MASSACHUSETTS FOREST RESERVES
LONG TERM ECOLOGICAL MONITORING PROGRAM

MOHAWK/MONROE/SAVOY
FOREST RESERVE

A report on the baseline characteristics of the Forest Reserve areas located within the Mohawk Trail, Monroe, and Savoy Mountain State Forests

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Avril de la Cretaz
Matthew Kelty
Lena Fletcher

Department of Natural Resources Conservation
University of Massachusetts Amherst

Cover: The Cold River, Mohawk Trail State Forest (photo by Matthew Kelty).

PREFACE

The Mohawk/Monroe/Savoy Mountain Forest Reserve is one of eight large Forest Reserves in the Commonwealth of Massachusetts (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 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 disturbance 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 first describes the physical features, disturbance history, land use history, and forest communities of the Mohawk/Monroe/Savoy Forest Reserve. Following this, baseline data on tree density, size distribution, and species composition from Continuous Forest Inventory (CFI) data are summarized and discussed.

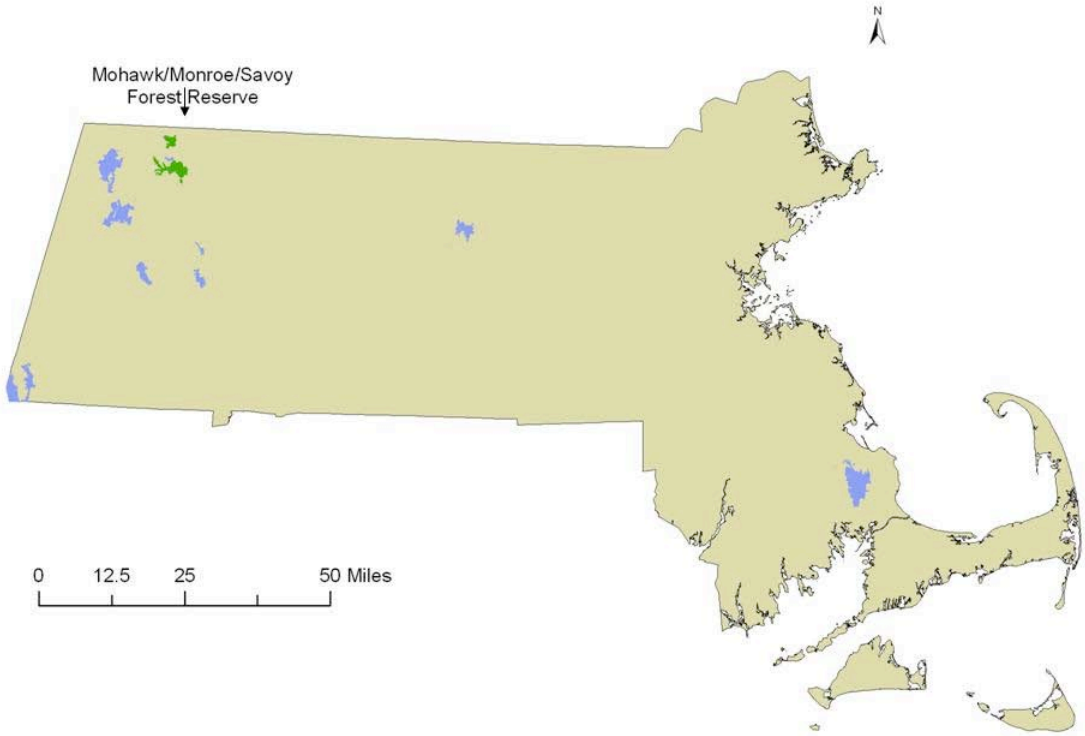

Fig. 1. The Mohawk/Monroe/Savoy Forest Reserve (green). Other large Forest Reserves are shown in blue (DCR 2008). All GIS analyses were performed using ArcGIS 9.3 (ESRI 2008).

THE MOHAWK/MONROE/SAVOY FOREST RESERVE

INTRODUCTION

The Mohawk/Monroe/Savoy Forest Reserve covers approximately 6,800 acres in the Mohawk Trail, Savoy Mountain, and Monroe State Forests. (All areas given, unless otherwise noted, are estimates from GIS analysis). A small section of the Forest Reserve extends into Florida State Forest (Fig. 2). The Forest Reserve consists of two sections. The northern section (Monroe State Forest), covers 1,700 acres in the towns of Monroe and Florida. The southern section of the Forest Reserve (Mohawk Trail and Savoy Mountain State Forests) covers 5,100 acres in the towns of Charlemont, Hawley, Savoy, and Florida. The Mohawk/Monroe/Savoy Forest Reserve is managed by the Massachusetts Department of Conservation and Recreation – Division of State Parks and Recreation (DCR).

The northern section (Monroe State Forest) is bounded on the east and south by the Deerfield River valley. The Deerfield River turns to the east between the Monroe and Mohawk Trail State Forests, forming the northern boundary of the southern section of the Forest Reserve. The Cold River, a major tributary of the Deerfield, runs through the middle of the Mohawk/Savoy section of the Forest Reserve (Fig. 2) (MassGIS 2000).

The Mohawk/Monroe/Savoy Forest Reserve falls within two different U.S. Forest subsections. Subsections are an ecoregional classification of the U.S. Forest Service and the basis for Massachusetts state ecoregions (Fig. 3). The northern portion of the Forest Reserve is located in the Southern Green Mountain subsection. The southern portion is located in the Berkshire-Vermont Uplands subsection. The Southern Green Mountains and the Berkshire-Vermont Uplands lie on different bedrock formations. Within these subsections, each portion of the Forest Reserve covers mid- and upper elevation Land Type Associations (LTAs). LTAs are finer-scale ecological areas, defined within subsections. These LTAs correspond in general to different forest types with red spruce being more common in the upper-elevations LTAs (Keys and Carpenter 1995, de la Cretaz and Kelty 2008).

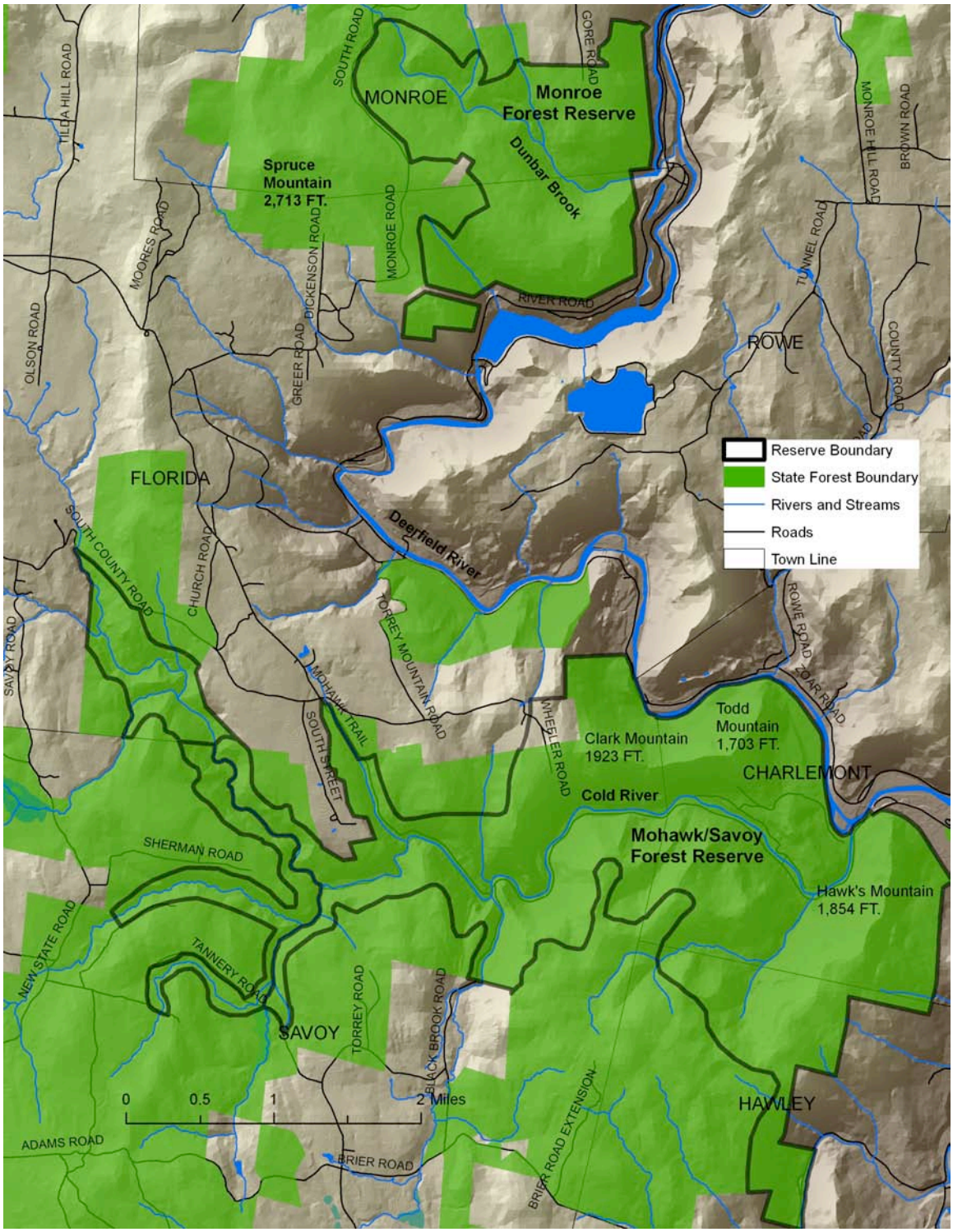

Fig. 2. The Mohawk/Monroe/Savoy State Forest Reserve (DCR 2008).

