Chapter 3

Woods Road: Barry Parrish/USFWS

Affected Environment

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Introduction

This chapter describes the physical, biological, and sociological environment of the John Hay Refuge. We begin with the physical landscape, the setting of the Refuge and our project area, including historical information, followed by Refuge administration and programs and then, descriptions of specific Refuge resources.

The Physical Landscape

Watershed

Our project area is part of the Lake Sunapee watershed, a drainage basin of 30,947.74 acres encompassing parts of Merrimack and Sullivan counties (SAWC 2008; see Map 3-1). This watershed is part of the Southern Upland Watersheds grouping in New Hampshire (NH FGD 2005), comprising 23 percent of the state's total area. Lake Sunapee is one of three lakes in this grouping larger than 1000 acres. Watersheds in this category are characterized as moderate, lacking the extremes of elevation or gradient found in other groupings, and by a higher percentage of hills and side slopes and higher natural acidity.

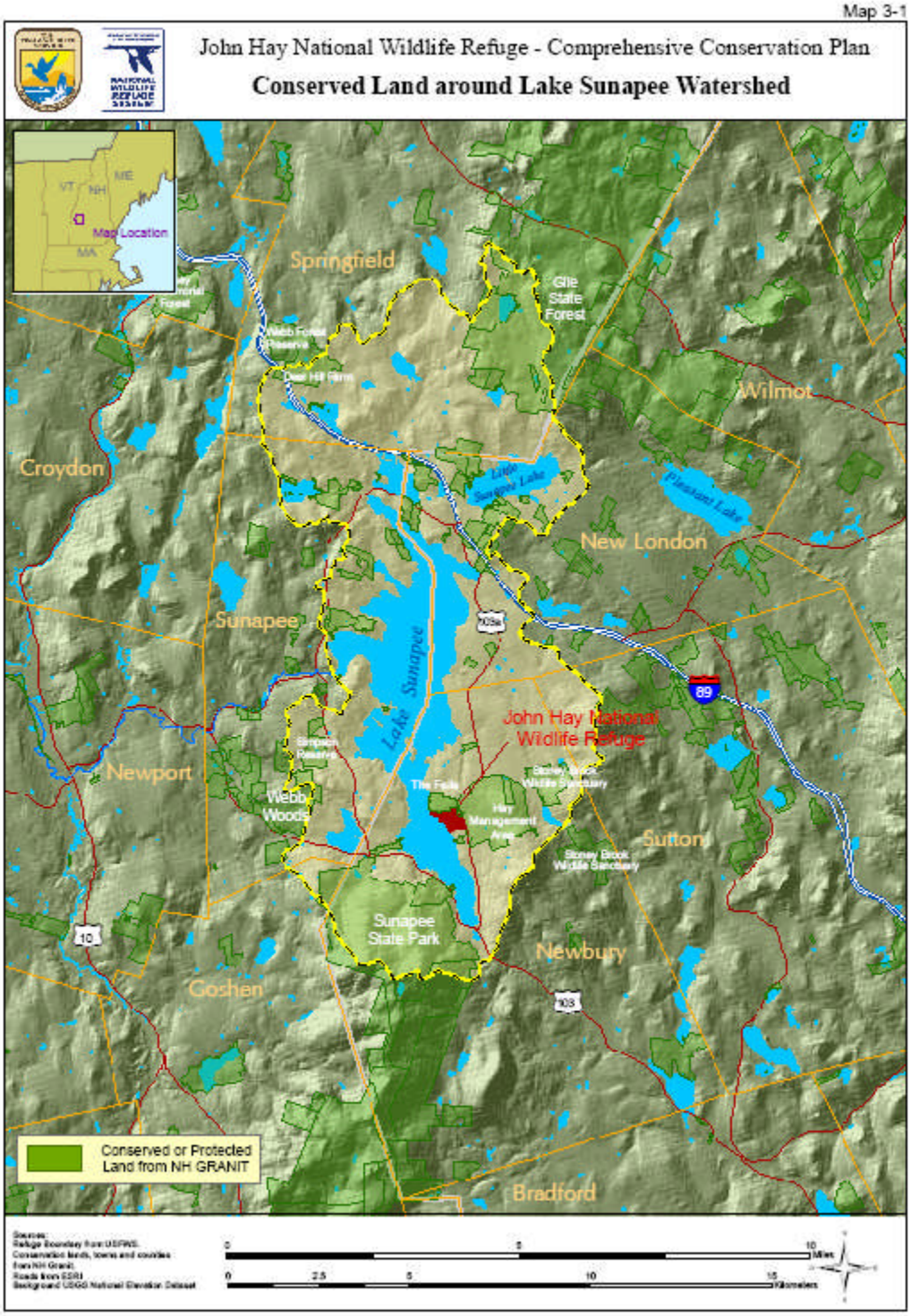
Developed land represents 3.3 percent of the total land area in Southern Upland Watersheds, or moderate-south watersheds, while 78 percent remains unfragmented. Conserved lands make up 19 percent of the total area, and there is a higher percentage of agriculture than in other areas of the state (5.1 percent; NH FGD 2005; see Map 3-1). These conserved lands around Lake Sunapee include the Refuge, The Fells, the Hay Reservation (Forest Society) across Route 103A from the Refuge, Stoney Brook Wildlife Sanctuary (NH Audubon) on Sunset Hill, and Sunapee State Park, among others. An array of habitat types within this watershed grouping support species such as Atlantic salmon (*Salmo salar*), bald eagle (*Haliaeetus leucocephalus*), common loon (*Gavia immer*), eastern brook trout, lake trout (*Salvelinus namaycush*), osprey (*Pandion haliaetus*), and wood turtle. While no critical threats have been identified for this watershed grouping at this time, acid deposition and non-point source pollution could pose problems in the future (NH FGD 2005).

These Southern Upland watersheds contain the major tributaries for larger river systems like the Merrimack and Connecticut Rivers (NH FGD 2005). One of these tributaries, the Sugar River, is part of the 11,000 square mile Connecticut River drainage basin. The headwaters for the Sugar River start at the outflow of Lake Sunapee in the Town of Sunapee, and then flow 27 miles west before meeting the Connecticut River west of the town of Claremont. Though the entire Connecticut River watershed is 7.2 million acres across four states, our project area comprises only 80 acres on the southeastern shores of Lake Sunapee in the Town of Newbury.

Notable Physiographic and Landform Features

Geomorphic regions or "physiographic provinces" are broad-scale subdivisions based on terrain texture, rock type, and geologic structure and history. Our project area lies in the New England Upland section of the Appalachian Highlands delineated by the USGS (http://tapestry.usgs.gov/physiogr/physio.html). The New Hampshire Department of Fish and Game refers to that region as the Sunapee Uplands (NH FGD 2005). This glaciated subsection is characterized by isolated hills and peaks of hard, resistant rock (mostly granite) commonly referred to as monadnocks (Sperduto and Nichols 2004). Granite, gneiss, and schist underlie this plateau (Poole 2008). Numerous small lakes and narrow valley streams are scattered throughout the area. John Hay Refuge lies on the lower slopes of Sunset Hill, one of several hills rising east of Lake Sunapee.

Map 3-1


John Hay National Wildlife Refuge - Comprehensive Conservation Plan
Conserved Land around Lake Sunapee Watershed
Map Location
VT
NH
ME
MA
Springfield
Gile State Forest
Wilmot
Croydon
New London
Sunapee
Lake Sunapee
John Hay National Wildlife Refuge
Newport
Webb Woods
Sutton
Sunapee State Park
Newbury
Goshen
Bradford
Conserved or Protected Land from NH GRANIT
Miles
Kilometers

Major Historical Influences Shaping Landscape Vegetation

Estimating what the historic natural vegetation types were, how they were distributed, and what ecological processes influenced them prior to major, human-induced disturbance, can help us evaluate future management options. However, many ecologists caution against selecting one point in time, and instead, recommend evaluating the "historical range of variation" for each habitat type.

According to noted ecologist Robert Askins of Connecticut College, "This approach recognizes that the proportions of grassland, shrub land, young forests, and old-growth forests have shifted constantly over the past few thousand years as the climate changed and people have modified the land by hunting, burning, and farming. Preserving the biological diversity of any region requires a range of habitat types, including those created by natural disturbances. If there are no natural or artificial disturbances generating grassland, shrub land, and young forest, then not only will early succession obligates be in trouble, but so will mature forest specialists that use early succession habitats at key points in their life cycles. Only large public lands like refuges, parks, preserves can sustain the full range of early succession and forest habitats, so in most regions land managers will need to cooperate to ensure that these habitats are adequately represented across the regional landscape" (Askins 2000).

A brief summary of influences on natural vegetation patterns across the landscape follows.

Glaciation

New Hampshire, like all of New England, was covered by the Laurentide ice sheet during the last glacial maximum (LGM), approximately 21,000 to 18,000 years before present (YBP). The effect this had on the geology and topography of New Hampshire was significant. Huge amounts of bedrock and soil were scoured, smoothed and redistributed, glacial erratics were deposited many miles from their origin, and many lakes and ponds, including lakes Winnipesaukee and Massabesic, now have irregular basins as a result of glacial advancement (Potter 1994).

In conjunction with glacial advance and retreat, sea level rose and fell. At LGM, much of what is now the submerged continental shelf along the New England coast was exposed dry land because much of the world's water was locked up in continental ice sheets. It is estimated that worldwide sea levels were lower than today by 85-130 meters (279 to 427 feet; Pielou 1991). As the ice sheets retreated, sea levels gradually rose. In addition, the earth's crust was slowly rebounding from the heavy weight of ice, but not as fast as sea levels were rising. This caused coastal flooding along the coast as far south as Boston (Jorgensen 1971). In New Hampshire, there is evidence that sea levels encroached as far inland as Kingston, Lee and Rochester (Potter 1994). By about 12,000 YBP the coastline between the Bay of Fundy and Cape Cod was much as it is now (Pielou 1991)

As the ice retreated, the landscape showed the immediate effects. Drumlins composed of glacial till were deposited as the ice retreated and kettle hole lakes and ponds were formed from freestanding melting blocks of glacial ice. Perhaps most significantly, proglacial lakes were formed as a result of the voluminous meltwater coming off the ice sheets, and in some cases were up to 200 miles in length, spanning what are now Connecticut, Massachusetts, Vermont and New Hampshire (Potter 1994, Pielou 1991, Jorgensen 1971). Keene and Concord were also sites of smaller proglacial lakes. In the White Mountains, glacial cirques, or steeply rounded basins, and valleys were transformed by glaciation (Jorgensen 1971). New Hampshire today is known for its stony soils, developed from the deposition of glacial till comprised of clay, silt, sand, cobbles and boulders. It covers approximately 85 percent of the state (Potter 1994).

The advance and subsequent retreat of the glacier, and changing climate had a profound impact on the local biota. With the advance of the glacier, many northern species were locally displaced and subsisted

in southern areas of refugia. The retreating glacier marked a period of time when much of the physical environment was in a constant state of flux. Climatic factors such as temperature, precipitation, humidity, and atmospheric carbon dioxide were fluctuating. The earth's crust was rebounding at the same time that sea levels were rising, and the local hydrology was still in a dynamic state. The glacier itself was directly altering the landscape as it retreated by depositing till, boulders, isolated slabs of ice that melted to form kettle hole ponds, and by forming proglacial lakes as a result of the voluminous meltwater pouring off the retreating glacial front (Williams 2002, Jackson et al. 2000, Prentice et al. 1991). Combined, these factors made for ever-changing conditions as plant and wildlife species attempted to recolonize the area.

As the climate changed, so did the landscape. By approximately 13,000-10,000 YBP, New England's pro-glacial lakes drained and formed terraces or "delta plains" which proved excellent sites for human habitation due to their well-drained soils, proximity to waterways and position above the floodplain (Jorgensen 1971, Potter 1994). The basins themselves often became the site of wetlands, connected by small streams and ponds. By 7,000 YBP, major rivers throughout the region reached their present channels due to the isostatic rebound of the earth's crust, after several thousand years of widely meandering courses. Hence, the present-day alluvial floodplain began to develop (Potter 1994).

