

# **ECOLOGICAL INVENTORY and ASSESSMENT of ANNETT STATE FOREST and HUBBARD POND**

**RINDGE and SHARON, NEW HAMPSHIRE**



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**Prepared for:  
Rindge Conservation Commission**

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**Cover Photograph: *Overlooking Hubbard Pond and Mount Monadnock in autumn 2010.***

## **ACKNOWLEDGEMENTS**

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# TABLE OF CONTENTS

<b>Acknowledgements</b>	<b>ii</b>
<b>Introduction</b>	<b>1</b>
<b>Methods</b>	
<b>Study Area</b>	<b>3</b>
<b>Methodology</b>	<b>5</b>
<b>Results and Discussion</b>	
<b>Wildlife Habitats</b>	<b>10</b>
<b>Natural Communities and Systems</b>	<b>23</b>
<b>Species Inventories</b>	<b>27</b>
<b>Conclusions</b>	<b>43</b>
<b>Literature Resources</b>	<b>46</b>
<b>Appendices</b>	
<b>Appendix A – NH Natural Heritage Ranking     Codes Descriptions</b>	<b>49</b>
<b>Appendix B – Wildlife Species List</b>	<b>51</b>

## INTRODUCTION

The Rindge Conservation Commission has worked diligently on the protection of its natural resources. They have completed many field-based assessments throughout Rindge in a continued effort to promote informed land use planning, sound land management, and overall protection of the town's natural resources. Their projects provide critical information on Rindge's natural resources and are meant to be used by the town boards and residents, as well as state agencies. This includes not only the Conservation Commission but also the Select Board, Planning Board, private landowners, and state-owned properties. In addition, these documents can be used for educational purposes for the residents of Rindge, as well as local and regional schools.

The Converse Meadow Conservation Area biodiversity assessment (Littleton 2005) was used to develop a management plan for the town-owned property, and it helped to establish rationale for a conservation easement on the property through the Monadnock Conservancy. The assessment demonstrated the significance of the property's ecological characteristics and assisted with landscape-level conservation planning. The findings of this project can be used for many other purposes such as forest management, general exploration on the property, as well as an outdoor learning lab for wildlife, plants, habitats, forest ecology, and interpreting past land use histories.

Spanning town-wide, the Rindge Conservation Commission continued with its conservation planning efforts through the development of a conservation plan (Bluepoint Ecological LLC 2007). Field-based assessments resulted in a map that identified priorities for conservation. The town can use this map for informed land use planning efforts, and the private landowners that provided permission to collect ecological data on their properties can use it for land management purposes. In fact, this effort helped to demonstrate the importance of the Hampshire Country School property, which led to a conservation easement on over 1,400 acres. This effort was then followed by a baseline documentation report (Littleton 2008 and Northeast Wilderness Trust 2008) as a required element for the conservation easement that the Northeast Wilderness Trust acquired. This effort further illuminated the ecological significance of this property in Rindge, as well as the region.

In keeping with its continued purpose of promoting wise land use planning and proper utilization of the town's natural resources, the Rindge Conservation Commission

contracted with Moosewood Ecological LLC to conduct an ecological inventory and assessment of Annett State Forest and Annett Wayside Park (hereinafter referred to only as Annett State Forest), including Hubbard Pond. This project was conducted from April 2010 through October 2011. The overall scope was to better understand the significant attributes of the property to help inform conservation and land management planning. Primary emphasis was placed on identifying ecologically significant areas, including important wildlife habitats and exemplary natural communities, and species of conservation concern. Secondary emphasis was placed on understanding the overall biological diversity of wildlife, including birds, mammals, amphibians, and reptiles.

A few ecological inventories have been completed in Annett State Forest and Hubbard Pond. A comprehensive forest inventory was completed by the NH Division of Forest and Lands, which is charged with managing the state-owned property. The Division has mapped a variety of forest stand types within 7 management compartments from which the Division is conducting ongoing forest management (Seaboyer 2010-2011). As part of their sustainable forestry practices they continue to collect more detailed information prior to timber harvests (Seaboyer 2010-2011).

To date, there have been no known documented quantitative or comprehensive surveys for wildlife in Annett State Forest. However, while conducting its forest inventory the NH Division of Forest and Lands has maintained a list of incidental wildlife observations (Seaboyer 2010-2011). Therefore, this document can serve as a valuable tool to assist with their future forest management planning. However, a wildlife inventory was completed for Hubbard Pond (Wolf 2004). This Masters of Science thesis focused on aquatic plants, fish, amphibians, reptiles, aquatic macroinvertebrates, waterbirds, and semi-aquatic mammals. As such, less emphasis was placed on these elements for this ecological inventory, especially as it pertained to amphibians, fish, and snakes within Hubbard Pond. The findings of this project were meant to develop a more comprehensive understanding of Hubbard Pond as a way of building upon the data collected by Wolf (2004).

## **METHODS**

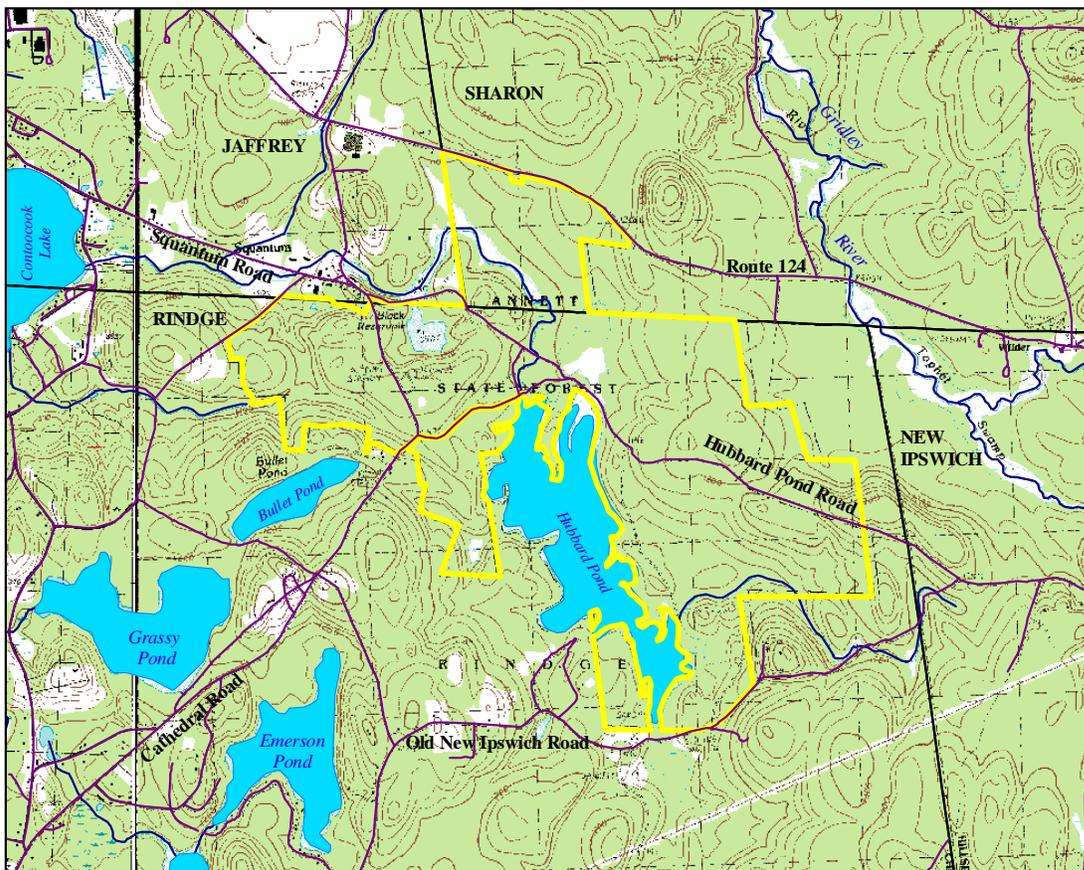
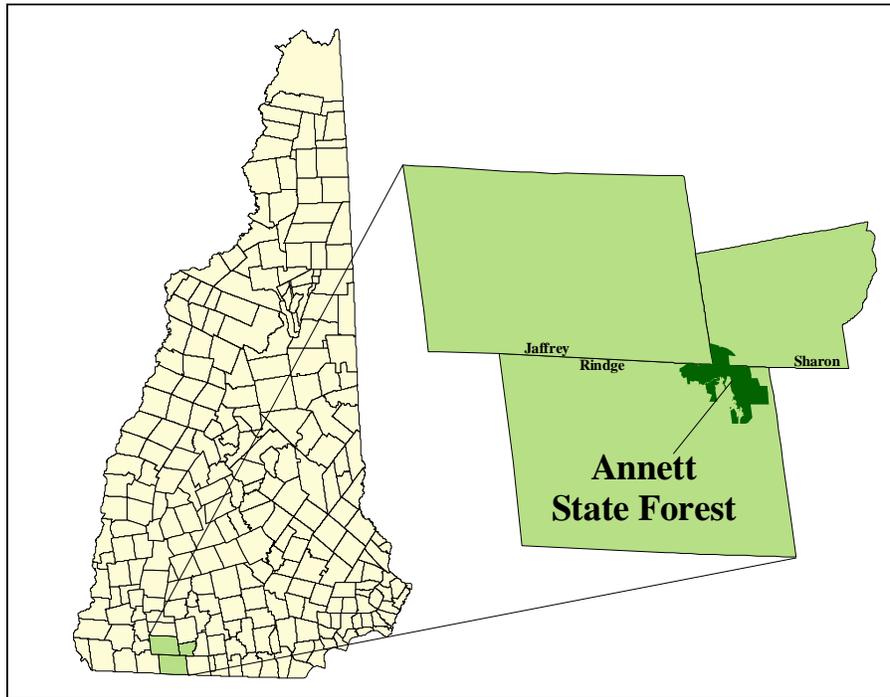
### **Study Area**

Annett State Forest and Hubbard Pond are properties of the state of New Hampshire. They are located in southwest New Hampshire, mostly in the town of Rindge with a small portion in Sharon (Figure 1). It is part of the Hillsborough Inland Hills and Plains of the Vermont-New Hampshire Uplands (NH Natural Heritage Bureau 2005), and forms part of the headwaters to the Contoocook River watershed.

Annett State Forest encompasses approximately 1,356 acres (Seaboyer 2010-2011). Hubbard Pond is adjacent to Annett State Forest, encompassing approximately 204 acres (NH Fish and Game 2010a). An additional 48.5 acres was added to Annett State Forest in 2011 (Seaboyer 2011). However, this parcel was not surveyed due to the timing of this acquisition and the timeline of the project.

Annett State Forest is predominantly a mixed coniferous and deciduous forest dominated by hemlock, beech, oak, and pine. Pure or nearly pure stands of red and white pine can be found scattered throughout, as well as dense hemlock stands. A few small patches of hardwood-dominated stands can also be found. Current and past timber harvests have created a mosaic of different age classes throughout Annett State Forest, including some early succession stands.

Hubbard Pond is a man-made impoundment with a dam located in the northwestern part of the pond. Vegetated wetlands can be found along the margins of the pond and secluded coves, as well as the northwest section. These mostly include peatlands, mudflats, and aquatic beds. Black Brook flows north of the dam and is bordered by marsh and shrub wetlands. These wetlands are best described as a peaty marsh due to the long-term influence of beaver dams, converting peatlands into more marsh-like conditions as a result of flooding. Other wetlands associated with Hubbard Pond and Black Brook include forested swamps, which are dominated by red maple, hemlock, or red spruce. A variety of isolated wetlands can be found scattered throughout the forested uplands. These include a marsh, shrub swamps, vernal pools, and forested swamps. Other water resources include approximately 885 acres of stratified drift aquifers underlain beneath Annett State Forest.



**Figure 1.** Top: locus map of Annett State Forest, Rindge and Sharon, NH.  
 Bottom: topographical base map of Annett State Forest and Hubbard Pond.

Upland soils are mostly a combination of sandy loams and loamy sands derived from outwash sands and glacial till as a result of our last glacial retreat about 11,000 years ago. Outwash sands are closely associated with Hubbard Pond and Black Brook, where drumlins have formed on the eastern edge of these waterbodies. Outwash sands can also be found in the western portion of Annett State Forest. Outwash sands are also prevalent just south of the study area where sand is currently being extracted. The majority of glacial till can be found in the most eastern portion of the property. Hydric soils mostly include mucky peats.