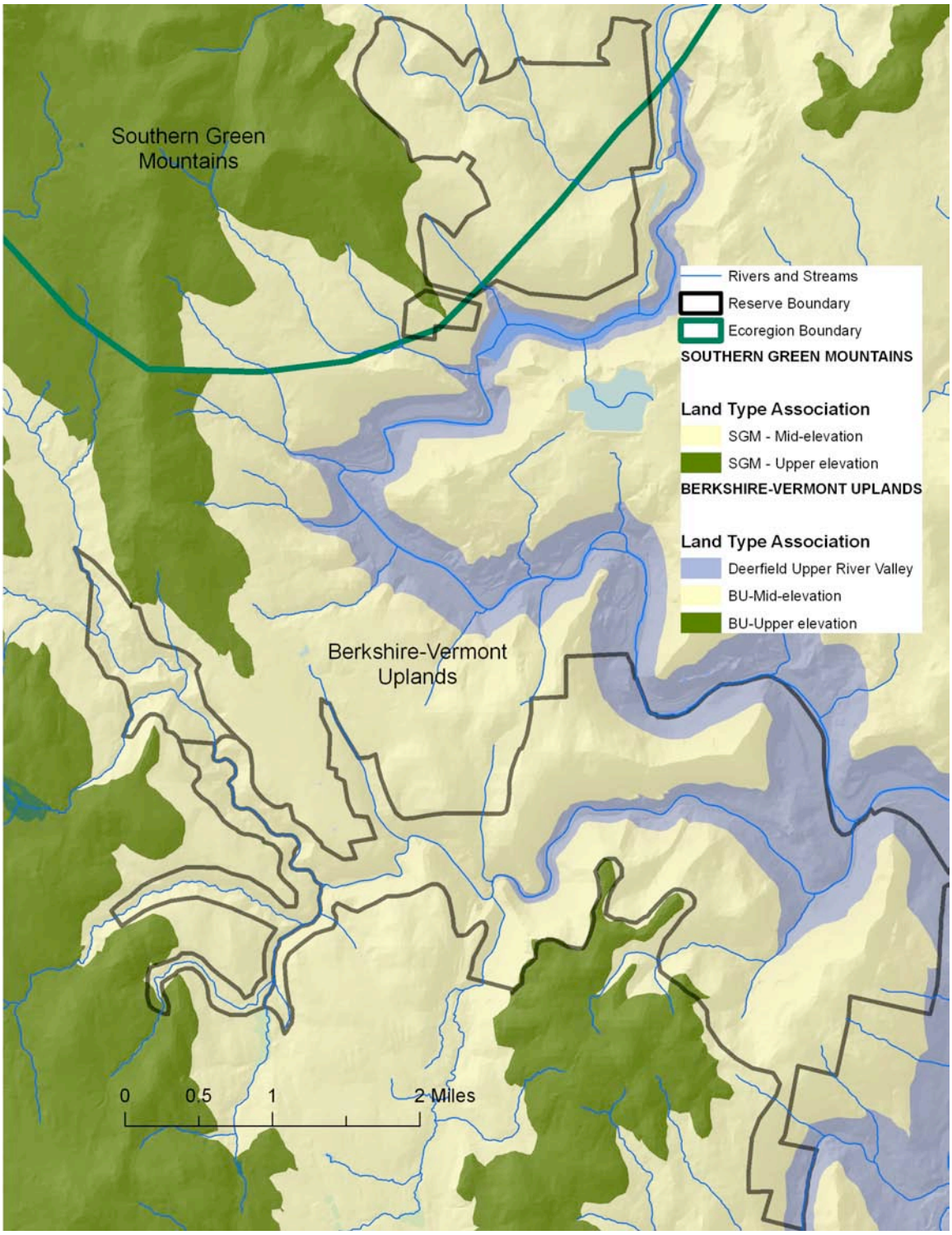

Fig. 3. Land Type Associations of the Mohawk/Monroe/Savoy Forest Reserve SGM = Southern Green Mountains, BU = Berkshire Uplands (de la Cretaz and Kelty 2008).

Associated Open Space

Within a 2-mile buffer extending from the outer boundary of the Forest Reserve (Fig.4), 29% (slightly over 14,000 acres) is permanently protected open space. Ninety-five percent of this area is owned by DCR and constitutes areas of the Mohawk, Monroe, Savoy, and Florida State Forests that lie outside of the Forest Reserve. Land owners other than the State include the Berkshire Natural Resources Council, The Nature Conservancy (TNC), the Rowe Land Trust, and private individuals.

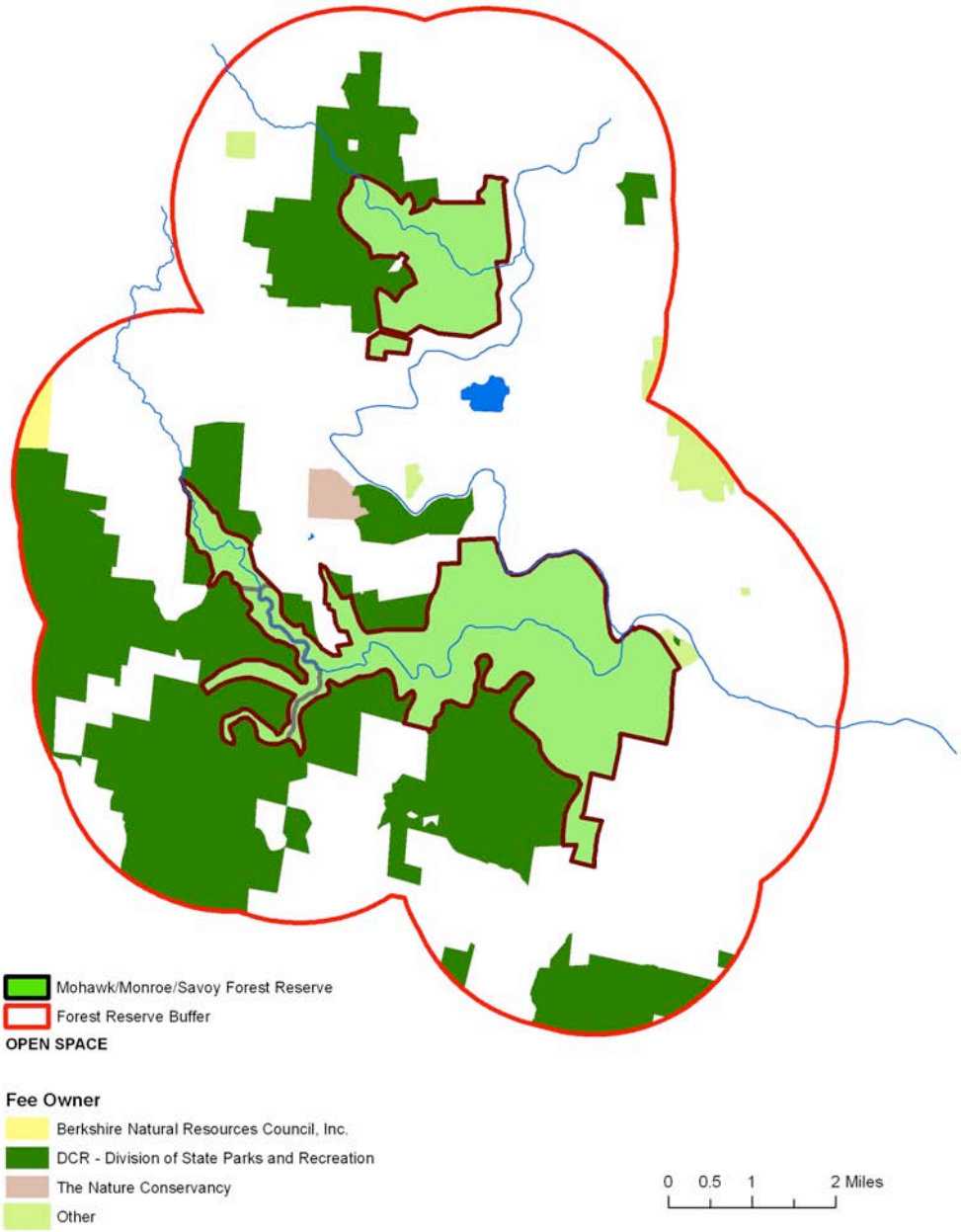

Fig. 4. Permanently protected open space within a buffer area extending 2 miles from the Mohawk/Monroe/Savoy Forest Reserve boundary (MassGIS 2009 (a)).

PHYSICAL FEATURES

Topography

Elevations range from 610 ft. in the Deerfield and Cold River Valleys to nearly 2,000 ft. on the mountain tops in the Mohawk/Savoy section of the Forest Reserve. Spruce Mountain in the Monroe State Forest, outside the Forest Reserve boundary is the highest elevation in the area at 2,713 feet (Fig. 2).

The southern (Mohawk/Savoy) portion of the Forest Reserve is located on a plateau divided by the Cold River valley (Fig. 5). Moderately steep to steep (25-45% 45->60%) slopes extend from the height of the plateau down to the bottom of the valley. There are some areas of steep slopes down to Dunbar Brook in Monroe and at the edge of the Deerfield River valley on the eastern boundary of the Reserve as well. Differences in solar radiation on north- and south-facing slopes along the Cold River affect soil conditions and forest type. In the Monroe section of the Forest Reserve, Dunbar Brook, a tributary of the Deerfield River runs from the northwest to the east through the Forest Reserve. Steep slopes in this area have a northeast aspect (Fig. 6).

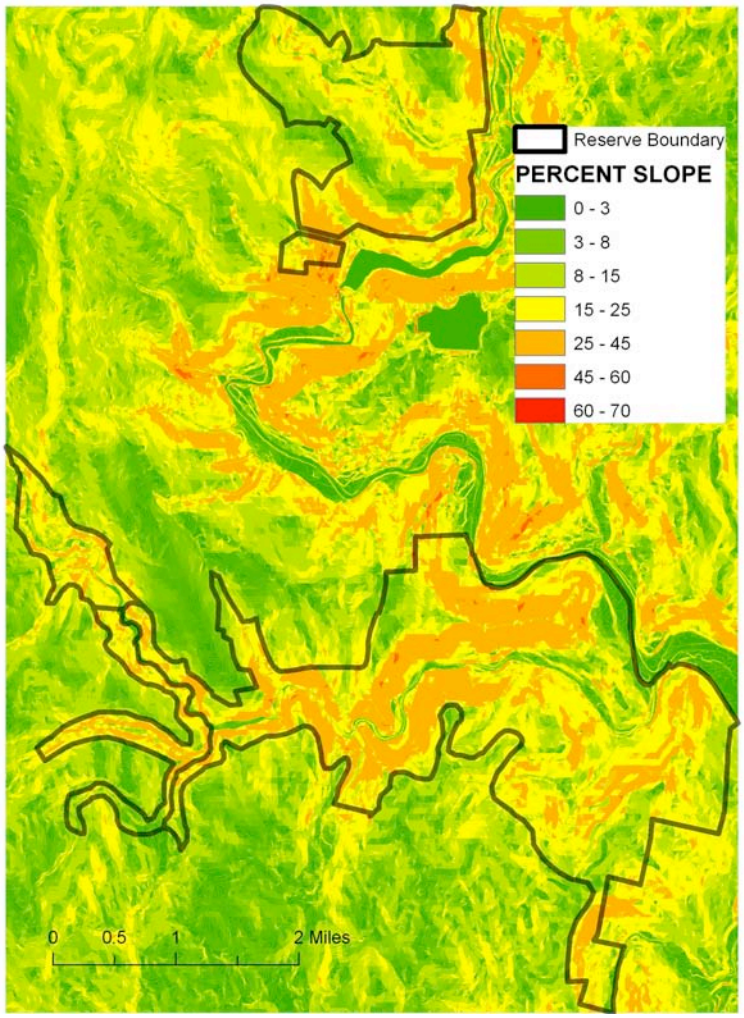

Fig. 5. Percent slopes, Mohawk/Monroe/Savoy Forest Reserve.