Vegetation was influenced not only by climate, but also by the changing landscape. Proglacial lakes and changing drainage systems posed an initial barrier to species colonization, but also a fertile bed for plants once the water was gone (Pielou 1991). Strong winds created dunes, and carried soil and seeds (Jorgensen 1971, Pielou 1991). The thin layer of rocky glacial till required time to form deeper, moister soil suitable for certain species of plants.

Initially, tundra-like vegetation was established and persisted for several thousand years until it was eventually replaced by forested communities. Rates of recolonization vary by tree species according to the specific habitat requirements of each. Recently, it has been shown that regional temperature and moisture levels working in concert may better explain the variability in the post-glacial phytogeography in New England, than temperature alone.

By 14,600 YBP spruce (*Picea sp.*) populations were prevalent in New England and they persisted until 11,600 YBP when white pine became the dominant taxa, replacing spruce during a drier, warmer climatic period. Hemlock, beech and birch increased by about 8,200 YBP, replacing the white pine after a concurrent rise in moisture availability. Hemlock, a more mesic species, experienced a population crash around 5,400 YBP. Originally thought to have been due to the first recorded occurrence of a pathogen, recent evidence indicates that its decline took place during a drier microclimate which may also have been a factor. Deciduous species such as hickory (*Carya sp.*) and chestnut (*Castanea dentata*) were much slower to reach New England, 6,000 YBP and 3,000 YBP respectively. This was likely due to regionally cooler temperatures and lower moisture levels than today (Shuman et al. 2004, Shuman et al. 2005).

Present day forests, consisting of hemlock, beech and yellow birch, were beginning to establish by 8,000 YBP. Sea-levels reached their present day levels by approximately 3,000 YBP, and by 4,000 YBP a fluctuating climate began that was characterized by cooler, wetter conditions than today, which persisted until the late 19th century (Potter 1994).

More Contemporary Influences on Vegetation Patterns

Natural disturbances vary across New England, depending on geographic location, forest type, and local conditions. For example, hurricane damage is greater on exposed versus sheltered slopes, lightning fires are more frequent on exposed ridges and on sandy versus loamy soils, and shallow root systems make softwoods vulnerable to wind-throw, particularly on shallow and poorly drained soils.

Historically, a general gradient of decreasing disturbance frequencies extends from coastal regions to interior uplands and mountains. In pre-settlement times, coastal oak-pine regions likely had more than 10 percent in early successional forest conditions, while interior northern hardwoods had one percent to three percent of young forest. The proportion of young forest in spruce swamps and spruce flats may have been as high as seven percent. Northern hardwood and mixed woods may have higher proportions of early successional stages today than in pre-settlement times, based on disturbance patterns (Lorimer and White 2003).

Native insects and disease, ice storms, droughts, floods, landslides, and avalanches have caused minor and major disturbances. For example, spruce budworm (*Choristoneura fumiferana*) periodically affects millions of acres of spruce-fir forest in northern New England and southern Canada, and the 1998 ice storm damaged forests, particularly hardwoods, across 12 million acres in northern New England (DeGraaf and Yamasaki 2001). Lorimer and White (2003) depict hurricane frequencies as varying from 85 years in southeastern New England, 150 years through central Massachusetts and the southeast corner of New Hampshire, to 380 years or more in northern New England. Lorimer (1977) estimated catastrophic disturbances from fire and wind throw at intervals of 800 and 1,150 years, respectively. In contrast, small gap disturbances were frequent in our forests, and may have occurred at scales smaller than what are currently delineated as "stands" today (Seymour et al. 2002).

In the 19th century, the climate began a general warming trend that continues today (Potter 1994). Tracking annual average temperatures over the past hundred years or so (1895-2007), New Hampshire shows a calculated trend of +1.96 degrees F (http://nhclimateaudit.org/index.html). Contemporary forests on the Refuge are classified as transition hardwood conifer, consistent with this latitude, elevation and current climate. This is characterized by the presence of beech, yellow birch, sugar maple, and hemlock, white pine and red oak, and is typical for mid-elevation sites between 2,000-4,000 feet, and occasionally as low as 1,000 feet.

Hemlock and sugar maple along the shore: Erin Victory

A recent forest inventory on the Refuge indicates that contemporary forest stands have developed from what was old-field habitat (former farmland) through natural processes (LaPointe 2008). The Hay family, after taking ownership in the 1890's conducted very little forest management. Stand structure is uneven, however, with at least three age classes present. This is at least partially explained by the losses incurred

during the 1938 hurricane, for which wind speeds on Mount Washington recorded 100 mph. Though specific losses on the Refuge are unknown it is estimated that half of New Hampshire's white pines were lost, and that the timber blow down was equivalent to 10 years worth of a normal cut for the state (Scotti 2003). A second age class on the Refuge is roughly 70 years old as a result. Other wind events and lightning strikes, and possibly insects and disease are small disturbances that have helped to create variability in age classes.

We describe in the next section some of the human activities that caused the current vegetation composition.

The Cultural Landscape Setting and Land Use History

Early Native American and European Influences

The earliest evidence of human settlement in New Hampshire is approximately 11,000 YBP by the Abenaki, or "People of the Dawnland" (NH Folklife Learning Center (NH FLC) 2004). The Abenaki people are a local group of the Algonquin Indians that share the Abenaki language, and can be further subdivided into bands including the Penacook, Winnipesaukee, Pigwacket, Sokoki, Cowasuck and Ossipee (NH FLC 2004). At least twenty-three prehistoric sites including settlements and roadways have been found on New Hampshire's sandy terraces formed by the drainage of pro-glacial lakes (Potter 1994; see above).

The Archaic Period (9,000-2,700 YBP) was characterized by seasonal movements of the Abenaki across the region, and a dependence on hunting, gathering and fishing to survive (State History Guide (SHG) 2008). Later during the Woodland Period (2,700-350 YBP), semi-permanent villages were established and communities developed that centered on trading. Clay beds were used for pottery, and bow and arrow technology dominated this time period (SHG 2008, Potter 1994). It was during this time that slash-and-burn agriculture began.

By the time of the Contact Period (350-250 YBP), New England Indians affected their environments minimally, but in different ways. To the south, life was based on agriculture with hunting and fishing used to supplement these stores in winter. In the north, life was dependent on hunting and fishing year-round. Due to the limitations and the intensive work involved in acquiring resources, population densities remained relatively low throughout the region. Throughout New England, there was an estimated Indian population of 70,000-100,000 by 1600, with the majority being in the southern, agriculture-based societies (Cronon 1983). Both societies held the village as the central organizing unit, and both societies were highly mobile. In this way too, they minimized their impacts on the land.

Southern New England Indians burned areas to clear woody debris, and planted crops of maize, beans, and squash. They used the same fields for 8-10 years until they became nutrient depleted, and then moved to other sites. Hunting, primarily bear and deer, and fishing, was emphasized during parts of the year when crop stores were running low or depleted. During the winter, the larger summer camps were often broken up into smaller units to be able to spread farther across the landscape to better utilize available resources. In addition, winter camps were often in different areas because by that time, fuel resources were depleted (Cronon 1983).

Northern New England Indians were more dependent on hunting and fishing year-round, because shallow, rocky soils limited agricultural production. They existed in smaller units to maximize resource utilization. Travel for them was primarily on waterways in birch-bark canoes, and fire was not used as much to clear forest understories or to create openings.

Researchers agree that the historical record offers clear evidence of use of fire by Native Americans (Foster and Motzkin 2003, DeGraaf and Yamasaki 2001). Fire was not only a tool for clearing land for agriculture, but was also a way to keep the forest understory clear to facilitate travel and hunting. However, Foster and Motzkin (2003) suggest that little historical evidence exists for the widely accepted idea that extensive areas of openland (grasslands, shrublands, heathlands) existed in pre-settlement times. Their research of pollen records indicates that the landscape was dominated by mature forest with localized patches of upland grasslands and shrublands before European arrival. Low-intensity natural disturbances including wind, ice and insects were frequent and local, while higher-intensity large-scale disturbances including hurricanes, tornadoes, and insect epidemics were infrequent. Beavers (*Castor canadensis*) created extensive wet meadow habitat, although there is no evidence that large grazing animals would have maintained open areas in the uplands (Foster and Motzkin 2003). They suggest an emerging view that the native populations were mobile and practiced shifting agriculture, creating a mosaic of forest ages, but not extensive areas of cleared land.

The 1600's brought the first European settlers to what is now known as New Hampshire. Throughout this period and beyond, settlers made use of the abundant resources New Hampshire had to offer. Whereas the philosophy of the Indians was to be mobile and diversify, and thereby ensure the continuation of the resources on which they depended, the philosophy of the colonists was significantly different. Their philosophy centered on a permanent village or town, and a fixed landscape in and around it, and so the landscape changed accordingly (Cronon 1983).

Land was cleared for farming, fuel, housing, and other facets of colonial life. Wood products emerged from New Hampshire's forests as one of the first exports, including pine for the masts of the Royal Navy, and oak for ships and casks (Garvin 1999). In fact, New Hampshire and Maine were the centers of commercial lumbering, where a variety of valuable species including white pines as large as four to six feet in diameter and 120-200 feet tall could be found (Cronon 1983). The uses for wood in villages as well as for export became evident as great tracts of forests dwindled and species such as cedars and pines were not recovered, but often replaced with hardwood species.

Trade between the colonists and Indians was economically important to both. As demand increased for furs and skins, and as introduced diseases began to reduce Indian populations, the ecosystem began to change. The fire regime once used by Indians to maintain a variety of successional habitats was changing because there their populations were declining, and the encroachment of colonial settlements throughout the landscape prevented it (Cronon 1983). Forests began to mature and change in composition, and available local wildlife species began to change. In addition, the heavy demand on wildlife for trading reduced populations of species like bear, wolf, turkey, deer, and beaver.

The 1800's witnessed the demise of many forest wildlife species in New England from the loss of habitat (forest clearing), bounty and market hunting, millinery trade, and natural history specimen collecting (Foster et al. 2002). Mountain lion (*Puma concolor*), gray wolf (*Canis lupus*), elk (*Cervus elaphus canadensis*) and caribou (*Rangifer tarandus*) were extirpated by the mid-1800s or early 1900s, and only the gray wolf recently returned to the region in small numbers in Maine. Other forest species declined, including moose (*Alces alces*), black bear, beaver, wild turkey (*Meleagris gallopavo*) and pileated woodpecker (*Dryocopus pileatus*). Heath hen (*Tympanuchus cupido cupido*), passenger pigeon (*Ectopistes migratorius*), great auk (*Alca impennis*), Labrador duck (*Camptorhynchus labradorius*), and sea mink (*Mustela vison mastodon*) became extinct at the hand of humans during the same period (DeGraaf and Yamasaki 2001, Foster et al. 2002). In contrast, grassland species such as meadowlark (*Sturnella magna*), bobolink (*Dolichonyx oryzivorus*), upland sandpiper (*Bartramia longicauda*), and woodchuck (*Marmota monax*) increased as hayfields and pastures expanded during the early 19th century (Foss 1992, Foster and Motzkin 2003).

By 1830, 80 percent of New Hampshire's land was in cultivation. In the 1840's, New Hampshire's granite stores were being mined for building materials. The ice of New Hampshire's lakes were cut into huge blocks and transported into the cities to keep foods "refrigerated" (Garvin 1999). In the mid-19th century, the focus shifted from a resource-based economy to an industrial-based economy. This was in large part due to the hydroelectric power generated by damming large rivers, lakes, and streams. By 1870, the New Hampshire textile industry was internationally recognized, and this demand for labor increased the immigrant population in the late 19th and early 20th centuries (Garvin 1999). This shift to industrialization lead to a reduction in farming throughout the state, as people abandoned their farms in favor of work in the cities.

