U.S. Environmental Protection Agency

New England Region
Boston, Massachusetts

Ecological Characterization

Of The

Housatonic River Downstream of Woods Pond

September 2002

Environmental Remediation Contract

General Electric (GE)/Housatonic River Project

Pittsfield, Massachusetts

Contract No. DACW33-94-D-0009/032

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ENVIRONMENTAL CONSULTANTS

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Of The
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Prepared by

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Prepared under

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Region 1

Boston, Massachusetts

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SECTION I INTRODUCTION

1.0 Introduction

The United States Environmental Protection Agency (USEPA) and Army Corps of Engineers (ACOE) are characterizing the natural resources and contaminants found in and adjacent to the Housatonic River. Elevated levels of polychlorinated biphenyls (PCBs), which originated from the General Electric facility in Pittsfield, Massachusetts, have been found in the river and its floodplain (Blasland, Bouck & Lee, Inc. 1996). An in-depth ecological characterization has already been prepared for a river section approximately 12 miles (19 kilometers) long extending from Newell Street in Pittsfield downstream to Woods Pond Dam in Lee, Massachusetts, including riverine habitat, adjacent floodplain wetlands, and uplands associated with the main stem of the river. That area has been referred to as the primary study area (PSA) and was the focus of three years of ecological inventory studies from 1998 – 2000.

The USEPA and ACOE are now in the process of identifying and characterizing ecological communities and contaminants found in the rest of the river, downstream of Woods Pond in Lee, Massachusetts, to just upstream of the Derby-Shelton Dam in Derby and Shelton, Connecticut. This stretch of river, approximately 110 miles long, is referred to as the rest-of-river (ROR) study area.

1.1 Purpose of Report

The objective of this study was to identify and characterize the ecosystems occurring within the ROR study area, including both plant and animal communities. It was conducted largely through agency consultation and a literature review. Some aerial photography was used to identify natural communities that potentially occur in the ROR study area. Finally, some very limited field visits to the upper parts of the ROR study area were conducted over the course of the last three years.

The purpose of this document is to present the natural communities that occur in this study area and identify wildlife assemblages associated with each community.

2.0 Report Organization

The report is organized into three sections:

- Section I Introduction
- Section II Study Area Description
- Section III Ecological Characterization

Section I introduces the purpose of the report, describes the report organization, and explains the relationship between the ecological characterization and previous and ongoing studies of a similar nature. A broad description of the study area is provided in Section II and includes discussions of land use patterns and the biophysical setting of the study area.

The bulk of the report is contained in Section III, the Ecological Characterization. This section is further divided into six chapters:

- Chapter 1 Natural Communities
- Chapter 2 Macroinvertebrates
- Chapter 3 Fish
- Chapter 4 Reptiles and Amphibians
- Chapter 5 Birds
- Chapter 6 Mammals

The report includes a species:habitat matrix of vertebrate wildlife species expected to occur in the ROR study area (Attachment A).

3.0 Relationship to Previous and Ongoing Studies

This ROR ecological characterization is related to the ecological characterization report and activities conducted within the original Newell Street to Woods Pond Primary Study Area in that's it goals are the same as that report. This characterization, however, did not

include detailed field investigations like that for the PSA. Instead, a landscape analysis and literature-based resource assessment was conducted to characterize the ecology of the ROR study area.

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Blasland Bouck and Lee Inc. 1996. Supplemental Phase II/RCRA Facility Investigation Report for the Housatonic River and Silver Lake, Vol. 1 or 2. Report prepared for General Electric Company, Pittsfield, MA, USA.

SECTION II STUDY AREA DESCRIPTION

1.0 Introduction

Following is a brief discussion of physical and biological setting of the ROR study area, including historical uses and changes in the river valley.

2.0 Land Use Patterns and Population Trends

2.1 Historical Land Use Patterns and Population Trends

The Mohican family of the Algonquin Indians are believed to have been the first peoples to settle in the Housatonic River valley. The Native Americans who settled in the valley had relatively little impact on the river and the surrounding natural communities (Weatherbee 1996). This changed, however, with European settlement of the area, beginning in 1639 (HVA 2001).

The first Europeans settled in Stratford, at the mouth of the river (HVA 2001). Settlement quickly spread up the river valley. Much of the river basin was developed for agriculture during the first 100 years of settlement, during which time the river itself was used largely for transportation and waste disposal. During the 18th and 19th centuries, water power played an important role in the development of the river and the river valley, first as mechanical power to turn grist and saw mills, and then for the generation of electric power.

With the onset of more advanced industry in the river valley came an increased rate of land use and changes to the landscape. The discovery of high-quality iron ore in northwest Connecticut resulted in increased forest harvesting to fuel smelting furnaces (HVA 2001). The start of paper making in the region also resulted in increased forest harvesting on the higher hills surrounding the valley. By 1850, most towns up and down the river had small factories on the river banks that used the river as both a source of water for their manufacturing and milling processes, and a source for their waste disposal needs (HVA 2001). This resulted in obvious decreases in water quality in the river.

2.2 Current Land Use Patterns and Population Trends

Current land use patterns are similar to historic patterns. The most highly developed portions of the Housatonic River valley occur in the broad alluvial plains in the valley bottom. Agriculture still plays an important role in the valley and is dominant in localized areas, including Great Barrington, Massachusetts, and Kent and New Milford, Connecticut, where broad, fertile floodplain soils occur. The largest population centers are also located low in the valley, near the river. Many former agricultural areas, however, have reverted back to forest. This is especially true along the hillsides rising above the river. These areas were abandoned as farmland because of their poorer soils and the difficulty in clearing and maintaining them. Some land areas immediately aquired by state and federal land agencies have become reforested adjacent to the river. This includes state wildlife management areas in Pittsfield, Lee, Lenox, and Stockbrige, Massachusetts, and the Appalacian Trail in Kent and Cornwall, Connecticut.

3.0 Biophysical Setting

The ROR study area is located in southern Berkshire County, Massachusetts, and western Litchfield, eastern Fairfield, and western New Haven Counties, Connecticut. Berkshire and Litchfield Counties contain the most topographical relief in the two states. Within these counties, the Housatonic River runs through a valley with varying topography. For much of its path through Berkshire County, the river lies in a wide alluvial plain called the Central Valley (Weatherbee 1996). The Berkshire Plateau, a southern extension of Vermont's Green Mountains, forms a ridge that runs along the eastern edge of the valley while the Taconic Range, extending from Vermont to New York, extends along the western edge of the valley.

In Connecticut, the river runs through the Northwest Highlands in Litchfield and northern Fairfield Counties and the Southwest Hills of eastern Fairfield and New Haven Counties (Bell 1985). The Housatonic River continues running through an alluvial valley, except that in Connecticut it is called the Marble Valley. The Taconic Range extends southward, along the western boundary of the Marble Valley, into northwest Connecticut. Two additional, similar ranges—Housatonic Highlands and Hudson Highlands—continue

south, along the western boundary of the Valley. East of the valley, the Berkshire Plateau continues southward and is called the Litchfield Hills Plateau. In two small areas of the Marble Valley, the Housatonic River has cut a channel through the much tougher Housatonic Highlands and Hudson Highlands. These departures from the softer, more easily eroded Marble Valley occur from Falls Village to Cornwall Bridge and from Gaylordsville to New Milford. The river finally leaves the valley south of New Milford and crosses the schists and gneisses of the Southwest Hills.