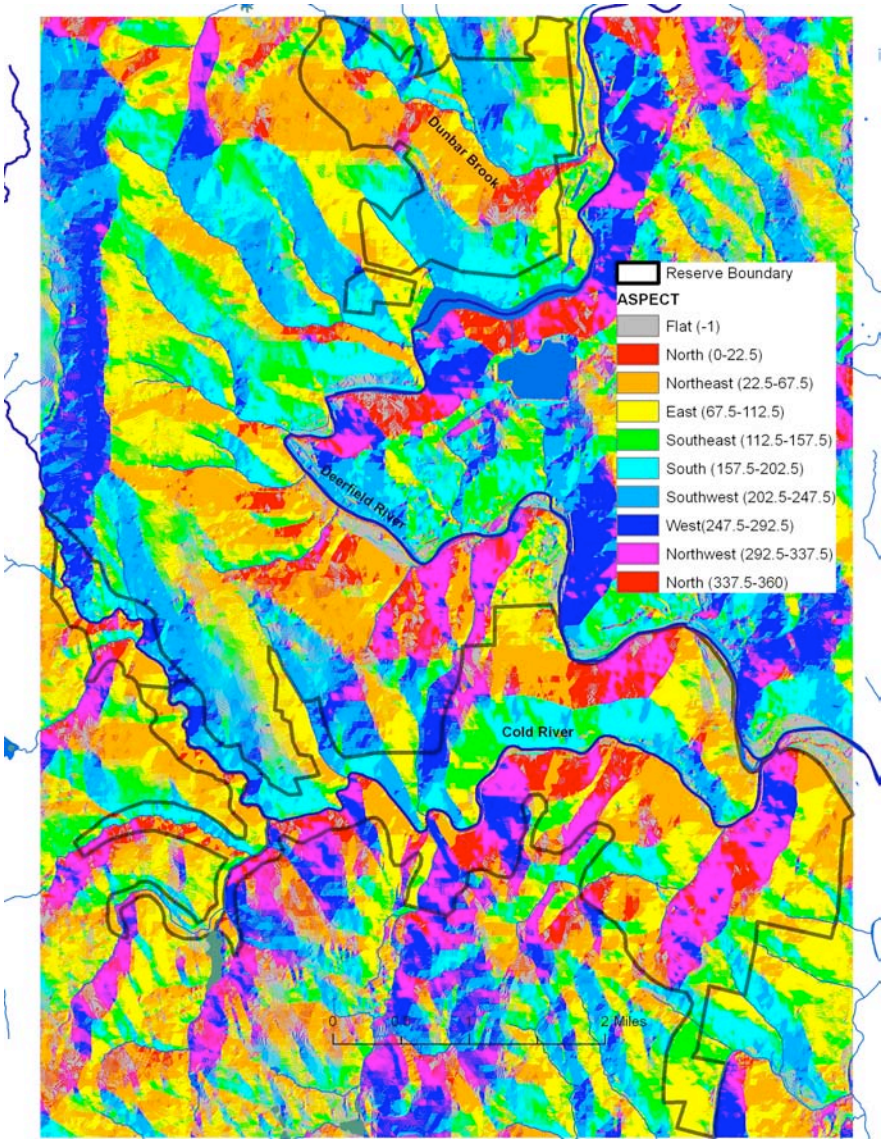

Fig. 6. Aspect analysis of the Mohawk/Monroe/Savoy Forest Reserve.

Bedrock Geology

The Mohawk/Monroe/Savoy Forest Reserve lies on the eroded remnants of mountains formed during the Taconic mountain building event that occurred in Ordovician and Silurian time, between 485 and 440 million years ago. During this period, the off-shore Shelburne Falls and Bronson Hill volcanic island chains moved slowly westward, colliding with the core North American continent of Laurentia. The continental basement rock, composed of granitic gneiss, formed more than a billion years ago during the Grenville mountain building event, was pushed upward (Fig. 7). Sedimentary material from the continental slope, rise, and deep ocean floor mixed with volcanic material from the Shelburne Falls volcanic island chain to the east and formed a series of thrust sheets that were compressed, folded, and squeezed up against the erosion resistant continental Grenville Gneiss. Bedrock formations in the Mohawk/Monroe/Savoy area originated from these thrust sheets (Skehan 2001). The majority of the Mohawk/Savoy portion of the Reserve lies on the Moretown Formation. The majority of the Monroe portion of the Reserve lies on the Hoosac Formation (Fig.8, Fig. 9, Table 1).

Fig. 7. Grenville continental basement rock, near Savoy. (photo courtesy of Christopher Condit, Department of Geology, University of Massachusetts, Amherst, MA).

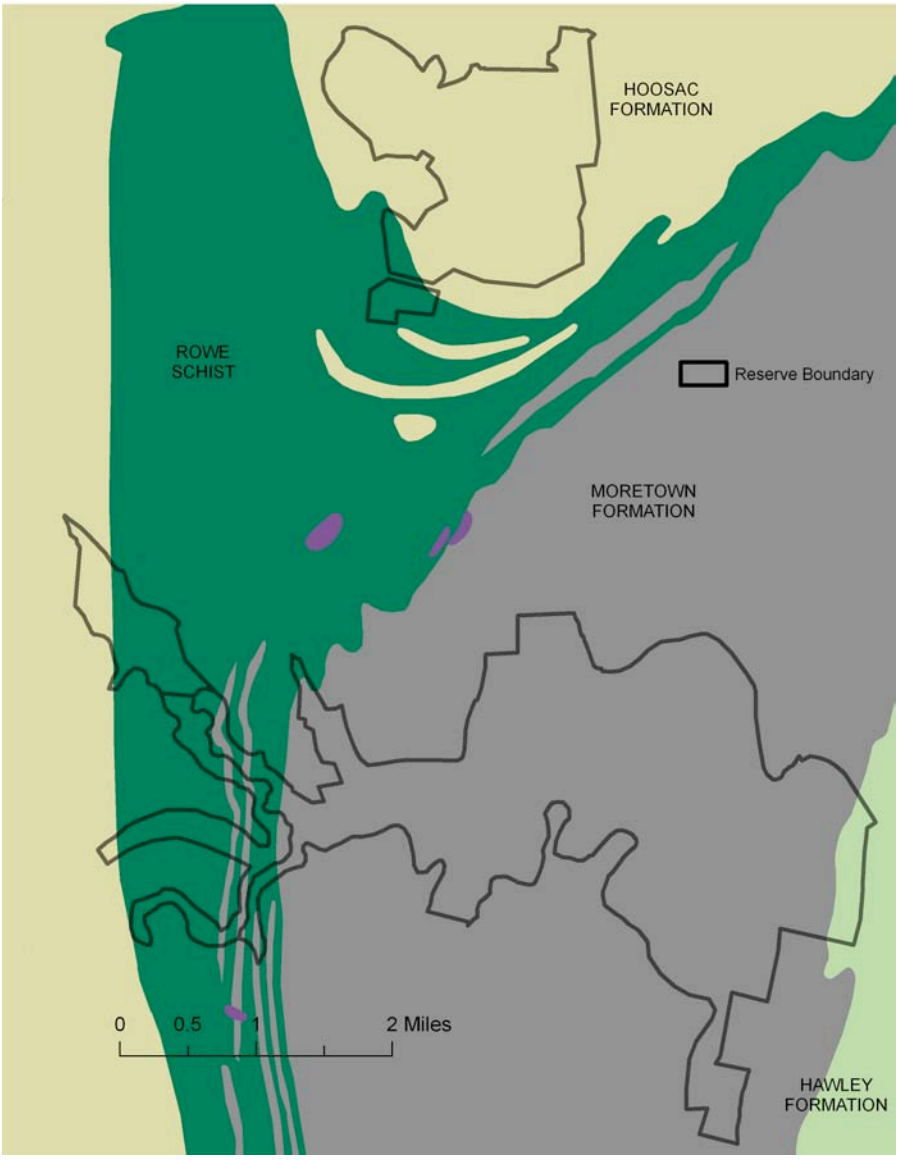

Fig. 8. Bedrock formations in the Mohawk/Monroe/Savoy area. Dark purple areas designate ultramafic deposits (Zen et al. 1983).

Bedrock Formations in the Mohawk/Monroe/Savoy Area

Hawley Formation: The Hawley Formation was formed in middle Ordovician times around 475 million years ago. It consists of green chlorite and hornblende schists, gray feldspar schists, and interbedded sulfidic black schists, all deposited in a volcanic environment. Quartzite, kyanite, and garnets are also found associated with this formation (Zen et al. 1983, Skehan 2001).

Moretown Formation: Also formed in the Ordovician period, the Moretown Formation is a mixture of metamorphosed sedimentary and volcanic material. Rock types include metasedimentary schists and metavolcanic amphibolites (Zen et al. 1983).

Rowe Schist: The Rowe schist formed in late Cambrian to Ordovician time (500 to 450 million years ago. It is a fine grained schist studded with tiny red garnets and black magnetite crystals with white lenses of quartz. It likely originated as volcanic ash basalt deposits (Skehan 2001).

Hoosac Formation: The Hoosac formation consists of schist, mica schist, gneiss, and phyllites formed in late Precambrian to Cambrian times (more than 495 million years ago). These metamorphic rocks formed from sedimentary material deposited on the continental slope or rise (Skehan 2001).

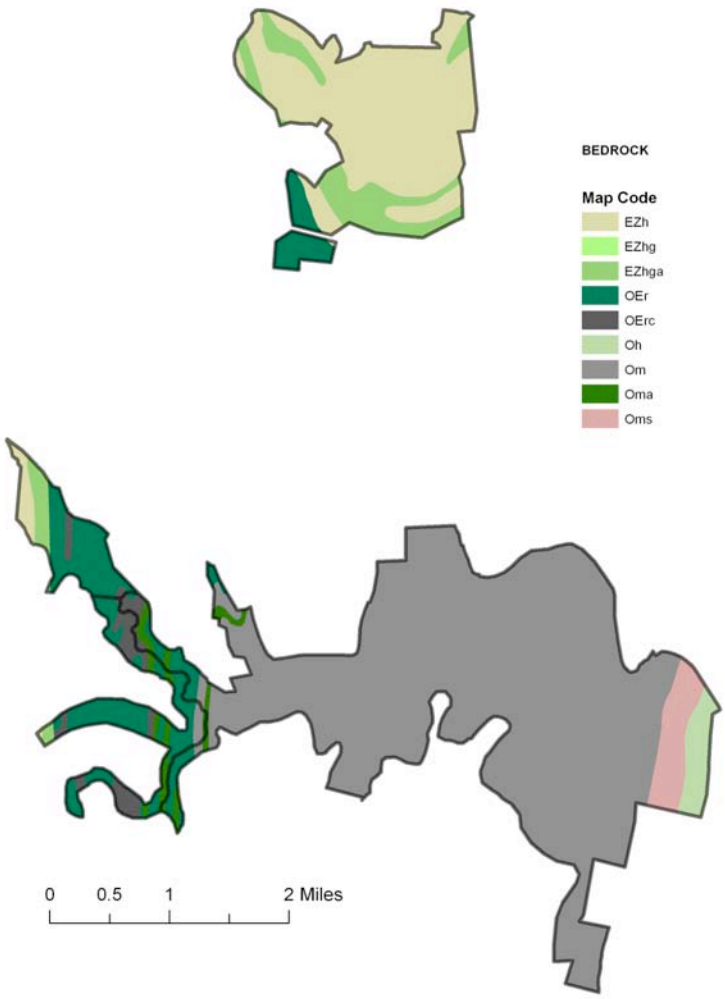

Fig. 9. Bedrock, Mohawk/Monroe/Savoy Forest Reserve (Zen et al. 1983).

Table. 1. Bedrock description, Mohawk/Monroe/Savoy Forest Reserve (Zen et al. 1983).