It was no different along the shores of Lake Sunapee. Historic deeds indicate that in the 1850's and 1860's, the lands eventually acquired by John Hay for his summer estate were a collection of working farms. These typically consisted of 100 to 400 acres (they seem to have increased in size overall between 1850 and 1860 from around 100 acres up to 400 acres), farm animals including sheep, cows, oxen, horses and pigs, and cash crops including wheat, rye, oats, corn, wool, peas, beans, potatoes, orchard products, butter, cheese, maple sugar, honey and meat. As urban industry grew in New Hampshire, the next generation of would-be farmers chose instead to leave the farm for the cities, or left farming in New England for farming in the Midwest so that by the 1880's, many of these farms were sold. For those that stayed, there was a noticeable shift in agriculture, from the cash crops mentioned above to a focus on forest (timber, maple sugar) and orchard products, except what crops and animals were necessary for subsistence (Brockway 1988).

In response to the widespread abandonment of farms, the New Hampshire state government capitalized on the state's natural beauty and partnered with a number of farmers and business owners to pitch the state as a scenic destination. Targeting those who had lived in New Hampshire and moved away, and wealthy urbanites, the state flourished under programs that touted the state as a place of rest and relaxation (Garvin 1999). It was during this period that John Hay began purchasing farms along the shore of Lake Sunapee.

Deed transactions indicate that John Hay acquired his land from 1888 through 1900, combining approximately seven farms, or portions of these farms, along the eastern shore of Lake Sunapee and the western slope of Sunset Hill totaling 976 acres. One of these deed transactions was for several portions of the Rowe farm, one of which was 126 acres along Lake Sunapee, and is the location of the Refuge today. The Fells, as Hay's summer estate house came to be known, was built between 1888 and 1895, and by 1896, the Hay's had settled in for the summers (Brockway 1988). The moniker "The Fells" was aptly chosen by Hay because it is a Scottish term meaning "rocky upland pasture". Hay kept much of the estate as a working farm, presumably continuing the established agricultural practices on the lands he acquired; open rocky fields around the house were sheep pastures, with sheep pens east of the house, and there are references in correspondences between Hay and his caretaker, Durgin, of hay and orchard production (Brockway 1988). Dairy farming and maple sugaring were also in operation (Historic Landscape Committee1993). Woodlots were scattered along the hillside affording views of the lake from the house.

Cultural Influences over the past 100 years

The efforts in the late 1800's to market New Hampshire's abandoned farms as summer retreats for the wealthy urban families of New York City and Boston proved successful. This launched New Hampshire's second largest industry at the beginning of the 20th Century: tourism (Garvin 1999).

After farm abandonment escalated in the early 1900s, grassland species ebbed, while species of thickets, brushlands, and young forests surged (Litvaitis 2003). Populations of black bear, bobcat (*Lynx rufus*), and broad-winged hawks (*Buteo platypterus*) increased. At the same time, intense logging followed by intense fires and heavy rains continued to wreck havoc on forest habitat and associated wildlife species in

northern New England (Foss 1992; DeGraaf and Yamasaki 2001). The young hardwood forests that emerged in the 1920s and 1930s, after the old-field pine harvests, provided premier habitat for ruffed grouse and American woodcock (DeGraaf and Yamasaki 2001). Continued forest maturation caused those early successional species to decline to levels approaching pre-settlement levels (Litvaitis 2003).

Nearly all the forest species that were extirpated or decimated have re-colonized the region. Some species arrived for the first time more recently. Eastern coyotes (*Canis latrans*) were first sighted in northern Maine in the 1930s, in Vermont and New Hampshire in the 1940s, and in Massachusetts in the 1950s (DeGraaf and Yamasaki 2001). DeGraaf and Yamasaki (2001) reported three major trends in New England's wildlife: forest species are increasing (e.g., bear, beaver, deer, wild turkey, pileated woodpecker), grassland and shrubland species are declining (e.g., bobolink, upland sandpiper, whip-poor-will (*Caprimulgus vociferous*)), and many southern species are expanding their ranges northward (e.g., Carolina wren (*Thryothorus ludovicianus*), northern cardinal (*Cardinalis cardinalis*), mockingbird (*Mimus polyglottos*), Virginia opossum (*Didelphis virginiana*). A few species, such as raven (*Corvus corax*), fisher, and moose are expanding southward. A group of species remains regionally extirpated, including mountain lion, although lynx (*Lynx canadensis*) have returned to northern Maine and New Hampshire (DeGraaf and Yamasaki 2001).

The Refuge itself was under the care of the Hay family from the late 1800's to the late 1900's. After John Hay died in 1905, his wife Clara deeded the estate to their son Clarence. This era under Clarence and his wife Alice was markedly different than previous due to two factors: Alice's discomfort by the rustic, uncultivated pastoralism of the farm and Clarence's naturalist tendencies. They expanded the overall acreage of the estate, as well as the buildings and gardens around the main house. Sheep may have grazed the pastures near the house up until 1915, when photographs still show the appearance of well-maintained pasture land. It was in 1915 that potatoes were planted in the lawns north and west of the house, in a practice commonly thought to divest the rocks and weeds from the soil to create a suitable substrate for lawn, which was established the following year. The grounds around the main house were cultivated and transformed into extensive formal and informal gardens. In the 1930s, farm buildings were constructed for Clarence Hay south of the house for dairy farming, and a road was created that ran from the house through the woods to access this site. This is what is now referred to as the "Woods Road". Some farming continued on the property until the 1940's, until it was no longer financially viable. Beyond the estate house and immediate grounds, the rest of the 1,000 acres were minimally managed and reverted to forestland (Brockway 1988).

Hay estate house: Erin Victory

In 1960, the Hays donated 675 acres of forested land east of Route 103A to the Forest Society. In 1972, Alice Hay, the daughter-in-law of historical figure John Hay, donated the remaining 164 acres along the shores of Lake Sunapee to the U.S. Fish and Wildlife Service, with two life-use reservations. Upon her death in 1987, her life-use reservation of 143 acres was turned over to the Service, and in 1998 the second life-use reservation of 21 acres was relinquished by her children, John Hay and Adele Hay Fath. This combined acreage contained all of the original estate buildings and grounds, as well as some additional forested land.

In 2008, approximately 84 acres containing the estate buildings and grounds were officially transferred to The Fells, a 501c(3) organization that has cared for and maintained the property since 1996. They continue to maintain the gardens and buildings, which are open for tours, and they provide programs to members of the public. Today, the John Hay National Wildlife Refuge consists of approximately 80 acres of upland forest.

Current Conditions

General Climate Description

New Hampshire has a moist continental, mid-latitude climate with warm to cool summers and cold winters. Daily and seasonal temperatures can vary widely, depending on proximity to the ocean, mountains, lakes, or rivers. Winter is typically cold with average temperatures ranging around 19 degrees Fahrenheit. The cold temperatures and humidity bring heavy, water-laden snow to all parts of the state. Nearby Mount Sunapee Ski Area receives an average of 100 inches of snow. Average summer temperatures are around 68 degrees Fahrenheit.

Global Climate Change

Global climate change is a significant concern to the Service and to our partners in the conservation community. Scientists are predicting changes in temperature, precipitation, soil moisture and sea level, all of which could adversely affect ecological systems. We expect that species ranges will generally shift northward or toward higher elevations as temperatures rise, but responses likely will be highly variable and species-specific. Under those rapidly changing conditions, migration, not evolution, will determine which species are able to survive (NH FGD 2005). Species that cannot migrate will suffer the most. For example, plants, mussels, and amphibians are more vulnerable to shifts in temperature that may affect their ability to survive, grow, and reproduce.

According to the NH Fish and Game Department, many of New Hampshire's habitats and species of conservation concern would be deleteriously impacted by climate change. In particular, air and water temperatures, storm frequency and intensity, and precipitation patterns would be the primary causal agents of change in New Hampshire. Climate change models predict an elevation in temperature for New England by 6.0-10.0 degrees Fahrenheit over the next century, which would cause a distributional shift in species and habitats to the north (NH FGD 2005). Already it has been documented that average winter air temperatures, and freeze-free periods have increased while the duration of lake ice and snow depth have decreased.

On the Refuge, exact changes are unknown due to the uncertainty in emissions levels over the next century, and the individualistic responses to climatic fluctuations by each species. Hemlock, for example, is a mesic species found throughout the Refuge and along Beech Brook that provides dense shade and thus a cooling effect on stream temperatures. Habitat conditions under high emissions levels over the next century would likely not support hemlock at the Refuge, and its replacement by deciduous species would not provide its dense streamside shade, resulting in an increase in stream temperature for Beech

Brook (Frumhoff et al. 2007). Eastern brook trout and other cold water species utilizing Beech Brook might be replaced by warmer water species.

In addition, the shorter duration of winter and the warmer winter temperatures could lead to a northward expansion of invasive pest species such as the hemlock wooly adelgid (*Adelges tsugae*). In 2000, it was first detected in Portsmouth, New Hampshire and has been identified in other southern New Hampshire communities since then (http://extension.unh.edu/news/new72204.htm). If there is any critical threshold at present, for example in average winter temperature and duration, that would prevent this pest species from continuing to spread northward, those safeguards would no longer apply in New Hampshire in the projected warming trend. Therefore, even if hemlock does persist on the Refuge under a lower emissions scenario, climatic factors could change enough so that it could become vulnerable to other threats including this pest species (Frumhoff et al. 2007). Other tree species like sugar maple could experience a large range contraction under high emissions scenarios, but red maple is thought to have a chance of persisting given its apparent adaptability over the last century.

Individual forest tree species are expected to respond individually as habitat conditions change, and this could result in species assemblages that do not resemble forests common today. Forest composition is expected to change as individual species respond to the changing climate, the degree to which varies depending on whether a high or low emissions scenario prevails over the next century (Frumhoff et al. 2007). The forest communities that characterize New Hampshire, consisting of northern and high elevation species like spruce, fir (*Abies sp.*), sugar maple, and aspen (*Populus sp.*) will shift north (NH FGD 2005). What is currently a predominantly mixed northern hardwood-conifer forest on the Refuge is likely to shift to a forest more indicative of the central hardwood region dominated by oak and hickory. This would mean that the forest species characteristic of the vibrant autumnal New England landscape, the beech-birch-maple forest species found on the Refuge, would shift northward (U.S. Environmental Protection Agency (US EPA) 1997).

Water temperatures in general could increase as a result of warmer ambient air temperatures, and this could also increase rates of evaporation (US EPA 1997). This coupled with no estimated increase in summer precipitation could mean that Beech brook would run drier in the summer months, and Lake Sunapee could see lower lake levels. Wildlife species would be impacted as a result of climate change, as well. The changing forest composition could mean a decrease in suitable habitat for many bird species now characteristic of Refuge forests. Species including the black-capped chickadee (*Poecile atricapillus*), rose-breasted grosbeak (*Pheucticus ludovicianus*), purple finch (New Hampshire's state bird), American goldfinch (*Carduelis tristis*) and Northern oriole (*Icterus galbula*) are projected to see decreases in abundance throughout the state, under both high and low emissions scenarios in the next century (Frumhoff et al. 2007).

Throughout New Hampshire, terrestrial wildlife dependent upon present day forest communities and climatic factors will likely shift northward as well as more northern latitudes become more suitable to their habitat requirements. Species such as the Canada lynx and American marten (*Martes Americana*), dependent on snow depth and frequency, would move northward, and species such as the northern bog lemming (*Synaptomys borealis*), moose, and snowshoe hare (*Lepus americanus*) would no longer be endemic to New Hampshire (NH FGD 2005).

These, of course, are just some of the postulated consequences of climate change in northern New England, and there are many factors to take into account. To address these issues associated with climate change, Newbury is one of the 164 towns in New Hampshire that has passed the New Hampshire Climate Change Resolution. By passing this resolution, towns are able to go on record to publicly support actions by the President and Congress to address climate change issues (http://www.carboncoalition.org/community/index.php). In addition, the state's Climate Task Force

released the Climate Change Action Plan (NH DES 2009) that details how the state will address emissions and other factors contributing to climate change (http://des.nh.gov/organization/divisions/air/tsb/tps/climate/action_plan/index.htm).

Air Quality

The NH DES monitors levels of ozone and particle pollution from several stations in New Hampshire for attainment or exceedance of the National Ambient Air Quality Standards (NAAQS) set by the US EPA. These standards are reviewed every five years by the US EPA and may be changed due to new scientific information. It is incumbent upon each state to ensure these standards are met and maintained. In the case of an exceedance of these standards, pollution control strategies are implemented, and once the standards are attained, a plan is developed to maintain that standard in such a way that incorporates future economic and emissions changes.

