www.mass.gov/Eoeea/docs/eea/lf/whatare_forestreserves.pdf (accessed September 2009).

Federal Writers' Project. 1939. *The Berkshire Hills.* Compiled and written by the Federal Writers' Project of the Works Progress Administration for Massachusetts, sponsored by the Berkshire Hills Conference, Inc. Funk & Wagnalls Company, New York.

www.forestpests.org 2008. Red Heart caused by *Fomes pini.* Forest Pests.org is a part of the Bugwood Network, The University of Georgia-Warner School of Forest Resources and College of Agricultural & Environmental Sciences – Department of Entomology, In cooperation with the Georgia Forestry Commission. Funding and support provided by the USDA Forest Service.

Hajek A.E., J.S. Elkinton, and J.J. Witcosky. 1996. Introduction and spread of the fungal pathogen *Entomophaga maimaiga* (*Zygomycetes: Entomophthorales*) along the leading edge of gypsy moth (*Lepidoptera: Lymantriidae*) spread. *Environmental Entomology* 25(5):1235-1247.

Hamid, A., T.M. O'Dell, and S. Katovich. 1995. White pine weevil. Forest Insect and Disease Leaflet 21, U.S. Department of Agriculture, Forest Service http://www.na.fs.fed.us/spfo/pubs/fidls/wp_weevil/weevil.htm (accessed February 2009).

Houston, D.R., and J.T. O'Brien. 1983. Beech Bark Disease, Forest Insect & Disease, Leaflet 75. U.S.D.A. Forest Service http://www.na.fs.fed.us/spfo/pubs/fidls/beechbark/fidl-beech.htm (accessed March, 2008).

Keys, J.E. Jr., and C.A. Carpenter. 1995. Ecological Units of the Eastern United States" First Approximation. Map compiled at 1:1,000,000. United States Department of Agriculture, Forest Service.

Kirby, E. 1995. Exploring the Berkshire Hills, A Guide to Geology and Early Industry in the Housatonic Watershed. Valley GEOlogy PUBlications, 36 Plantation Circle, Greenfield, MA.

Lamson, O.E. 1908. Historical Sketch of Mount Washington, Memorial of Ebenezer Lamson of Concord, Mass.: His ancestry and descendents 1635-1908. Transcribed by Michele Valenzaro. http://genealogy.stellarwinds.org/.

Liebhold, A. 2003. Gypsy moth in North America. USDA Forest Service Northeastern Research Station. (Forestry Sciences Laboratory). http://www.fs.fed.us/ne/morgantown/4557/gmoth/ (accessed March, 2008).

Maine Department of Conservation, Maine Forest Service – Forest Health and Monitoring Division. 2000. Oak Leaf Tier. http://www.state.me.us/doc/mfs/oakleaft.htm (accessed January 2009).

Massachusetts Foundation for the Humanities. No date given. Missionary opens school for Mohican Indians, November 5, 1734. http://massmoments.org/moment.cfm?mid=319 (accessed April 2009).

MassGIS. 1997. *Insect Infestation (BUGS)*. http://www.mass.gov/mgis/bugs.htm (accessed April 2008).

MassGIS. 1999. *Surficial Geology* 1:250,000. http://www.mass.gov/mgis/sg.htm (accessed August 2008).

MassGIS. 2000. *Hydrography*, 1:100,000. http://www.mass.gov/mgis/hd.htm (accessed November 2008).

MassGIS. 2005. *1:5,000 Color Ortho Imagery.* http://www.mass.gov/mgis/colororthos2005.htm (accessed August 2009).

MassGIS. 2009 (a). *Protected and Recreational Open Space* http://www.mass.gov/mgis/osp.htm (accessed September 2009).

MassGIS. 2009 (b). *Towns.* (includes U.S. Census data for all towns, 1980, 1990, 2000) http://www.mass.gov/mgis/towns.htm (accessed September 2009).

McDonald, R.I., G. Motzkin, M. Bank, D. Kittredge, J. Burk, and D.R. Foster. 2006. Forest harvesting and land-use conversion over two decades in Massachusetts. *Forest Ecology and Management* 227(1-2):31-41.

McManus, M., N.Schneeberger, R. Reardon, and G. Mason. 1989. Gypsy Moth, Forest Insect&Disease Leaflet 162. USDA Forest Service. http://www.na.fs.fed.us/spfo/pubs/fidls/gypsymoth/gypsy.htm (accessed March, 2008).