As with most of New England, the lands of Annett State Forest have seen some dramatic changes over time. Much, if not all, of the property was once cleared for agricultural purposes. However, scattered woodlots may have also been present. Evidence of crop cultivation, pastures, hayfields, and homesteads are present throughout Annett State Forest, which most likely began in the late 1700s to early 1800s. After land abandonment in the late 1800s to early 1900s the forests were allowed to regenerate. In the early and mid 1900s the Civilian Conservation Corps (CCC) planted red pine plantations. These red pines plantations have since become naturalized. The CCC camp was located in the current-day Annett Wayside Park and they helped with the creation of the park from 1933-1942. A plaque placed in their honor still remains at the wayside park.

A variety of unpaved roads traverse Annett State Forest, which seems to be used on a fairly regular basis. Some are gated in a few locations, and most recently near the outlet of Black Brook from Hubbard Pond to help prevent further erosion and harm to the dam and associated dike to the east. Many types of recreational activities occur in the study area. These include fishing, hunting, paddle boating, hiking, dog walking, nature study, snowmobiling, and timber harvesting. Illegal ATV and four-wheeled drive vehicle activity and littering appear to be an ongoing issue.

## **Methodology**

### ***Wildlife Habitats and Natural Communities***

Basic habitat and natural community types were initially mapped using existing geospatial data and aerial photography interpretations in a GIS (geographic information system). Geospatial data included the NH Wildlife Action Plan (WAP) habitats (2010), US

Fish and Wildlife Service National Wetlands Inventory (NWI), NH Natural Heritage Bureau (NHB) known exemplary natural communities (2010), US Geological Survey topographic maps, hydrography dataset, and soils. Color and infrared aerial photographs from a flyover in 2010 were used to interpret more fine-scale habitat types, such as potential vernal pools. Wildlife habitats and natural communities were then field verified to ensure accuracy of existing data. Additional habitats and natural communities were mapped as they were encountered. Nomenclature follows that of the WAP (2010) and NHB (2011). Additional habitats mapped included forested swamps and aquatic beds, as well as dens, nests, and beds.

### ***Species Inventories***

Four taxa of wildlife were surveyed, including birds, mammals, amphibians, and reptiles. These species were sampled to either determine presence/not detected or to determine their relative abundance and/or frequency of occurrence. Primary focus was on species of conservation concern. Rare plant surveys were also conducted. Incidental observations were also recorded throughout the project duration.

### **Birds**

Birds were sampled within uplands, wetlands, open water, and riparian areas. These surveys were designed to calculate relative abundance, as well as to determine presence/non detection of targeted species. Four priority lists were used to determine if a species was listed as a conservation concern (Dettemers 2003, NH Fish and Game 2005 and 2009, Partners In Flight 2008, and US Fish and Wildlife Service 2008). Hunt (2009) was used to determine a species general trend, which refers to how well populations of birds are responding over time (i.e., increasing, stable, decreasing, uncertain, and unknown). In addition, any sign of breeding behavior was recorded (Table 1), following Foss (1994).

**Table 1.** List of the breeding evidence codes.

<b>Breeding Code</b>	<b>Description of Indicators</b>
OB = "Observed "	1. Species observed during its breeding season, but not in potential breeding habitat
PO = "Possible" Breeding	1. Individual observed in possible nesting habitat 2. Singing male; OR courtship display of waterfowl or diurnal raptors
PR = "Probable" Breeding	1. Pair observed in possible nesting habitat 2. Territory presumed from observations of territorial behavior 3. Courtship and display 4. Visiting probable nest site 5. Agitated behavior or anxiety calls 6. Brood patch or cloacal protuberance 7. Excavating nest hole; OR nest building by wrens 8. Species observed at point during both sampling periods
CO = "Confirmed" Breeding	1. Distraction display 2. Nest building for species other than wrens 3. Used nests 4. Recently fledged young 5. Adult leaving or entering cavity indicating occupied nest; OR adult on nest 6. Adult carrying food or fecal sac 7. Nest containing eggs 8. Nest with young

Source: Foss (1994).

Breeding birds sampled in forested habitats included uplands and spruce-fir forested swamps. A total of 30 bird stations were located at least 250 meters apart and sampled twice from May 2010-July 2010 from 5:00-10:00am. Each point was sampled for five minutes and the total number of each species was recorded by sight and sound.

Open wetland (marsh and shrub habitats, open water, and peatlands) bird stations were placed at least 250 meters apart. Each station was sampled two times during the field season from 5:00-10:00am. Four bird stations were sampled along the edge of Hubbard Pond from May 2010-July 2010. Birds were recorded by sight and sound for a total of 20 minutes using a sighting scope. Four bird stations were sampled along Black Brook from May 2011-

June 2010. Birds were recorded by sight and sound for a total of 16 minutes using broadcast calls of secretive species, including least bittern, sora, Virginia rail, American bittern, common gallinule (formerly known as common moorhen), and pied-billed grebe. Broadcast surveys consisted of a 5-minute quiet period, followed by a 6-minute broadcast of each species above, then followed by a 5-minute quiet period.

Migratory waterfowl were sampled in fall 2010 and spring 2011 in Hubbard Pond using direct searches from boat and shoreline. The purpose was to establish baseline data on presence of migratory waterfowl and to determine if Hubbard Pond was functioning as an important migratory stopover area. Boat surveys included paddling the perimeter of the pond to search vegetated wetlands and secretive coves, as well as open water. Shoreline surveys were conducted in three locations: dam in the northwest, shoreline in the northeast, and roadside along Old New Ipswich Road in the southern end as stream inlet. Black Brook was sampled by boat in spring 2011 to augment incidental observations recorded from the upland/wetland edge in 2010.

Supplemental sampling was conducted within forests and wetlands using direct search. These surveys were aimed at detecting secretive species and to increase the probability of detecting additional species of conservation concern, as well as to identify signs of breeding (i.e., nests, fledglings).

### Mammals

Winter mammal tracking surveys were conducted from December 2010-March 2011 to better understand species diversity and frequency of occurrence of medium to large-sized mammals (mammals larger than but including red squirrel). A total of five transects equaling 1.5 kilometers were established in upland forests on the property and sampled 3 times. All transects were sampled on the same day 2-3 days after a fresh snow. All focal species that were intercepted along the transect were tallied by species and number of intercepts.

Roadside surveys were also conducted to examine road crossings by species. Mammal crossings were sampled four times. The routes sampled included the following: that portion of Cathedral Road that runs adjacent and through the study area (1.1km); Route 124 from Annett State Forest western boundary to Tophet Swamp (2.7km); Old New Ipswich Road from Wildwood Mass Audubon Camp to Hubbard Pond Road (3.0km); and along

Annett Road that traverses through the property (3.6km). Each of these routes was sampled four times, except for Annett Road. This segment was only sampled on 2 occasions due to inaccessibility by a four-wheeled drive truck in deep snow conditions. All focal mammals observed approaching or leaving the road were investigated. Each was identified to species and classified as a “crossing” or a “turn-around” (whereas the mammal approached the road but did not cross).

Direct searches were conducted to determine the presence of focal keystone species, including bobcat, black bear, moose, river otter, mink, and beaver. This included searching habitats within riparian areas, upland forests, and isolated shrub and forested wetlands, as well as Hubbard Pond, Black Brook, and their associated wetlands. Direct searches were also conducted to locate and map active den sites.

### Amphibians

The main focus was placed on mapping and surveying vernal pool amphibians. Egg masses within known vernal pools were sampled from April-May 2011. Relative abundance was calculated for each species. Direct searches were conducted in other terrestrial and wetland habitats to determine species presence throughout the project duration.

### Reptiles

Turtles were the focal species. Turtle trapping was conducted in two locations within Hubbard Pond and one site along Black Brook for a total of 14 traps. Trapping occurred from July-August 2010. Each site was sampled over a 12-day period and traps checked every 48 hours. Hoop traps were baited with sardines and were located at least 2-3 inches above the water line to allow trapped animals to breathe. On June 23, 2010, permission was granted to Jeffrey N. Littleton of Moosewood Ecological LLC by the NH Fish and Game Dept. to conduct turtle trapping surveys within Hubbard Pond and its associated inflow and outflow streams. On July 1, 2010, permission was also granted, through Special use permit #10-020, from the Division of Forest and Lands to conduct the turtle trapping survey. If Blanding’s turtles were captured then they would be measured, photographed, and marked with a shell notch for future identification. Basking surveys were also conducted within Black Brook during May 2011. Direct searches for snakes were conducted throughout the property.

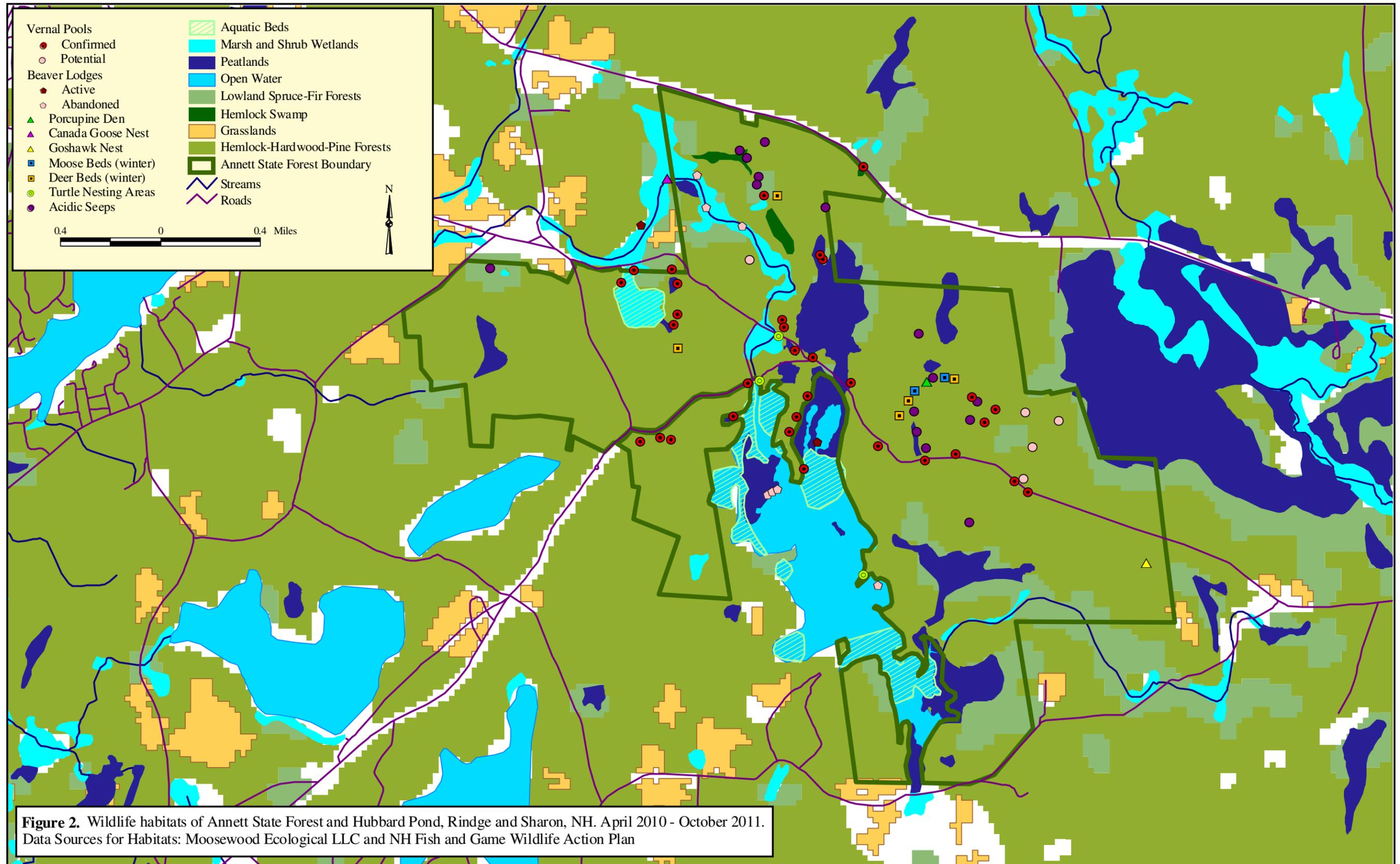
## **Limitations of Data and GIS Disclaimer**

The maps contained herein are for information and planning purposes only. They are suitable for general land use and management planning. However, they are not suitable for wetlands delineations and other jurisdictional determinations, as well as defining legal property boundaries. The accuracy of the data is the end user's responsibility. Moosewood Ecological LLC and the Town of Rindge make no warranty, expressed or implied, as to the accuracy or completeness of GIS data retrieved from existing sources (i.e., GRANIT database and NH Division of Forest and Lands), and do not assume any liability with the use and/or misuse of this data. Furthermore, Moosewood Ecological LLC and the Town of Rindge shall assume no responsibility for any errors, omissions, or inaccuracies in the information provided.