There are 20 air quality monitoring stations across New Hampshire. They range from the Lake Francis Dam in Pittsburg at the northernmost location, south to Nashua, and as far east as Appledore Island in Rye. Not all of these stations monitor all air quality indicators. For example, only two of these twenty stations monitor carbon monoxide, and thirteen monitor ozone (McDougall 2008). There are no air quality monitoring stations in near proximity to the Refuge, however, there is one located in Claremont, sixteen miles to the west.

According to the US EPA, New Hampshire is well below the primary and secondary NAAQS levels for carbon monoxide, sulfur dioxide, nitrogen dioxide, and coarse particulate matter, but has not fared as well with ozone and fine particulate matter (McDougall 2008). Fine particulate matter is classified as anything smaller than 2.5 microns. Two of the nine fine particulate monitoring stations, located in Keene and Nashua, recorded relatively high numbers compared to the other seven stations, but were still below the primary NAAQS for their annual weighted arithmetic means (McDougall 2008). The Claremont station did record some days in exceedance of the NAAQS standard, but its annual weighted arithmetic mean was well below the NAAQS primary standard as well.

In 2007, two of the thirteen stations monitoring ozone were in violation of the 8-hour NAAQS (McDougall 2008). A violation occurs when an exceedance of the NAAQS has been averaged over three years at the same site. These two locations were at the Seacoast Science Center in Rye, and at the Pack Monadnock Summit in Hillsborough County. The 8-hour standard for ozone, 0.080 parts per million (ppm) established in 1997, has been lowered beginning in 2008 to 0.075 ppm. The two sites previously mentioned were in violation of both standards. The site at Claremont, however, was not in exceedance of 1997 standards, but was reported in exceedance of 2008 standards for a total of 5 days (McDougall 2008).

New Hampshire has an average of ten days per year with air quality officially classified as unhealthy (Underhill 2004). This is due in large part to exceedances in ozone and fine particulate matter. This results in a designation of non-attainment of the NAAQS by the US EPA for parts of New Hampshire, which is located in the southeastern portion of the state. Currently, the 8-hour ozone standard non-attainment zone extends from the coastline northwest as far as the towns of Rochester, Hookset, Goffstown, Amherst, Milford, and Brookline (http://des.nh.gov/organization/divisions/air/do/asab/ozone/index.htm). Until 2005, a 1-hour ozone standard was enforced and the non-attainment zone encompassed the entire 8-hour standard non-attainment zone, and extended further north and west as far as the towns of New Durham, Danbury, Newbury, Antrim, Hannock, and New Ipswich (http://des.nh.gov/organization/divisions/air/do/asab/ozone/index.htm). John Hay NWR, located in Newbury, was included in the former 1-hour standard non-attainment zone, meaning that an average of 10

days per year, air quality is classified as unhealthy at the Refuge. Since 2005, the 1-hour ozone standard has been revoked, and only the 8-hour ozone standard remains in effect.

Ozone is a respiratory irritant that can reduce the overall function of the lungs, cause asthma attacks, and aggravate chronic lung diseases. It also inhibits vegetation growth, and is often found in higher concentrations far downwind from the origination of the precursors that react to form it. From 92 percent to 100 percent of the pollution that causes these unhealthy air quality days comes from areas outside New Hampshire (Underhill 2004). New Hampshire is currently working to reduce state emissions, and with neighbors, to increase overall air quality.

Water Quality

Summary of the General Condition of the Lake Sunapee Watershed

The entire Lake Sunapee watershed covers 30,947.74 acres in southwestern New Hampshire, and spans the towns of Goshen, New London, Newbury, Springfield, Sunapee, and Sutton (SAWC 2008). Lake Sunapee is found in USGS hydrologic unit (HUC) 01080104–Upper Connecticut-Mascoma Watershed spanning the Vermont-New Hampshire border (http://cfpub.epa.gov/surf/huc.cfm?huc_code=01080104).

There are thirteen lakes and ponds within the Lake Sunapee watershed ranging in surface area from 9.9 acres at the smallest to 4,088.4 acres at the largest (McAlvin Pond and Lake Sunapee, respectively). Three hundred wetland units have been identified in the watershed, comprising a total of 3.6 percent of the total area, though few of them are permanently protected from development (SAWC 2008).

Over the last 20 years, development around the lake has increased by 24 percent, and impervious surfaces comprise 28 percent of the 250 foot buffer zone around the lake, which exceeds the 10 percent value considered to be the threshold at which water quality begins to decline (SAWC 2008). These two factors indicate an increase in human activity, and provide a likely explanation for the increase in phosphorus levels over the last 18 years by more than 50 percent. The Sunapee Area Watershed Coalition monitors Lake Sunapee for water quality (see section on Long Term Trends below), and they have stated they would like to maintain phosphorus levels at or below 0.008 milligrams per Liter (mg/L), considered to be indicative of an oligotrophic lake system (SAWC 2008). Oligotrophic lakes are typically cold, clear and deep, with low concentrations of plant nutrients (i.e., phosphorus) and therefore have low algal production, and can be good sources of drinking water. Overall, the water quality of Lake Sunapee is good, and it is increasingly important to maintain monitoring efforts as human uses are increasing around the region, and particularly around Lake Sunapee.

Influences on Water Quality

Point Source Pollution

Point sources include any municipal, commercial and industrial activities requiring a permit, as these have a known origination (SAWC 2008). In 1977, the Sugar River was the site of a fish kill due to a release of sulfuric acid into the river, and the subsequent drop in pH levels. Since then, in large part due to the Clean Water Act, conditions have generally improved to meet state standards (NH FGD 2005). More recently, the Sugar River was associated with a Brownfield Site in Newport at an old woolen mill that was being used as a storage site for used oil. Clean up began in 1999 to remove approximately 9,500 gallons of hazardous materials and 2,500 gallons of non-hazardous materials, and to address the petroleum-soaked oil surrounding above-ground storage tanks (http://des.nh.gov/organization/divisions/waste/hwrb/sss/brownfields/index.htm).

Non-Point Source Pollution

Non-point pollution sources for the Lake Sunapee Watershed have been identified as: site development and lot conversion, agriculture, recreation on and around the water, residential land use, transportation corridors, storm water management and utility right-of-ways. The impacts of these activities could alter the local hydrology, or introduce sediment, chemicals and waste into the water system (SAWC 2008).

Sediments

Lakes undergo several natural processes that determine its trophic level, or "age." Sedimentation is one of these processes, and has an impact on a lake's turbidity, or clarity, which is one measure of water quality. Erosion is the natural process by which this happens, but human alterations of the landscape, such as development and agriculture, can increase rates of sedimentation. This can lead to an increase in turbidity. Turbidity, in turn, affects light penetration, water temperature and subsequently, dissolved oxygen content which can have a negative affect on the fisheries (SAWC 2008). Erosion control, steep slope protection, and buffers are important tools that can help mitigate increased rates of sedimentation.

Long-Term Trends and Status of Water Quality for the Lake Sunapee Watershed

State-reported Impaired Waters in the Lake Sunapee watershed

In 2008, the NH DES released the 305(b)/303(d) Surface Water Quality Report. It combines both the 305(b) Water Quality Assessment and the 303(d) Report on Impaired Waters for each river basin. The NH DES compiled those reports and submitted them to the US EPA and Congress, to satisfy the federal reporting requirements under section 305(b) of the Clean Water Act. In New Hampshire, all lakes and ponds are listed as impaired due to a statewide fish consumption advisory as a result of increased mercury levels in fish tissue (http://iaspub.epa.gov/tmdl_waters10/waters_list.control?state=NH&p_cycle=2006&huc=01070002).

Water quality is monitored by the NH DES and its partners throughout the state through VLAP and the Volunteer Rivers Assessment Program (VRAP). The Lake Sunapee Protective Association is part of the VLAP program, monitoring fifty sites throughout the Lake Sunapee watershed. They have conducted both physical/chemical and biological analyses through their Water Quality Laboratory at Colby-Sawyer College (http://www.lakesunapee.org/).

View across Lake Sunapee from Refuge shore: Erin Victory

Of the suite of factors monitored through these programs, waterbodies within the Lake Sunapee watershed were found to be slightly acidic, which may be attributable to natural processes of decomposition by bacteria, but were still suitable for aquatic life (SAWC 2008). It should be noted that the mean pH for surface waters of lakes and ponds in New Hampshire is slightly acidic (6.6). In addition, most were found to be only moderately vulnerable to acidic input (Acidic Neutralizing Capacity), indicating a capacity to withstand some acidic deposition.

Measures of phosphorus throughout the watershed, on the other hand, do show some cause for concern. While deep spot monitoring locations in Lake Sunapee still indicate low levels of phosphorus and an oligotrophic condition, some of the near-shore sampling locations show elevated levels, some greater than 25 micrograms per liter (µg/L), which is considered excessive (SAWC 2008). Continued monitoring of the tributaries, particularly around precipitation events, may help to pinpoint the origination and to quantify phosphorus loading. One of these monitored tributaries, Beech Brook, flows through the Refuge. The reach above the Refuge, east of State Highway 103A serves as the biological control for Lake Sunapee due to the brook's high water quality.

The Sugar River has been monitored as part of the VRAP program. Results from 2000-2002 showed that the Sugar River met the state criteria for Class B waters in terms of dissolved oxygen and turbidity levels all three years, but fell below these standards in pH levels (NH FGD 2005). There is currently no readily available explanation for this, other than that it is located in a region with higher natural acidity. Acidic precipitation is another potential factor.

The Regional Socio-Economic Setting

Socio-economic Factors: Regional Economic Setting

Lake Sunapee and the Mount Sunapee ski resort make Newbury a destination for outdoor recreationists. John Hay's selection of The Fells for the family vacation retreat foreshadowed the recreational importance of this area a century later. The Refuge contributes to outdoor recreation by providing opportunities for wildlife observation and photography, environmental education, and interpretation.

Town of Newbury

The town covers 35.8 square miles of land and 2.3 square miles of water, and includes seven villages (Blodgett Landing, Edgemont, Mount Sunapee, Pine Cliff, South Newbury, Box Corner, and Chalk Pond). Newbury is governed by a Select Board, has a full-time police department, and a part-time fire department. Elected boards and commissions include planning, zoning, library, cemetery, and trust funds.

The population has increased substantially since the 1990 census, rising more than twice as much as Merrimack County and the state (Table 3.1).

Table 3.1. Census Data - Population Changes (1990 – 2007).

Municipality	1990	2007	Percent Change
Newbury	1,351	2,076	54
Merrimack County	120,618	148,274	23
New Hampshire	1,109,252	1,315,828	19

Economy

The Newbury economy is service-oriented, catering in large part to those coming to the area for outdoor recreation. Table 3.2 shows that most of the workforce is engaged in the service industry. That number has increased substantially, both in terms of employees and wages, from 1994 to 2007 (NH Economic and Labor Market Bureau, NH Employment Security 2008; http://www.nh.gov/nhes/elmi/htmlprofiles/newbury.html). In contrast, the town supports a minimal number of industrial jobs, which have declined in the past decade. The government workforce also increased, but less so than service industries. The largest employers are Mount Sunapee Resort (150+ employees or 12 percent of the workforce), Mount Sunapee Best Western (25 or 1.6 percent), and Baker Hill Golf Club (20+ or 2 percent), all of which are service-oriented. These data confirm the importance of tourism and recreation to the local economy. In fact, service wages make up 79 percent of the total town wage base.

Table 3.2: Census Data - Employment by Sector (NH Economic and Labor Market Information Bureau, NH Employment Security 2008).

Employment Sector	Number of Employees 1994	Number of Employees in 2007	Percent Change	Total Annual Salary 1994*	Total Annual Salary 2007*	Percent Change
Goods Producing Industries	23	30	30	$577,668	$843,960	46
Service Providing Industries	158	499	216	$2,440,152	$8,796,372	260
Government (Local, State, Federal)	25	59	136	$526,500	$1,527,864	190
Unemployed	24	31	29			

*Calculated from average weekly data of workforce numbers and wages.