Miller, C.P. No date given. Iron and steel industry. The encyclopedia of Cleveland History. Case Western Reserve University http://ech.cwru.edu/ech-cgi/article.pl?id=IASI (Accessed April 2009).

Mook, P.V., and H.G. Eno. 1961. *Fomes annosus*: what it is and how to recognize it. Station Paper No. 146, Northeastern Forest Experiment Station. USDA Forest Service, Upper Darby PA.

Motzkin, G., D.A. Orwig, and D.R. Foster. 2002. History and Dynamics of a Ridgetop Pitch Pine Community, Mount Everett Massachusetts. Harvard Forest Paper No. 25, Harvard Forest, Petersham, Massachusetts.

NCSS (Natural Resources Conservation Service) Official Soil Series Descriptions; Taconic Series (2005), Lanesboro Series (2005), Fullam Series (2007), Brayton Series (2008), Farmington Series (2007), Nellis Series (2006), Pittsfield Series (2007), Amenia Series (2006), Kendaia Series (2007), Hoosic Series (2002), Copake Series (2001), Hero Series (2000). http://soils.usda.gov/technical/classification/OSD/index.html (accessed December 2008).

NHESP (Massachusetts Natural Heritage and Endangered Species Program). 2004. *Biomap and Living Waters*: Core Habitats of Mount Washington. Natural Heritage and Endangered Species Program, Massachusetts Division of Fisheries and Wildlife, Executive Office of Environmental Affairs, Commonwealth of Massachusetts.

NPS (National Park Service) no date given. Kingston, discover 300 years of New York history: Dutch colonization. http://www.nps.gov/history/NR/travel/kingston/colonization.htm

O'Brien, J., and P. Snowden. 1989. Pear thrips on forest trees. USDA Forest Service, http://www.na.fs.fed.us/spfo/pubs/pest_al/pt/pt.htm (accessed March, 2008).

Orwig, D.A., D.R. Foster, and D.L. Mausel. 2002. Landscape patterns of hemlock decline in New England due to the introduced hemlock woolly adelgid. *Journal of Biogeography* 29:1475-1487.

Resch, T., and J. Katz. 1976. *Berkshire, the first three hundred years, 1676-1976.* The Eagle Publishing Company, Pittsfield, Massachusetts.

Rivers, W.H. 1998. Manual for Continuous Forest Inventory Field Procedures. Massachusetts Department of Environmental Management. Bureau of Forestry, Division of Forests and Parks.

Scanu, R.J. 1988. *Soil Survey of Berkshire County Massachusetts.* United States Department of Agriculture, Soil Conservation Service in cooperation with Massachusetts Agricultural Experiment Station.

Skehan, J.W. 2001. *Roadside Geology of Massachusetts.* Roadside Geology Series, Mountain Press Publishing Company, Missoula, Montana.

Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. 1999. Soil Survey Geographic (SSURGO) Database for Berkshire County, MA. Available online at http://soildatamart.nrcs.usda.gov (accessed April 2008).

Tillinghast, E. 2000. Rattlesnakes on Mount Everett, in *Ecological Significance of the Mount Everett Summit: Preliminary evaluations and recommendations for additional research and protection.* A report prepared for the Massachusetts Department of Environmental Management and Town of Mount Washington, Massachusetts.

Tyrrell, L.E. and T.R. Crow, 1994. Structural characteristics of old-growth hemlock-hardwood forests in relation to age. *Ecology* 75(2): 370-386.

Wawrzynski, R. P. 2009. Sawflies of trees and shrubs. University of Minnesota Extension Service, College of Agricultural, Food, and Environmental Sciences. http://www.extension.umn.edu/distribution/horticulture/DG6703.html (accessed April 2009)

Woodall, C. and M. Williams. 2005. Sampling protocol, estimation, and analysis procedures for the down woody materials indicator of the FIA program. Gen. Tech. Rep. NC-

256. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station. 47 p.

World Climate. 1996. Copyright, 1996-2008 Buttle and Tuttle Ltd. All Rights Reserved. Created by Robert Hoare. Created 1 Aug 1996. Latest Update (minor changes) 5 Jan 2005. v271. http://www.worldclimate.com (accessed June 2008).