Map Code	Description	Area (%)	Formation	Rock Type
EZh	Schist, mica schist, gneiss, phyllite, conglomerate, granofels, calc-silicate rock	19	Hoosac	Metamorphic
EZhg	Phyllite, schist, quartzite	<1	Hoosac	Sedimentary
EZhga	Mica schist, granofels	6	Hoosac	Metamorphic
OEr	Schist with quartz lenses; kyanite and staurlolite	10	Rowe Schist	Metamorphic
OErc	Schist, quartzite	2	Rowe Schist	Metamorphic
Oh	Greenstone (chlorite), amphibolite	2	Hawley	Meta-igneous
Om	Granofels, schist	57	Moretown	Metamorphic
Oma	Greenstone (chlorite), amphibolite	1	Moretown	Meta-igneous
Oms	Schist, granofels, amphibolite	3	Moretown	Metamorphic

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, scraping away existing material, then 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 (Skehan 2001). In the Mohawk/Monroe/Savoy Forest Reserve till covers most of the area, with small outwash deposits bordering the Deerfield and Cold Rivers (Fig. 10).

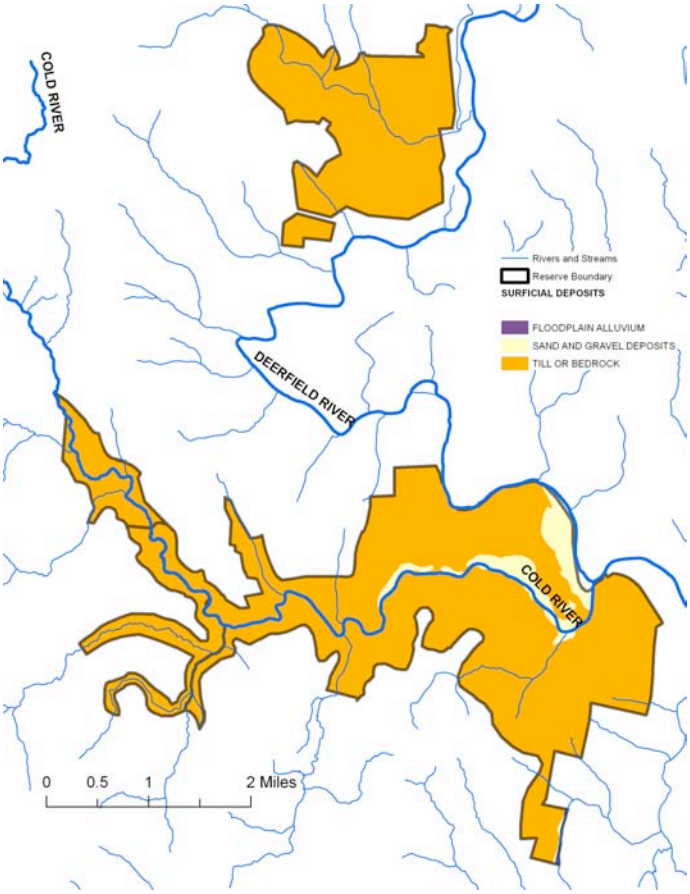

Fig. 10. Surficial geology of the Mohawk/Monroe Savoy Reserve (MassGIS 1999).

The towns of Monroe, Charlemont, and Hawley are part of Franklin County, while Savoy and Florida are in Berkshire County (Fig. 11). At the time this report was completed, the most detailed level (SSURGO) of digital soil mapping was completed for Berkshire County, but not for Franklin County. Therefore, soil information for the Mohawk/Monroe/Savoy Forest Reserve was available at 2 different scales. SSURGO digital data (Berkshire County) use a minimum mapping unit of 5 acres and are based on 1:12,000 scale maps and 1:24,000 (converted to 1:25,000) aerial photographs (NRCS 20007) with field verification. Digital data for Franklin County soils is based on STATSGO regional soils data. STATSGO data use a minimum mapping unit of 1,544 acres (625 ha) and are based on 1:250,000 scale maps. SSURGO digital data delineates fine scale soil series, while STATSGO data delineates soil consociations or the dominant soil within each mapping unit.

The majority of soils within the Mohawk/Monroe/Savoy Forest Reserve are spodosols. Spodosols are acid, sandy, nutrient poor, leached soils that form in acidic glacial till in cold, wet environments typically under forests. Spodosols are characterized by an E or eluviated horizon, below the organic (O) horizon. Clay, iron, and aluminum oxides have leached out of the E horizon, leaving a soil layer that is light-colored and contains only resistant minerals such as quartz (Scanu 1988, Brady and Weil 2002).

The Lyman, Tunbridge, Berkshire, and Peru series are classified as spodosols (Fig. 11, Table 2). Lyman soils are shallow to bedrock(10 to 20 inches) and somewhat excessively drained. They are found on rocky hills, mountains, and high plateaus and develop in a thin layer of glacial till and frost fractured rock fragments derived from schist rocks with lesser amounts of phyllite, granite, and gneiss (NCSS 2007). Tunbridge soils are moderately deep (28 inches) well drained soils. They form in glacial till derived from micaceous schist, gneiss, and phyllite on uplands (NCSS 2008). Berkshire soils are very deep (65 inches) and well drained and also formed in upland till. Bedrock underlying Berkshire soils is composed of mica schist with some phyllite, granite, and gneiss (NRCS 2006). The Peru series consists of very deep (65 inches), moderately well drained soils that formed in dense, loamy glacial till. Unlike the previous series, Peru soils are underlain by a dense substratum of compacted glacial material with limited permeability (NCSS 1998).

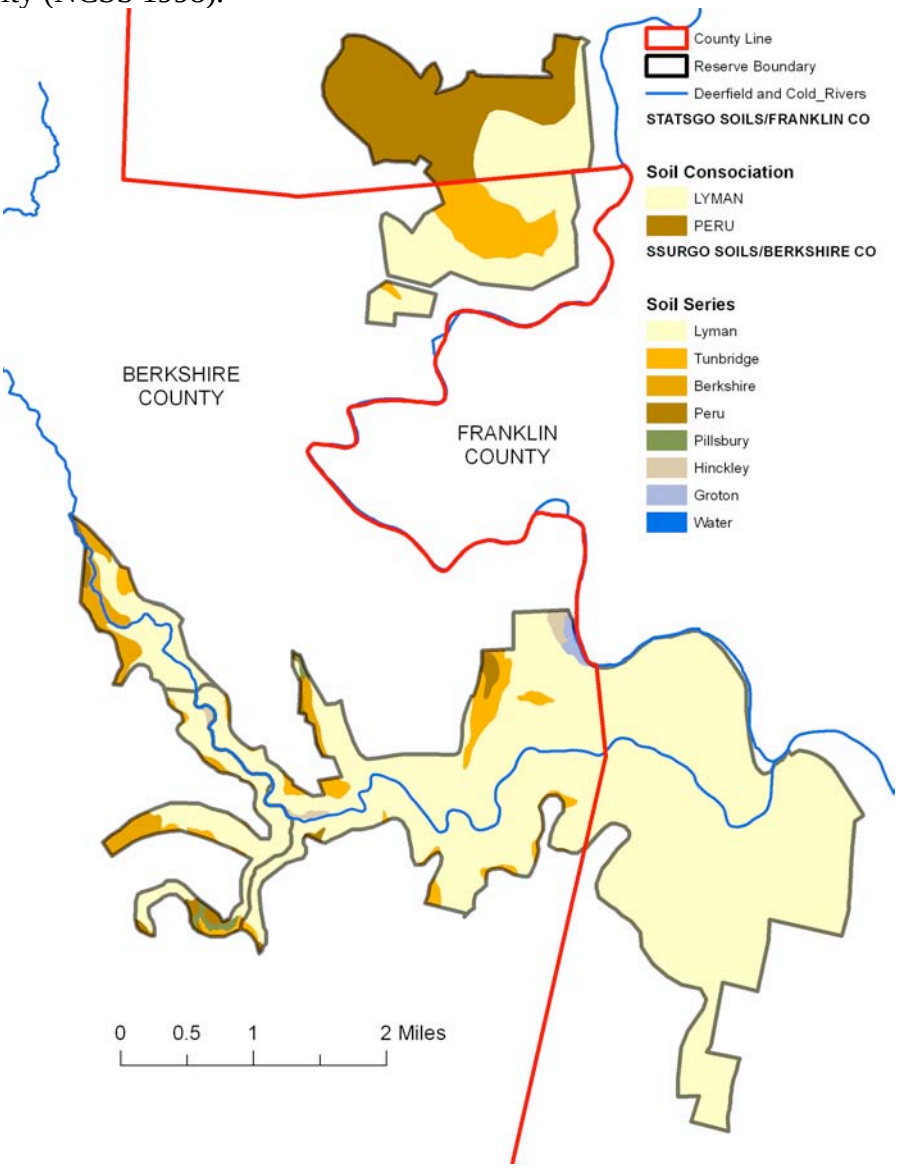

Fig. 11. Soils in the Mohawk/Monroe/Savoy Forest Reserve (Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture 1999; 2006).

In addition to the soil series described above, there are small areas of poorly drained soils and outwash soils in riparian areas along the Deerfield River and the Cold River in the Mohawk/Savoy section of the Reserve. It is possible that there are additional areas of these soils along reaches of the Cold River in Franklin County, that were not mapped as separate polygons at the STATSGO mapping scale. The Pillsbury soil series consists of poorly and somewhat poorly drained soils that form in slightly concave areas and shallow drainageways. They form in glacial till derived from granite, gneiss, and schist. Pillsbury soils are shallow to a dense substratum and very deep (66 inches) to bedrock (NCSS 1997). Hinckley and Groton soils are both very deep and excessively drained outwash soils. The Hinckley soils developed in material derived from outwash formed in granite, gneiss, and schist (NCSS 2007). Groton soils developed in outwash sand and gravel deposits derived from limestone, gneiss, and schist (NCSS 2004). While the presence of soils derived from limestone bedrock can have dramatic effects on forest type, the area of Groton soils in the Reserve is quite small and the influence of these soils on the forest would only be noticed in fine scale observations.

Table 2. Soil Series, Mohawk/Monroe/Savoy Forest Reserve (NCSS 2007, 2008, 2006, 1998, 1997, 2007, 2004).

Series Name	**Soil Characteristics**
Soils formed in glacial till	
Lyman	Shallow, somewhat excessively drained
Tunbridge	Moderately deep, well drained
Berkshire	Very deep, well drained
Peru	Very deep, moderately well drained
Pillsbury	Very deep, poorly drained
Soils formed in glacial outwash (sand and gravel) deposits	
Hinckley (granite, gneiss, and schist bedrock)	Very deep, excessively drained
Groton (limestone, gneiss, and schist bedrock)	Very deep, excessively drained

Combined data from the SSURGO and STATSGO indicate that close to 80% of the soils in the Reserve belong to the Lyman Soil Series with about 18 percent of the remaining soils belonging to either the Tunbridge or Peru Soil Series (Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture 1999; 2006).

Climate

Climate on the Berkshire Plateau is characterized by cold winters and moderately warm summers with occasional hot spells. The nearest weather station at a similar elevation to the Mohawk/Monroe/Savoy Forest Reserve is in Cummington Hill (elevation 1,607 feet) located approximately 15 miles south/south east of Savoy.

Table 3. Mean 24-hour temperature and mean precipitation by month, Cummington, MA (World Climate 1996).

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
[1]Temp.˚F	19.9	22.1	31.5	42.4	54.0	62.6	67.3	65.7	58.3	48.2	37.0	24.6	44.4
[2]Precip. Inches	3.6	2.9	3.0	4.0	5.0	3.6	4.9	4.6	4.0	3.9	3.9	3.7	47.2

[1]Temperature derived from National Climatic Data Center, NCDC TD 9641 Clim 81 1961-1990 Normals. 30 years between 1961 and 1990.
[2]Precipitation from NCDC Cooperative Stations.16 complete years between 1963 and 1994.