Tax Revenue Base

Public ownership of the Refuge has had an effect on the local property tax base because the Service does not pay a traditional property tax. In lieu of this, an annual revenue sharing payment, authorized by the Refuge Revenue Sharing Act of 1935 (16 USC 715s), as amended, has been made to the Town of Newbury since the Refuge was established.

Nationally, the Service has made revenue sharing payments to towns with refuges since 1935. Funding, derived from revenues earned on refuges for the sale of refuge products and privileges, are collected and pooled across the country, then disbursed on a uniform basis to local taxing authorities where national wildlife refuge land is located. There are three formulas used to calculate the payment to the local taxing authority:

1. Seventy-five cents per acre;

2. Twenty-five percent of the annual net receipts; or

3. Three-fourths of one percent of market value.

Payments to Newbury, New Hampshire are based on the last of these methods. The 2008 refuge revenue sharing payment to Newbury was $11,609 or 41.9 percent of full entitlement due to shortfalls in refuge-generated receipts and supplementary Congressional appropriations.

These payments are intended to help offset property tax losses in communities due to land acquisition and property ownership by the Service. For revenue sharing purposes, property values are based on the real estate appraisal for the first five years following a land transaction. Refuge properties are reappraised on a five-year schedule to keep payments current with the fair market value.

Refuge Administration

Refuge Establishment and Land Acquisition

The Refuge was donated to the Service on December 11, 1972 by Alice Hay. Two deeds separated the estate into two life-use reservations. The first was a 143-acre parcel including the main house, which contained a life-use reservation for Mrs. Hay. The second deed for a 21-acre parcel included a lakeshore cottage, boat house, and dock and provided a life-use reservation on that tract for Clarence and Alice Hay's children, John Hay and Adele Hay Fath.

Mrs. Hay passed away March 19, 1987. Her life-use on 143 acres of the estate terminated at that time, initiating management by the Service. Her children turned their life-use over to the Service in 1999. Since then, the Service has worked with a number of public and private entities to manage the property and facilities. From 1993 to 1996, New Hampshire State Parks operated the Refuge under a MOU. In 1996, a non-profit organization called The Fells was formed, dedicated to the continuance of on-site education, short- and long-term programming objectives, and oversight of daily operations (see section on Partnerships below). Under a MOU signed in 1997, they assumed responsibility to manage 62 acres that includes the gatehouse, main house, nursery, gardens, lawns, and roads. They also oversaw public visitation, interpretation, education, and staffing.

The mismatch of the nation's premier wildlife management agency being responsible for an historic estate over the past 36 years has been evident. The Service has limited resources and expertise available to conserve and rehabilitate historic structures. The buildings need to be maintained and the Service has not

had sufficient resources to stem the normal damages caused by age and decay. The Fells, the friends group at the John Hay National Wildlife Refuge, also has an interest in conserving the estate, but its ability to generate revenues from the property was limited by federal and national wildlife refuge policies.

In 2008, a land transfer was completed that gave The Fells the title to approximately 84 acres of Refuge property to include the buildings, gardens, parking lot, and access road. In exchange, the Service acquired a 727 acre (+/-) tract of land that has an equal or greater appraised price with higher wildlife values for addition to the Umbagog National Wildlife Refuge headquartered in Errol, New Hampshire.

The Service retained title to the southern half of the original Refuge comprising approximately 80 acres. We will continue to manage this area located south of the house as the John Hay National Wildlife Refuge. This portion of the estate has better wildlife habitats and opportunities for wildlife-dependent public uses.

The John Hay Refuge is bounded on the east by NH Route 103A, to the north by property formerly owned by John Hay but now owned by The Fells, to the west by Lake Sunapee, and to the south by a private landowner. The Refuge is contiguous except for a small 0.10 acre island located a short distance from the shoreline near the northwestern corner of the contiguous tract.

The Silvio O. Conte NFWR Complex and Staffing

Administratively, the Refuge has been an unstaffed satellite station of the Great Bay National Wildlife Refuge and more recently, the Silvio O. Conte National Fish and Wildlife Refuge Complex, headquartered in Sunderland, MA. The lack of on-site staff has limited our ability to facilitate, manage, monitor, or evaluate public uses. Refuge Complex staff share the responsibility of managing the three refuges in the complex. The Refuge manager is responsible for determining how to distribute staff time to accomplish priority work.

Funding

The funding for the John Hay Refuge is embedded in the budget for the Silvio O. Conte National Fish and Wildlife Refuge. Operational funding also known as base funding includes salaries, supplies, fuel, travel, and all other operational activities (wildlife and habitat surveys and management) that are not funded by special projects. Our annual funding fluctuates according to the number and size of the projects funded that year (e.g., vehicle or equipment replacement, visitor service enhancements, and facility improvements). In 2008, the Conte NFWR Complex base funding was $1,143,857, and project funding was $250,528.

Refuge Facilities and Maintenance

At the present time, the only property the Refuge has to maintain are the boundary signs, the Refuge entrance sign, and the Ecology Trail. Otherwise, the Refuge has no facilities or vehicles to maintain. As part of an agreement with The Fells, we jointly use the parking area located at the estate. Under Alternatives B and C, we will be looking into establishing a kiosk at the parking lot trailhead, increasing signage for the Refuge, and sharing space at the gatehouse for proposed Refuge staff.

Interpretive station along the Ecology Trail: Erin Victory

Refuge step-down plans

No step-down plans are currently in place at the Refuge.

Findings of Appropriateness and Compatibility Determinations

Below are the compatibility determinations to date for the Refuge, all of which were deemed compatible. These were approved when the Hay estate was managed as part of the Refuge, and as such allowed for opportunities such as bicycling and picnicking on the estate grounds. Since 2008, with the completion of the land transfer, the estate is no longer managed as a part of the Refuge. The compatibility determinations for photography, environmental education, and wildlife observation need to be updated because they expired on September 2, 2009. Compatibility determinations for the remaining public uses have already lapsed. These latter uses need to undergo an appropriateness evaluation, and if the use is found to be appropriate, a new compatibility determination. Chapter 1 describes these two decision processes in detail. See also the discussion below on special use permits.

- MOU with State of New Hampshire—9/2/94
- Photography—9/2/94
- Picnicking—9/2/94
- Jogging/Walking—9/2/94
- Hiking/Backpacking—9/2/94
- Environmental Education-Non-staff Conducted—9/2/94
- Bicycling—9/2/94

- Snowshoeing and Cross Country Skiing—9/3/94
- Wildlife Observation—9/3/94

Partnerships

Since 1989, the Refuge has combined its resources with others to form a wide array of outstanding partnerships. Some partners have joined us to create public programs, operate the Refuge, and restore the estate buildings and gardens, and to secure funding for maintenance and restoration. Naming all that we have worked with over the past several decades to advance common conservation objectives would be difficult. However, we should recognize at least some for their longevity and significant contributions.

The Fells sign: Karen Terwilliger

The Fells, John Hay National Wildlife Refuge Friends Group

When American writer and diplomat John M. Hay (1838-1905) first established his summer home on the shores of Lake Sunapee, he named it "The Fells", a Scottish word meaning "rocky, upland pasture". In 1996, a friends group was established to assist the Refuge with the care and maintenance of the estate buildings and grounds, and took on this name. Originally intended to assist the Refuge in securing funds for estate and grounds maintenance and providing education programs, The Fells now owns the estate and immediate grounds, after a land transfer in 2008. Its mission is to "stimulate appreciation of the environment, horticulture and the significance of the past by preserving and sharing the Hay family's historic lakeside summer home" (The Fells 2006). They accomplish this through five primary areas of concern: environmental conservation, protection of historic structures and setting, horticultural excellence, educational programs, and community outreach.

The Main House, built in the cottage style in 1891 and enlarged in 1897, was transformed into a 22-room Colonial Revival house in 1915 and is listed on the National Register of Historic Places. The 22-room Colonial Revival mansion is open seasonally for historic guided tours and the nature and hiking trails are open year-round, dawn to dusk. Hay's son Clarence inherited the property and along with his wife Alice Appleton Hay, transformed the rock pasture into extensive formal and informal gardens. The gardens include a 100-foot perennial border, masses of rhododendrons, formal rose terrace, hillside rock garden, and a Japanese water lily pool, with views of Lake Sunapee. An entrance fee is collected for tours of the house and the gardens. The Fells is also rented out for weddings and other events.

Their membership includes over 1000 individual households, 10 inns, hotels and bed and breakfasts, and 23 participating libraries. Fifteen people sit on their Board of Directors, and meet once every other month. Since their inception, The Fells have played a critical role in operating the Refuge by staffing and maintaining the property, conducting educational programs, and partnering with local entities to secure resources for projects. The Fells group continually grows in membership, stature, and effectiveness.

Refuge Operation

Throughout the history of the Refuge, we have worked with local and state organizations to operate the Refuge. The New Hampshire State Parks, the Society for the Protection of New Hampshire Forests, and The Fells as well as volunteers have been instrumental in their efforts to provide visitor services and to maintain the estate and grounds. Through their efforts, work has been done at the main house to the restroom facilities and roof, to rehabilitate the collapsed carriage house, and to renovate the gatehouse into a headquarters through funds donated by the Lake Sunapee Protective Association. They have also provided educational programs to the public, interpretation, fund-raising, and staffing.

Historic Preservation

Many national, regional, state and local organizations have contributed to the preservation and maintenance of the estate and grounds. These include the National Park Service, New Hampshire State Parks, Lake Sunapee Protective Association, The Historic Landscape Committee, National Garden Conservancy, and The Fells, along with several volunteer committees. Politicians like current U.S. Senator and former Governor Judd Gregg and former Senator Warren Rudman have appropriated funding for restoration. Governor Gregg established the John Hay Commission to promote protection of the historic facilities, engage in fund-raising activities for The Fells, and accept contributions on behalf of the state. All of these entities have helped to secure funding for projects, develop plans to guide projects, have restored, repaired or renovated structures, and have maintained the historic character of the gardens and vista of the estate. As a result, the estate buildings, grounds, and gardens were listed in the National Register of Historic Places in 1999.

State Agencies and Commissions

State agencies and commissions have proven to be invaluable resources and have greatly benefited the Refuge through their assistance and partnerships. In 1992, The John Hay Commission was created by Governor Judd Gregg, as previously mentioned, to assist in the protection of the estate through fund-raising, promotion, and the ability to accept contributions. From 1993 to 1996 the New Hampshire State Parks (State Parks) operated the Refuge under a MOU with the Service, offered educational programs through the Forest Society and completed work on the main house restrooms and installed a new roof. Within the last decade, Senator Gregg has also secured over one million dollars to help with renovations to the main house, carriage house and gatehouse.

The Refuge Complex has a long standing cooperative relationship with the NH FGD. This partnership involves a diversity of habitat and wildlife management programs and activities. It includes coordination on hunting, fishing, law enforcement, habitat and species inventory and monitoring, and visitor services and educational programming.

Volunteer Program

Since the inception of the John Hay NWR, volunteers have played a critical role in Refuge operation. Starting in 1989, with the formation of a volunteer advisory committee for the Refuge, volunteers also eventually formed the Historic Landscape, Historic Preservation, and Education committees to assist at the Refuge and help provide guidance to managing and maintaining the grounds and gardens.

With the formation of The Fells, many of these responsibilities were folded into their operations. Since then, volunteers have been instrumental in contributing to the maintenance of the historic buildings, gardens and also in providing environmental education and interpretation. In 2007 and 2008, prior to the land exchange with The Fells, volunteers contributed 7,725 and 3,800 hours respectively attributed to Hay estate visitation. The 2008 numbers include the period of time from October 1, 2007 through March 25, 2008 when the land exchange was completed. Other volunteer activities over the same time periods totaled 260 hours in 2007 and 160 hours in 2008 for time spent on habitat and wildlife, maintenance, cultural resources, and environmental education. The amount of volunteer time for the Refuge is expected to decline substantially because the Service no longer owns the Hay estate infrastructure where a majority of the activities occur.

Community Outreach

To date, a lack of Refuge funding and staffing has precluded our ability to provide sustained community outreach. Under Alternatives B and C, we are proposing the addition of on-site Refuge staff, which will enable us to expand our visitor services programs, including outreach, by reaching out to local communities with programs and to participate in community events.