## **RESULTS AND DISCUSSION**

### **Wildlife Habitats**

Annett State Forest and Hubbard Pond offer a variety of important wildlife habitats for use by a wide range of species (Figure 2). These include habitats such as the open water, aquatic beds, and peatlands of Hubbard Pond, Black Brook and its marsh and shrub wetlands, coniferous and deciduous swamps, upland forests, seeps, and vernal pools. These also include other fine-scale habitats such as dens, beds, and nest sites. These habitat types help to paint a picture for the variety of wildlife and plants that exist on and adjacent to the study area. The following subsections provide a brief account of these wildlife habitats specifically as they relate to Annett State Forest and Hubbard Pond.



### *Hemlock-Hardwood-Pine Forests*

The hemlock-hardwood-pine forest dominated the uplands of Annett State Forest. This forested habitat mainly occurred as a variety of mixed coniferous and deciduous stands, as well as nearly pure coniferous stands. The hemlock-beech-oak-pine forest served as the matrix forest. Smaller upland forest types included hemlock forest, hemlock-white pine forest, dry red oak-white pine forest, and lowland spruce-fir forest.



Typical hemlock-hardwood-pine forest at Annett State Forest, Rindge and Sharon, NH. July 2010.

Many coniferous-dominated stands were observed throughout Annett State Forest. These included red and white pine stands and hemlock stands. Red pine plantations were planted in the early-mid 1900s by the Civilian Conservation Corps. Since then this species has become naturalized in Annett State Forest. Some stands of dense hemlock functioned as deer wintering areas, as evidenced by deer beds, well-used trails, and browse and incisor scrapes on hemlock saplings. Many smaller forest stands have been delineated by the NH Division of Forest and Lands as part of their land management and timber harvest planning. These forest stand maps have been created for forestry purposes. These maps date back as far as 1985 and are refined periodically as needed, such as when planning a timber harvests (Seaboyer 2010).

Species composition and forest structure varied throughout the study area. Relative abundance of species within each forest type varied greatly, depending upon many factors including slope, aspect, soil type, and previous land use history. As such, past timber harvests have created a mosaic of age classes throughout the forest. These include areas of dense tree regeneration and early succession stands to older forests.



Diverse forest structure promotes greater biological diversity, such as old, large trees with complex canopy structures (left) for large nesting birds and large coarse woody debris (right) to promote decaying organisms and cover for wildlife such as amphibians and small mammals .

### ***Lowland Spruce-Fir Forests***

These forests consist of a mosaic of lowland spruce-fir forests and red spruce swamps throughout the property. These coniferous-dominated forests offer a distinct habitat for wildlife communities, especially birds such as the northern goshawk and Canada warbler, which are species of conservation concern. Pockets of red spruce swamps consist of shallow organic soils over sandy soils that are characteristic of the study area as a whole. Species diversity for the lowland spruce-fir forests and red maple swamps throughout New

Hampshire totals 101 vertebrates, including 9 amphibians, 53 birds, 37 mammals, and 2 reptiles.



Lowland spruce-fir swamp with mountain laurel in bloom. Annett State Forest, Rindge and Sharon, NH. June 2010

### *Peatlands*

Peatlands were distributed throughout the study area but were predominately associated with Hubbard Pond. In particular, this habitat type was found along its margins and protected coves in northern and southern areas of the pond. They also existed as small, isolated pockets. Peatlands of Annett State Forest and Hubbard Pond varied in their composition and form, ranging from open sedge lawns, floating peat mats, and dwarf-medium height shrub thickets to forested swamps. Peatlands are considered as a distinct habitat type due to the unique species composition, sensitivities to changes in pH (level of acidity), and potential to contain rare species and unique natural communities. In fact, the NH Natural Heritage Bureau recognizes the medium level fen system within Hubbard Pond as exemplary.

While peatlands are considered significant due to their rare plants and natural community diversity, they do provide important habitat for various wildlife, including

species of conservation concern. These include species such as eastern smooth green snake, northern leopard frog, ribbon snake, and bobcat. The latter two were observed on the study area. Another species of concern includes the ringed boghaunter, a type of dragonfly that is strongly associated with peatland habitats. While this species was not observed during this study it was found at the Converse Meadow Conservation Area (Littleton 2005) and has the potential to occur within the study area.



Pitcher plants were commonly found in the peatlands associated with Annett State Forest, Hubbard Pond, and Black Brook. Rindge and Sharon, NH. June 2010

### ***Marsh and Shrub Wetlands***

Marsh and shrub wetlands were mostly associated with Black Brook but a small, isolated example was observed in the southwest part of Annett State Forest. Similar to peatlands, the marsh and shrub wetlands offer a variety of smaller habitats based on plant community composition and structure. These included emergent marshes, aquatic beds, pockets of open water within the wetlands as well as Black Brook, and shrub thickets. Beaver activity over the years has continued to change the structure and composition as dams are

built, altering the hydrologic and nutrient regime. However, this activity does provide for greater species diversity within wildlife communities.



Marsh and shrub wetlands associated with Black Brook, Annett State Forest, Rindge and Sharon, NH. August 2010.

### *Aquatic Beds*

Due to the relatively shallow nature of Hubbard Pond, aquatic beds were found throughout in association with pond margins and protected coves adjacent to peatlands. Black Reservoir also contains an aquatic bed. These extensive beds of pond lilies provide habitat for fish, turtles and frogs, as well as waterfowl feeding in and among this habitat while occasionally taking cover in the adjacent herbaceous and shrub thicket habitats.



Aquatic beds can be found throughout the shallow edges and protected coves of Hubbard Pond, as well as along Black Brook and Black Reservoir. Annett State Forest and Hubbard Pond, Rindge and Sharon, NH. July 2010

### *Forested Swamps*

In addition to the red spruce swamps discussed in the Spruce-Fir Forests section, other hardwood and conifer-dominated forested swamps were observed on Annett State Forest. Red maple swamps were found mostly associated with Black Brook and were relatively small. A good example can be viewed from Annett Road where it crosses Black Brook. These swamps were generally associated with a lush understory of tussock sedge and mixed with medium height shrubs. Hemlock swamps were generally scattered as isolated wetlands in the northern part of Annett State Forest. Top predators such as barred owls, red-shouldered hawks, Cooper's hawks, and mink are associated with forested swamps, as well as reptiles and amphibians, which may breed within these wetlands.



Seasonally flooded red maple swamps can be found along the edges of Black Brook, Annett State Forest, Rindge and Sharon, NH. August 2010

### ***Hubbard Pond and Black Brook***

The open water of Hubbard Pond, Black Brook, and Black Reservoir provide great habitat for nearly all types of wildlife. Both aquatic and semi-aquatic species were observed using these waterbodies, including otter, beaver, muskrat, osprey, various waterfowl, great blue heron, painted and snapping turtles, northern water snake, red-spotted newt, and fish. Other potential important species strongly associated with open waterbodies include bald eagle and common loon. These areas also provide critical habitat for a variety of waterfowl as feeding and resting sites during spring and fall migrations. Migration is a tremendously energy demanding activity, requiring sufficient areas for waterfowl to rest and replenish their depleted fat storage levels. Although these sites were not associated with relatively large numbers of migrating waterfowl, they were functioning as migratory stopover sites.



The open waters of Hubbard Pond, Black Brook, and Black Reservoir provide important space for migratory waterfowl, such as these buffleheads, for resting and feeding. Hubbard Pond, Rindge, NH. April 2011

### ***Vernal Pools***

A total of 35 vernal pools were documented within the study area. These included isolated pools, as well as pools associated with larger wetland complexes such as forested swamps and peatlands. Some were created or enhanced by human disturbance (i.e., skidder trails as part of timber harvesting). In one area in the southwest part of the property just east of Cathedral Road a fairly recent timber harvest was conducted. A good example of a vernal pool was found with a forested buffer that was left in place during the timber harvest. However, there were no egg masses observed within the pool. Instead amphibians, including spotted salamanders and American toads, were using several pools created by skidder trails.

Vernal pools are typically temporary or seasonal woodland pools that are found within upland or floodplain forests, or as part of a larger wetland complex. These woodland pools fill with water in the spring and fall, and generally dry partially or even completely in the summer. Vernal pools are critical for the long-term survival of many species of amphibians, reptiles, and macroinvertebrates<sup>1</sup>. Species considered as obligate or strongly

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<sup>1</sup> Macroinvertebrates are large water bugs that can be easily seen with the naked eye. They inhabit aquatic ecosystems such as vernal pools, ponds, lakes, rivers, and streams.

associated with vernal pools include the state endangered Blanding's turtle, spotted turtle, ribbon snake, Jefferson's salamander, blue-spotted salamander, spotted salamander, state endangered marbled salamander, wood frog, fingernail clams, and fairy shrimp.



Vernal pools serve as significant breeding habitat for wood frogs and mole salamanders (i.e., spotted salamander), as well as many macroinvertebrates. Annett State Forest, Rindge and Sharon, NH. April 2011

### ***Forest Seeps***

Forest seeps are basically small swamps that are fed by groundwater and generally less than an acre in size. They function as important refugia for a variety of amphibians, especially during the driest parts of the year since they are associated with nearly continuous flow. Such species can include wood frogs, green frogs, northern leopard frogs, pickerel frogs, and stream salamanders including dusky and two-lined. Forest seeps were generally observed in the northern and northeastern section of Annett State Forest but may also be adjacent to wetlands and streams.



*Sphagnum* carpets are common in acidic seeps. Annett State Forest, Rindge and Sharon, NH. November 2010

### ***Deer Wintering Areas***

During the winter months, deer utilize a variety of sites as wintering areas or deer yards. These sites are usually found within hemlock forests but can be found in a variety of other dense coniferous-dominated forests as well. These wintering areas are critical for deer survival as they provide areas of reduced snow cover on the ground, as well as protection from wind and storms. It is crucial for deer to reduce the amount of energy expended during the winter months when food supplies are scarce. During field reconnaissance and winter tracking in 2010 and 2011, deer wintering areas were observed in Annett State Forest. Major travel routes, deer beds, and browse on hemlock saplings provided evidence of this critical habitat. These areas may also be providing critical winter habitat for moose as well (Bluepoint Ecological LLC 2007). In March 2011, several moose beds and trails were observed to be used by a cow and her calf.



A deer bed located within an important wintering area, Annett State Forest, Rindge and Sharon, NH. January 2011

### ***Dens, Nests, and Beds***

Throughout Annett State Forest and Hubbard Pond a variety of active dens, nests, and beds were observed. These included the following: a goose nest within the marsh and shrub wetland in Black Brook; a porcupine den in a hollow beech tree; a northern goshawk nest in the southeast; deer and moose beds as indicated above; two turtle nesting areas along Hubbard Pond, as well as another site located on the Wildwood MASS Audubon Camp property; and one active and eight abandoned beaver lodges within Hubbard Pond and Black Brook, as well as another active lodge just west of the property on the bank of Black Brook.

## **Natural Communities and Systems**

The New Hampshire Natural Heritage Bureau (NHNHB), a bureau within the Department of Resource and Economic Development's Division of Forest and Lands, is responsible for locating, tracking, and facilitating the protection of rare and imperiled plants and exemplary natural communities. In cooperation with the Nongame and Endangered Wildlife Program (NEWP) of the New Hampshire Fish and Game Department, the NHNHB also helps to maintain information regarding rare and imperiled wildlife. The NHNHB has developed an extensive classification system for natural communities in New Hampshire (Sperduto and Nichols 2011). This classification system was the basis from which the various natural communities of Annett State Forest were identified.

Natural communities are assemblages of organisms, their physical environments, and ecological processes that affect them. Essentially, they are ecological units that are repeated on the landscape. Natural communities include both uplands and wetlands such as forests and woodlands, shorelines, vernal pools, forested swamps, peatlands, floodplains, and deep aquatic systems. Each natural community is distinguished by its species composition and physical structure and condition. These communities provide scientists and resource managers with an ecological understanding of the land and its inhabitants to make intelligent, informed decisions regarding land use. Therefore, natural community classifications provide conservationists with a powerful tool to guide strategic planning. Equally as important, they provide a basis from which inventory and monitoring programs can be developed, and a means to document and track rare species and exemplary natural communities.