3.1 Climate

The ROR study area has a continental climate, similar to the rest of interior New England, characterized by cold winters and hot summers. Average annual temperature, average daily July temperature, and average daily January temperature for Stockbridge, near the north end of the study area, have been 8, 20, and –6 degrees Celsius, respectively, for the time period 1951 – 1974. At Cornwall, Connecticut, near the middle of the study area, average annual and average daily July and January temperature have been 9, 21, and –4 degrees Celsius, while at Danbury, Connecticut, nearer the southern end of the study area, they have been 10, 22, and –3 degrees Celsius (USDA SCS 1970, 1981, 1988).

The number of frost-free days (i.e., the growing season) at those locations ranges from 103 to 183 days. The growing season for native vegetation (e.g., willows, evergreen trees, skunk cabbage) begins in March and ends in October with the last frost-tolerant herbs (e.g., asters, gentians) (Weatherbee 1996). Moisture supply usually exceeds evaporation, except during periods of drought. Total rainfall is evenly distributed throughout the year and averages 109 cm in Berkshire County, increasing slightly southward to 114 in Litchfield County and 119 in Fairfield and New Haven Counties (USDA SCS 1970, 1979, 1981, 1988). Conversely, average total snowfall for these counties decreases drastically north to south and is 180, 155, 99, and 81 cm, respectively (USDA SCS 1970, 1979, 1981, 1988).

3.2 Geology

3.2.1 Regional Geological Setting

The Housatonic River lies within the New England Physiographic Province, more specifically within the Taconic geologic region of western Massachusetts and the Northwest Highlands and Southwest Hills regions of Connecticut.

Within Massachusetts, the river occupies a broad, sediment-filled valley that separates two major geologic terranes: the Taconic Hills to the west; and the Berkshire Massif (also referred to as the New England Uplands) to the east. Upon entering northwestern Connecticut the river flows mostly within the Northern and Southern sections of the Marble Valley, a region of easily-eroded metamorphosed limestone lying between the Taconic Plateau (an extension of the Taconic Hills of Massachusetts) and the Litchfield Hills (an extension of the Berkshire Range). Within this region the river departs from the Marble Valley only in two short stretches: where it cuts gorges through the granite and metamorphic rocks of the Housatonic Highlands Plateau near Falls Village and the Hudson Highlands Plateau near Gaylordsville.

The river finally departs from the Marble Valley south of New Milford, Connecticut, where it cuts across the metamorphic rocks of the Southwest Hills and ultimately reaches Long Island Sound. This departure from the Marble Valley marks a crossing into a separate geologic terrane, first identified as a regional geologic fault by Eugene Cameron and referred to as “Cameron’s Line” (Bell 1985).

The geomorphology of the Massachusetts and Northwestern Connecticut section is typified by rounded hills and mountains draped with glacial deposits, and relatively narrow, steep-sided valleys cut into the hills by streams and rivers. More gently-rolling hills are found in the Southwest Hills section of Connecticut. Due to extensive continental glaciation and the thick deposits of glacial materials left behind, bedrock formations are generally exposed only in the hills and mountains, or as riverbed exposures in high-gradient areas.

3.2.2 Bedrock Geology

In passing from its source in Massachusetts to Long Island Sound, the Housatonic River moves through at least two distinct geologic terranes. In fact, it passes over the remnants of two completely separate tectonic plates, one representing an ancient continental margin with granite basement rocks and marble, and the other a displaced series of ancient deep-water ocean sediments. The boundary between the two terranes is marked by "Cameron's Line," which passes through New Milford (Bell 1985). The rock types contained within each plate have been extensively deformed and metamorphosed, and their compositional and physical features influence many characteristics of the Housatonic River basin.

The Taconic region of Massachusetts and the Northwest Highlands region of Connecticut have been subjected to a series of depositional and tectonic events over the past 600 million years, related to repeated openings and closings of the Iapetus ocean basin (precursor to the Atlantic) and resultant continental collisions. From the late Cambrian to the early Ordovician period (from about 450 – 500 million years ago) the region was on the edge of a stable warm-water continental shelf, located near the equator. The main part of the continent, located to the west, consisted of an accumulated series of granitic rocks and metamorphosed sediments more than 1 billion years old, comprising the proto-North American plate. Shallow water marine sediments, dominated by carbonates such as magnesium- and iron-rich dolomite and calcium-rich limestone and quartz-rich sands, were deposited on the continental margin, located in present-day western Massachusetts and northwestern Connecticut, while deeper-water deposits such as mud and silt were deposited in the ocean basin that lies much further to the east (Zen 1983, Rodgers 1985).

In the late Ordovician period (about 410 – 440 million years ago) the closing of the Iapetus ocean basin represented the onset of the Taconic Orogeny (mountain building activity), a tectonic event that compressed and buried the offshore deep-water sediment pile, metamorphosing the mud and silt into a series of slates and pelitic schists (Zen 1983). Continued compression eventually pushed these basin deposits up and over the shelf carbonate rocks, forming a series of stacked, fault-bounded thrust sheets that today

form the Taconic Hills found west of the Housatonic River in Massachusetts and in northwestern Connecticut. These compressed and metamorphosed ocean sediments also comprise the bulk of the Southwest Hills of Connecticut, through which the Housatonic flows between New Milford and Long Island Sound. As the Iapetus ocean basin closed completely, a series of older, highly-metamorphosed schists and gneisses (representing either the leading edge of the colliding continent or more deeply-buried volcanic-derived sediments on the western side of the basin) was also pushed upward and westward to form the Berkshire Massif, which lies east of Pittsfield, and possibly the Bolton Range in Connecticut (Bell 1985, Rodgers 1985).

During the Devonian period (350- 400 million years ago) another tectonic event (the Acadian Orogeny, which sent yet another micro-continent crashing into eastern Massachusetts and Maine) further compressed and heated the rocks in the Housatonic region, producing an overprinted series of geologic faults, folds, and fractures and completing the transformation of dolomite and limestone into the marble that underlies much of the Housatonic valley today in Massachusetts and northwestern Connecticut. Subsequent dissolution of this marble along fractures and joints has established a network of interconnected fractures and openings, producing a significant groundwater aquifer in the entire region (Olcott 1995). Dissolution and remobilization within some iron-rich sections of marble also produced a series of pod-like iron-oxide deposits (limonite) near the towns of Salisbury, Canann, Cornwall and Kent. These deposits were mined beginning in 1734 to provide iron ore for early blast furnaces, and represented some of the most important mining operations in the colonial era in Connecticut (Bell 1985).

These marble formations are important not only because they are the largest economic marble deposits in the two states, but also because their character significantly impacts the hydrology, groundwater chemistry, soil composition, and resultant natural communities in the river valley within Massachusetts and upstream from New Milford, Connecticut.

3.2.3 Glacial Geology

The most recent chapter in the area's geologic history involved extensive glaciation and Quaternary sediment deposition over the past 14,000 years. As in most of New England, continental glaciers advanced and retreated over the study area several times during the last 100,000 years, scouring bedrock and leaving behind discontinuous deposits of sand, silt, clay, and a series of poorly sorted gravels generally referred to as glacial till.

Following the last glacial retreat in Wisconsinan time (10,000 – 14,000 years ago) glacial till and sands filled the Housatonic valley locally to depths of 30 m (100 feet) or more.