Special Use Permits, including Research

Special use permits are issued to individuals, organizations, and agencies that request the use of Refuge facilities or resources beyond what is available to the public. In order to ensure that wildlife disturbance is minimized, special conditions and restrictions are identified for each request, and we evaluate each request individually. Table 3.3 identifies some of the permits we have issued since 1989. You may obtain additional details from the Refuge headquarters. We support research activities on the Refuge, when they are compatible with the Refuge purposes, and help us gain knowledge and understanding to benefit our management goals and objectives.

Purple finch: Dr. Thomas G. Barnes/USFWS

Table 3.3. Sample of special use permits since 1989.

Year Issued	Permittee	Purpose
1989	Society for the Protection of New Hampshire Forests	To hold a reception, and lead a guided tour for up to 30 people of the estate and grounds
1990	Friends of John Hay NWR	To conduct a birding tour of the refuge for the local chapter of the Audubon Society of NH
1990	New London Garden Club	To receive a tour of the gardens lead by the grounds caretaker
1990	Dave Anderson	To hold a reception, and lead a guided tour for up to 90 people of the estate and grounds
1990	Society for the Protection of New Hampshire Forests	Conduct a series of programs and guided tours of the buildings, gardens and woods trail system
1990-1991	Dave Anderson	To remove fallen trees and limbs near roads and trails and to maintain appearance of property
1993	Emily Ayers	To hold a wedding reception for up to 140 guests at the estate
1997	Friends of John Hay NWR	Provide programs on historic structure interpretation, cultural and natural history, formal garden planting and maintenance, backyard landscaping for wildlife, seminars for school educators, and for maintenance and protection of the buildings, grounds, and gardens.
2000-2001	Friends of John Hay NWR	To store a kayak near boat house for the Friends and LSPA to assist in the prevention of aquatic invasive plant species like milfoil and water chestnut.
2007	The Fells	Host a one-day kids fishing event on the shore of Lake Sunapee

Refuge Natural Resources

Physical and Vegetation Resources

Soils—General description

Soils at the Refuge and in the uplands of this region are typically shallow and stony. "The Fells", the name John Hay gave his estate, was particularly appropriate, as this is a Scottish term meaning "rocky upland pasture." According to the Merrimack-Belknap county soil surveys (still in progress, http://www.nh.nrcs.usda.gov/Soil_Data/), the Refuge is made up of Moosilauke (3-8 percent slopes) and Skerry (3-8 percent slopes, and 8-15 percent slopes) fine sandy loams, as well as Tunbridge-Lyman-Becket complex (8-15 percent slopes) soils. These can all be found at elevations from 250-2,940 feet, and on hillslopes, with the exception of the Moosilauke which can most commonly be found in drainageways.

These soils are all listed as very stony, and range from nearly level ground to rounded hillsides, from poorly to excessively drained soils, and from 20 to 80 inches in depth to restrictive feature (bedrock), and are found in glaciated uplands. The Town of Newbury is north of the mesic/frigid line in New Hampshire, which is an indicator of soil temperature; soils north of this line are classified as having a frigid temperature regime, or an annual mean soil temperature less than 47 degrees Farenheit (http://www.nh.nrcs.usda.gov/Soil_Data/attribute_data/mbss.html).

Refuge Vegetation

Upland Forest Habitats

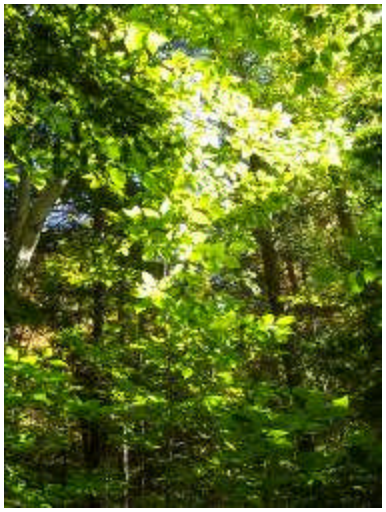
The Refuge is composed of uplands classified as transition hardwood-conifer forests (Sperduto and Nichols 2004). The northern hardwood forest formation is generally characterized by species with distributions corresponding to the eastern deciduous forest, although more northern species are often present, which is the case at the John Hay Refuge (Table 3.4).

The Refuge forest is a product of old field succession, where the former farm fields and pastures of the mid 1800's, and in some locations the early 1900's, gradually reverted back to a forested condition over the last century. The era of land use under Clarence and Alice Hay, which marked most of the twentieth century, was one that was characterized by little management beyond the house and immediate grounds. Thus the forests throughout the property were left virtually unmanipulated as a whole. The possible exception to this is a few small areas where naturalized plantings of trees and shrubs remain near once-used roads and along the Beech Brook stream corridor as shade trees for farm animals (Garvin and Graney 1999). As a result of this philosophy of minimal forest management, natural processes are the predominant force that shaped the Refuge forest and many mature, large diameter trees abound on the property (LaPointe 2008).

These natural processes have also resulted in at least three age classes identified on the Refuge. In October 2008, the Service completed a forest inventory. As part of this process, trees throughout the Refuge were cored, and results ranged from 67 to 155 years in age. One age class in particular is quite marked, and represents the effects of the 1938 hurricane (LaPointe 2008). This event resulted in areas where trees were completely blown down, and other areas where there was only partial removal of trees, with root sprouting evident (Garvin and Graney 1999). Regeneration has resulted in this younger age class nearing 70 years of age. Other age classes are a result of smaller, localized disturbances due to lightning and wind events (LaPointe 2008).

The Refuge forest is essentially lacking a shrub understory, and crown closure is almost complete (71-100%). Regeneration is consistent with this almost complete crown closure, and the majority of the species (75%) are shade tolerant sugar maple, beech, and hemlock. These species will likely persist in the understory for some time, until natural disturbances create openings and release them. They represent a late stage of natural forest succession called a climax forest (LaPointe 2008).

This 2008 inventory delineated five different forest management units based on similarities in species composition, structure, and topography (Map 3-2). The forest is approximately 71 percent hardwoods and 29 percent softwoods. The dominant tree species (by percent basal area) are hemlock (28%), white pine (12%), red maple (11%), sugar maple (10%), white ash (*Fraxinus americana*; 10%), Northern red oak (9%), American beech (7%), white (paper) birch (5%), yellow birch (3%), and aspen (2%). Other species scattered in the forest include red spruce (*Picea rubens*), basswood (*Tilia americana*), American elm (*Ulmus americana*), and red pine (*Pinus resinosa*). Tree species abundance (by percent basal area) varies by stand type, which is summarized in Table 3.4 (Lapointe 2008).



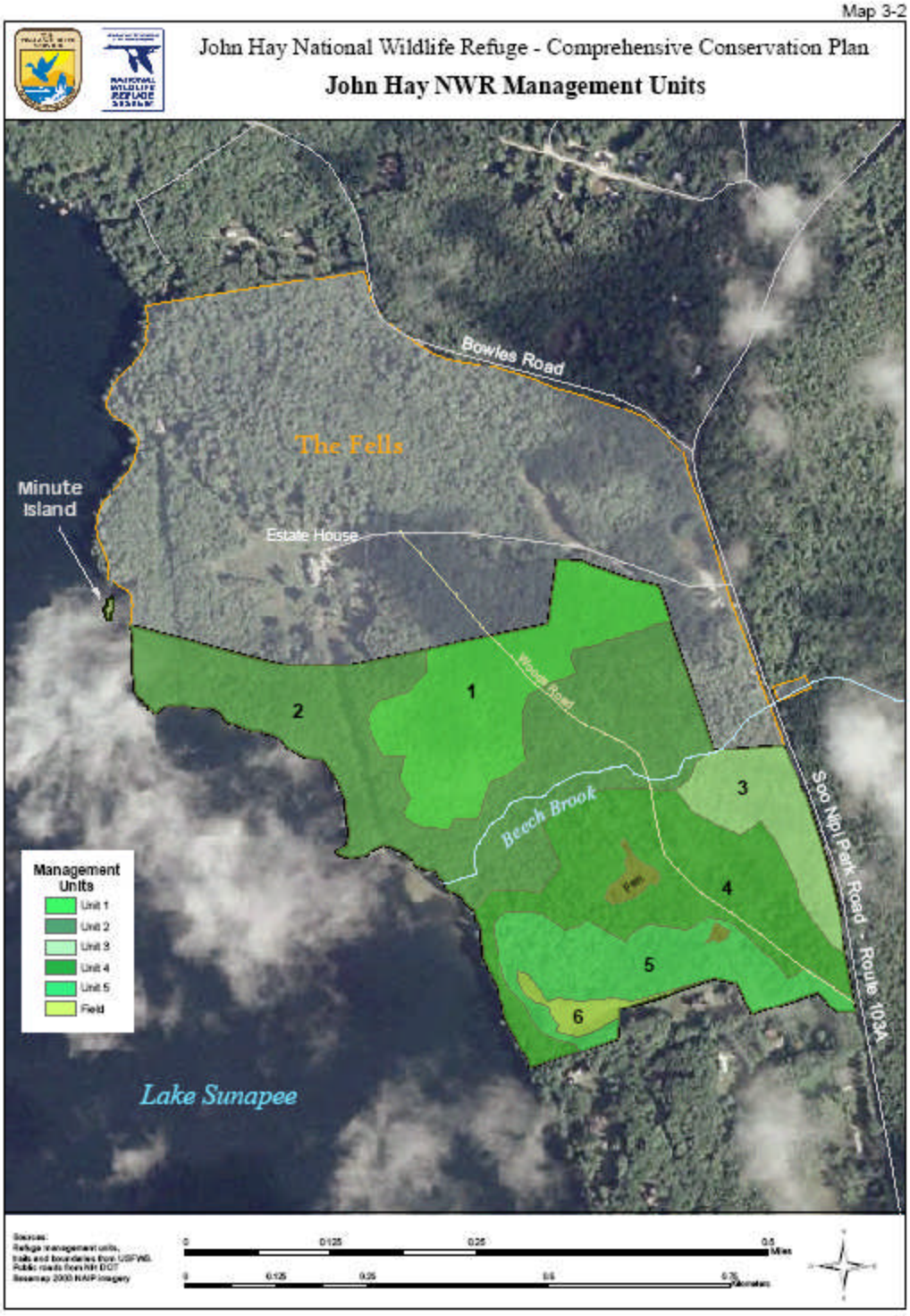
Understory beech: Erin Victory

Table 3.4. Tree species abundance by percent basal area by Management Unit (MU) on the Refuge (LaPointe 2008).

	MU 1	MU 2	MU 3	MU 4	MU 5
Hemlock	19%	52%	14%	13%	9%
White pine	--	6%	--	30%	6%
Red maple	3%	5%	7%	29%	--
Sugar maple	13%	7%	--	7%	29%
White ash	19%	5%	21%	5%	19%
Northern red oak	19%	2%	30%	1%	28%
American beech	15%	8%	--	4%	3%
White birch	3%	3%	14%	9%	3%
Yellow birch	3%	--	7%	--	--
Aspen	3%	2%	7%	--	3%

There are many features that provide a unique character to this forest. Two tree species are found on the Refuge that are at the limits of their respective ranges. Black gum (*Nyssa sylvatica*), typically a more southern species, is found in a small stand along the lakeshore, and red spruce is a more northern species found on the Refuge as well. As mentioned previously, the Refuge forest is very mature and contains many old, large diameter trees. There are some hemlock and spruce trees over 200 years old. More typical, however, are the large old white pines. These are perhaps 150 years old or more, and are found throughout the property, but are more concentrated near the lakeshore and along Beech Brook corridor. These "supracanopy" trees are sometimes used by perching bald eagles and osprey (D. Anderson, pers. comm.), and are a unique cultural feature appreciated by the local community.