This classification system places a heavy emphasis on vegetation. It is the particular composition of the vegetation that helps to define each community. While wildlife is an important aspect of these natural communities they are not considered when classifying such. Mainly because of their high mobility, animals are often associated with a variety of communities and most are not diagnostic in their classification. For example, a bear's home range can be well over 20 square miles. As such, they are found using a mosaic of natural communities, from wetland to upland.

Twenty-three different types of natural communities have been observed during this study, as well as by Bowman (2010) and Nichols (2012) from the NH Natural Heritage Bureau, spanning six different types of ecological systems (Table 2). These include 5 upland

forest communities and 18 wetland communities. These natural communities and systems are not considered rare but two have been documented as exemplary by the NH Natural Heritage Bureau (Figure 3; NH Natural Heritage Bureau 2010 and Bowman 2010). The exemplary red spruce swamp (21 acres) is located in the southeast part of the property and is dominated by red spruce with red maple and hemlock as co-associates. The exemplary medium level fen system (70 acres) is located within Hubbard Pond and its peripheral peatlands. This ecological system is made up of at least 8 different wetland communities (Table 2)



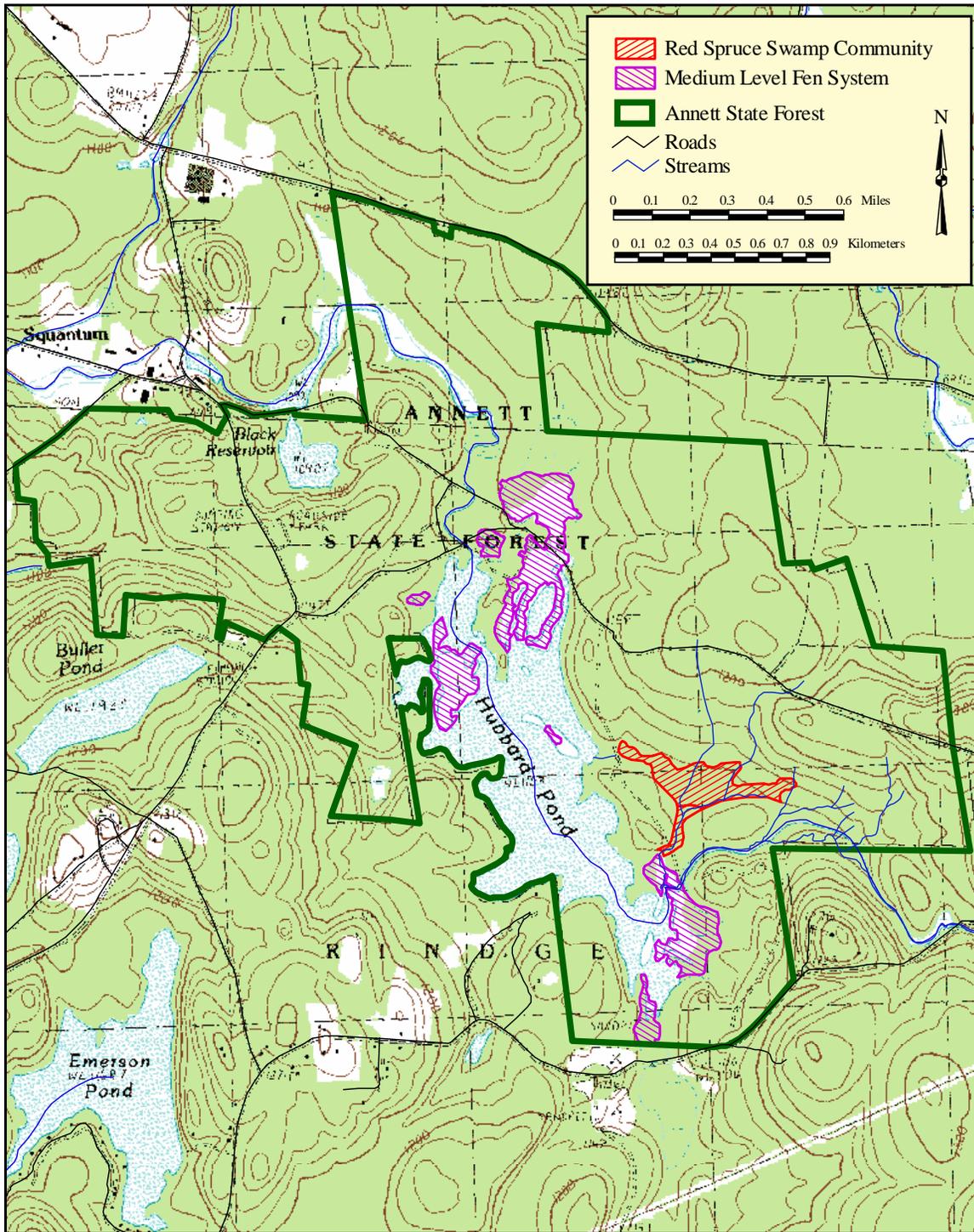
Part of the exemplary medium level fen system in the northwest part of Hubbard Brook just south of the dam, Rindge, NH. July 2010

**Table 2.** List of natural community and system types observed on Annett State Forest and Hubbard Pond, Rindge and Sharon, NH. April 2010-October 2011.

Natural Community and System Types	State Ranking
<i>Lowland spruce-fir forest/swamp system</i>	
red spruce swamp	S3
lowland spruce-fir forest	S3
<i>Hemlock-hardwood-pine forest system</i>	
hemlock-beech-oak-pine forest	S5
hemlock forest	S4
hemlock-white pine forest	S4
dry red oak-white pine forest	S3S4
<i>Medium level fen system</i>	
large cranberry-short sedge moss lawn	S3
highbush blueberry-mountain holly wooded fen	S3S4
floating marshy peat mat	S3S4
water willow- <i>Sphagnum</i> lagg	S3
liverwort-horned bladderwort fen	S3
sweet gale-meadosweet-tussock sedge fen	S4
leatherleaf-black spruce bog	S3
leatherleaf-sheep laurel dwarf shrub bog	S2S3
<i>Temperate minerotrophic swamp system</i>	
highbush blueberry-winterberry shrub thicket	S4
seasonally flooded red maple swamp	S4
hemlock-cinnamon fern forest	S4
<i>Forest seep/seepage swamp system</i>	
acidic <i>Sphagnum</i> forest seep	S3S4
<i>Emergent marsh-shrub swamp system</i>	
tall graminoid meadow marsh	S4
peaty marsh	S4
emergent marsh	S4
aquatic bed	S5
mixed tall graminoid-scrub-shrub marsh	S4S5
highbush blueberry-winterberry shrub thicket	S4
seasonally flooded red maple swamp	S4

See Appendix A for explanation of state rankings.

Data sources: Moosewood Ecological LLC and NH Natural Heritage Bureau



**Figure 3.** Exemplary natural communities and systems of Annett State Forest, Rindge and Sharon, NH. October 2011. Data Source: NH Natural Heritage Bureau

## Species Inventories

### *Birds*

A total of 82 species were observed on the study area from April 2010 to October 2011 (Appendix B). These species were found in a variety of habitats, including forests, swamps, open water, marshes, and riparian areas. Eleven species were confirmed breeders while five were classified as probable breeders and the majority of birds were classified as possible breeders.

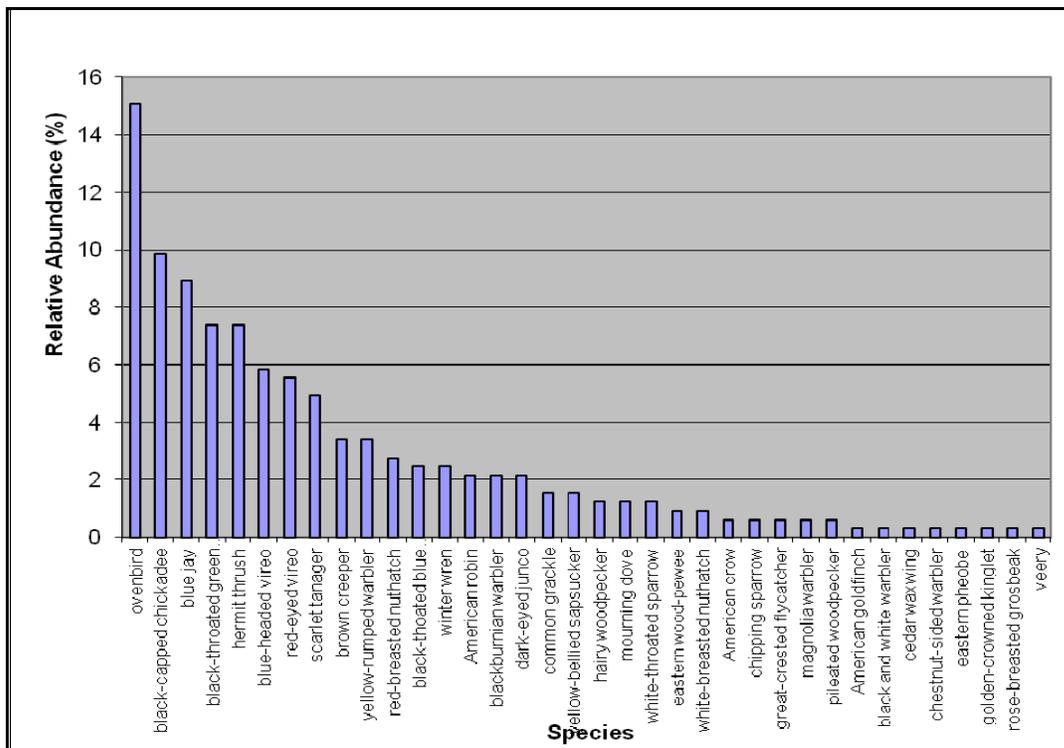
Thirty-five species were listed as conservation concern using the four priority lists. Of these, four were observed only during the migratory season, including the purple finch, osprey, hooded merganser, and northern harrier (state endangered). The purple finch was observed using the forested habitat during fall migration. The latter three were observed using open water and wetlands during spring migration. In particular, the osprey was fishing in Hubbard Pond. This species was recently delisted as state threatened but is still considered as a species of special concern to facilitate further recovery (NH Fish and Game 2009). Based on habitat availability and breeding ranges of these four species the osprey is the only bird that may potentially use the study area during the breeding season.



An osprey, a species of conservation concern, perched along the shoreline of Hubbard Pond after a failed attempt at fishing, Rindge, NH. April 2012

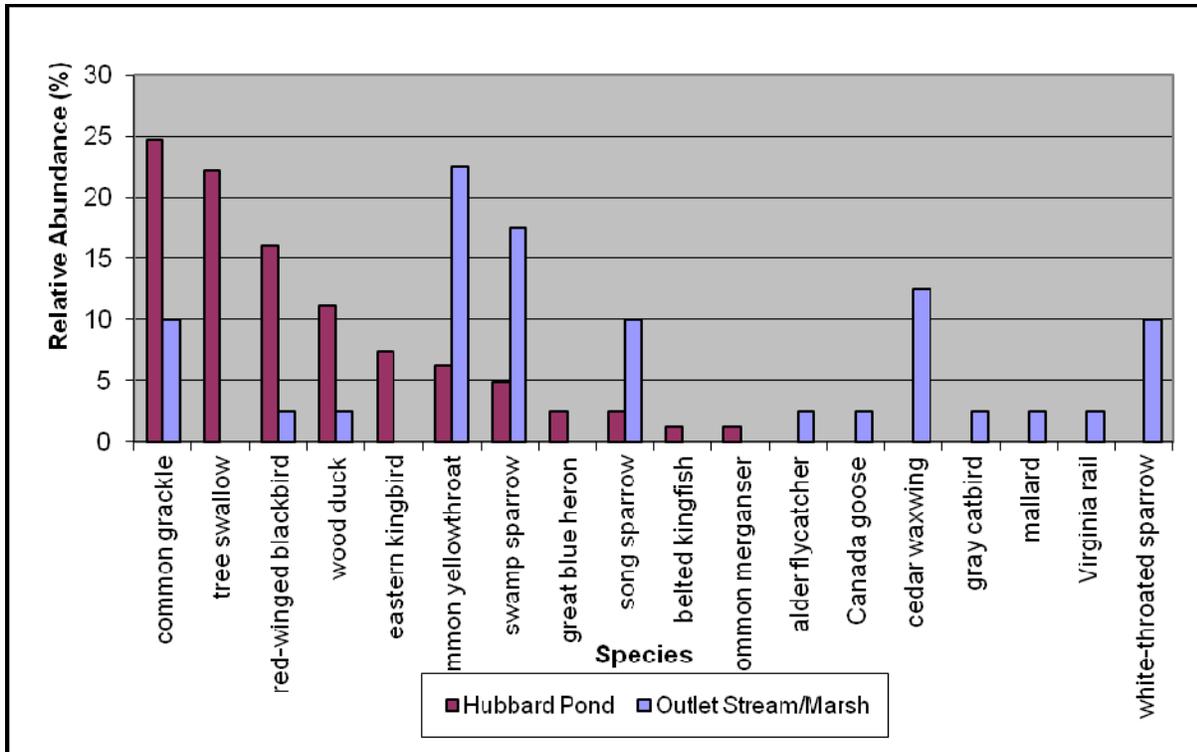
Of the remaining 31 species observed during the breeding season none were listed as endangered or threatened. However, wood thrush and Canada warbler occur on all priority lists (Dettemers 2003, NH Fish and Game 2005 and 2009, Partners In Flight 2008, and US Fish and Wildlife Service 2008) and have been determined to be in decline, meaning that there is a significant negative trend in the population. Ten other species have also been determined to be in decline, including ruffed grouse, northern flicker, eastern wood-pewee, eastern kingbird, gray catbird, veery, chestnut-sided warbler, black and white warbler, scarlet tanager, and rose-breasted grosbeak.

