Northern Hardwood-Conifer Forest

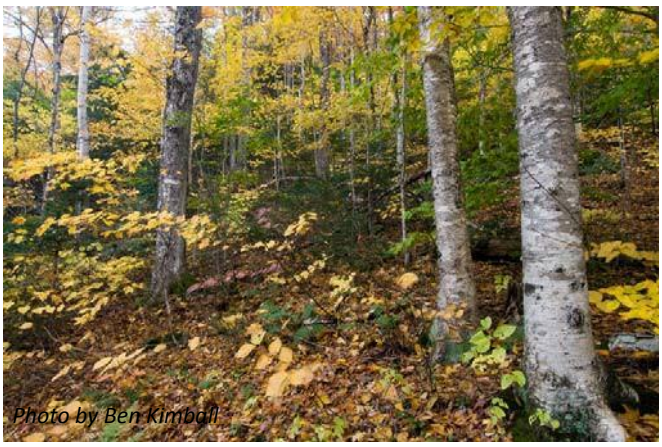
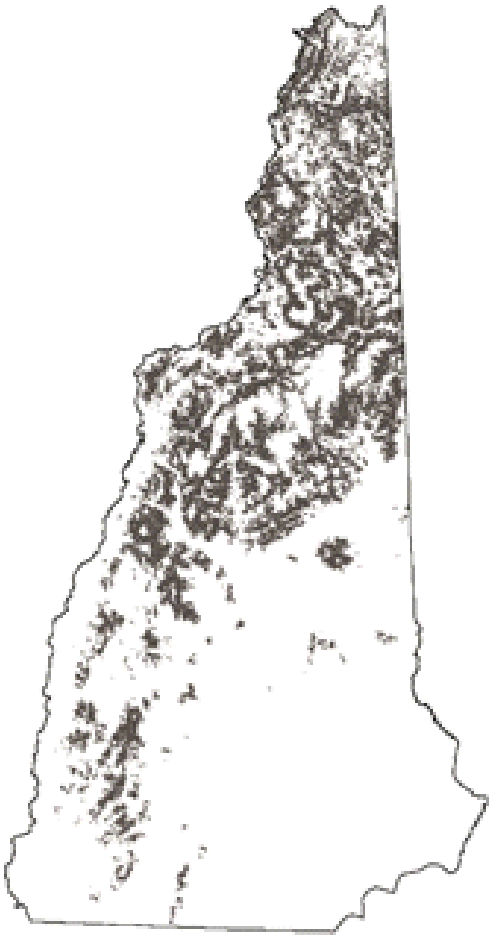


Photo by Ben Kimball

Acres in NH:	1263512
Percent of NH Area:	21
Acres Protected:	694932
Percent Protected:	55



Habitat Distribution Map

Habitat Description

Northern hardwood – conifer forests are found generally between 1,400 and 2,500 ft. in elevation in northern and central New Hampshire. In latitude and elevation, this matrix forest is positioned between the high-elevation spruce - fir and hemlock - hardwood - pine forests. The primary natural community of this system is the sugar maple - beech - yellow birch forest, which is characterized by American beech (*Fagus grandifolia*), sugar maple (*Acer saccharum*), and yellow birch (*Betula alleghaniensis*). This community forms a matrix containing patches of several other communities. Hemlock - oak - northern hardwood forests occur at lower elevations (800 to 1,500 ft.) and are differentiated from the matrix community by a substantial presence of hemlock (*Tsuga canadensis*), with red oak (*Quercus rubra*) and white pine (*Pinus strobus*) also frequent. This community occurs in valley bottoms and lower slopes of the White Mountains, and at middle to higher elevations of hills and low mountains in western New Hampshire. Hemlock - spruce - northern hardwood forests are also found at elevations below 2,000 ft. This is a conifer or mixed hardwood – conifer forest with considerable hemlock and red spruce (*Picea rubens*) mixing with variable amounts of birches, other northern hardwoods, balsam fir (*Abies balsamea*), and sometimes white pine. It occurs primarily on river terraces, stream ravines, and compact till settings in the mountains, where it transitions to more typical northern hardwoods on richer soils (e.g., fine tills). Semi-rich mesic sugar maple forests are a common but relatively small part of this system, found where there is slightly enriched till or fine river terrace sediments. Both beech forest and hemlock forest types are occasional in this and hemlock -

hardwood - pine forest habitats, but generally form small patches.
Northern hardwood - spruce - fir forests mark the transition to the high-elevation spruce - fir forest habitat, but in most cases are considered part of the northern hardwood - conifer forest system because the hardwood trees that disappear in high-elevation spruce - fir (due to climate and/or soil conditions) are still present. Some spruce - fir or mixed forests that have been cut or heavily disturbed may currently support a hardwood or mixed forest canopy, and may or may not succeed to greater spruce - fir prominence.