Zen, E, editor.1983. *Bedrock Geologic Map of Massachusetts*, Compiled by R. Goldsmith, N.M. Ratcliffe, P. Robinson, and R.S. Stanley. Reston, VA: U.S. Geological Survey. Scale 1:250,000, 3 sheets.

## Appendix A. Mount Washington Forest Reserve Species List

| | |
|---|---|
| Balsam fir | *Abies balsamea* |
| Basswood | *Tilia americana* |
| Beech (American beech) | *Fagus grandifolia* |
| Black birch | *Betula lenta* |
| Black cherry | *Prunus serotina* |
| Black oak | *Quercus velutina* |
| Butternut | *Juglans cinerea* |
| Chestnut | *Castanea dentata* |
| Chestnut oak | *Quercus prinus* |
| Gray birch | *Betula populifolia* |
| Hemlock | *Tsuga canadensis* |
| Hickory | *Carya spp.* |
| Mountain laurel | *Kalmia latifolia* |
| Pitch pine | *Quercus ilicifolia* |
| Poplar | *Populus spp.* |
| Red maple | *Acer rubrum* |
| Red oak (northern red oak) | *Quercus rubra* |
| Red spruce | *Picea rubens* |
| Sugar maple | *Acer saccharum* |
| White ash | *Fraxinus americana* |
| White birch | *Betula papyrifera* |
| White oak | *Quercus alba* |
| White pine | *Pinus strobus* |
| Yellow birch | *Betula alleghaniensis* |

## Appendix B: CFI Plot Disturbance History

| Plot Number | Plot Location | Disturbance Description | Year |
|---|---|---|---|
| 0650 | Bashbish | | 0 |
| 0651 | Bashbish | | 0 |
| 0652 | Bashbish | | 0 |
| 0661 | Bashbish | Snow&Ice | 1977 |
| 0662 | Mount Washington | Snow&Ice | 1977 |
| 0663 | Mount Washington | | 0 |
| 0664 | Mount Washington | Timber stand improvement | 1985 |
| 0665 | Mount Washington | Insects | 1980 |
| 0666 | Mount Washington | | 0 |
| 0667 | Mount Washington | | 0 |
| 0668 | Mount Washington | Fire | 1938 |
| 0669 | Mount Washington | | 0 |
| 0670 | Mount Washington | Snow&Ice | 1977 |
| 0671 | Mount Washington | Snow&Ice | 1977 |
| 0672 | Mount Washington | | 0 |
| 0673 | Mount Washington | Fire | 1938 |
| 0674 | Mount Washington | | 0 |
| 0675 | Mount Washington | | 0 |
| 0676 | Mount Washington | Harvest cut | 1977 |
| 0677 | Mount Washington | Fire | 1938 |
| 0678 | Mount Washington | Fire | 1977 |
| 0679 | Mount Washington | Snow&Ice | 1977 |
| 5201 | Mount Everett | | 0 |
| 5202 | Mount Everett | Snow&Ice | 1996 |
| 5204 | Mount Everett | | 0 |
| 5205 | Mount Everett | Snow&Ice | 1988 |
| 5206 | Mount Everett | Snow&Ice | 1996 |
| 5207 | Mount Everett | Snow&Ice | 1958 |
| 5208 | Mount Everett | | 0 |
| 5209 | Mount Everett | | 0 |
| 5210 | Mount Everett | | 0 |
| 5211 | Mount Everett | | 0 |
| 5251 | Jug End | | 0 |
| 5255 | Jug End | Harvest cut | 1982 |
| 5257 | Jug End | | 0 |
| 5258 | Jug End | Snow&Ice | 1990 |
| 5259 | Jug End | | 0 |
| 5301 | Mount Washington | | |
| 5303 | Mount Washington | Harvest cut | 0 |
| 5304 | Appalachian Trail | Disease | 1988 |

**Appendix C: Massachusetts Natural Heritage and Endangered Species Program, BioMap and Living Waters**

The entire Mount Washington Forest Reserve Area and the valley between the Mount Washington State Forest and the Mount Everett State Reservation/Jug End WMA are classified as Core HabitatBM969 by the NHESP.