Disturbance History

The most common natural disturbances in this area are windstorms (hurricanes), snow and ice, insects, and disease. State foresters recorded tree damage from snow and ice (no date give), insects (1978), and disease (DCR 2000). Aerial photo surveys (MassGIS 1997) indicated defoliation in the Monroe Forest Reserve in 1969 and 1977 and again in 1979 (240 acres) from unknown causes. Gypsy moth infestations caused defoliation of about 600 acres in the Mohawk/Savoy and 400 acres in the Monroe Forest Reserve from 1979 to 1980. In the Mohawk/Savoy Reserve, damage was confined to the south facing slopes along the Cold River where oaks, favored by gypsy moths, are concentrated. In 1983, defoliation from oak leaf tier caterpillars was evident in about 30 acres on the mountain ridge to the north of the Cold River. From 1987 to 1988, pear thrips infested all areas of the Monroe Forest Reserve and all the Mohawk/Savoy Forest Reserve south of the Cold River, plus a 150 acre strip on the north side of the mountain ridge north of the Cold River. In 1996, dead trees were noted in a 1,000-acre area on both sides of the Cold River in Charlemont (the eastern end of the Mohawk/Savoy Forest Reserve). The most recent CFI sampling noted tree damage from beech bark disease, heart rot, nectria, cherry black knot, sugar maple borers, and birds (DCR 2000). 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:

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* (Houston and O'Brien 1983).

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).

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).

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).

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).

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).

The sugar maple borer (*Glycobius speciosus*) is a long-horned wood boring beetle that is a common pest of sugar maple, the only known host. The Sugar maple borer has a 2-year life cycle. Sugar maple borers lay eggs near cracks in the bark or under the bark scales of the tree. Following hatching, larvae mine beneath the bark and excavate a shallow cell in sapwood where they spend the winter. The second summer, the larvae continue to mine under the bark. As winter approaches, they bore a tunnel into the wood and remain there until they emerge as adults the following summer. Sugar maple borer infestation is rarely fatal, but does damage and weaken the tree, leaving openings for fungi, which can cause further decay (Hoffard and Marshall 1978)

LAND USE HISTORY

Fig. 12. Orthophotos of the towns of Charlemont, Savoy, Hawley, Florida, Monroe, and Rowe (MassGIS 2005) with Forest Reserve boundaries shown in red.

In pre-colonial times, Pocomtuc peoples maintained semi-permanent agricultural settlements in the Deerfield and Connecticut River valleys while the Mahican people occupied the rich agricultural lands in the Hoosic and Housatonic River valleys on the western side of the mountains. A trail, following roughly the path of the current Mohawk Trail Highway (Massachusetts Route 2), from the Hoosic River valley over the steep western slope of the Hoosac Range along the Cold River, with passages along some upland ridgelines, to the Deerfield River Valley provided a route between these two settled areas. This trail was part of a much more extensive system of trails that had been used by native populations for countless generations. The trail provided access to hunting grounds and passage for messengers, scouts, and warring parties. During colonial times, it was used by the Mohawk people of New York to attack other native settlements and by Canadian Mohawks, allied with the French, to attack English settlements and thus became known as the Mohawk Trail (Browne 1920, Manataka American Indian Council 2002).

Settlement of western Massachusetts by the English colonists proceeded slowly during the first half of the 18th Century due to the constant threat of violence during the French and Indian Wars. The first towns in Franklin County were established in the lowlands. In the Connecticut River Valley, Deerfield was incorporated in 1682, Northfield in 1713, Greenfield and Montague in 1753. Most of the people living in the Berkshire uplands during this time were located in forts, set up by the Massachusetts government to act as a buffer for towns to the south and east (Garrison 1991).

English settlement accelerated following the defeat of the French at the Battle of Quebec in 1759 and the signing of the Treaty of Paris in 1763, which established English hegemony throughout the area (Resch and Katz 1976, Garrison 1991). Charlemont, with lowlands along the Deerfield River was first settled in the 1740s and incorporated in 1765; however, the thin, rocky soils in the uplands of Charlemont and Hawley, and in most of Monroe, Savoy, and Florida, combined with the long cold winters, attracted few settlers. In fact, the General Court of Massachusetts attempted to encourage settlement in Savoy by giving the land away. Savoy (Northern Berkshire Township No. 6) had been auctioned in 1765 to Able Lawrence, a Boston landowner for £1,350 who never paid more than a down payment of £20, claiming that "the land was not as good as represented." Following this, the land was presented to the "heirs of Captain Samuel Gallup and Company for services rendered and endured during an expedition against Canada during King William's war around 1690" (Federal Writers' Project 1933). The land was given to Colonel William Bullock. By 1787, thirty-four families had settled in the Savoy area. Savoy was incorporated in 1797. Florida was settled in 1783 and incorporated in 1805. Monroe was first settled in 1800 and incorporated in 1822 (The Berkshire Web (no date given), The Berkshire Web, Historic Preservation Report 1978).

Upland farmers relied on a mix of agricultural activities for their economic survival. These included maple sugaring in the spring, providing hay and pasture for lowland cattle in the summer, and apples and cider in the fall. During the winter, commercial timber harvesting was an option if the snow was not too deep. Sheep farming was a major agricultural activity in the uplands in the first half of the nineteenth

century (Garrison 1991). The harsh climate of these towns limited agricultural production to wool, maple sugar, potatoes and apples (The Berkshire Web, Historic Preservation Report 1978). While surrounding areas were cleared for pasture and apple orchards, land that is now within the Forest Reserve boundaries appears to have been sparsely settled and a large portion of the land may have been kept as woodlots (Hall et al. 2002, Harvard Forest 2002). The most developed area within the Forest Reserve boundaries was along the Cold River at the foot of Hawks Mountain. Three businesses, all owned by members of the Hawks Family, and all relying on timber products were located here: H. & E. Hawks Turning and Planing Shop, E.C. Hawks Manufacturer and Dealer in Hemlock and All Kinds of Hardwood Lumber, and E.D. Hawks & Sons, Manufacturers & Dealers in Lumber, Chair Stock, Lathe, etc. In the towns of Charlemont, Savoy, and Florida, within the boundaries of the southern section of the Reserve, there were fewer than forty homes and five sawmills. In all of Savoy, there were 145 dwellings, 7 schools, 9 sawmills, 1 blacksmith shop and 2 stores. The northwest corner of Hawley, also included in the Forest Reserve, was uninhabited. There were only 3 or 4 homesteads in the northern section of the Reserve in the towns of Monroe and Florida. There were six sawmills, however, in the town of Monroe, plus several sawmills and a wood pulp mill in Florida. (Beers Atlas 1871, 1876). The Federal Writers Project (1939) described Savoy in the nineteenth century as a township with five villages, six religious bodies, sixteen sawmills, sixteen cemeteries, and a tavern.

The towns of Florida, Savoy, and Monroe experienced a population boom in the 1860s and 1870s as laborers moved to the area to work on the construction of the Hoosac Tunnel, a massive project, designed to facilitate the transport of freight and passengers from Boston to North Adams through the northern Berkshire Mountains. Construction of the tunnel began in 1851; the first trains passed through in 1875, and work on the tunnel continued into the 1880s (Carney 1976, Howes 2006). Monroe gained population following the opening of the James Ramage Paper Company in 1887. Populations in this area in 1870 were: Charlemont 1,005, Monroe 201, Savoy 861, Florida 1,322 (Beers 1871, 1876). Population in the area fell in the late nineteenth and early twentieth centuries when the tunnel construction was completed and manufacturing activity at the paper mill declined. By 1925, Monroe had lost over a third of its population, with only 143 residents remaining (Massachusetts Historical Commission 1982). The region surrounding the Mohawk/Monroe/Savoy Reserve at the current time is sparsely populated (Fig. 12). The current populations of Charlemont, Monroe, Savoy, and Florida are 1,358, 93, 705, and 676 respectively (MassGIS 2009(b), U.S. Census 2000). Monroe is the smallest town by population and population density in Franklin County and the second smallest town in Massachusetts.

The state acquired several large blocks of forestland in the early 20th century to establish Mohawk Trail, Savoy, Florida, and Monroe State Forests. Most of the land purchases were completed between 1917 and 1936. In the Mohawk Trail State Forest area, 44 landowners sold more than 6,000 acres to the state between 1921 and 1936. In 1924 the state acquired 1,164 acres from the Monroe Bridge Paper Company. This parcel was the beginning of the Monroe State Forest. This was followed by a purchase of 1,091 acres from representatives of the Parker estate. An additional 1,628 acres in small parcels

were purchased from 1924 to 1930 from 12 additional landowners. Savoy Mountain State Forest was created in 1917-1918 with the purchase of 1,000 acres of abandoned farmland from 12 landowners. Over the next 18 years an additional 74 landowners sold more farmland adding 9,300 acres to the forest (DCR Deed Database, 2008). During the 1930s, the Civilian Conservation Corps planted Norway and blue spruce on numerous sites throughout the area (DCR (no date given)).

An area of about 300 acres near the eastern border of the Reserve in Mohawk Trail State Forest was harvested between 1989 and 1995 (McDonald et al. 2006). This is primarily a northern hardwoods area.

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 Mohawk/Monroe/Savoy is shown in Figure 13 and summarized in Table 4.

Reserve Forests are primarily composed of northern hardwoods, and oak with hemlock and white pine. A small area of red spruce and red spruce-balsam fir, about 100 acres, is located at higher elevations in the western portion of the Forest Reserve in Savoy State Forest. Dramatic differences in forest type due to differences in aspect can be found on the steep slopes north and south of the Cold River in the Mohawk Trail State Forest. Oaks that grow well on sunny dry sites predominate on south facing slopes north of the river, while the forests on north facing slopes south of the river are composed of northern hardwoods (Fig. 14, Fig. 15). In the Monroe State Forest Reserve, the forest is primarily composed of northern hardwoods with hemlock and white pine concentrated at lower elevations and near Dunbar Brook. There also are about 65 acres of red pine and Norway spruce plantations in the Monroe Forest. Descriptions of Core Habitats and rare species (NHESP 2004, 2008) are provided in Appendix C.