Of the 82 species observed throughout the study period, a total of 50 were recorded during the systematic breeding bird surveys (Figure 4). Species that exhibited the highest relative abundance included ovenbird, black-capped chickadee, blue jay, black-throated green warbler, hermit thrush, blue-headed vireo, red-eyed vireo, and scarlet tanager. In contrast, those with the lowest relative abundance included American goldfinch, black and white warbler, cedar waxwing, chestnut-sided warbler, eastern phoebe, golden-crowned kinglet, and rose-breasted grosbeak.



**Figure 4.** Relative abundance of forested upland birds within Annett State Forest, Rindge and Sharon, NH. June-July 2010.

Eighteen wetland associated species were observed using Hubbard Pond and/or Black Brook wetland complex during the breeding season (Figure 5). Common grackle, tree swallow, and red-winged blackbird were the most abundant in Hubbard Pond while common yellowthroat, swamp sparrow, and song sparrow were most commonly observed in the Black Brook wetland complex.



**Figure 5.** Relative abundance of wetland associated birds within Annett State Forest, Rindge and Sharon, NH. June-July 2010 (Hubbard Pond) and May-June 2011 (outlet stream/marsh).

Species only associated with Hubbard Pond included tree swallow, eastern kingbird, great blue heron, belted kingfisher, and common merganser. In contrast, alder flycatcher, Canada goose, cedar waxwing, gray catbird, mallard, Virginia rail, and white-throated sparrow were only recorded during the breeding season in the Black Brook wetland complex. This does not suggest that one would only find these species in the sites where they were recorded. However, the difference in relative abundance between the two sites may be more of a function of habitat size and structure.

Hubbard Pond is mostly open water habitat with small patches of vegetated wetlands, including the shrub peatland in the northwest area near the dam, open graminoid and shrub peatland in the northeast area, and the open peatland in the southeast area. In fact, the shrub peatland in the northwest functions as significant habitat for roosting tree swallows, as well as other swallows, where one can observe more than 100 swallows feeding on flying insects (Preston 2012). Conversely, the Black Brook wetland complex includes open water associated with the brook, as well as rather extensive emergent-shrub wetlands adjacent to the brook. Together, both sites offer various habitats to support a diversity of wetland associated birds on the study area.

Migratory waterfowl were observed using Hubbard Pond, Black Brook, and Black Reservoir during fall 2010 and spring 2011. These included Canada goose, wood duck, mallard, American black duck, green-winged teal, bufflehead, hooded merganser, and common merganser. Wolf (2004) also noted ring-necked duck during migration.



Great blue heron pausing before another attempt at fishing in Hubbard Pond, Rindge, NH. April 2011.

## *Mammals*

A total of 21 species were observed throughout Annett State Forest from April 2010 to October 2011 (Appendix B). These species represent a range of mammals that are terrestrial and semi-aquatic, as well as those utilizing both habitats. Bobcat was the only species considered to be a species of special concern in New Hampshire (NH Fish and Game 2005). Other targeted keystone<sup>2</sup> species included beaver, black bear, mink, moose, and river otter.

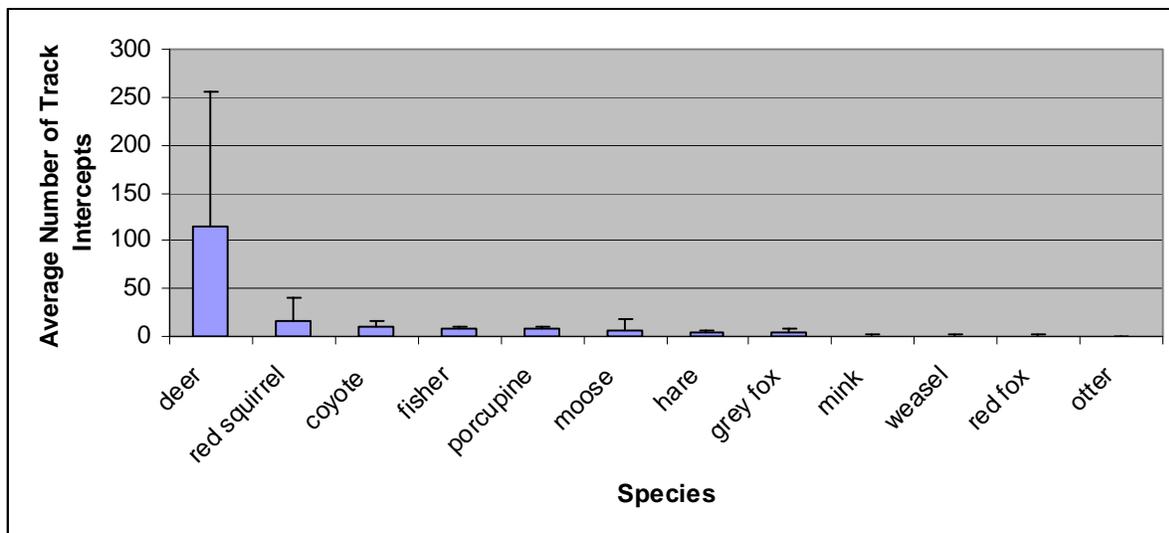
Of the 21 species observed, 12 were recorded along winter tracking transects located in upland forests (Table 3 and Figures 4 and 5). Deer had the highest frequency of occurrence. However, there was great variability in the data collected (standard deviation = 141). The majority of the tracks were observed on January 11, 2011 (272 intercepts) and none on the final sample. On January 11, deer were rather widespread in their distribution across the study area. However, this was prior to the heavy snowfall events, which most likely localized their distribution into deer wintering areas within dense hemlock stands. This was confirmed based on direct searches to identify major deer trails, deer beds, and browse on hemlock saplings. Mammals observed along transects on all days sampled included coyote, snowshoe hare, and porcupine. In contrast, mammals only observed on one day included river otter, red fox, and a weasel (track size and stride overlapped between long-tailed weasel and ermine and therefore, could not be identified to species). Mink was observed once on the first and last day of sampling.

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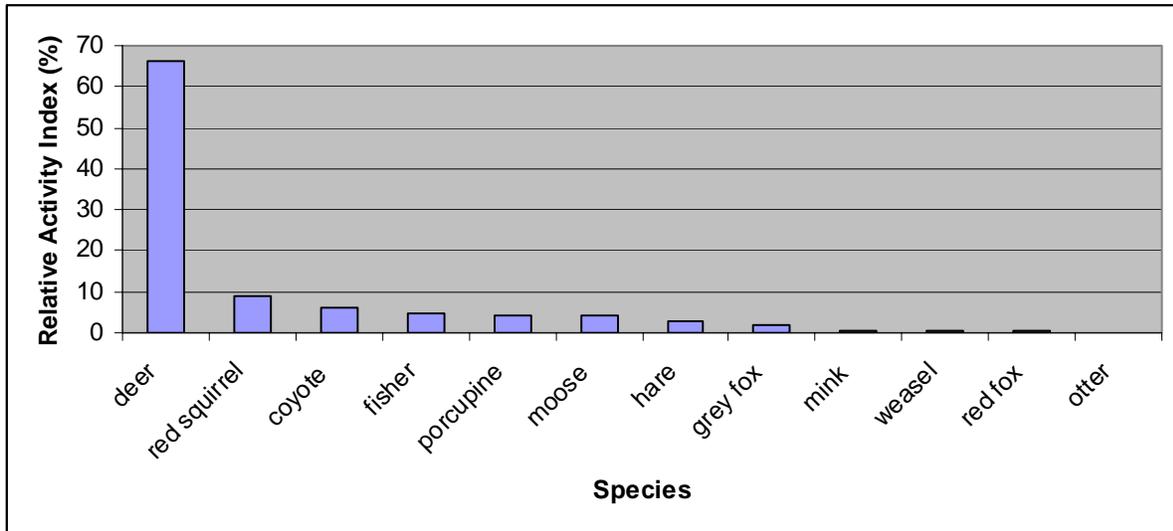
<sup>2</sup> A keystone species is one in which has a large effect on its environment in relation to its relative abundance. They are important for ecosystem functioning and help to determine species composition and abundance.

**Table 3.** Frequency of occurrence of medium to large-sized mammals within Annett State Forest, Rindge and Sharon, NH. Data shows 1 standard deviation. January-March 2011.

Species	Average Number of Intercepts	Activity Index (# intercepts/km)	Relative Activity Index (%)
deer	114.7 (SD 141)	45.9	66.2
red squirrel	15.3 (SD 24.8)	6.1	8.8
coyote	10.3 (SD 6.1)	4.1	6
fisher	8 (SD 1.7)	3.2	4.6
porcupine	7.3 (SD 2.9)	2.9	4.2
moose	7 (SD 12.1)	2.8	4
hare	5 (SD 1.7)	2	2.9
grey fox	3.3 (SD 4.9)	1.3	1.9
mink	0.7 (SD 0.6)	0.3	0.4
weasel	0.7 (SD 1.2)	0.3	0.4
red fox	0.7 (SD 1.2)	0.3	0.4
otter	0.3 (SD 0.6)	0.1	0.2

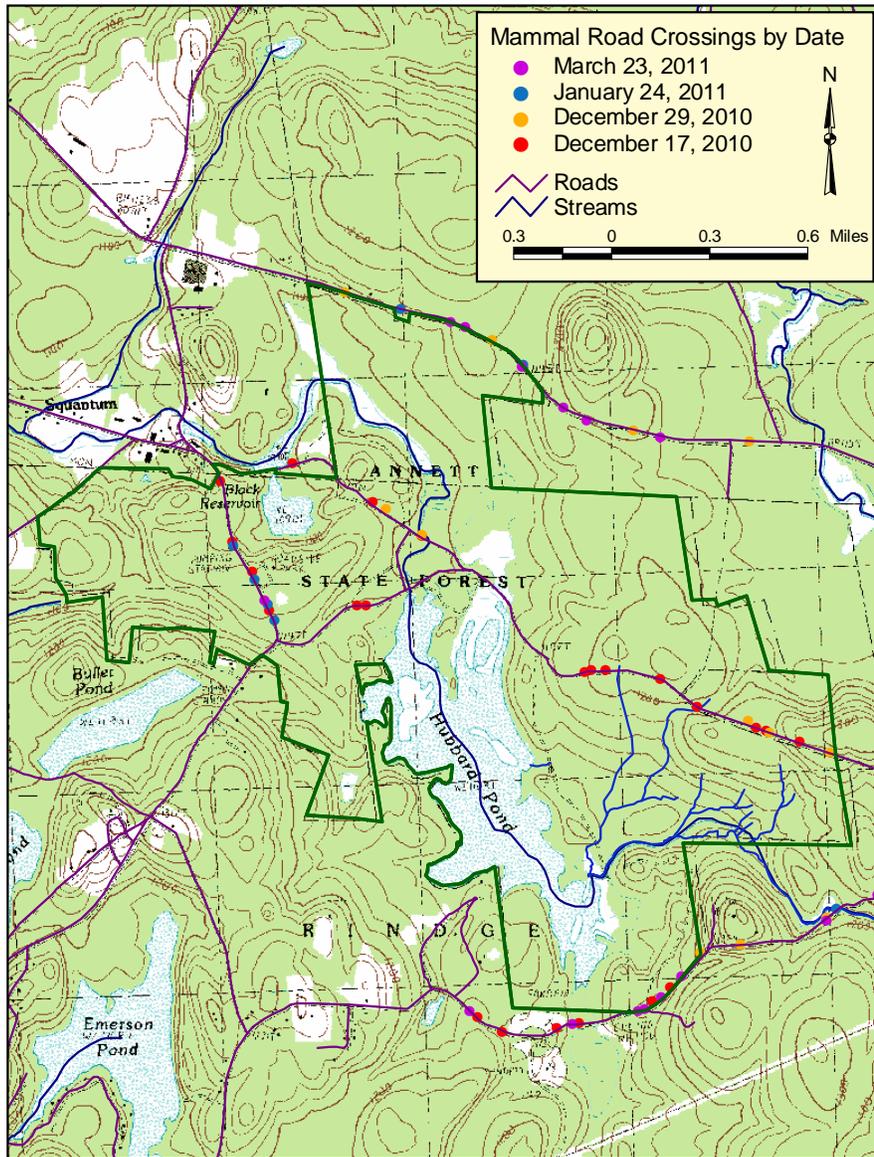


**Figure 4.** Average number of track intercepts of medium to large-sized mammals within Annett State Forest, Rindge and Sharon, NH. Data shows 1 standard deviation. January-March 2011.