Justification (Reason for Concern in NH)

Northern hardwood - conifer forest covers approximately 20% of New Hampshire. Available data indicate that approximately 55% of the state's northern hardwood - conifer forest is on permanently protected lands. This forest type supports 137 vertebrate species in the state, including 42 mammals, 73 birds, 8 reptiles, and 14 amphibians. Threatened and endangered wildlife species occurring in this forest type include peregrine falcon and bald eagle. Development pressure is heavy within some parts of the range of northern hardwood - conifer forest in New Hampshire, particularly in the Lakes Region and the perimeter of the WMNF.

Protection and Regulatory Status

Much of New Hampshire's northern hardwood - conifer forest is under private management for production of pulp, veneer, and lumber. Approximately 55% of this forest type occurs on conservation lands. Public ownerships include the WMNF, Lake Umbagog National Wildlife Refuge, various state lands, and town forests and conservation lands. Extensive areas of northern hardwood - conifer forests occur on the Connecticut Lakes Headwaters property, which are protected by a conservation easement held by DRED. Several non-governmental conservation organizations also hold northern hardwood - conifer forest lands in fee or easement.
Forestry on state lands is covered by RSAs 216, 217, and 218. RSA 227 stipulates requirements for residual basal area in riparian areas. The manuals "Best Management Practices for Erosion Control on Timber Harvesting Operations in New Hampshire" (NHDFL 2004) and "Good Forestry in the Granite State" (Bennett 2010) provide recommended management practices for sustainable forestry in New Hampshire.

Distribution and Research

Northern Hardwood-Conifer forest occurs primarily in northern New Hampshire, with approximately 45% by area in Coos County and approximately 30% in Grafton County. Carroll and Sullivan counties support 5 to 10%, and Belknap, Cheshire, and Hillsborough counties support less than 5%.
Additional fieldwork is needed to evaluate correlations between soil series and forest type as outlined in Homer (2005). County soil surveys outline soils suitable for forestry from an economic perspective. However, little has been done to evaluate soils from an ecological perspective (e.g., if left unmanaged, an area with a particular soil would eventually succeed to northern hardwood-conifer forest).

Relative Health of Populations

Relative Health of Populations: The acreage of northern hardwood - conifer forest on conservation lands increased significantly as a result of several large land protection projects in the past 15 years, including the Connecticut Lakes Headwaters, expansion of Lake Umbagog NWR, and the Androscoggin Headwaters Forest Legacy Easement.

Habitat Condition

A set of GIS data was used to assess ecological condition of each habitat type. Chapter 3 describes the methodology. The data used for this habitat is described below.

Biological Condition:
Species richness of rare animals within their dispersal distances from the polygon
Species richness of rare plants in polygon
Richness of rare and exemplary natural communities in polygon
Vertebrate species richness (VT/NH GAP Analysis)

Landscape Condition:
Landscape Complexity
Local Connectedness
Similarity of habitat within 5km
Size of unfragmented block within which matrix forest is located

Human Condition:
Index of Ecological Integrity

Habitat Management Status:

Certified Tree Farms cover approximately 55% of the two-county area in which approximately 80% of New Hampshire's potential northern hardwood - conifer forest area occurs (calculated from TNC data and data in Thorne and Sundquist 2001).

Threats to this Habitat in NH

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

Habitat degradation and mortality from insect pests (Threat Rank: High)

There are a number of non-native insect pests that have the potential significantly impact forest habitats, including gypsy moth, hemlock wooly adelgid, emerald ash borer, and Asian longhorned beetle. In northern hardwood – conifer forests, where white ash is a frequent canopy tree, emerald ash borer (EAB) currently presents the greatest threat, with the potential to virtually eliminate this species from New Hampshire forests.

There are 3 species of ash (*Fraxinus* spp.) native to New Hampshire, all of which are vulnerable to attack from emerald ash borer. The most common, white ash, is widespread in upland forests, and is a frequent, if rarely dominant, component of northern hardwood – conifer forests (Morin & Pugh 2014). EAB is a non-native beetle from Asia that became established in Michigan in 2002, where larval infestations began attacking native ash species. Since then it has spread throughout the midwest and northeastern U.S., resulting in the mortality of tens of millions of ash trees (USFS 2008). While biological control methods are in development, the spread of EAB has been unchecked to date. EAB

was first discovered in NH in 2013 in Concord. Since then it has been documented in 10 towns in the southern part of the state.