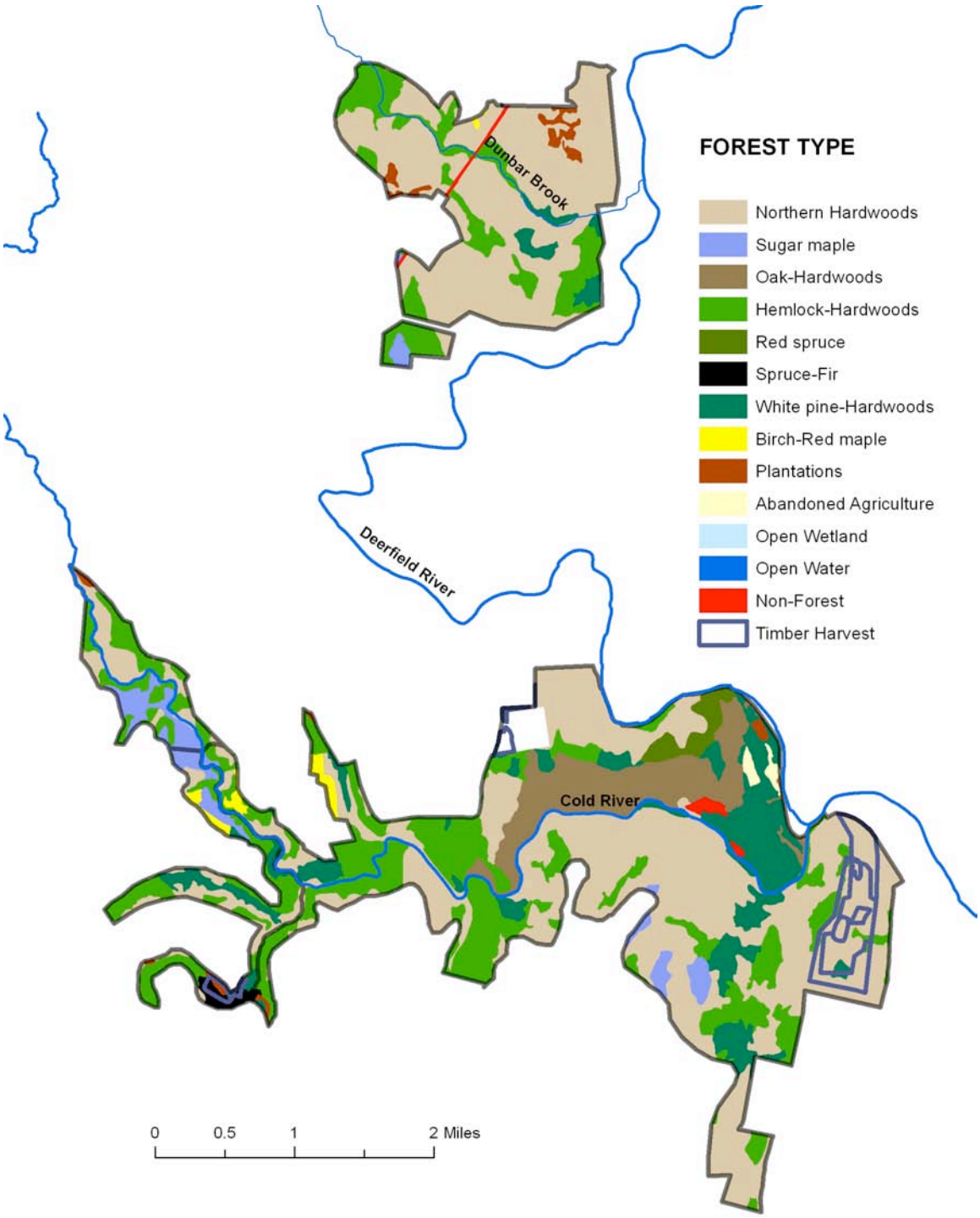

Fig. 13. Mohawk/Monroe/Savoy Forest Reserve, Forest Type Map, indicating predominant overstory species (DCR 2003) and timber harvests 1984-2003 (McDonald et al. 2006). The white area was not part of the State Forest at the time the mapping was done.

Table 4. Forest types, Mohawk/Monroe/Savoy Reserve (DCR 2003).

Forest Type	Area (%)
Northern Hardwoods	52
Sugar maple	3
Oak-Hardwoods	7
Hemlock-Hardwoods	24
Red spruce	1
Spruce-Fir	<1
White pine-Hardwoods	10
Birch-Red maple	1
Plantations	1
Abandoned Agriculture	<1
Open Wetlands	<1
Open Water	<1
Non-Forest	<1

Fig. 14. Red oak and mountain laurel growing on a south-facing slope north of the Cold River, Mohawk/Monroe/Savoy Forest Reserve, Mohawk Trail State Forest (photo by Matthew Kelty).

Fig. 15. Hobblebush, a characteristic northern hardwoods understory species growing on a north-facing slope, south of the Cold River, Mohawk/Monroe/Savoy Forest Reserve (photo by Matthew Kelty).

Old-Growth in the Mohawk/Monroe/Savoy Forest Reserve

A recent study (D'Amato et al. 2006, D'Amato 2007,) identified 19 old-growth stands in the Mohawk/Monroe/Savoy State Forests varying in size from 2 to 200 acres with a median area of 15 acres (Figs. 16, 17, 18). The largest area of old-growth is located in the area of Todd and Clark Mountains. 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 in 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 Reserve develop through forest succession subject to the effects of natural disturbances.

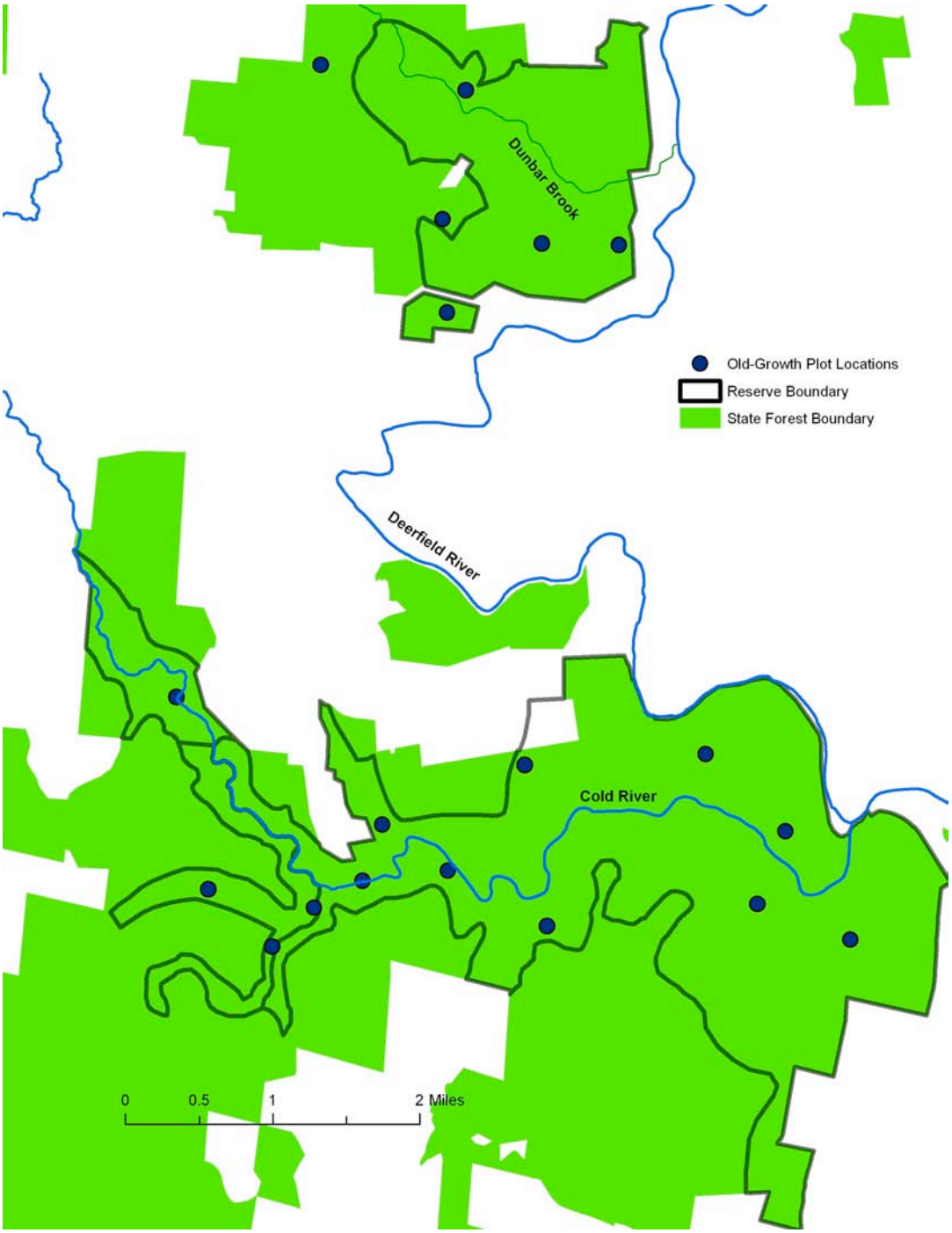

Fig. 16. Old-Growth stand locations in the Mohawk/Monroe/Savoy Forest Reserve and surrounding forest (D'Amato et al. 2006).

Fig. 17. Old-growth forest, near the Cold River, Mohawk/Monroe/Savoy Forest Reserve, Mohawk Trail State Forest (photo by Avril de la Cretaz).

Fig. 18. Old-growth forest stand, near the Cold River, Mohawk/Monroe/Savoy Forest Reserve, Mohawk Trail State Forest (photo by Avril de la Cretaz).

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. 19). 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. Except where otherwise indicated, all analyses are based the 2000 CFI dataset (DCR 2000). The CFI data were analyzed using SAS 9.1.3 Statistical Software (2004).

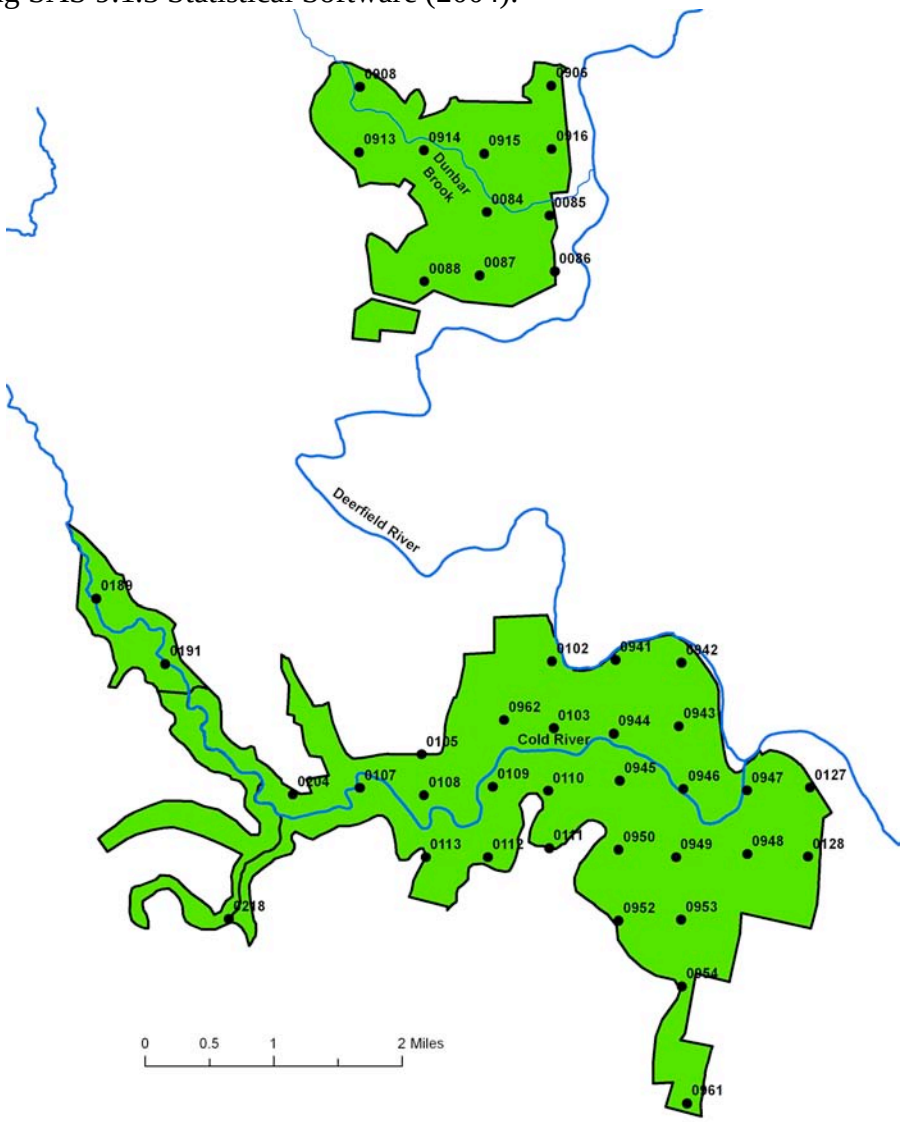

Fig. 19. Continuous Forest Inventory (CFI) plots, Mohawk/Monroe/Savoy Forest Reserve. There are 42 plots that fall within the boundaries of the Mohawk/Monroe/Savoy Reserve. Plot 0961 is shown on the map but there is no data recorded for this plot (DCR 2000).