Within the Pittsfield, Massachusetts, area, till is reported to overlie marble bedrock directly under the Housatonic River, with till thickness ranging from 2 feet to more than 50 feet (Blasland, Bouck & Lee 1994; Roy F. Weston, Inc. 2000). Cobbles of reworked marble within glacial tills suggest that the bedrock marble was exposed and scoured by the glaciers in this area, contributing significant amounts of carbonate material to the sediments. Subsequent erosion and reworking of these deposits by streams has produced a complex set of surficial deposits that serve as aquifers and exert control over the hydrologic features of the region.

3.2.4 Soils

Six major soil associations are present in the Housatonic River basin (New England River Basins Commission 1980). Three of the associations—Paxton-Woodbridge-Ridgebury, Charlton-Hollis, and Lyman-Peru-Marlow-Berkshire—are derived from glacial till and schist. These soils are characterized by shallow depth to bedrock, hardpan, stoniness, or steep slope. Two of the soil associations are derived from limestone and schist. These are called Copake-Groton, found in the Central Valley region, and Stockbridge-Farmington-Amenia-Pittsfield, located in the Taconic Range. They are characterized by deep, well-drained soils. The final soil association is called the Hinckley-Merrimac. This association is located along the valley edges on glacial outwash terraces. It is characterized by deep, sandy, well-drained, acidic soils.

Upstream from Kent, Connecticut, the soils of the river valley are comparable to the Copake-Groton soil association, which are typically deep, well-drained loamy soils derived from glacial outwash. Housatonic River floodplain soils are derived directly from bedrock (marble or schist), from glacial outwash, or from calcareous glacial till (USDA SCS 1966, 1979, 1988). Overwash of silt and fine sand into the floodplain is apparent in much of the low floodplain. Heavier soil particles, such as medium to coarse sands, remain within the channel and are the dominant soils of the riverbanks and bars (Bent 1996). Downstream from Kent, the soils are dominated by Hinckley-Merrimac-Hartland sandy soils and Charlton-Hollis loamy soils (USDA SCS 1966.)

The regional juxtaposition of more acidic source material (e.g., schists) with more neutral carbonate-rich bedrock (marble) in Massachusetts and northwestern Connecticut has created a diverse series of soils that contribute to the richness of the natural communities, and may explain the number of rare plant species found in portions of the study area. These rich soils should also be expected within the Marble Valley sections of the river in Connecticut, whereas the lack of carbonate bedrock downstream from New Milford suggests that soils in that section may not be as productive.

3.3 Hydrology

3.3.1 Ground Water

The calcareous bedrock in the Marble Valley of Connecticut and the Massachusetts section of the river serves as a major aquifer for the region, and its composition also influences the ground water quality. Ground water from this aquifer generally contains high concentrations of calcium and magnesium compared to water in other rock types, resulting in moderately hard to very hard water (i.e., a neutral pH and relatively high concentration of dissolved solids) (Olcott 1995). Ground water moving through the aquifer may also come in contact with calcareous glacial tills, which can maintain or increase the pH and mineral content of the water.

Regional groundwater in the Housatonic basin originates in upland areas, which consist predominantly of schist, quartzite and marble bedrock locally overlain by thin glacial

deposits. Groundwater recharge presumably includes precipitation percolating through the glacial overburden or directly into the carbonate aquifer, and ground water movement is assumed to follow the carbonate bedrock surface down gradient toward the Housatonic River. Within these areas of carbonate bedrock, ground water retains its neutral pH and high nutrient content, enhancing the rich soil conditions present along the river and floodplain areas.

Downstream from New Milford, the bedrock in both the river valley and the upland areas consists of relatively acidic schists and gneisses, with no carbonate present (Rodgers 1985). Precipitation percolating into and groundwater passing through this source material is expected to retain a low pH.

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SECTION III ECOLOGICAL CHARACTERIZATION

Chapter 1 Natural Communities

1.0 Introduction

A natural community is an assemblage of interacting plants and animals and their common environment, recurring across the landscape, in which the effects of recent human intervention are minimal (Gawler 2000). Natural communities, therefore, include the biota and the physical substrate and characteristics. Natural communities are repeatable units identified by their unique combination of plants and animals, and serve as convenient categories for landscape discussion. Some communities are populated by common species with general habitat requirements, while other communities are inhabited by rare species with very specific substrate requirements.

For purposes of this study, rare plants are those species that are considered to be of conservation concern in Massachusetts or Connecticut (MNHESP 1999, CDEP 1998). Rare species, including plants, are commonly classified according to their rarity. Factors that influence a given species' rarity include number of state occurrences, number of global occurrences, vulnerability to disturbances, rarity of the associated natural community, fecundity, and other aspects of its biology. Definitions of rarity (e.g., endangered, threatened) can be found in Table 1-1.

The characteristics of natural communities provide detailed landscape descriptions and a framework to discuss animal-habitat associations. Rare species provide a measure of landscape uniqueness, as they occur more frequently in regions with unusual physical aspects (e.g., high elevation, high pH bedrock) or in transition zones between ecoregions. Furthermore, rare plants are protected from take by the Massachusetts Endangered Species Act (M.G.L. c. 131A), its implementing regulations (321 CMR 10.00), and the Connecticut Endangered Species Act (Public Act 89-224).

Table 1-1 State ranking and status definitions.

Term	Definition
Endangered	Native species which are in danger of extinction throughout all or part of their range or which are in danger of extirpation, as documented by biological research and inventory.
Threatened	Native species which are likely to become endangered in the foreseeable future, or which are declining or rare as determined by biological research and inventory.
Special Concern	Native species which have been documented by biological research or inventory to have suffered a decline that could threaten the species if allowed to continue unchecked, or which occur in such small numbers or with such restricted distribution or specialized habitat requirements that they could easily become threatened.
Watch List	Rare or uncommon species that are not formally protected by legislation but are monitored by the MNHESP or CDEP. This category contains species which may have been dropped from the official rare plant list, are candidate species for listing, may have questions as to taxonomic identity or native range, or have had insufficient collection effort to ascertain rarity.
S1	Critically imperiled because of extreme rarity (five or fewer, or very few, remaining individuals or hectares) or because some aspect of its biology makes it especially vulnerable to extirpation.
S2	Imperiled because of rarity (6–20 occurrences or few remaining individuals or hectares) or because of other factors making it vulnerable to further decline.
S3	Rare (on the order of 20–100 occurrences).
S4	Apparently secure, but with cause for long-term concern.
S5	Demonstrably secure.
SH	Occurred historically, and could be rediscovered; not known to have been extirpated.
SX	Apparently extirpated (historically occurring species for which habitat no longer exists.
SU	Possibly in peril, but status uncertain; need more information.
S?	Probably rare or historic, based on status elsewhere in New England, but not yet reviewed or documented by MNHESP or CDEP.
Global ranks (“G” instead of “S”)	Follow the criteria for state ranks but refer to the entire range of a species, rather than just its statewide distribution.

2.0 Methods

2.1 Background

Landscape analysis, a multi-step process involving information collation, interpretation, and summarization (Lortie *et al.* 1992), was performed to provide a macroscopic view of the ROR study area's history and ecology. The landscape analysis process identified natural communities likely to occur in the study area, including those with moderate to high potential for containing a targeted feature (e.g., rare plants, animals, or natural communities). The process involved using available natural resource information such as United States Geological Survey (USGS) 7.5 minute topographic maps, surficial and bedrock geology maps, aerial photographs, soils maps, wetlands maps, land use history information (e.g., fire, cutting, herbicide spraying), and species descriptions to develop a search image of the targeted feature (e.g., a rare plant) or its associated natural community. The study area was then assessed to determine if areas occurred that could harbor the targeted feature.