**Figure 5.** Relative activity indices of medium to large-sized mammals within Annett State Forest, Rindge and Sharon, NH. January-March 2011.

In addition, 10 species were recorded having crossed roadways within the greater Annett State Forest area from December 2010 through March 2011 (Figure 6). These included deer, coyote, red fox, gray fox, river otter, fisher, mink, ermine, porcupine, and snowshoe hare. Deer had the highest average number of intercepts (10.7) over the four day sampling period, followed by coyote (4.7), red fox (4.3), and gray fox (3.3). On the third day of sampling (January 24, 2011) no deer were observed to cross roadways. This observation corresponds with the results of the upland forest transects in that when deeper snow conditions prevail deer tended to be more localized within their deer wintering areas. In fact, only two species were observed to cross roadways on January 24, including red and gray fox. River otter, porcupine, and ermine were observed to cross roadways on only one occasion. The greatest densities of road crossings occurred in three main locations: the portion of Cathedral Road that runs through Annett State Forest, across Route 124, and across Old New Ipswich Road south of Annett State Forest.



**Figure 6.** Winter mammal road crossings within and adjacent to Annett State Forest, Rindge and Sharon, NH. December 2010-March 2011.

Mammal trails were prevalent along the eastern and western sides of Hubbard Pond, as well as parallel to both the inlet and outlet brooks. Particularly well-used paths were observed along the eastern side of Hubbard Pond and the outlet stream, as well as along the northwest-southeast trending ridge east of outlet stream. Heavily traveled deer winter trails were observed in hemlock forests north of the outlet stream in Sharon and east of Hubbard Pond. Deer beds and abundant incisor scrapes on hemlock saplings were also found in these hemlock forests, indicating deer wintering areas. Bluepoint Ecological (2007) had also

identified Annett State Forest as critical deer wintering habitat. Based on the tracking surveys it appears that the majority of winter mammal movement occurred on the eastern portion of the property running north-south. This suggests that this area may be functioning as an important wildlife corridor. Additionally, the forest on either side of Cathedral Road may be an important corridor for fox moving east-west.

Based on systematic and direct search surveys, several patterns have emerged. It appears that coyote mostly used the eastern portion of the property and fox were using the western section. Porcupine sign was most often observed in the northern section, as well as the western section where an active den was found in a beech tree. Fisher and red squirrel were observed throughout the property as the upland forest is ideal habitat for both species. Deer were observed throughout the property except confined to dense hemlock stands during deep snow conditions. Snowshoe hare sign was localized to habitats with dense tree regeneration or dense shrub cover (e.g., shrub swamps).



Coyote hunting small rodents within the peatlands in the northeast part of the study area. Annett State Forest and Hubbard Pond, Rindge, NH. October 2010.

Some focal keystone species also exhibited patterns of activity. Moose sign was strongly associated with the eastern part of Annett State Forest where incisor scrapes on red maples were abundant and moose beds, tracks, and scat were also found. Moose sign was

also abundant within the Tophet Swamp area that abuts Annett State Forest (Littleton 2006). In contrast, moose was nearly absent west of Hubbard Pond and Black Brook. Bluepoint Ecological (2007) had identified Annett State Forest as having critical moose wintering habitat and noted sign as well.

River otter sign and visualizations occurred throughout Hubbard Pond and Black Brook. Several latrine sites were found along the shoreline of Hubbard Pond and on abandoned beaver lodges in the pond and Black Brook. In the winter, river otter tracks were found mainly along the riparian area of Black Brook, especially after Hubbard Pond was completely frozen. River otter tracks were also observed within forested uplands in Annett State Forest. In early spring 2010, tracks were observed to cross Cathedral Road, heading west through the forest and crossing the western boundary towards Bullet Pond.

Hamilton (2012) had similar observations on river otter. Hamilton (2012) studied river otters in Hubbard Pond and Annett State Forest where she was interested in latrine use and location, as well as beaver sign, as a means to identify conservation management strategies for this species. The abundant sign of river otter within the study area is most likely attributed to the low level of human intrusion, as this species tends avoid areas that are more heavily impacted by humans.



Otter swimming in Black Brook, Jaffrey, NH just west of Annett State Forest, Rindge and Sharon, NH. April 2012

Several old beaver lodges, dams, and browse were noted throughout the study area in and along Hubbard Pond and Black Brook. These abandoned lodges can serve as important denning habitat for a variety of species, including river otter and mink. However, in fall 2010 an active beaver lodge was found in the northeast part of Hubbard Pond along the edge of the shrub peatland. Based on the timing that the beaver had inhabited the abandoned lodge it was most likely a dispersing juvenile. Later in spring 2011 the beaver built a new lodge adjacent to the abandoned lodge and was very territorial. Another large active lodge was located along the bank of Black Brook just to the west of the Annett State Forest boundary.

Beaver and river otter have a direct relationship with one another. River otter are known to inhabit new and abandoned beaver impoundments (LeBlanc et al. 2007), as they create ideal otter habitat (Melquist and Hornocker 1983). Through their manipulation beaver create conditions conducive for feeding and denning by river otter (Melquist and Dronkert 1987).

Sign of other focal keystone species were less abundant. This could be a factor of the home range of the species and/or the species occurring in relative low abundance on the property. Sign of black bear was only found in one location along a wildlife trail. Old markings were observed on a red pine along a wildlife trail just east of Hubbard Pond. However, bear may be using the property for feeding or for travelling through to other locations within the larger landscape. Mink was observed in five locations during tracking surveys and was closely associated with wetlands as expected. Mink, as river otter, tend to be more abundant in areas with less human disturbance.

Finally, bobcat sign was observed in three locations during direct searches for this species. Tracks were observed twice in the southeast part of the property. One location was associated with a deer kill site along the boundary line where coyote also fed on the animal. The other location was nearby in association with a shrub swamp. Scat was found along a woods road just east of Black Brook. These observations do not correspond with any of the bobcats that are part of a UNH study that focuses on bobcat population in the Monadnock region (Broman 2011).

## *Amphibians*

A total of 10 species from 6 families were observed within Annett State Forest and Hubbard Pond (Appendix B). There were no species of conservation concern recorded. These observations were recorded during direct searches to determine species presence within targeted habitats, which focused on Hubbard Pond and Black Brook, and absolute egg mass counts within vernal pools.

Amphibians associated with Hubbard Pond, Black Brook, and their associated wetlands included bullfrog, green frog, pickerel frog, gray tree frog, spring peeper, American toad, and red-spotted newt. Wood frog and spotted salamanders were also recorded in the adjacent peatlands of Hubbard Pond. These species may also associate with the Black Brook wetland complex but were not observed during this project. Terrestrial salamanders included redback salamanders and the red eft stage of the red-spotted newt. Wolf (2004) also noted two-lined salamanders in Black Brook at the outlet of Hubbard Pond.

As noted above, 35 vernal pools were documented on the study area. Table 6 and Figure 7 provides a summary of the data recorded. Obligate amphibians included spotted salamander and wood frog. Spotted salamander egg masses were slightly more abundant and were more frequently observed than wood frogs. This was mainly due to higher wood frog egg mass counts within pools where they are observed. The relatively high standard deviation within both species was mainly a function of vernal pool size and productivity. For instance, some vernal pools were rather productive, some boasting as many as 75-162 egg masses for spotted salamanders and 140-200 for wood frogs. Other species present within vernal pools included pickerel frogs, green frogs, spring peepers, and American toad. In fact, egg masses of the latter species were observed in a few vernal pools with relatively open canopies.

**Table 6.** Summary of 35 vernal pools obligate breeding amphibians, Annett State Forest and Hubbard Pond, Rindge and Sharon, NH. April-May 2011

<b>Species</b>	<b>Total Count</b>	<b>Mean</b>	<b>Range</b>	<b>Relative Abundance</b>	<b>Standard Deviation</b>	<b>Frequency of Occurrence</b>	<b>Relative Frequency</b>
spotted salamander	958	27.4	1-162	53%	38.6	97%	66%
wood frog	854	24.4	1-200	47%	44.9	49%	34%



**Figure 7.** Mean number of egg masses per species for vernal pool obligate breeding amphibians, Annett State Forest and Hubbard Pond, Rindge and Sharon, NH. Data shows one standard deviation. April-May 2011



Double-stranded egg masses of the American toad observed in a vernal pool. Annett State Forest, Rindge, NH. April 2011.

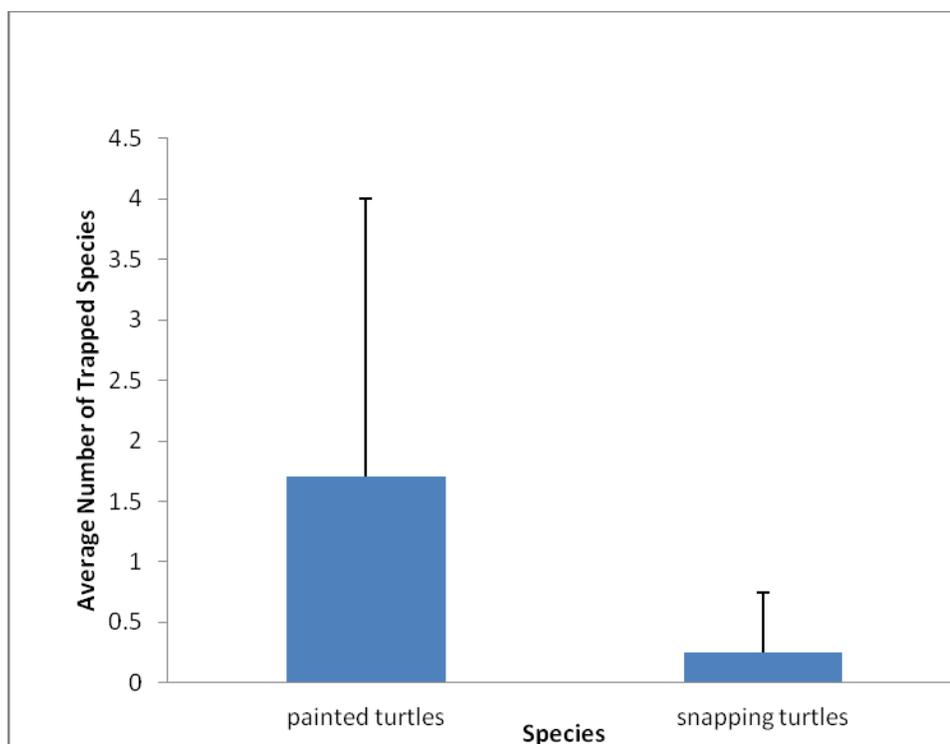
## ***Reptiles***

A total of six species, representing 3 families, were observed within Annett State Forest and Hubbard Pond (Appendix B). The wood turtle and ribbon snake are considered as species of conservation concern. The wood turtle was recorded along the inlet brook to Hubbard Pond located in the southeastern part of the property. The ribbon snake was observed in the sedge peatland community in the northeastern part of Hubbard Pond.