Core Habitat BM969

Natural Communities

*This Core Habitat contains many exemplary rocky communities ranging from the exposed, acidic, dry summits of Mount Everett to some of the best mesic, species-rich, calcareous cliffs in the state. Ridgetop Pitch Pine-Scrub Oak communities of various sizes are found on the ridges and summits of Alander Mount, Mount Everett, Bash Bish Mountain, Mount Bushnell, and Mount Race. The Ridgetop Pitch Pine-Scrub Oak community occurs on acidic bedrock along mountain ridges, often in a mosaic with an Acidic Rocky Summit community. This fire dependent community is tolerant of severe growing conditions. The rocky communities found here are all embedded within 16,000 acres of minimally fragmented, naturally forested land. The forest itself is diverse: mostly Northern Hardwoods-Hemlock-White Pine Forest with scattered areas of old-growth forest, some high-quality Hickory-Hop Hornbeam Forest/Woodland, and at least one very good Hemlock Ravine community.*

Plants

*A great diversity of rare plant species is located within this very large Core Habitat. Several of the rare plants here are adapted to the cliffs or rocky outcrops of the Taconic Mountains. For example, Smooth Rock-Cress, Lyre-Leaved Rock Cress, Tiny-Flowered Buttercup, and Rand's Goldenrod all make their home on exposed rock.*

Invertebrates

*This Core Habitat includes an area around the summit of the Mount Everett that is undeveloped and unfragmented ridgetop pitch pine-scrub oak barrens and heath land habitat for rare moth species, including the Gerhard's Underwing moth. The population of Gerhard's Underwing on Mount Everett is the only known population of this species in Massachusetts that is not located on the coastal sandplain. Most of the rare moth habitat on Mount Everett is within the Mount Everett State Reservation…*

Vertebrates

*Many miles of coldwater, high-gradient brooks provide significant habitat for Spring Salamanders, Jefferson Salamanders occur where vernal pools are present in mixed or deciduous forests. Extensive rocky woodlands and talus slopes that are relatively inaccessible and largely free from human*

*disturbance provide habitat for rare reptiles. The large areas of forest contained within this Core Habitat provide breeding and migration habitat for many species of forest songbirds and other landbirds characteristic of Berkshire County. This Core Habitat also encompasses forest habitat around the entrance to a bat overwintering site.*

Core Habitat BM969

## Natural Communities

| Common Name | Scientific Name | Status |
|---|---|---|
| Acidic Rocky Summit/Rock Outcrop Community | | Secure |
| Calcareous Rock Cliff Community | | Vulnerable |
| Calcareous Talus Forest/Woodland | | Vulnerable |
| Hemlock Ravine Community | | Secure |
| Hickory – Hop Hornbeam Forest/Woodland | | Imperiled |
| Mixed Oak Forest | | Secure |
| Northern Hardwoods – Hemlock – White Pine Forest | | Secure |
| Rich, Mesic, Forest Community | | Vulnerable |
| Ridgetop Pitch Pine – Scrub Oak | | Imperiled |

## Plants

| Common Name | Scientific Name | Status |
|---|---|---|
| Alleghany Buttercup | *Ranunculus alleghiensis* | Watch Listed |
| Autumn Coralroot | *Corallorhiza odontorhiza* | Special Concern |
| Downy Arrowwood | *Viburnum rafinesquianum* | Endangered |
| Hairy Agrimony | *Agrimonia pubescens* | Threatened |
| Lyre-Leaved Rock Cress | *Arabis lyrata* | Endangered |
| Michaux's Sandwort | *Minuartia michauxii* | Threatened |
| Mountain Winterberry | *Ilex Montana* | Endangered |
| Purple Clematis | *Clematis occidentalis* | Special Concern |

| | | |
|---|---|---|
| Rand's Goldenrod | *Solidago simplex spp randii var randii* | Endangered |
| Red Mulberry | *Morus rubra* | Endangered |
| Rigid Flax | *Linum medium var texanum* | Threatened |
| Roundleaf Shadbush | *Amelanchier sanguina* | Special Concern |
| Sensitive Rare Plant | | |
| Smooth Rock-Cress | *Arabis laevigata* | Threatened |
| Stiff Gentian | *Gentianella quinquefolia* | Watch Listed |
| Tiny-Flowered Buttercup | *Ranunculus micranthus* | Endangered |