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 5). In the Mohawk/Monroe/Savoy Forest Reserve, selected trees in stands where CFI plots are located were found to be between 38 and 121 years old.

Table 5. Plot age summary, Mohawk/Monroe/Savoy Forest Reserve CFI plots (DCR 2000).

Age (Years)		#Plots
38-50		2
51-60		1
61-70		1
71-80		5
81-90		8
91-100		11
101-110		5
111-120		6
121-130		1
	Total Plots	40[a]
	Age Range	38-121

[a]Plot 0191, age listed as 0, forest subtype BB, (beech-birch-maple), assume omission.

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 (Table 6). No disturbances were recorded for CFI plots in the Monroe State Forest portion of the Reserve. Two plots in the Mohawk Reserve were recorded as harvest cuts in 1964. These cuts were not included in the Forest Type map shown earlier in this report, which only displays harvest cuts that occurred after 1983. The date for the pastured plot was 1920. A complete disturbance record by plot is given in Appendix B.

Table 6. Disturbance summary, Mohawk/Monroe/Savoy Forest Reserve.

CFI Plot Disturbance		
Disturbance Type		
Code	**Description**	**#Plots**
0	None	23
1	Fire	0
2	Wind	2
3	Snow & Ice	1
4	Other use, cleared	1
5	Other use, pastured	1
6	Insects	2
7	Disease	4
8	Timber stand improvement	1
9	Harvest cut	6
	Total Plots	41

Live Trees

Size distribution in the Mohawk/Monroe/Savoy Forest Reserve follows a typical inverse-J curve with larger numbers of trees in the smaller size classes (Fig. 20). The number of trees/acre declines progressively as dbh increases. Mean stand density for the Mohawk/Monroe/Savoy Forest Reserve for trees ≥ 5 inches dbh is 201.7 ± 21.5 stems/acre (95% confidence interval). Mean stand density for large trees (≥ 20 in. dbh) is 9.2 ± 5.3 stems/acre.

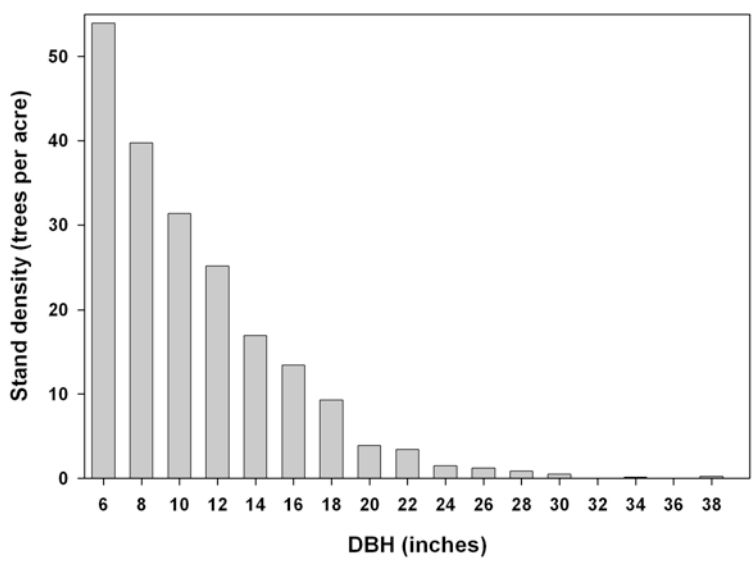

Fig. 20. Mean stand density (trees/acre) by 2-inch dbh classes, Mohawk/Monroe/Savoy Forest Reserve (N=41 plots) (DCR 2000).

Estimates based on CFI 2000 data indicate that the primary species groups in the Mohawk/Monroe/Savoy Forest Reserve are northern hardwoods, oaks, and hemlock (Fig.21). This corroborates the landscape level data shown in the overstory forest type mapping (Fig.13, Table 4). Northern hardwoods (beech, yellow birch, sugar maple) and northern hardwood associates (white ash and black cherry) account for 36% of the total basal area. Oaks, predominantly red oak, but also including black oak, white oak, and chestnut oak constitute 15% of the total basal area. Twenty-two percent of the basal area is hemlock. Red maple is about 11%.

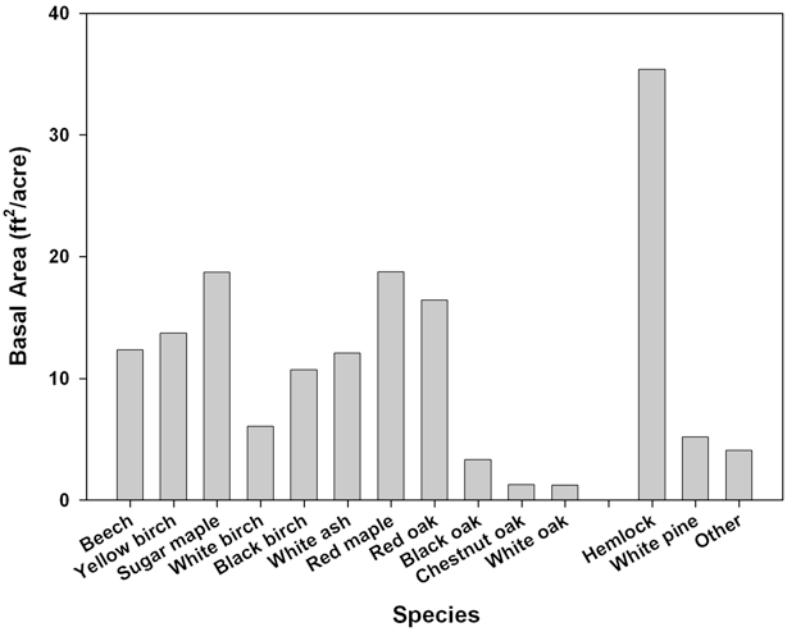

Fig. 21. Mean basal area (ft^2/acre) by species (DCR 2000). Mohawk/Monroe/Savoy Forest Reserve (N=41 plots). "Other" includes black cherry, red spruce, Norway spruce, basswood, hickory, aspen, grey birch, misidentified and unidentified species. Each of these with the exception of unidentified species (BA = 1.2 ft^2/acre) had a basal area of less than 1.0 ft^2/acre.

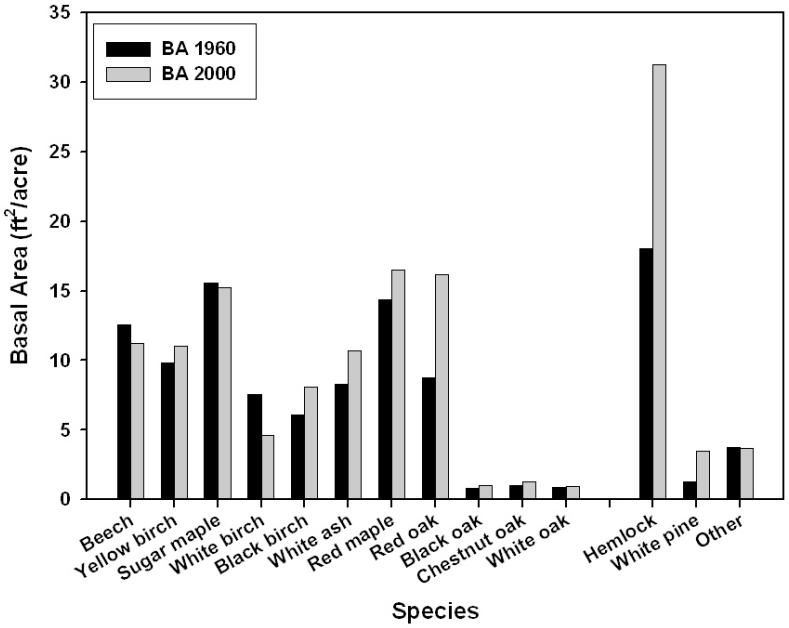

Fig. 22. Species comparison, 1960 – 2000, Mohawk/Monroe/Savoy Forest Reserve (N=36 plots). Other" includes black cherry, red spruce, norway spruce, basswood, hickory, aspen,grey birch, misidentified and unidentified species for both datasets. In 1960 there were additional species:butternut, gray birch, and "other oak". Each of these,with the exception of black cherry in 1960 (BA = 1.37 ft^2/acre) had a basal area of less than 1.0 ft^2/acre (DCR 1960, 2000).

A comparison of 2000 and 1960 CFI data shows that white birch has decreased, while red oak and hemlock have increased (Fig. 22). Basal area for beech, yellow birch, and sugar maple shows little change. The live tree biomass estimate from 2000 CFI data was 105.6 ± 18.1 tons/acre (N=41 plots).

Deadwood

Biomass of standing deadwood (snags) and down deadwood (coarse woody debris) was estimated using 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). The biomass estimate for standing deadwood was 3.8 ± 2.0 tons/acre (95% confidence interval) (N = 41). The down deadwood estimate was 4.5 ± 3.1 tons/acre (N = 41). Standing deadwood was composed primarily of northern hardwoods (38%), especially sugar maple, and red maple (22%). The next most abundant species were hemlock (13%) and white birch (12%). Down deadwood was 53% northern hardwoods, 17% white birch, and 13% red maple (Fig. 23).