Habitat impacts from an increase in invasive plants moving north (Threat Rank: Medium)

Many invasive plants are currently limited by temperature, and are likely to expand northward into New Hampshire as a result of climate change. These species can displace or outcompete native plants and alter the composition and structure of habitats.

Invasive species can have a variety of negative impacts on natural communities and habitats (Stein and Flack 1996). In some cases, they can alter the chemistry of forest soils, leading to permanent changes in species composition (Ehrenfeld et al. 2001). A warming climate can enhance the spread of invasive plants through multiple pathways (Hellman et al. 2008).

Habitat degradation and impacts (fragmentation) from increased demand for wind power and associated transmission lines (Threat Rank: Medium)

Within the past 10 years, there have been 3 large scale wind energy facilities constructed in New Hampshire. These "wind farms" are typically located on long ridgetops to maximize exposure to sustained winds, and include turbines that are approximately 400 feet tall, which can pose a significant threat to birds and bats. Birds that migrate along ridgelines at night are at greatest risk for tower collision by becoming disoriented when encountering lighted towers (Partners in Flight, unpublished data). The habitats that occupy the footprints of wind turbines and transmission corridors are lost, and the remaining adjacent habitat is fragmented.

Kerlinger (2000) prepared an extensive literature review for the USFWS Office of Migratory Bird Management on avian mortality at towers and turbines. Birds that migrate along ridgelines at night are at greatest risk for tower collision by becoming disorientated when encountering lighted towers (Partners in Flight, unpublished data). Current estimates of the numbers of birds killed annually by communication towers range between 4 and 10 million (www.towerkill.com). A study at a West Virginia wind energy facility identified significant mortality of bats from collisions with wind turbines (Hein et al. 2013).

Habitat degradation from warming conditions that allow cold-limited forest pests to move north (Threat Rank: Medium)

New Hampshire forests are currently at risk from a variety of insect pests (emerald ash borer, balsam wooly adelgid, gypsy moth, etc.). The current ranges of some of these pests, such as hemlock wooly adelgid, are believed to be limited by cold winter temperatures (NHDFL 2015). Under a warming climate scenario, the ranges of some of these species could expand, and new insect species could move into the state.

Hemlock woolly adelgid has significantly impacted stands of hemlock in the southern and central Appalachians, but has only spread slowly in northern New England due to its inability to tolerate cold winter temperatures (Paradis et al. 2007). However, under warming climatic conditions, it could expand its range northward, with the potential for widespread mortality of hemlock in New Hampshire.

Habitat degradation from increased ice and wind storms that cause damage to trees resulting in acceleration of species composition changes (Threat Rank: Medium)

More frequent disturbance events (e.g., hurricanes, ice storms, tornadoes) will likely favor shade-intolerant, early successional species (paper birch and aspen) over shade tolerant, late successional species (beech and hemlock). Higher rates of disturbance would also alter the relative proportions of different seral stages of forest.

Many climate change scenarios predict that intense storms with high winds and heavy rainfall will become more frequent (Hayhoe et al. 2008). In general, hardwood tree species tend to be more vulnerable to damage from ice storms than softwood species (Miller-Weeks et al. 1999). These storms could cause widespread impacts to forests through windthrow and damage to tree canopies, leading early successional species to become more abundant, but evidence to support these predictions is speculative.

Habitat conversion and impacts to wildlife from fragmentation (Threat Rank: Medium)

Within the past 10 years, there have been 3 large scale wind energy facilities constructed in New Hampshire. These facilities include wind turbines that are approximately 400 feet tall, which can pose a significant threat to birds and bats. Birds that migrate along ridgelines at night are at greatest risk for tower collision by becoming disoriented when encountering lighted towers (Partners in Flight, unpublished data).

There were 78 known towers sited in New Hampshire as of 2010 (www.towerkill.com) and 475 towers currently mapped by NHFG. Kerlinger (2000) prepared an extensive literature review for the USFWS Office of Migratory Bird Management on avian mortality at towers and turbines. Current estimates of the numbers of birds killed annually by communication towers range between 4 and 10 million (www.towerkill.com). Bats are also vulnerable to impacts from wind energy facilities. Based on field data collection in a study of bat mortality at a wind energy facility in West Virginia, Hein et al. (2013) estimated a mortality rate of roughly 100 bats per turbine per year.

Habitat conversion due to development (Threat Rank: Medium)

Development reduces matrix forest habitat by converting natural forest to landscaped lawns and impermeable surfaces (e.g., buildings, roads). Development also contributes to forest fragmentation by directly reducing habitat, increasing traffic on existing roads, and requiring construction of new transportation infrastructure.