2.2 Literature review

Available information on rare plants and natural communities was collected from published and unpublished sources. The Massachusetts Natural Heritage and Endangered Species Program (MNHESP) and the Connecticut Department of Environmental Protection (CDEP) were contacted for rare plant and community information. Locations of known rare features were plotted on study area base maps. MNHESP and CDEP botanists and natural community scientists were also consulted regarding the availability of reports on plants and communities for the study area. Information on rare plant species taxonomy and biology was collected from botanical texts (e.g., Flora of North America Editorial Committee 1993, 1997 and 2000; Gleason and Cronquist 1991; Haines and Vining 1998; Dowhan and Craig 1976; Fernald 1950) and herbarium vouchers. Available information on rare plants and communities in and near the study area was reviewed to predict whether additional rare plant or community sites might occur in the study area based on species ranges, ecology, and available habitat types.

Taxonomy of vascular plants follows Haines and Vining (1998) and Flora of North America Editorial Committee (1993, 1997, and 2000). Natural community classification for the entire study area largely follows Swain and Kearsley (2000). This treatment represents the most current and comprehensive system for Massachusetts. Many river and lake ecosystems, however, are not described. Classification of these latter communities follows Weatherbee (1996) and Weatherbee and Crow (1992). Gawler (2000) and Swain (pers. comm., A. Haines of Woodlot with P. Swain of the MNHESP, several contacts in 1999 and 2000) were referenced for community characterization. The CDEP natural community classification has not been completed; therefore, the MNHESP classification was used for the entire study area (pers. comm. Metzlier 2001). This use of just one classification system also allowed for continuity across this large study area.

2.3 Aerial Photograph Interpretation

Color infra-red and true color aerial photographs (1:6000 scale) of Massachusetts and black and white aerial photographs (approx. 1:6000 scale) of Connecticut were used to review the types and locations of natural communities in the study area. Natural communities in the study area that appeared to be in a natural state (i.e., they had not been altered by agricultural activities, development, human-induced flooding, or other factors) were identified on maps and aerial photographs.

3.0 Natural Community Descriptions

Twenty-eight community types occur in the ROR study area. Scientific names for plants referenced in this document are listed in Attachment B.

3.1 Lacustrine Communities

Lacustrine communities include wetlands and deepwater habitats located in topographic depressions and impounded river channels. These communities have limited (less than 30 percent) areal coverage of woody and emergent herbaceous plants and may also have active, wave-formed shoreline features (Cowardin *et al.* 1979). Along the Housatonic River, lacustrine communities are essentially human-created features (i.e.,

impoundments). One lacustrine community type was found to occur in the ROR study area.

Moderately Alkaline Lake/Pond

This lacustrine community is usually found on limestone and marble bedrock in the Housatonic River valley. These lakes/ponds tend to have gently sloped shores and soft-substrate bottoms. Measurements of pH are usually between 7.0 and 9.0 (Weatherbee and Crow 1992). Many species of submerged and floating-leaved aquatic species may be present in shallow areas. Rosette-forming species, however, tend to be less common and are more frequent in acidic lakes. Some of the more common plants include common hornwort, common water-nymph, Canada waterweed, tape-grass, and long-beaked water crowfoot. Moderately alkaline lake/pond communities also appear to be more susceptible to invasive plant species, such as Eurasian milfoil and crisped pondweed.

Many species of fish utilize this community type. Bluegill sunfish, pumpkinseed sunfish, largemouth bass, yellow perch, chain pickerel, brown bullhead, and golden shiner are common species. Eastern elliptio and eastern floater are two species of fresh water mussels occurring in this habitat. Common herpetile species include green frogs, pickerel frogs, American toads, eastern newts, wood frogs, and painted turtles. Several species of swallows are likely to feed on insects over this community. These included tree swallows, bank swallow, barn swallows, and northern rough-winged swallows. Wood ducks and mallards are common waterfowl and great blue herons are common wading birds. Long-tail weasel, mink, and river otter are carnivorous mammals that may commonly use this habitat.

3.2 Riverine Communities

Riverine systems are wetland and deepwater habitats with continually or periodically flowing water contained within a channel. They are not significantly dominated by woody or emergent herbaceous vegetation (less than 30 percent areal cover) and do not have ocean-derived salts exceeding 5 parts per thousand. Riverine systems may occur in natural or created channels and sometimes are merely connections between two bodies of

water (Cowardin *et al.* 1979). Three riverine communities occur on the Housatonic River: low-gradient stream, medium-gradient stream, and high-gradient stream.

Low-Gradient Stream

This community describes slow-moving riverine systems with low elevational gradients. In-stream substrate indicators of this community include fine silt and organic muck. Low-gradient streams are often bordered by relatively flat, alluvial plains. Water pH depends on local bedrock. The flora of low-gradient streams is more developed compared to faster moving streams, and often takes the form of dense aquatic beds of submersed and floating vegetation in suitable areas. Depth is commonly 2.0 – 3.0 m.

Common hornwort, Canada waterweed, Eurasian milfoil, and crisped pondweed, all of which produce submersed vegetative organs, are the most common aquatic plants of the low-gradient portions of the Housatonic River. Yellow pond-lily, lesser duckweed, and greater duckweed are common floating-leaved plants in backwater areas. Giant bur-reed is a common emergent species. Narrow-leaved bur-reed, green-fruited bur-reed, water stargrass, large-leaved pondweed, and star duckweed are also common species.

Many species of fish from diverse taxonomic groups use low-gradient stream habitat. Bluegill sunfish, pumpkinseed sunfish, golden shiner, spottail shiner, largemouth bass, common carp, goldfish, yellow perch, white sucker, and brown bullhead are some of the more common species. Rock bass, black crappie, black-nosed dace, fallfish, and northern pike are also observed. Freshwater mussels occurring in this community include eastern floater. Northern leopard frogs, eastern newts, green frogs, and bullfrogs use this community extensively. Painted turtles and snapping turtles are the most frequently seen reptiles. A number of bird species use low-gradient stream habitat of the Housatonic River for feeding. Belted kingfishers feed in the water and nest on steep, stream-cut banks. Tree swallows, barn swallows, and northern rough-winged swallows all feed on insects over the river channel. Great blue herons also forage in the shallow sections. This community is used extensively by Canada geese and is an important habitat for spring migrants. Mallards and wood ducks utilize this community for feeding and brood rearing. Both American black ducks and mallards are frequently seen using low-gradient

stream habitat during the winter. Little brown bats and silver-haired bats are common species feeding on insects over this habitat.

Medium-Gradient Stream

Medium-gradient streams describe a riverine community of moderate velocity water flowing over sand and gravel substrate. The elevational gradient is observable, and riffles are present in sections of the stream. Vascular plant communities are sparsely developed and often present only in shallow, protected areas. Water depth is typically 0.5 – 1.5 m. Vascular plants are restricted to small colonies. Crisped pondweed, Eurasian milfoil, and narrow-leaved bur-reed occur in limited extent. The increased water velocity often leads to strict, elongate plants.

The fish community utilizing medium-gradient stream habitat is largely similar to that found in low-gradient streams. A few species more common in cold water systems, however, such as rainbow trout, brown trout, and brook trout, can be found here as well. Some species that require shallow water with ample aquatic vegetation, such as carp and goldfish, are limited in this habitat. Mallards and spotted sandpipers use shallow water and shoreline areas in this community.