Two species of turtles were observed in Hubbard Pond during trapping surveys, including painted and snapping turtles (Table 7 and Figure 8). No turtles were trapped in the outlet stream. However, painted and snapping were observed during basking surveys. Based on the sampling in Hubbard Pond, painted turtles were more abundant (mean = 1.67, standard deviation = 2.3, and relative abundance = 0.87) as compared to snapping turtles (mean = 0.25, standard deviation = 0.5, and relative abundance = 0.13). A brief report was submitted to the NH Fish and Game Department in as required by the permit for trapping turtles (Littleton 2011).

**Table 7.** Summary of trapped turtles within Hubbard Pond, Rindge, NH. July-August 2010

<b>Species</b>	<b>Total Count</b>	<b>Mean</b>	<b>Relative Abundance</b>	<b>Standard Deviation</b>	<b>Frequency of Occurrence</b>	<b>Relative Frequency</b>
painted turtles	20	1.7	87%	2.3	67%	99.6%
snapping turtles	3	0.25	13%	0.5	0.25%	0.4%



**Figure 8.** Mean number of trapped species within Hubbard Pond, Rindge, NH. Data shows one standard deviation. Rindge and Sharon, NH. July-August 2010.



Wood turtle found along the forested edge of the inlet of Black Brook in the southeastern part of Annett State Forest, Rindge, NH. July 2010

## ***Fish***

Hubbard Pond provides warm-water fisheries habitat. It has an average depth of four feet with a maximum depth of 16 feet. A total of 8 species have been documented for Hubbard Pond. Yellow perch and chain pickerel were observed during turtle trapping surveys in 2010. Largemouth bass and chain pickerel have been documented by the NH Fish and Game Department (2010). Yellow perch, golden shiner, brown bullhead, pumpkinseed, largemouth bass, and chain pickerel were observed by Wolf (2004). Largemouth bass is an introduced species in New Hampshire while the others are native fish. American eel also has the potential to exist in Hubbard Pond (Gries 2012). The banded sunfish is another species that may be present as well. This is a species of conservation concern in NH that was observed at the Converse Meadow Conservation Area less than 2 miles south of the study area (Littleton 2005).

## ***Rare Plants***

There were no rare plants observed within the targeted areas of Annett State Forest and Hubbard Pond. However, one species, American chestnut, was recorded that is considered as a “state watch” species by the NH Natural Heritage bureau. Only one invasive species, glossy buckthorn, was observed along Annett Road crossing Black Brook. This species was noted to occur in low abundance.



Rose pogonia associated with the floating marshy peat mat within the larger medium level fen system. Annett State Forest and Hubbard Pond, Rindge, NH. June 2010

## CONCLUSIONS

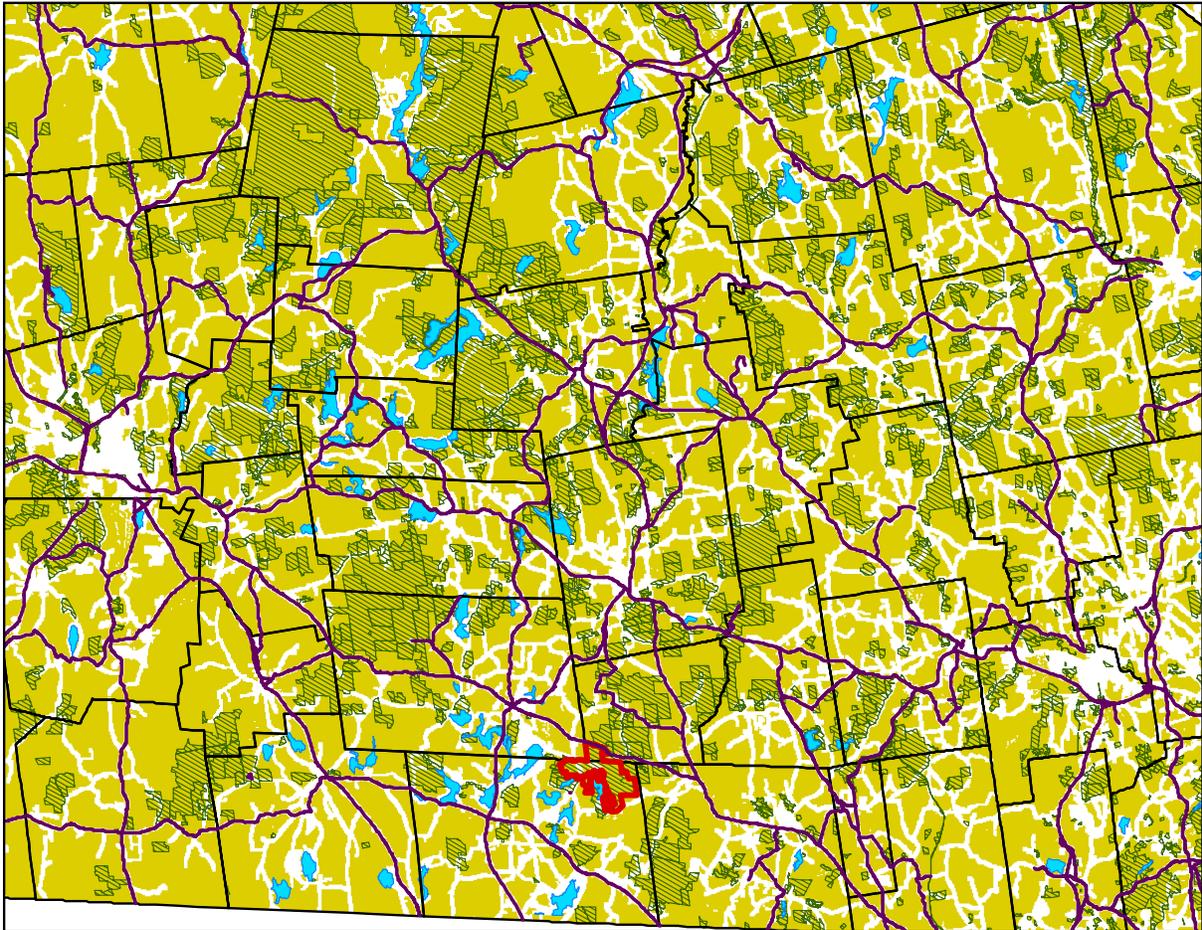
Annett State Forest and Hubbard Pond serves as a significant ecological resource for the town of Rindge, the Monadnock region, and the state of New Hampshire. It boasts some excellent examples of significant wildlife habitats, exemplary natural communities, diverse wildlife and plant communities, and hosts habitat for a variety of species of conservation concern and keystone species, including top predators. It provides both economic and social benefits as a source for local timber products and various recreational activities. Annett State Forest and Hubbard Pond is also an invaluable resource for educational opportunities and scientific research.

Annett State Forest and Hubbard Pond is also part of a much larger landscape from which it should also be viewed (Figure 9). When making considerations for conservation planning it is critical to incorporate a landscape-level perspective with fine-scale habitat data. This consideration aids in a more comprehensive approach that recognizes large-scale habitats and ecological processes within the developed and natural environments. When these elements are considered in combination with the distribution of currently protected lands then a more successful conservation plan can be prepared that incorporates the concepts of biological conservation and ecosystem reserve design to help maximize and sustain biodiversity protection for the long-term.

One major landscape-level consideration includes the size and distribution of unfragmented lands. These areas are defined by the surrounding human infrastructure (roads and developed areas) and can negatively affect species survival rates, including mortality or lowered rates of breeding success. The degree of severity of fragmentation depends upon many aspects, such as the size and shape of unfragmented block, the species in question, the extent of loss of natural habitat, and intensity of human use.

Large blocks of unfragmented areas are widely known to support greater biodiversity than smaller blocks. As forest blocks become smaller due to the construction of roadways and developments their biodiversity will generally be reduced. This fragmentation affect has less immediate impact on generalist species or those with small home ranges (such as gray squirrels, raccoon, and small rodents) while affecting and potentially eliminating area-sensitive specialists that need large forested blocks in order to maintain their home ranges

and for long-term survival (such as bear, bobcat, moose, some reptiles, wood thrush, and goshawk).



**Figure 9.** Annett State Forest and Hubbard Pond within a regional context. This map shows how the study area fits into the unfragmented landscape (mustard yellow) and among other conserved lands (green hatching) within the Monadnock region.

Large landscapes provide the ability for wildlife movement and connect multiple habitat elements. By maintaining connectivity between critical habitats it may be possible to provide permanent wildlife corridors within the developed environment. Wildlife travel corridors function as areas that one or many species may use to move from one habitat need to another. This movement can be based on traveling to different areas for feeding, breeding, or shelter. These habitat elements are required by all species.

Wildlife must be able to travel safely throughout the landscape in order to meet their biological needs. Many depend upon a variety of habitats for their survival and may utilize many natural features for travel. These may include features such as riparian zones of wetlands, ponds, and streams, ridgelines, utility right-of-ways, and forest patches acting as a safe route between two or more habitats. A variety of wildlife can be associated with these corridors, including otter, fox, coyote, bobcat, deer, moose, fisher, mink, beaver, and bear.

Corridors are not only significant for mammals but equally as important for amphibians, reptiles and migratory birds. Both amphibians and reptiles begin to move from their wintering habitats to their respective breeding and nesting grounds in the spring. This is the time of year that most mortality can be noticed as these species travel across roadways in search of critical habitats. This can be especially devastating for local turtle populations as some species breed only after 15 years of age (e.g., wood turtle). This effect can often be exacerbated as the same individuals must return back to their wintering habitats. Thus, there is a great significance in maintaining habitat connectivity, as well as understanding where these patterns of movement are taking place.

In consideration of the findings of this project the conservation of biological diversity could have a positive affect by concentrating one of Rindge's conservation planning efforts within the unfragmented block south of Annett State Forest and Hubbard Pond. Linking the study area with the conserved lands of the Wapack Wilderness can have a significant overall impact. This notion is also supported by the Rindge biodiversity-based conservation plan (Bluepoint Ecological 2007).

Finally, this document can also have important implications to assist with future land management planning. The information herein can continue to help guide future sustainably-based forest management of Annett State Forest by the NH Division of Forest and Lands, as well as to guide management and maintenance of Hubbard Pond by the NH Division of Environmental Services. Management considerations could focus on maintaining proper functioning of critical habitats (i.e., vernal pools, deer wintering habitats), wildlife movement, and species-specific management, such as keystone species, species of concern, and species with declining trends.

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# **APPENDIX A**

## **NH Natural Heritage Ranking Code Descriptions**

## Appendix 1. Explanation of global and state rank codes.

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

### *Code Examples Description*

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

Modifiers are used as follows.

### *Code Examples Description*

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

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

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



# **APPENDIX B**

## **Wildlife Species Lists**

## Birds of Annett State Forest and Hubbard Pond

<b>Family</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Breeding</b>	<b>Priority</b>	<b>General Trend</b>
<b>Ardeidae</b>	<i>Ardea herodias</i>	<b>Great blue heron</b>	PO	NH	uncertain
<b>Anatidae</b>	<i>Branta canadensis</i>	<b>Canada goose</b>	CO	BCR	increasing
<b>Anatidae</b>	<i>Aix sponsa</i>	<b>Wood duck</b>	PO	BCR	increasing
<b>Anatidae</b>	<i>Anas crecca</i>	<b>Green-winged Teal</b>	OB	BCR	stable
<b>Anatidae</b>	<i>Anas rubripes</i>	<b>American black duck</b>	OB	NH, BCR	stable
<b>Anatidae</b>	<i>Anas platyrhynchos</i>	<b>Mallard</b>	PR	BCR	increasing
<b>Anatidae</b>	<i>Bucephala albeola</i>	Bufflehead			1
<b>Anatidae</b>	<i>Lophodytes cucullatus</i>	<b>Hooded merganser</b>		BCR	unknown
<b>Anatidae</b>	<i>Mergus merganser</i>	Common merganser	PO		uncertain
<b>Cathartidae</b>	<i>Cathartes aura</i>	Turkey vulture			increasing
<b>Accipitridae</b>	<i>Circus cyaneus</i>	<b>Northern harrier</b>		NH, BCR	uncertain
<b>Accipitridae</b>	<i>Buteo lineatus</i>	<b>Red-shouldered hawk</b>	PO	NH	uncertain
<b>Accipitridae</b>	<i>Buteo platypterus</i>	<b>Broad-winged hawk</b>	PO	BCR	stable
<b>Accipitridae</b>	<i>Buteo jamaicensis</i>	Red-tailed hawk			uncertain
<b>Accipitridae</b>	<i>Accipiter gentilis</i>	<b>Northern Goshawk</b>	CO	NH, BCR	increasing
<b>Accipitridae</b>	<i>Accipiter cooperii</i>	<b>Cooper's hawk</b>	PR	NH	increasing
<b>Accipitridae</b>	<i>Accipiter striatus</i>	Sharp-shinned hawk	PR		unknown
<b>Accipitridae</b>	<i>Pandion haliaetus</i>	<b>Osprey</b>		NH	increasing
<b>Phasianidae</b>	<i>Bonasa umbellus</i>	<b>Ruffed grouse</b>	CO	NH, BCR	declining
<b>Phasianidae</b>	<i>Meleagris gallopavo</i>	<b>Wild turkey</b>	PR	NH	increasing
<b>Rallidae</b>	<i>Rallus limicola</i>	Virginia rail	PO		unknown
<b>Scolopacidae</b>	<i>Actitis macularia</i>	Spotted sandpiper	PO		uncertain
<b>Columbidae</b>	<i>Zenaida macroura</i>	Mourning dove	PO		increasing
<b>Strigidae</b>	<i>Strix varia</i>	Barred owl	PO		unknown
<b>Trochillidae</b>	<i>Archilochus colubris</i>	Ruby-throated hummingbird	PO		increasing