Invertebrates

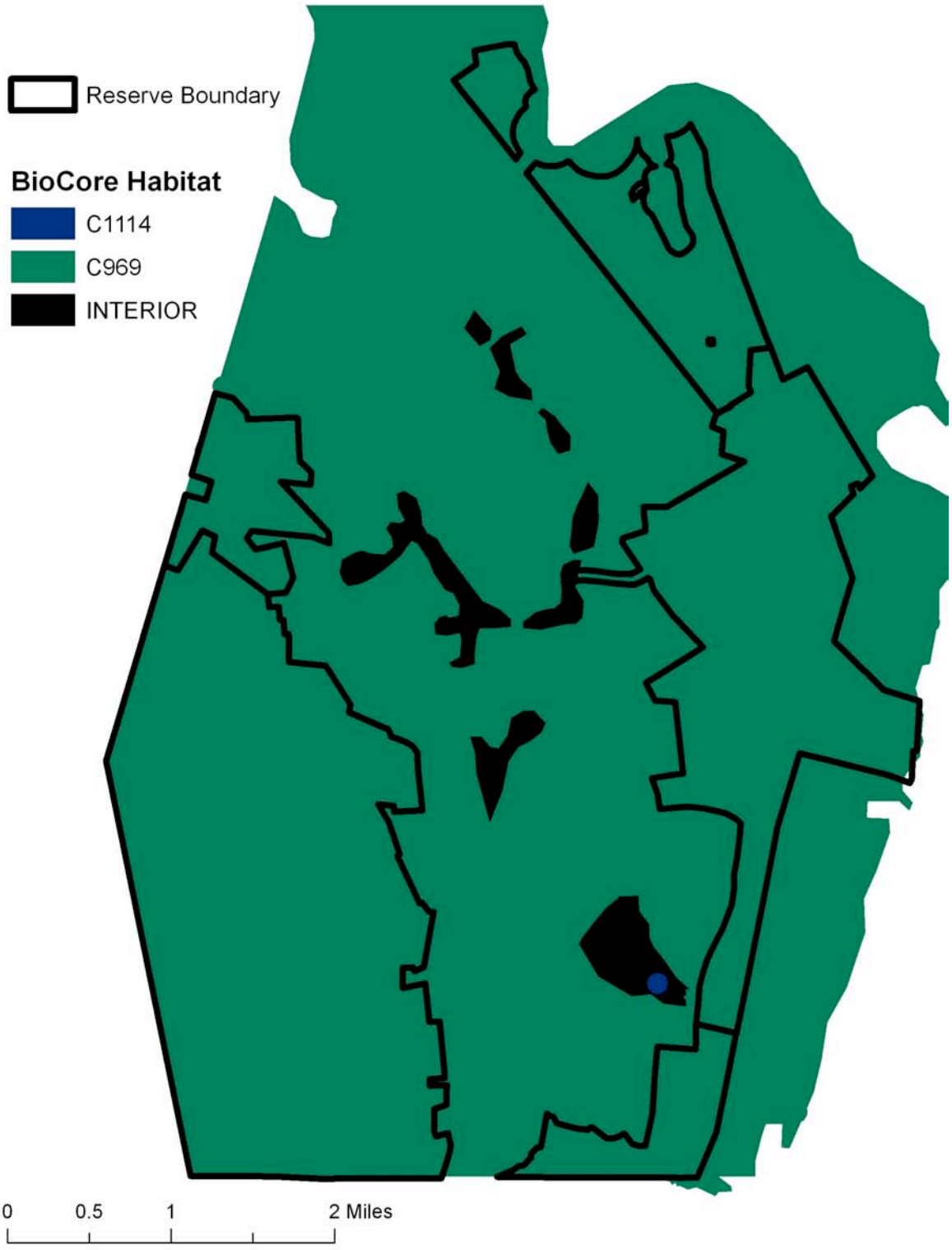
| Common Name | Scientific Name | Status |
|---|---|---|
| Blueberry Sallow | *Apharetra dentate* | |
| Gerhard's Underwing Moth | *Catocala herodias gerhardi* | Special Concern |

Vertebrates

| Common Name | Scientific Name | Status |
|---|---|---|
| Bat Hibernaculum | | |
| Jefferson Salamander | *Ambystoma jeffersonianum* | Special Concern |
| Sensitive Rare Vertebrate | | |
| Spring Salamander | *Gyrinophilus porphyriticus* | Special Concern |

Core Habitat BM1114

This Core Habitat is identified as a small site for a rare plant.




Appendix C. Fig. 1. Core Habitat designations within the Mount Washington Forest Reserve (NHESP 2004).