High-Gradient Stream

This community most often includes low-order streams that flow and cascade down hillsides. Moderate-sized streams that are classified as high-gradient have significant stretches of riffles, rapids, and whitewater. Due to stream velocity, few plants are capable of colonizing the gravel, cobble, and ledge substrate. Most vascular plants found in this community occur in protected microsites, such as low-slope shorelines and calm pools and along their shorelines, which are often vegetated with species from the adjacent upland community.

Coldwater fish species such as brook trout, brown trout, rainbow trout, smallmouth bass, blacknose dace, and Cutlips minnow may be found in high-gradient streams. Spring salamanders, northern two-lined salamanders and dusky salamanders are associated with

high-gradient streams. Eleven palustrine communities were identified in the ROR study area.

3.3 Palustrine Communities

Palustrine systems are non-tidal wetlands dominated by herbaceous plants (Cowardin *et al.* 1979). They may occur in topographic depressions and drainage basins, adjacent to lakes and rivers, or anywhere groundwater is discharged to the ground surface, such as at the base of a slope that intersects an impermeable layer. As these communities are wetlands, the soil is inundated or at least saturated to near the surface during a portion of the growing season.

Deep Emergent Marsh

Deep emergent marshes are herb-dominated communities growing on inundated, or at least permanently saturated, soils. Water depth is generally 15 – 90 cm, though standing water may be absent during drought years. Due to anaerobic conditions, a surface layer of well-decomposed muck usually overlies the mineral soil base. Tall grass-like herbs are indicative of this community, but shorter, broad-leaved plants are also common. This community dominates many backwater pools, sloughs, and oxbows of the Housatonic River.

Characteristic herbs of deep emergent marshes in the Housatonic River valley include broad-leaved cattail, common reed, and giant bur-reed. Pickerelweed, tuckahoe, common arrowhead, and the invasive purple loosestrife are also frequent. Sweet-flag, lakeside sedge, and bulblet water-hemlock are additional associates of this community. This habitat frequently has a shrub component and often intergrades with shrub swamps. Silky dogwood, buttonbush, and speckled alder are commonly found in and adjacent to deep emergent marshes.

Deep emergent marshes often contain or are adjacent to water that is used by a number of herpetile species, including eastern newts, northern leopard frogs, bull frogs, and painted turtles. Foraging wading birds frequent this community, with great blue herons being the most common. Virginia rails and the state-listed common moorhen also utilize this

community. Red-winged blackbirds are characteristic birds of this community and their nests commonly occur among tall herb stems along the Housatonic River. Other birds include mallard, green heron, song sparrow, and yellow warbler. Muskrats are the most obvious mammal that use deep emergent marshes.

Shallow Emergent Marsh

Shallow emergent marshes are also herb-dominated communities growing on inundated, or at least permanently saturated, soils. They are different from deep emergent marshes in that water depth is relatively shallower, commonly ranging from 0 – 25 cm. Soil conditions are similar, however, in that a surface layer of well-decomposed muck is usually present. This natural community is primarily vegetated by grass-like and broad-leaved herbs of small to medium stature. Herbs characteristic of deep emergent marshes (robust, graminoid plants) are absent or sparse, except that the invasive purple loosestrife is often present. This community dominates many of the temporary vernal pools of the Housatonic River floodplain and some of the grass-dominated river shore habitats. This habitat is also common in beaver-influenced areas.

The vegetation of shallow emergent marshes is highly variable and, to some extent, dependent on canopy closure and site history. Open sites that are within current or former beaver flowages are dominated almost exclusively by rice cut-grass and tussock sedge. Sites located within the depressions of shaded vernal pools have a mixture of false water-pepper, dotted smartweed, wool-grass, cuckoo-flower, water-parsnip, common arrowhead, and northern water-plantain. As noted above, purple loosestrife is a common non-native species in marshes associated with the Housatonic River. Pools with relatively permanent water are also vegetated by floating aquatic plants, such as lesser duckweed. Shrubs are commonly intermixed in this community, including silky dogwood, buttonbush, meadowsweet, and silky willow. Wapato is a plant of state-conservation concern in both Massachusetts and Connecticut that occurs in this habitat. As the water level recedes in late summer, shallow emergent marshes will sometimes have a marginal band of exposed mud flat community.

Shallow emergent marshes are used by many herpetile species for breeding or feeding. The species utilizing the community is dependent on landscape position. Marshes located in open fields and beaver flowages are commonly used by northern leopard frogs, green frogs, and eastern newts. Marshes located in somewhat isolated depressions in floodplain forests are used by wood frogs and spotted salamanders. Predaceous reptiles, such as snapping turtles and painted turtles, can be observed moving to vernal pools to feed on amphibian larvae. Wading birds commonly utilize this community for foraging. Great blue herons are frequent and the state-listed American bittern have also been noted to use this habitat. Northern harriers, a state-listed raptor, can be observed flying over this community. Shallow emergent marshes located in forested settings are also used by wood ducks. Other birds include common yellowthroat, red-winged blackbird, and song sparrow. Meadow voles are the most common small mammals found in this community along the Housatonic River. Long-tailed weasels and mink are also known to use this community.

Wet Meadow

This wetland community can generally be described as a shallow emergent marsh that requires repeated disturbance (e.g., mowing, grazing) to maintain its character and halt succession. This habitat is seasonally flooded but usually does not have standing water through the growing season. Soils are primarily mineral and will display redoximorphic features. Dominant vegetation is usually grass-like, but broad-leaved herbs and shrubs can be common.

Wet meadows differ substantially in the ROR study area depending on their landscape position. Those meadows adjacent to the Housatonic River are often dominated by reed canarygrass, spotted touch-me-not, Canada blue-joint, and lakeside sedge. Many broad-leaved herbs are common to this community, though limited in areal extent. They include spotted joe-pye weed, swamp milkweed, common milkweed, and stinging-nettle. Shrubs are frequent and usually form small, dense colonies within or along the fringe of the wet meadow. Red raspberry, pussy willow, silky dogwood, and red-osier dogwood are typically encountered. Vines are less common, but wild morning glory and wild cucumber do occur. Scattered trees may be present, with black willow, silver maple, and

boxelder being the more common species. Due to similarities in species composition, this plant association is very difficult to separate from shallow emergent marshes without prior knowledge of site history. Some other wet meadows may display a different vegetation association. Wet meadows influenced by high-pH groundwater discharge can harbor known calciphiles such as shrubby cinquefoil, autumn willow, grass-of-Parnassus, and green-keeled cotton-grass. At sites with a history of agricultural use, species common to farmed areas can be intermixed (e.g., meadow fescue, reed fescue, red clover, sweet vernal grass, white bedstraw). Autumn willow, fringed-gentian, and variegated scouring-rush are three plants of conservation concern that may occur in this habitat.

Wet meadows are used extensively during the summer season by northern leopard frogs, particularly those that are near breeding pools that contain water for most of the growing season. Meadow voles and white-footed mice are common small mammals observed in this habitat. Raptors, particularly American kestrels and northern harriers, utilize this open ground for hunting. Other birds commonly found in this habitat include eastern kingbird, song sparrow, willow flycatcher, and yellow warbler.

Mud Flat

This community is usually found adjacent to river channels, vernal pools, and backwater areas. As its name suggests, it is a plant community occurring on saturated mud substrate. It is commonly inundated early in the growing season and during other high water periods, and gradually becomes exposed in summer as water levels recede. Mud flats vary in percent areal plant cover, ranging from sparse to moderate. Many plants occurring in this community exist in a vegetative state until later in the season when they are completely emersed from the water, at which time they will flower. Small occurrences of this community can be almost completely shaded by overhanging trees. In some areas, mud flats may intergrade with shallow emergent marshes and riverine pointbars and beaches.