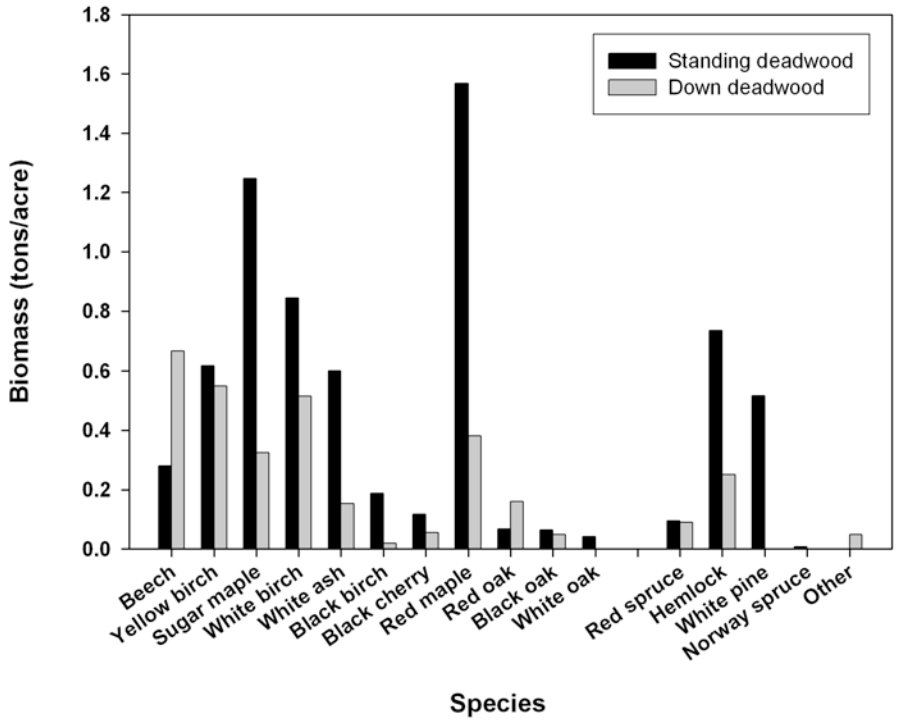

Fig. 23. Species composition of standing and down deadwood (2000 CFI data) (N=41 plots), Mohawk/Monroe/Savoy Forest Reserve. Standing deadwood, other includes white pine and Norway spruce. Down deadwood, other includes unidentified species only.

Fig. 24. Deadwood, north-facing slope, south of the Cold River, Mohawk/Monroe/Savoy Forest Reserve, Mohawk Trail State Forest (photo by Matthew Kelty).

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Appendix A: Mohawk/Monroe/Savoy Species List

Aspen	*Populus tremuloides*
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 oak	*Quercus prinus*
Gray birch	*Betula populifolia*
Hemlock	*Tsuga Canadensis*
Hickory	*Carya spp.*
Hobble bush	*Viburnum alnifolium*
Mountain laurel	*Kalmia latifolia*
Norway spruce	*Picea abies*
Poplar	*Populus spp.*
Red Maple	*Acer rubrum*
Red oak (Northern red oak)	*Quercus rubra*
Red pine	*Pinus resinosa*
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 #	State Forest	Disturbance Code	Description	Year
0084	Monroe	0	None	0
0085	Monroe	0	None	0
0086	Monroe	0	None	0
0087	Monroe	0	None	0
0088	Monroe	0	None	0
0906	Monroe	0	None	0
0908	Monroe	0	None	0
0913	Monroe	0	None	0
0914	Monroe	0	None	0
0915	Monroe	0	None	0
0916	Monroe	0	None	0
0107	Florida	0	None	0
0189	Florida	9	Harvest cut	0
0102	Mohawk	0	None	0
0103	Mohawk	6	Insects	1978
0105	Mohawk	0	None	0
0108	Mohawk	0	None	0
0109	Mohawk	7	Disease	0
0110	Mohawk	0	None	0
0111	Mohawk	9	Harvest cut	1964
0112	Mohawk	9	Harvest cut	0
0127	Mohawk	9	Harvest cut	1999
0128	Mohawk	9	Harvest cut	1997
0941	Mohawk	0	None	0
0942	Mohawk	2	Wind	1998
0943	Mohawk	0	None	0
0944	Mohawk	6	Insects	1978
0945	Mohawk	7	Disease	0
0946	Mohawk	4	Other use, cleared	0
0947	Mohawk	0	None	0
0948	Mohawk	2	Wind	0
0949	Mohawk	7	Disease	0
0950	Mohawk	7	Disease	2000
0952	Mohawk	9	Harvest cut	1964
0953	Mohawk	0	None	0
0954	Mohawk	0	None	0
0962	Mohawk	3	Snow & Ice	0
0113	Savoy	0	None	0
0191	Savoy	0	None	0
0204	Savoy	5	Other use, pastured	1920
0218	Savoy	8	Timber stand improvement	1995

Appendix C: Mohawk/Monroe/Savoy Reserve – Core Habitats and Rare Species
Massachusetts Natural Heritage and Endangered Species Program
Biomap and Living Waters

HABITATS

Massachusetts NHESP has identified the following core habitats within the Mohawk/Monroe/Savoy Forest Reserve. "Core habitats represent habitat for the state's most viable rare plant and animal population that include exemplary natural communities and aquatic habitats" (NHESP 2004). Rare species are specifically associated with the described Core Habitat. Observations are listed by town (NHESP 2008).

Core Habitat BM173

> *This Core Habitat contains a large, unfragmented mixed forest of deciduous and evergreen trees. It includes much of the Cold River and its tributaries with steep-sided riverbanks, and encompasses old-growth forest. These high-quality habitats support a wide array of rare insect species, including those of moths, butterflies, tiger beetles, and dragonflies. The area is also important for several rare plant species, and includes one of the state's few Nodding Pogonia populations. The Core Habitat provides an overwintering area for bats, includes significant habitat for Spring Salamanders, as well as wetland habitats for American Bitterns.*

Natural Communities	Status
Acidic Rocky Summit/Rock Outcrop Community	Secure
High-Energy Riverbank	Vulnerable
High-Terrace Floodplain Forest	Imperiled
Northern Hardwoods – Hemlock – White Pine Forest	Secure
Rich, Mesic Forest Community	Vulnerable

Rare Species

Plants			
Common Name	**Scientific Name**	**Status**	**Most Recent Observation**
Plants			
Autumn coralroot	*Corallorhiza odontoriza*	Special Concern	2007 (Charlemont)
Bartram's shadbush	*Amelanchier bartramiana*	Threatened	2005 (Savoy)
Crooked-Stem Aster	*Symphotrichum prenanthoides*	Threatened	2003 (Savoy)
Large-leaved sandwort	*Moehringia macrophyllla*	Endangered	2001 (Florida)
Michaux's Sedge	*Carex michauxiana*	Endangered	1994 (Savoy)
Mountain Alder	*Alnus viridis ssp crispa*	Threatened	2006 (Monroe)
Nodding pogonia	*Triphora trianthophora*	Endangered	2005 (Florida)
Northern bog violet	*Viola nephrophylla*	Endangered	
Shore sedge	*Carex lenticularis*	Threatened	2006 (Florida)
Thread rush	*Juncus filiformis*	Endangered	2001 (Savoy)
Woodland millet	*Millium effusum*	Threatened	1996 (Savoy)

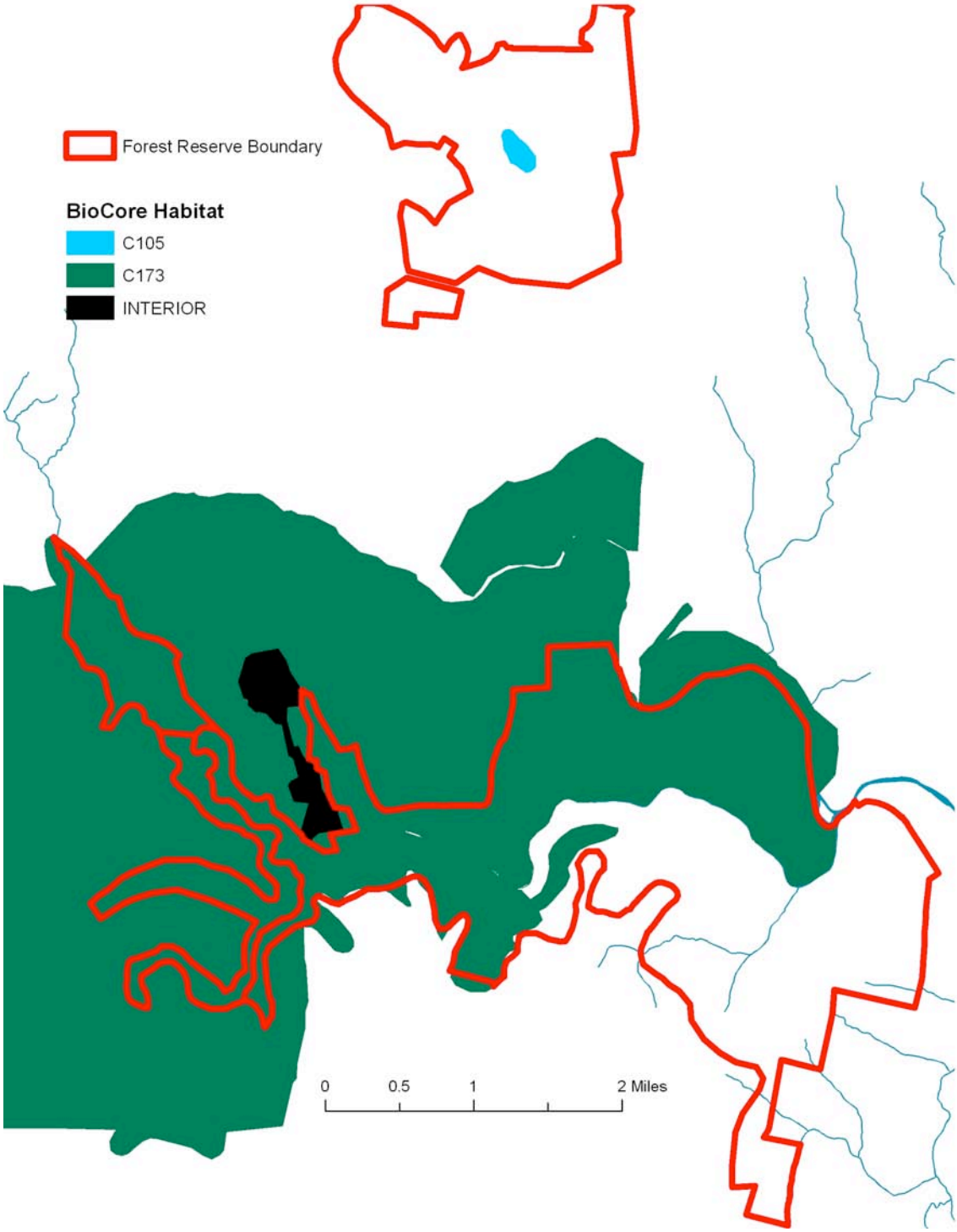
Invertebrates			
Common Name	**Scientific Name**	**Status**	**Most Recent Observation**
Beaver pond clubtail	*Gomphus borealis*	Special Concern	
Early hairstreak	*Erora laeta*	Threatened	1988 (Florida)
Orange sallow moth	*Rhodoecia aurantiago*	Threatened	
Ski-Tailed emerald	*Somatochlora elongate*	Special Concern	
Twelve spotted Tiger Beetle	*Cicindela duodecimguttata*	Special Concern	

Vertebrates			
Common Name	**Scientific Name**	**Status**	**Most Recent Observation**
American bittern	*Botaurus lentiginosus*	Endangered	2005 (Savoy)
Bat hibernaculum			
Black poll warbler	*Dendroica striata*	Special Concern	1980 (Savoy)
Spring salamander	*Gyrinophilus porphyriticus*	Special Concern	

Core Habitat BM105

Natural Communities

Although small, this Northern Hardwoods-Hemlock-White Pine community contains one of Massachusetts few remaining old-growth stands. Within this forest, tree diameters exceed 1 meter (39 inches), and hemlocks have been aged at over 300 years. Northern hardwoods – Hemlock – White pine forests have a mix of evergreen and deciduous trees, with a closed full canopy, and sparse shrub and herbaceous layers.



Appendix C. Fig. 1. Core Habitat designations within the Mohawk/Monroe/Savoy Forest Reserve (NHESP 2004).