Map 3-2


John Hay National Wildlife Refuge - Comprehensive Conservation Plan
John Hay NWR Management Units
Bowles Road
The Fells
Minute Island
Estate House
Woods Road
Beech Brook
Pond
Soo Nipi Park Road - Route 103A
Lake Sunapee
1
2
3
4
5
6
Management Units
Unit 1
Unit 2
Unit 3
Unit 4
Unit 5
Field
Miles

Upland Meadow and Early Successional Habitat

There are two small areas on the property that are open, or early successional, habitat. The first, a 1.4 acre field or meadow, is located on the southern end of the Refuge adjacent to private property in Management Unit 5. This has been maintained over the years by this Refuge neighbor through mowing, and provides habitat for American woodcock and other wildlife that utilize meadows.

In addition, a one-acre viewshed, or linear corridor, has been established between the Hay's main house on The Fells property to the lake to recreate the scenic and cultural views from the house. This cuts a slightly southeast-oriented rectangular swath through the Refuge forest in Management Unit 2. As a part of the land exchange in 2008, when The Fells obtained ownership of the northern 84 acres of the original property, there was an easement placed on this corridor that enables The Fells to continue its maintenance.

Upland Wetland, Aquatic, and Riparian Habitats

Although the Refuge is primarily upland, it has several important aquatic habitats. These include the 3,100 feet of undisturbed shoreline along Lake Sunapee and the 0.1 acre Minute Island that is just off-shore. Beech Brook (so named by the Hays; also called Bartlett Brook) runs east to west through the Refuge for approximately 1,750 feet before it discharges into the lake. There is also an intermittent stream associated with one of the fens. The riparian habitats along the brook and the lakeshore are mostly forested, and some of the trees along the brook are the oldest on the Refuge. These are likely the remnant pasture trees referenced earlier established to provide shade for farm animals. Because the entirety of this stream is on conserved lands (emanating near the top of Sunset Hill on Forest Society property), it is remarkably uninfluenced by many of the anthropogenic factors that detract from stream health and water quality. Therefore, it has been used as a reference stream for the entire Lake Sunapee watershed water quality monitoring program by the Lake Sunapee Protective Association, which has a monitoring station just east of Route 103A on Forest Society property. Route 103A crosses over the brook and provides the divisor between Forest Society property and the Refuge. Route 103A is the primary threat to the water quality of Beech Brook due to road run-off, which is an increasing concern in the region.

Beech Brook: Erin Victory

Other aquatic habitats include two fens located on the Refuge in Management Units 4 and 5, typified by red maple and black ash (*Fraxinus nigra*). The larger fen, approximately 0.75 acre, is characterized by stunted trees, mossy hummocks, and ferns. It is fairly saturated and likely fed by spring water. The smaller of the two, at 0.1 acre, is also likely fed by spring water. This one is associated with an intermittent stream with black ash more predominant (T. LaPointe, pers. comm.).

One vernal pool was located on the Refuge during the habitat inventory. Because this was found in the autumn, how well it functions as a vernal pool and what species it supports is not presently known. The initial assessment indicated that it may be a result of human modification, as it looked unnatural in its surroundings. The presence of other vernal pools is not known at this time; no others were found during the inventory and given the soils and topography of the Refuge, others are not expected (La Pointe 2008).

Table 3.5. Present number of acres of each Refuge habitat type.

Refuge Habitat Types	Refuge Acres
Forest (including 1 acre of fen habitat)	77.65
Field	1.40
TOTAL	**80**

Federal- and State-Listed Species

Though there are no known federally-listed plants on the Refuge, the Loesel's twayblade, also called the fen orchid, does occur in the vicinity of the Refuge and is state-listed as threatened (Poole 2008). This species is an herbaceous perennial of the orchid family and is associated with fens and bogs, and cool moist ravines. It is primarily found in the Northeast and upper Midwest into Canada (http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=220007680).

Unique and Significant Natural Plant Community Types

There are two exemplary natural community types within the Town of Newbury. These are: circumneutral cliff, which had a historical occurrence, and rich red oak rocky woods. While these are not necessarily associated with the Refuge proper, the rich red oak rocky woods community does occur in the vicinity of Sunset Hill, which rises just east of the Refuge (Poole 2008).

Invasive Plants

The presence of invasive plants can have a major adverse impact on the biological integrity, diversity and environmental health of refuges and other natural areas. Though we have not conducted an exhaustive search of the Refuge, Japanese barberry is the only terrestrial invasive plant species documented to date. More information is needed to verify this, and to examine the extent and potential impacts there might be on the Refuge.

Though not technically part of the Refuge, aquatic invasive species can still have a negative impact on near-shore habitat and is worth mentioning given the 3,100 feet of Refuge shoreline, and associated Beech Brook. Variable milfoil (*Myriophyllum heterophyllum*) is the only invasive aquatic plant species documented in Lake Sunapee, and was discovered through the LSPA Weed Watcher's program in 2001 (NH DFG 2005, http://www.lakesunapee.org/). It has been contained to a two acre area in Georges Mills. Thirty teams of volunteers patrol the 26.2 miles of Lake Sunapee shoreline three times per summer looking for invasive aquatic species, and the LSPA has initiated a boat wash program to prevent the spread of invasive species from other lakes coming in on boats.

Refuge Biological Resources

Federal-listed endangered or threatened species

No federal-listed species have been documented on the Refuge and there is no federal critical habitat designated within the Refuge.

Many of the species listed for the Refuge below came from French (1972), Culp (1987), and Moses (1998). Additional sources of biological information are cited where appropriate.

Birds

The mix of transitional forest, fields, and proximity to Lake Sunapee result in a variety of bird species that use the Refuge year-round. Breeding bird surveys on the Refuge and adjacent conservation land owned by the Society for the Protection of New Hampshire Forests and Audubon Society of New Hampshire have confirmed 77 species, including fifteen warblers (Tolman et al. 1994, Quinn 1995). Of the total suite of birds found here, the wood thrush, Canada warbler, and American woodcock are identified as Highest Priority species for BCR 14 (Map 3-3). Within the PIF physiographic area 27 (northern hardwood forest-mixed forest) blackburnian warbler and black-throated-blue warbler are also priorities (Map 3-3).

In developing this CCP, we compiled a list of species of conservation concern for the project area, which includes birds on the NH WAP list, the BCR 14 Plan 2007, the PIF Area 27 plan list, the Atlantic Coast Joint Venture Plan, and our regional Birds of Conservation Concern list (Appendix A).

Songbirds

Based on breeding bird surveys conducted in 2001 and 2002 (Quinn 2001, Suomala 2002), as well as incidental observations, we have documented 72 species on the Refuge property. Nine of these species are listed as Highest Priority or High Priority by the Atlantic Northern Forest Joint Venture (Table 3.6).

Table 3.6. BCR 14 priority species on the Refuge or project area.

Species	Breeding, Wintering or Migrating Status on the Refuge	Priorities
Wood thrush	B	Highest
Veery	B	High
Yellow-bellied sapsucker	B	High
Eastern wood pewee	B	High
Black-throated blue warbler	B	High
American redstart	B	High
Canada warbler	B	Highest
Chestnut-sided warbler	B	High
Purple finch	B, W	High
B=Breeding, W=Wintering		

Raptors

Raptors that have been documented breeding on the Refuge or have been seen near the Refuge include the red-tailed hawk (*Buteo jamaicensis*), red-shouldered hawk (*Buteo lineatus*), broad-winged hawk, northern goshawk (*Accipiter gentilis*), Cooper's hawk (*Accipiter cooperii*; state-listed threatened), and sharp-shinned hawk (*Accipiter striatus*). The northern goshawk is a species of greatest conservation need in New Hampshire. Two other diurnal raptors of conservation concern occasionally use the Refuge during migration. These are the osprey (state-listed threatened) and bald eagle (federally-delisted in 2007, state-listed as threatened; D. Anderson, pers. comm.).

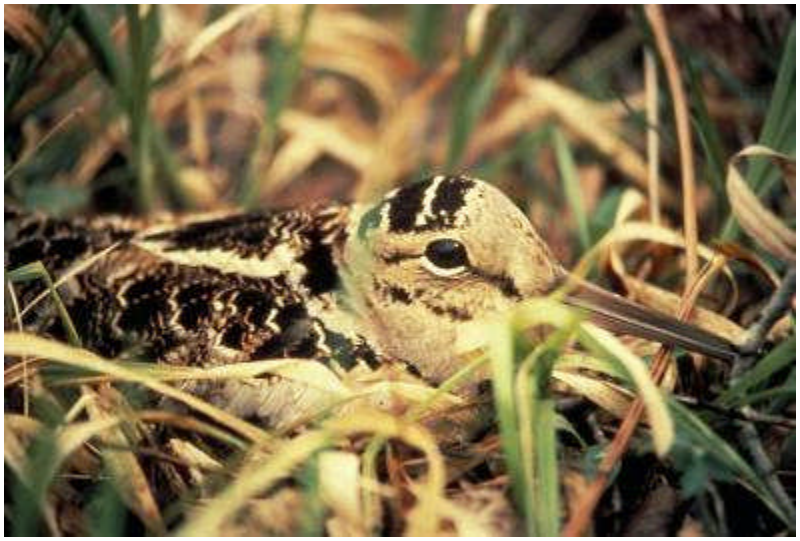
Nocturnal raptors documented either on the Refuge, or on the Hay Reservation include the great-horned owl (*Bubo virginianus*), barred owl (*Strix varia*), and northern saw-whet owl (*Aegolius acadicus*). Though eastern screech owl (*Otus asio*) has not been confirmed on either property, it is likely to be found there (D. Anderson, pers. comm.).

Waterfowl

Three species of waterfowl have been documented on the Refuge through breeding bird surveys or incidental observations. These are the mallard, American black duck, and wood duck. Although the Refuge does not support breeding or winter habitat for waterfowl, the undisturbed shoreline is likely valuable during migration, and later in the breeding season as broods are foraging. All three are designated a High Continental Priority in the Atlantic Coast Joint Venture – Waterfowl Implementation Plan Revision (2005; http://www.acjv.org/acjv_publications.htm). A common merganser (*Mergus merganser*) family has also been seen on the lake.