Mud flats are dominated by herbaceous species, though shrubs and some trees may occur at their edges. Common herbaceous species include northern water-plantain, common arrowhead, American bur-reed, needle spikesedge, and threeway sedge. Southern water-

plantain, false water-pepper, water-parsnip, long-stalked monkey-flower, water-purslane, false nutsedge, and wool-grass are less frequent species. Buttonbush and silky dogwood sometimes form dense clumps at the edge of the community. Silver maple, thought not occurring in the community, frequently overhangs and shades mud flats that occur in vernal pool depressions. Wapato and mudflat spikesedge are two plant species of state conservation concern that occur in mud flat communities.

Mud flats are used by several shore bird species as feeding areas. Spotted sandpipers, solitary sandpipers, and least sandpipers can be observed in this habitat. Larger shorebirds, such as great blue herons, also utilize this community. Other birds include song sparrow, common grackle, and red-winged blackbird. Beaver, muskrat, raccoon, waterfowl, and various species of small mammals are common species found on mud flats.

Riverside Seep

Riverside seeps are groundwater discharge sites adjacent to river channels on gravel, till, and ledge substrates. This community is often associated with riverside rock outcrops and high-energy riverbanks. When the underlying rock is calcareous the resulting alkaline community is known as a calcareous sloping fen (see below).

The riverside seep community is dominated by herbaceous vegetation and may have some shrub species present, especially at the edges. Common species include boneset, spotted touch-me-knot, fringed loosestrife, muskflower, Canada burnet, and golden Alexanders. Silky dogwood, red-osier dogwood, swamp buckthorn, shadbush, and highbush blueberry may be present.

Shore and wading birds utilize this habitat, especially during spring and fall migrations. Other birds likely to be observed in this habitat include waterfowl, red-winged blackbirds, and swamp sparrows. Snakes, such as the eastern garter snake, northern water snake, and ribbon snake, can be observed in this community. Painted turtles and snapping turtle may use this habitat during the breeding season.

Calcareous Sloping Fen

Calcareous sloping fens are open wetlands for which the primary water supply is alkaline groundwater flowing through calcareous bedrock. This groundwater slowly flows through the fen, supplying plants with high levels of minerals and forming small rivulets. Sites generally have a gentle slope, allowing organic layers to form over calcareous glacial tills. This situation creates a characteristically different flora that includes calciphilic species.

The wet, gravelly soil of this community type is usually too unstable to support trees and, therefore, perpetuates as unshaded openings in which small herbaceous species dominate. The herbaceous stratum consists mainly of sedges, commonly inland sedge, long-beaked sedge, bristle-stalked sedge, yellow sedge, and porcupine sedge. Other associated herbs include grass-of-Parnassus, rough-leaved goldenrod, northern bog goldenrod, and marsh fern. A well-developed bryophyte layer is usually present, typically consisting of *Sphagnum*, *Campylium stellatum*, *Drespanocladus revolvens*, and *Scorpidium scorpioides*. A sparse shrub layer may be present, including such species as silky dogwood, shrubby-cinquefoil, autumn willow, currants, shadbush, and alder-leaved buckthorn. Autumn willow and long-beaked sedge are species of Special Concern in Connecticut.

Animals utilizing calcareous sloping fens are likely to be similar to those found in riverside seeps. Salamanders, such as the dusky salamander and four-toed salamander, a species of Special Concern in Massachusetts, are commonly associated with seeps and wet, mossy habitats, thus may be found in this community type. Turtles, such as the spotted turtle, bog turtles, painted turtle, and wood turtle, are likely to use this habitat. Calcareous wetlands such as this community are critical habitat for the federal- and state-endangered bog turtle.

Shrub Swamp

This community is highly variable and species occurrence is dependent on many factors, including substrate, landscape location, and water depth. All examples of this community share in common the lack of a closed tree canopy and dominance by the

shrub stratrum. The soils of this community demonstrate wetland characteristics such as redoximorphic features in seasonally saturated mineral horizons, or varying depths of surface muck. Many occurrences of this community in the ROR study area are the result of past disturbance and currently represent a stage in site succession.

Shrub swamps are difficult to specifically describe due to the large number of potential species and variants. Silky dogwood, winterberry, speckled alder, and meadowsweet form common associations in the Housatonic River valley. Those swamps occurring in standing water are frequently dominated by buttonbush, sometimes to the exclusion of other species. Northern arrowwood, silky willow, and pussy willow are also frequent. Other species occurring in this community are highbush blueberry, red raspberry, swamp dewberry, steeplebush, and meadowsweet. Shrub swamps supplied by calcareous groundwater may have autumn willow, shrubby cinquefoil, silky willow, and pussy willow as common shrubs. Trees often do occur in shrub swamps but are either small or sparse. Common species include red maple and, when near the Housatonic Rive channel, silver maple. Herbaceous plants vary as well, but are generally restricted to facultative and obligate wetland species. Sensitive fern, calico aster, cinnamon fern, and rough-stemmed goldenrod are common associates.

Valuable breeding habitat for amphibians can be found in some of the study area's shrub swamps. Pools that lack fish are used by wood frogs and spotted salamanders. Common birds occurring in shrub swamps include yellow warbler, common yellowthroat, and gray catbird. In some areas near the Housatonic River channel, beaver have assisted in creating small shrub swamps by felling some of the canopy trees. Bristly crowfoot, a species of state conservation concern, occurs in shrub swamps adjacent to the Housatonic River channel.

Red Maple Swamp

Red maple swamps are forested wetlands where red maple is dominant in the canopy stratum. They can occur in seepages on or at the base of slopes, within drainage basins, or along riparian systems. In the ROR study area, this community primarily occurs within the Housatonic River floodplain and therefore is transitional to alluvial red maple

swamps, a community known from eastern Massachusetts. The soils of re maple swamps are mineral and will demonstrate redoximorphic features.

Red maple is always present and is the dominant tree. Other trees, such as swamp white oak, gray birch, and black cherry, are sometimes present, depending on the site. Lianas (i.e., vines) are frequently present, but are restricted to low-growing species such as swamp dewberry and carrion flower. The subcanopy is typically poorly developed and comprised of tree saplings like red maple and gray birch. Dominant shrub species vary by site and sometimes form dense thickets. Common species include northern arrowwood, winterberry, and silky dogwood. The genus *Osmunda* is usually well represented in the herb layer, and one or more species may be present (e.g., royal fern, cinnamon fern, interrupted fern). New York fern is usually present as well. Other common herbs include drooping wood-reed and calico aster. Crooked-stem aster, a species of conservation concern, is also found in this community.

This community sometimes possesses vernal pools, which are important for breeding amphibians. Wood frogs and spotted salamanders use pools in this habitat, as do American toads and spring peepers. The rare Jefferson's salamander and northern four-toed salamander are also known to use vernal pools within this community. Predatory species use vernal pools for feeding areas, including snapping turtles, eastern garter snakes, and great blue herons. Several species of small mammals are encountered in this community, including herbivorous, omnivorous, and insectivorous types. White-footed mice and northern short-tailed shrews are typically most common. Southern red-backed voles can also be seen in this community. Common birds included yellow-bellied sapsucker, northern waterthrush, eastern wood pewee, and chestnut-sided warbler.