<b>Family</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Breeding</b>	<b>Priority</b>	<b>General Trend</b>
<b>Alcedinidae</b>	<i>Ceryle alcyon</i>	Belted kingfisher	PO		stable
<b>Picidae</b>	<i>Sphyrapicus varius</i>	<b>Yellow-bellied sapsucker</b>	PO	BCR	increasing
<b>Picidae</b>	<i>Picoides pubescens</i>	Downy woodpecker	PO		increasing
<b>Picidae</b>	<i>Picoides villosus</i>	Hairy woodpecker	CO		stable
<b>Picidae</b>	<i>Colaptes auratus</i>	<b>Northern flicker</b>	PO	BCR	declining
<b>Picidae</b>	<i>Dryocopus pileatus</i>	Pileated woodpecker	PO		increasing
<b>Tyrannidae</b>	<i>Sayornis phoebe</i>	Eastern phoebe	PO		stable
<b>Tyrannidae</b>	<i>Contopus virens</i>	<b>Eastern wood-pewee</b>	PO	BCR	declining
<b>Tyrannidae</b>	<i>Myiarchus crinitus</i>	<b>Great-crested flycatcher</b>	PO	BCR	stable
<b>Tyrannidae</b>	<i>Tyrannus tyrannus</i>	<b>Eastern kingbird</b>	PR	BCR	declining
<b>Tyrannidae</b>	<i>Empidonax alnorum</i>	Alder flycatcher	PO		uncertain
<b>Corvidae</b>	<i>Cyanocitta cristata</i>	Blue jay	PO		declining
<b>Corvidae</b>	<i>Corvus corax</i>	Common raven			increasing
<b>Corvidae</b>	<i>Corvus brachyrhynchos</i>	American crow	PO		increasing
<b>Hirundinidae</b>	<i>Tachycineta bicolor</i>	Tree swallow	CO		uncertain
<b>Paridae</b>	<i>Poecile atricapilla</i>	Black-capped chickadee	CO		uncertain
<b>Paridae</b>	<i>Baeolophus bicolor</i>	Tufted titmouse	PO		increasing
<b>Sittidae</b>	<i>Sitta canadensis</i>	Red-breasted nuthatch	PO		stable
<b>Sittidae</b>	<i>Sitta carolinensis</i>	White-breasted nuthatch	PO		increasing
<b>Certhiidae</b>	<i>Certhia americana</i>	<b>Brown creeper</b>	PO	BCR	uncertain
<b>Troglodytidae</b>	<i>Troglodytes troglodytes</i>	Winter wren	PO		increasing
<b>Troglodytidae</b>	<i>Troglodytes aedon</i>	House wren	PO		declining
<b>Regulidae</b>	<i>Regulus satrapa</i>	Golden-crowned kinglet	PO		stable
<b>Regulidae</b>	<i>Regulus calendula</i>	Ruby-crowned kinglet			declining
<b>Mimidae</b>	<i>Dumetella carolinensis</i>	<b>Gray catbird</b>	PO	BCR	declining

<b>Family</b>	<b>Scientific Name</b>	<b>Common Name</b>	<b>Breeding</b>	<b>Priority</b>	<b>General Trend</b>
<b>Turdidae</b>	<i>Catharus guttatus</i>	Hermit thrush	PO		increasing
<b>Turdidae</b>	<i>Catharus fuscescens</i>	<b>Veery</b>	PO	NH, BCR	declining
<b>Turdidae</b>	<i>Hylocichla mustelina</i>	<b>Wood thrush</b>	PO	NH,BCR,FWS,PIF	declining
<b>Turdidae</b>	<i>Turdus migratorius</i>	American robin	CO		stable
<b>Bombycillidae</b>	<i>Bombycilla cedrorum</i>	Cedar waxwing	PO		declining
<b>Vireonidae</b>	<i>Vireo olivaceus</i>	Red-eyed vireo	PO		uncertain
<b>Vireonidae</b>	<i>Vireo solitarius</i>	Blue-headed vireo	PO		stable
<b>Parulidae</b>	<i>Oreothlypis ruficapilla</i>	Nashville warbler	PO		declining
<b>Parulidae</b>	<i>Setophaga petechia</i>	Yellow warbler	PO		declining
<b>Parulidae</b>	<i>Setophaga pensylvanica</i>	<b>Chestnut-sided warbler</b>	PO	BCR	declining
<b>Parulidae</b>	<i>Setophaga fuscus</i>	<b>Blackburnian warbler</b>	PO	BCR	stable
<b>Parulidae</b>	<i>Cardellina canadensis</i>	<b>Canada warbler</b>	PO	NH,BCR,FWS,PIF	declining
<b>Parulidae</b>	<i>Setophaga magnolia</i>	Magnolia warbler	PO		stable
<b>Parulidae</b>	<i>Setophaga caerulescens</i>	<b>Black-throated blue warbler</b>	PO	BCR	stable
<b>Parulidae</b>	<i>Setophaga coronata</i>	Yellow-rumped warbler	PO		increasing
<b>Parulidae</b>	<i>Setophaga virens</i>	<b>Black-throated green warbler</b>	PO	BCR	stable
<b>Parulidae</b>	<i>Setophaga pinus</i>	Pine warbler			increasing
<b>Parulidae</b>	<i>Mniotilta varia</i>	<b>Black-and-white warbler</b>	PO	BCR	declining
<b>Parulidae</b>	<i>Seiurus aurocapillus</i>	<b>Ovenbird</b>	CO	BCR	stable
<b>Parulidae</b>	<i>Geothlypis trichas</i>	Common yellowthroat	CO		declining
<b>Emberizidae</b>	<i>Junco hyemalis</i>	Dark-eyed junco	PO		declining
<b>Fringillidae</b>	<i>Carpodacus purpureus</i>	<b>Purple finch</b>		NH,BCR	declining
<b>Fringillidae</b>	<i>Carduelis tristis</i>	American goldfinch	PO		increasing
<b>Thraupidea</b>	<i>Piranga olivacea</i>	<b>Scarlet tanager</b>	PO	BCR	declining
<b>Cardinalidae</b>	<i>Pheucticus ludovicianus</i>	<b>Rose-breasted grosbeak</b>	PO	BCR	declining

<b>Family</b>	<i>Scientific Name</i>	<b>Common Name</b>	<b>Breeding</b>	<b>Priority</b>	<b>General Trend</b>
<b>Emberizidae</b>	<i>Spizella passerina</i>	Chipping sparrow	PO		increasing
<b>Emberizidae</b>	<i>Melospiza melodia</i>	Song sparrow	CO		declining
<b>Emberizidae</b>	<i>Melospiza georgiana</i>	Swamp sparrow	CO		stable
<b>Emberizidae</b>	<i>Zonotrichia albicollis</i>	White-throated sparrow	PO		declining
<b>Icteridae</b>	<i>Agelaius phoeniceus</i>	Red-winged blackbird	CO		stable
<b>Icteridae</b>	<i>Molothrus ater</i>	Brown-headed cowbird			declining
<b>Icteridae</b>	<i>Quiscalus quiscula</i>	Common grackle	PO		declining

**Breeding Status** - Adapted from Foss (1994); see Table 1 for explanations of codes; if no code is listed the species was not observed during the breeding season

**Priority**

NH = NH Fish and Game Wildlife Action Plan (species of conservation concern)

PIF = Partners in Flight (Watch List species; Eastern and Northern Forest Avifaunal Biome)

BCR = Atlantic Northern Forest Bird Conservation Region (BCR 14)

FWS = US Fish and Wildlife

**General Trend**

1 = does not breed in NH; migratory species

**Bold** - species of conservation concern

## Mammals of Annett State Forest and Hubbard Pond

<u>FAMILY</u>	<u>SCIENTIFIC</u>	<u>COMMON</u>
Canidae	<i>Canis latrans</i>	Eastern coyote
Canidae	<i>Vulpes vulpes</i>	Red fox
Canidae	<i>Urocyon cinereoargenteus</i>	Gray fox
Castoridae	<i>Castor canadensis</i>	American beaver
Cervidae	<i>Alces alces</i>	<b>Moose*</b>
Cervidae	<i>Odocoileus virginianus</i>	<b>White-tailed deer*</b>
Cricetidae	<i>Ondatra zibethicus</i>	Muskrat
Felidae	<i>Felis rufus</i>	<b>Bobcat</b>
Leporidae	<i>Lepus americanus</i>	Snowshoe hare
Leporidae	<i>Sylvilagus floridanus</i>	Eastern cottontail
Mustelidae	<i>Lutra canadensis</i>	River otter
Mustelidae	<i>Martes pennanti</i>	Fisher
Mustelidae	<i>Mustela erminea</i>	Ermine (short-tailed weasel)
Mustelidae	<i>Mustela vison</i>	Mink
Procyonidae	<i>Procyon lotor</i>	Raccoon
Erethizontidae	<i>Erethizon dorsatum</i>	North American porcupine
Muridae	<i>Peromyscus</i> spp.	Deer or White-footed mouse
Sciuridae	<i>Sciurus carolinensis</i>	Gray squirrel
Sciuridae	<i>Tamias striatus</i>	Eastern chipmunk
Sciuridae	<i>Tamiasciurus hudsonicus</i>	Red squirrel
Ursidae	<i>Ursus americanus</i>	<b>Black bear*</b>

**Bold** - species of conservation concern listed in the NH Fish and Game Wildlife Action Plan

\* - Listed in the Big Game Management Plan section of the NH Fish and Game Wildlife Action Plan

## Amphibians of Annett State Forest and Hubbard Pond

<u>FAMILY</u>	<u>SCIENTIFIC</u>	<u>COMMON</u>
<b>Ambystomatidae</b>	<i>Ambystoma maculatum</i>	Spotted salamander
<b>Plethodontidae</b>	<i>Plethodon cinereus</i>	Redback salamander
<b>Salamandridae</b>	<i>Notophthalmus v. viridescens</i>	Red-spotted newt
<b>Bufo</b>	<i>Bufo americanus</i>	American toad
<b>Hylidae</b>	<i>Hyla versicolor</i>	Grey tree frog
<b>Hylidae</b>	<i>Pseudacris crucifer</i>	Spring peeper
<b>Ranidae</b>	<i>Rana catesbeiana</i>	Bullfrog
<b>Ranidae</b>	<i>Rana clamitans</i>	Green frog
<b>Ranidae</b>	<i>Rana palustris</i>	Pickerel frog
<b>Ranidae</b>	<i>Rana sylvatica</i>	Wood frog

## Reptiles of Annett State Forest and Hubbard Pond

<u>FAMILY</u>	<u>SCIENTIFIC</u>	<u>COMMON</u>
<b>Chelydridae</b>	<i>Chelydra serpentina</i>	Common snapping turtle
<b>Emydidae</b>	<i>Chrysemys p. picta</i>	Eastern painted turtle
<b>Emydidae</b>	<i>Glyptemys insculpta</i>	Wood turtle
<b>Colubridae</b>	<i>Nerodia s. sipedon</i>	Northern water snake
<b>Colubridae</b>	<i>Thamnophis s. sauritus</i>	Eastern ribbon snake
<b>Colubridae</b>	<i>Thamnophis s. sirtalis</i>	Eastern garter snake