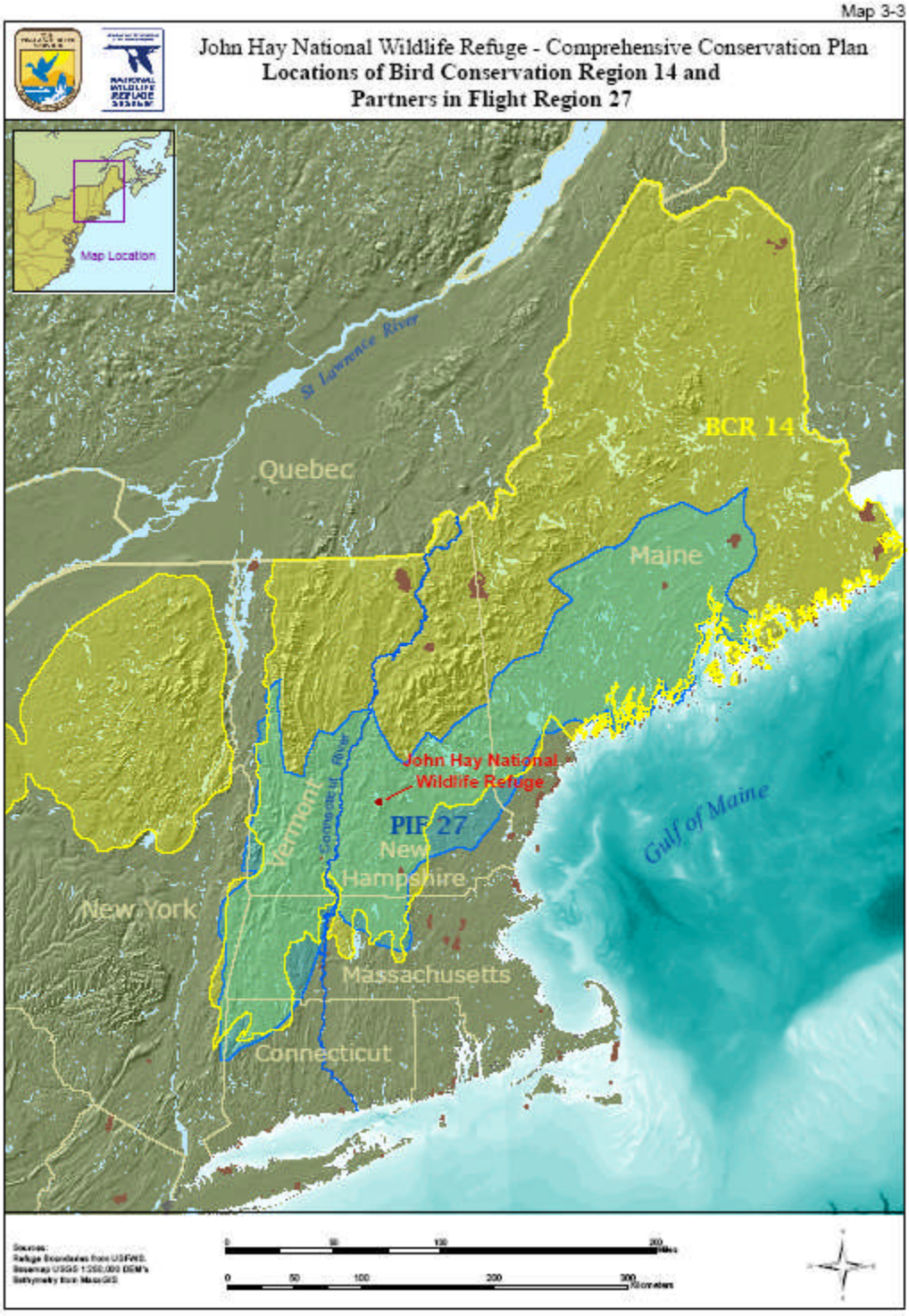
Shorebirds

The American woodcock has been documented on the property, typically in association with the southern 1.4 acre meadow, and is listed as a Highest Priority species in the North Atlantic Regional Shorebird Plan (http://www.fws.gov/shorebirdplan/RegionalShorebird/downloads/NATLAN4.doc). The species is morphologically classified in the *Scolopacidae*, or "Sandpiper" family of birds, however, it prefers upland open field and early successional forest habitats. This is a species of regional concern, as it is experiencing declines throughout its range (Kelley et al. (eds) 2008).



American woodcock: Richard Baetson

Map 3-3


John Hay National Wildlife Refuge - Comprehensive Conservation Plan
Locations of Bird Conservation Region 14 and
Partners in Flight Region 27
Map Location
St Lawrence River
Quebec
BCR 14
Maine
John Hay National
Wildlife Refuge
PIF 27
New
Hampshire
Vermont
Connecticut River
New York
Massachusetts
Connecticut
Gulf of Maine

Fish and other Aquatic Species

Fish species documented on the Refuge include rainbow smelt and eastern brook trout. These two species are typical of cold water lakes and both spawn in or near the outflow of Beech Brook. They are considered species of greatest conservation need in New Hampshire, as both species have shown population declines as a result of overharvesting, barriers to reaching spawning grounds, sedimentation, and water quality (NH FGD 2005). Conservation of native eastern brook trout is a priority for the Service (http://www.easternbrooktrout.org/index.html). The New Hampshire Fish and Game Department has supplemented natural brook trout populations in many streams with hatchery stock for the last 100 years.

Mammals

Mammals typical of upland woods and fields are found on the property: white-tailed deer, black bear, mink, short- and long-tailed weasel (*Mustela erminea* and *Mustela frenata*, respectively), raccoon (*Procyon lotor*), red fox (*Volpes volpes*), river otter, muskrat (*Ondatra zibethicus*), fisher, snowshoe hare, gray and red squirrels (*Sciurus carolinensis* and *Tamiasciurus hudsonicus*, respectively), porcupines (*Erethizon dorsaum*), eastern chipmunk (*Tamias striatus*), striped skunk (*Mephitis mephitis*), star-nosed mole (*Condylura crestata*) and numerous species of mice, voles, and shrews. White-footed (*Peromyscus leucopus*), deer (*Peromsycus maniculatus*) and woodland jumping (*Napaeozapus insignis*) mice, southern red-backed voles (*Clethrionomys gapperi*), water shrew (*Sorex palustris*) and short-tailed shrew (*Blarina brevicauda*) have all been documented on Hay Reservation property owned by the Forest Society across Route 103A from the Refuge. Although not confirmed, gray fox (*Urocyon cinereoargenteus*) bobcats and coyote probably wander onto the Refuge as well (C. Bridges, pers. comm.; D. Anderson, pers. comm.).

Amphibians and Reptiles

No detailed surveys have been completed, but wood frogs and spotted salamanders reside on the Refuge. The wood turtle and blue-spotted salamander are listed as two species of concern in the region that could potentially occur on the Refuge (Appendix A).

Spotted salamander: Steve Shively/USFS

Invertebrates

Arthropods, including insects, are so vital to the functioning of the earth's biological and nutrient cycles that, if all were to disappear, humanity would probably fade within a few months, and mammals, reptiles and birds would go extinct about the same time (Wilson 1992). This group serves vital functions as pollinators, detritivores (aiding in the decomposition of matter and returning nutrients to the soil), and as a prey base to insectivorous mammals, reptiles, fish and birds. Despite their importance to functioning ecosystems, no formal invertebrate surveys have been conducted on the Refuge. Presumably, a rich diversity of terrestrial insects such as spiders, beetles, ants, dragonflies, butterflies, moths, flies, wasps, and bees exist on the Refuge, as well as ticks, chiggers and mosquitoes.

Insect Pests

Currently, there is no data on insect pests at the Refuge.

Refuge Visitor Services Program

Priority Wildlife-Dependent Recreational Uses

We identify below the current opportunities on the Refuge for engaging in four of the six priority public uses of national wildlife refuges permitted at John Hay NWR: wildlife observation, wildlife photography, environmental education and interpretation. These four are available to visitors at the Refuge and can take place anywhere on the Refuge.

There are two trails that run through the Refuge. One is the 0.9 mile interpretive Ecology Trail that begins at The Fells gatehouse and winds through the diverse Refuge habitats before ending at The Fells main estate house. Officially dubbed the John Hay II Forest Ecology Trail, it was created by Tudor Richards along with Refuge staff to honor John Hay II, regional author. This is a dirt path that can be narrow and rocky at times, crosses Beech Brook, and then parallels Beech Brook very closely until they both reach the lake. It is a self-guided interpretive trail, with a brochure corresponding to numbered markers highlighting and describing notable natural features of the Refuge. Wildlife viewing and photography tend to be concentrated along this trail and on the shore of Lake Sunapee. Most interpretation, however, is offered through occasional organized classes conducted by The Fells, LSPA and the Forest Society among other partners at the John Hay estate.

The other trail is actually a former drive through the woods used by the Hay family for access to the working farm south of the estate house. Named the Woods Road, it is about 0.5 miles in length from Route 103A heading northwest to the gravel drive running between The Fells gatehouse and main house. The Service access gate is located on Woods Road at the junction with Route 103A, and was used in the past by the Service for management access. Only a portion of this road is traversable by vehicle; near the center of this road, where the Ecology Trail crosses it, there is a sign indicating that no motorized vehicles are permitted beyond that point towards The Fells.

Environmental education is associated with the classroom at the gatehouse, although outdoor classes take advantage of the wide variety of plants in the gardens, the lakeshore, and the interesting forest features. The majority of people visiting the Refuge are there to see the estate and learn more about John Hay. The Fells help meet these demands by providing public programs and workshops on historical, architectural, and landscaping aspects of the Hay estate.

We have not conducted formal surveys of annual Refuge visitation, despite our desire to do so. However, we have data representing numbers of visitors by activity over the course of six months from visitor contacts at The Fells gatehouse, program attendance, and observations by our partners at The Fells.

The visitor numbers to The Fells in Table 3.7 represent the period of October 1, 2007 through March 25, 2008 when the estate and grounds were exchanged to The Fells. From this data we estimated that the visitors participating in wildlife observation, photography, environmental education, and interpretation, also visited the Refuge. This provided an estimate of 1,805 visitors to the Refuge during the six month period.

Most people travel to the site to see the estate and gardens, learn about John Hay and his family, or attend workshops and classes offered by The Fells. The only developed visitor service facility on the Refuge is

the Ecology Trail. We do not have good estimates of the number of people that use the trail, nor do we know how many visitors walk through the Refuge off the trail. We expect visitation at the Refuge to increase in the coming years commensurately with statewide and regional trends, and our planned development of an additional trailhead and interpretive efforts. However, an increase in Refuge visitation does not necessarily mean there will be more total visitors to the Refuge and The Fells combined. It is more likely that a larger proportion of visitors to The Fells will take advantage of an improved nature trail on the Refuge.

Table 3.7. Estimated number of total visitors to The Fells (2,195) that also visited the Refuge, by activity: October 2007 to March 2008.

Activity	Visitors
Freshwater Recreational Fishing (One-time Special Use Permit)	25
Wildlife Observation	1,500
Nature Photography	30
Environmental Education Programs On-site	150
Interpretative Programs On-site	100
Total	**1,805**

Other Public Use Activities

Activities not allowed

In determining compatibility of public uses of the Refuge, many were deemed compatible on The Fells estate and grounds, but need to be re-evaluated to reflect the current acres of Refuge property. As part of this CCP, compatibility determinations will be conducted to evaluate the possibility for these activities in the context of the mission of the Refuge, public safety, and feasibility (see Appendix B). We also have to assess appropriateness for any non-priority uses.

Law enforcement concerns

Most visitors respect the Refuge rules and regulations on public uses and activities. However, some choose not to. Those who have been in violation of Refuge policies have done so by bringing dogs onto the Refuge, beaching boats and rafts, using the beach area as a restroom. Since the Refuge was established, we have not allowed those activities for the following reasons.

- First those activities are not wildlife-dependent recreational uses, as defined by the Refuge Improvement Act of 1997, nor are they necessary for the safe, practical, or effective conduct of a compatible priority public use.

- Second, they are likely to cause the disturbance of wildlife in important habitats. Specifically, because these activities tend to be along the shoreline, they can affect waterfowl and other waterbirds that frequent Lake Sunapee near the Refuge and repetitive use degrades the shoreline and habitats.

- Finally, they are likely to interfere with other visitors engaging in compatible priority public uses.

Though the Refuge does not have a full time law enforcement officer at this time, the Silvio O. Conte National Fish and Wildlife Refuge Complex does have officers on staff that can patrol the Refuge on an as-needed basis. We also can work with the Town of Newbury and the NH Marine Patrol and NH Department of Fish and Game to help monitor the Refuge and enforce our rules and regulations.

As part of this CCP, we will increase our efforts towards community outreach and education of Refuge policies. This includes additional signage for property delineation and to post rules and regulations, particularly on the beaches. It also includes working with town marinas to create awareness of Refuge beach policies for boaters accessing the Refuge in this manner. By creating awareness through education, we hope to decrease incidents of unauthorized activities on the Refuge.

Archaeological, Historical and Cultural Resources

The John Hay Refuge and The Fells has national importance as the summer home of John Hay during the time he was ambassador to Great Britain and Secretary of State (1891-1905) and is the only remaining residence associated with Mr. Hay's adult life. The property also has local prominence as an excellent and virtually unaltered example of an early twentieth century summer estate. In recognition of its importance, the estate and gardens were listed on the National Register of Historic Places in 1999.

The one-acre viewshed through the Refuge maintained by The Fells has cultural importance, as it represents a connection of the estate to the larger region. The area around the house today is much different from during the Hay's tenure on the property, as forest is now the dominant feature on the landscape and has begun to extend closer to the main house and grounds. Maintaining this vista, then, becomes of greater import as a critical component in the overall appreciation of the site and in establishing the context of the surrounding landscape (Historic Landscape Committee 1993).

The Fells viewshed: Erin Victory

Another feature of the Refuge that has cultural importance is the presence of the large white pines and other mature trees. These legacy pines are impressive landscape features that are remnants of the historic landscape and help tell the story of land use over time. They are also testimony of the Hay's minimalist land management philosophy on the majority of their property during the twentieth century.

No formal archaeological surveys of the Refuge property have been conducted to date. However, according to the NH SHPO, the Refuge has high site potential for both Native American and early historic period archaeological resources. Its proximity to the lake and associated rivers and streams are likely places for Native American and early European settlements.