Black Ash–Red Maple–Tamarack Calcareous Seepage Swamp

This forested swamp occurs in areas with calcareous groundwater seepage. This creates a high-pH substrate that harbors a diversity of plant species and often possesses a concentration of state-listed rarities. Many examples of this community are found on or at the base of slopes where groundwater seepage meets an impervious layer, is redirected, and emerges at the surface. Within the wettest examples of this community, pit and

mound topography is usually present. This community is of conservation concern in Massachusetts, and, ecologically, is extremely important for flood flow storage.

This natural community is recognized by the dominance of black ash, red maple, and tamarack in the canopy. Some sites in Massachusetts, however, are unusual in that tamarack is lacking and bur oak, a rare species, is present. Yellow birch and northern white cedar may also occur in this community. An understory shrub layer is typically present and may form dense colonies within the swamp. Common shrub species include spicebush, American hornbeam, northern arrowwood, red-osier dogwood, and speckled alder. Common herb species include sensitive fern, royal fern, brome-like sedge, skunk cabbage, and water avens. The rare Gray's sedge, bur oak, hemlock-parsley, and eastern black currant were all documented from this habitat in the PSA.

The black ash–red maple–tamarack calcareous seepage swamp community often possesses vernal pools that are important for breeding amphibians. This community often occurs adjacent to backwater areas and contains mast trees (e.g., bur oak) that can be utilized by white-tailed deer, squirrels, and black bears. Fisher and mink can be found in this community, as can many other common mammals. Birds found in this community include warbling vireo, veery, ovenbird, black-capped chickadee, and great-crested flycatcher.

Transitional Floodplain Forest

Transitional floodplain forest is a plant community of conservation concern in Massachusetts. This community occurs on rivers of intermediate size and is, therefore, a transitional plant community between major-river and small-river floodplain forests. Sites commonly experience over-bank flooding during high water events. The soils often do not appear hydric in the upper horizons, but will display redoximorphic features within 60 cm of the surface.

Silver maple is generally the dominant tree and often occurs as large, multi-stemmed plants. Boxelder, American elm, red maple, and eastern cottonwood are common associates and may be locally dominant. Tree size and age can vary greatly by site. Shrubs are normally sparse, providing an open, park-like atmosphere to the community.

However, silky dogwood, red-osier dogwood, American hornbeam, common buckthorn, and Morrow's honeysuckle can be common understory woody plants in some areas. The latter two species are non-native and sometimes abundant. The herb stratum is variable, and largely dependent in the site's hydrology. Some sites will possess large, monotypic stands of robust herbs that form dense colonies, particularly in canopy gaps. Dominant species include ostrich fern, wood-nettle, sensitive fern, false-nettle, moneywort, cuckoo-flower, garlic-mustard, and dames rocket. The latter four species are well-known and problematic non-native species. Black mustard is another non-native species that can be prevalent near open channel edges. Climbing plants (e.g., vines and lianas) frequent this plant community with wild cucumber and river grape the most common. As these sites occur adjacent to the river, they frequently possess meander scars. These flood drainages are devoid of water for much of the season and often have sand or scoured substrate that provides structural and floristic diversity. Ditch-stonecrop, water-pepper, wirestem muhly, and yellow wood-sorrel are common species in these areas.

This habitat sometimes possesses vernal pools in depressions and meander scars. Vernal pools that have standing water for at least three months of the year and lack fish are important for breeding amphibians. Wood frogs and spotted salamanders use pools in this habitat extensively, as do Jefferson salamanders, northern leopard frogs, and spring peepers. Predatory species, including snapping turtles, painted turtles, and garter snakes, use vernal pools for feeding areas. Several species of small mammals are encountered in this community, including herbivorous, omnivorous, and insectivorous types. White-footed mice, meadow voles, northern short-tailed shrews, cottontails, and gray squirrels are most common. Transitional floodplain forests are also used as a travel corridor by mink, river otters, and raccoons, as well as larger mammals such as white-tailed deer, coyotes, and black bears. Beavers forage in this community extensively. Birds occurring in this habitat type include downy woodpeckers, red-bellied woodpeckers, Baltimore orioles, eastern tufted titmice, and veerys.

High-Terrace Floodplain Forest

This community occurs on elevated terraces and banks of medium to large rivers, and although influenced by river-deposited silts, is flooded less regularly than transitional

floodplain forests. The higher elevation above mean river line compared to other riparian forests, and the infrequency of flooding, creates a forest with many similarities to rich, upland stands. In Massachusetts, this natural community is known for its spring ephemeral flora and concentration of state-listed plants.

Common canopy trees include basswood, white ash, and black cherry. American hornbeam commonly forms a subcanopy layer. Choke cherry is a common native shrub, while Morrow's honeysuckle, common buckthorn, and Japanese barberry are prevalent, invasive shrubs. The herb stratum changes character dramatically through the season. In the spring prior to leaf emergence of the canopy trees, several characteristic species appear, including wild leek, spring beauty, trout lily, and Dutchman's breeches. These tuber- or bulb-bearing plants utilize the sunlight reaching the forest floor, which would be intercepted by tree foliage later in the season, to complete most of their life cycle. By late summer, these plants have senesced, leaving only fruiting structures, if anything, above ground. At this later time, slower-appearing plants, such as white snakeroot, zig-zag goldenrod, ostrich fern, and jumpseed, will dominant the herb stratum. Uncommon herbs characteristic of this community include long-beaked sedge, bottlebrush grass, and pubescent sedge. Early blue cohosh, black maple, and downy wild-rye are plants of conservation concern that may occur in this habitat.

High-terrace floodplain forest is a plant community of conservation concern in Massachusetts. This habitat sometimes possesses vernal pools. Pools that have standing water for at least three months of the year and lack fish are important for breeding amphibians, particularly wood frogs and spotted salamanders. Common birds include wood thrush and ovenbird. Gray squirrel is a common rodent active year-round, and white-tailed deer may be common.

3.4 Terrestrial Communities

Terrestrial systems are uplands that lack prolonged inundation or soil saturation. They may have closed canopies or be relatively open and dominated by low herbs. Terrestrial systems occur in a variety of locations with respect to elevation, slope, and aspect. Ten terrestrial or upland communities were identified in the ROR study area.

Riverine Pointbar And Beach

This community is usually restricted to sand beaches found along major rivers (e.g., the Connecticut River). The pointbars and beaches of the Housatonic River are generally limited in size (often less than 20 m long) and often contain a small amount of silt and mud, rather than being comprised of pure sand. However, they are important to describe as they are a community of conservation concern and contain a unique flora that consistently harbors rare species. Riverine pointbars and beaches are derived of river-deposited sediments. This community type often occurs on and below the inside bend of the river where stream velocity has slowed and mineral particles have settled out. The size of each pointbar and beach varies from year to year depending on whether destructive (erosion) or constructive (accretion) processes have recently occurred. This community occurs sporadically along the Housatonic River.

False nutsedge, awned nutsesedge, Canada lovegrass, and false pimpernel are characteristic herbs of this community. Water-purslane, common cocklebur, Pennsylvania smartweed, smooth creeping lovegrass, and devil's beggar ticks are additional frequent plant species. Purple loosestrife, an invasive species, can occur at the upper edge of the beach. Mudflat spikesedge, a species of conservation concern in Massachusetts, routinely occurs in this community when the sand contains some silt and mud.