A study of 10 New Hampshire communities found that their populations increased by an average of 70.9% (range 9.7 to 189.7%) between 1974 and 1992, while developed land increased by an average of 137.2%. In the community with 9.7% population growth, developed land increased by 15.9% (New Hampshire Office of State Planning (NHOSP) 2000).

Habitat conversion resulting from decisions on land use and management (Threat Rank: Medium)

In New Hampshire, land use decisions are made at the municipal scale by volunteer planning boards with little or no training in natural resource issues. In cities and some of the larger towns, professional planning staff evaluate proposed developments and provide input to the planning board, but this is the exception rather than the rule. Most professional planners lack training in ecology or natural resources. Decisions are typically based on engineering and aesthetic considerations, with no recognition of direct or cumulative impacts on the underlying ecological functions of the affected lands or on impacts to wildlife habitat.

A Growth Management Advisory Committee convened by the New HOSP in 1999 concluded that:
• Impacts of growth and development are cumulative over decades
• Development in New Hampshire has occurred incrementally, resulting in fragmentation and loss of important and environmentally sensitive areas, including forestlands and wildlife habitat
• Communities seldom evaluate the potential impacts of their zoning ordinance or land use regulations (NHOSP 2000)

List of Lower Ranking Threats:

Habitat and species impacts from salvage logging that occurs after storms and pest invasions resulting in species composition changes

Species and habitat impacts from species composition changes related to climate change

Habitat degradation from mercury deposition

Habitat degradation from acid deposition

Habitat conversion and degradation of forest to permanent openings and infrastructure, fragmentation, and disturbance to wildlife by visitor activity

Habitat degradation and mortality from legal and illegal OHRV and snowmobile activity

Disturbance and habitat degradation from hiking and biking trails

Habitat impacts and conversion from the reduction in forest-based economy and infrastructure

Mortality and habitat degradation from road fragmentation

Mortality and habitat degradation from the creation and presence of roads

Habitat degradation from increased storm intensity and frequency

Actions to benefit this Habitat in NH

Incorporate habitat conservation into local land use planning

Primary Threat Addressed: Habitat conversion resulting from decisions on land use and management

Specific Threat (IUCN Threat Levels): Residential & commercial development

Objective:
Enhance protection of northern hardwood - conifer forests by incorporating conservation goals into planning documents, such as municipal and regional master plans, zoning ordinances, and subdivision regulations.

General Strategy:
The critical gap that NHFG can address is the scientific basis for implementing land use policies and regulations that protect the ecological function and health of wildlife populations and their habitats. This technical assistance needs to be combined with an integrated approach to land use decisions among local decision-makers. NHFG should work with UNH Cooperative Extension and New Hampshire Office of Energy and Planning, key outreach partners to facilitate training for NHFG biologists on the integration of wildlife habitat information into local land use planning and regulation. Likewise, Cooperative Extension can facilitate training for town planners, planning boards,

regional planners, and others involved in writing master plans and local ordinances, on how to integrate wildlife considerations into local planning.

Political Location:
Statewide

Watershed Location:
Pemi-Winni Watershed

Location Description:
Northern hardwood - conifer forests occur statewide, but are most prevalent in central and northern NH.

Continue monitoring program to identify new pests and pathogens that threaten forest health.

Primary Threat Addressed: Habitat impacts from an increase in invasive plants moving north

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

Objective:
The objective is to protect forest habitats from new forest pests arriving in New Hampshire as a result of movement by people or natural dispersal.

General Strategy:
The Division of Forests and Lands Forest Health Program currently conducts regular monitoring of forest health issues, and undertakes activities specifically designed to document the arrival of new pests and pathogens. One example is the program using swimming pool filters to try and document occurrences of Asian longhorned beetle.

Political Location:
Statewide

Watershed Location:

Protect unfragmented blocks and other key wildlife habitats.

Primary Threat Addressed: Habitat conversion due to development

Specific Threat (IUCN Threat Levels): Residential & commercial development

Objective:
The objective is to protect the largest and highest quality occurrences of northern hardwood - conifer forest habitat, with an emphasis on developing and maintaining corridors for wildlife movement and species dispersal.

General Strategy:
NHFG should use maps of prioritized unfragmented blocks and other key habitat information to review and identify land protection projects. These maps should also be distributed to the conservation community. Virtually all wildlife and habitats will directly or indirectly benefit from habitat protection, and the land protection strategy should be viewed as one of the most important ways to ensure long-term wildlife protection.

Political Location:
Statewide

Watershed Location:
Pemi-Winni Watershed

Location Description:
Northern hardwood - conifer forests occur statewide, but are most prevalent in central and northern NH.

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2015 Authors:
Peter Bowman, NHNHB

2005 Authors:
Carol R. Foss, NHA

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