Three Massachusetts-listed dragonflies can be observed using riverine pointbars and beaches, as well as other substrates, to emerge from the water and metamorphose to adult form. They are the riffle snaketail, zebra clubtail, and arrow clubtail. Shore and wading birds also use this habitat, most commonly spotted sandpipers and great blue herons. Many mammal species (i.e., beaver, muskrat, raccoon, mink) are likely to pass through this habitat when accessing the river.

High-Energy Riverbank

High-energy riverbanks are sparse, herb-dominated communities found on course substrate (e.g., cobble, gravel) adjacent to the river channel. This community is

periodically scoured by ice and water, which removes invading woody species. Scouring can be intense, especially at the upstream end of islands.

Common plant species include false dragonhead, common cocklebur, lady's thumb, river horsetail, and hemp dogbane, the latter two species being more common on gravel and sand. Often, a distinct band of switchgrass is present. Sites that are being recolonized with woody plants may contain silky dogwood, sand cherry, and other species such as willows and alders.

Many dragonfly species use these riverbanks to emerge from the water and metamorphose to adult form. Several Massachusetts-listed species, including riffle snaketail, zebra clubtail, and arrow clubtail can be found here. Shore and wading birds also use this habitat, most commonly spotted sandpipers and great blue herons. This community, especially when containing regenerating trees and shrubs, may harbor several bird species, including yellow warbler, eastern kingbird, red-winged blackbird and song sparrow.

Riverside Rock Outcrop

Riverside rock outcrops are dry-mesic to xeric rock outcrops adjacent to the river channel with varying substrate and pH characteristics. These rock outcrops are flood-scoured during high water and may be ice-scoured during the winter. This community is also prone to severe summer drought, which may stress or kill some species, especially woody vegetation. Vegetation often occurs in patches, likely due to microsite conditions.

This grassland community is commonly composed of big bluestem, little bluestem, indian grass, gray goldenrod, and bluebell. Shrubs such as alders and willows and small trees may be present in some locations. Shrubby-cinquefoil is common in areas with a high-pH substrate.

Herpetiles such as garter snake, northern water snake, black racer, pickerel frog, and leopard frog may use this habitat during the breeding season. Many raptors are likely to hunt in this community. Other birds may include swallows, brown-headed cowbirds,

chipping sparrows, and killdeer. Bats such as the little brown bat and big brown bat are likely to forage above this habitat.

Calcareous Rock Cliff

Vertical cliffs of limestone, dolomite, and marble make up the calcareous rock cliff community within the ROR study area. Vegetation in this community is scarce, being restricted to crevices in the rock and small ledges. This community is found at Bartholomew's Cobble, Massachusetts, and on the riverside cliffs at Falls Village, Connecticut, among other locations.

Vegetation is scarce, but diverse, including species such as maidenhair spleenwort, purple cliff-brake, and blunt-lobed cliff fern. Many rare plant species, such as the slender cliff-brake, may occur in this community.

Due to the inaccessibility of this community, fewer wildlife species are found here than in surrounding communities. Reptiles, such as five-lined skinks, eastern milk snakes, timber rattlesnakes, and northern copperheads, can be found on these rock ledges. All except the eastern milk snake are species of conservation concern, primarily due to the study area being near the northernmost limit of these reptiles and to historic persecution. Several bird species, such as the cliff swallow, common nighthawk, and common raven, may nest on these cliffs. Mammals likely to utilize this habitat are primarily bat species, which roost in caves, crevices, and overhanging ledges.

Northern Hardwoods–Hemlock–White Pine Forest

This upland community has a mixed canopy of hardwood and conifer trees. Species composition is highly variable and ranges from pure stands of eastern hemlock to largely hardwood forests with scattered individual hemlock trees. Common hardwood species found in this community include sugar maple, yellow birch, black cherry, and red oak. White pine is a frequent associate, but may also be absent. Shrubs and herbs, though present and sometimes diverse, usually form sparse to moderate cover. This community frequently occurs on dry-mesic slopes and is often somewhat acidic.

Two different associations of this community can be found in the ROR study area. One is located at relatively higher elevations and is dominated by sugar maple and eastern hemlock. Hobblebush, striped maple (or mountain maple), and Canada elder are common shrubs. Though herbs are variable from site to site, frequent species include Christmas fern, shining ground fir, evergreen woodfern, and partridgeberry. The second association occurs on level terraces adjacent to the Housatonic River floodplain. Sites are dry-mesic and dominated by red oak, with white pine and eastern hemlock. The conifer component is variable and may range from nearly absent to dominant in a given area. The shrub stratum is diverse and often will consist in part of eastern hemlock and American beech regeneration. Clubmosses are often abundant, as are southern running-pine and ground pine. Canada mayflower, bracken fern, Swan's sedge, and wintergreen are additional common herbs.

Wood frogs and American toads are common amphibians in this community. Eastern garter snakes are likely the most common reptile. Many species of neo-tropical migrant birds can be observed in this forest community. Common birds include hermit thrush, ovenbird, black-throated green warbler, and myrtle warbler.

Red Oak–Sugar Maple Transition Forest

This community is transitional between forests of northern and southern New England. It combines northern hardwoods (primarily maple) with central hardwoods (primarily oak) but lacks extreme examples of northern or southern species (i.e., blue-bead lily, creeping snowberry, and bunchberry are species common to north temperate and boreal forests and would not be expected to occur in this community). The mesic soils are mineral and lack redoximorphic features.

This community typically has a mature, intact canopy, dominated by red oak, white ash, and sugar maple. The larger individuals range from 75 – 95 cm in diameter and stand over 20 m in height. Maple-leaved viburnum, American hornbeam, and witch-hazel are common shrubs. The patchy herb stratum is dominated largely by fern species. New York fern, hay-scented fern, Christmas fern, white wood aster, and wild sarsaparilla are common.

This community often forms a largely continuous travel corridor along the river channel. Therefore, it is likely used by various species of birds and mammals, including larger herbivores and carnivores. Small mammals that are common to the area, such as white-footed mice and northern short-tailed shrew, are also expected to use this community.

Spruce–Fir–Northern Hardwood Forest

This community is described as a mixed conifer-hardwood forest of middle to upper elevations. It often occurs on slopes with northern aspects and other cool climate areas. The thin, often rocky and nutrient-poor soils are non-hydric, and therefore do not display redoximorphic features. Red spruce, balsam fir, and eastern hemlock are the common needle-leaved species. Sugar maple, American beech, yellow birch, white birch, heart-leaved birch, and mountain ash are some of the common broad-leaved species. Mountain ash, smooth shadbush, yellow birch, red spruce, and balsam fir, as well as other small individuals common to the tree stratum, dominate the sapling and shrub layers. Herbs are typically sparse and generally include species with northern affinity, such as blue-bead lily, Canada mayflower, ground-pine, goldthread, wild sarsaparilla, wood sorrel, and mountain wood fern. Bryophyte cover may be substantial in this community, with *Leucobryum*, *Sphagnum* (at upland/wetland edge) and *Polytrichum* as the dominant genera.

Wood frogs, American toads, and spring peepers are likely in this community. Four-toed salamanders, a species of Special Concern in Massachusetts may be found within the mossy areas, especially areas dominated by *Sphagnum* . Common birds would include golden-crowned kinglet, black-throated blue warbler, ovenbird, hermit thrush, and red-breasted nuthatch. As this community is often part of a largeer forest complex, many mammals are expected to occur in this habitat (e.g., red squirrels, eastern cottontails, coyote, fisher, bobcat, white-tailed deer).

Successional Northern Hardwoods

This is a highly variable community that characterizes relatively young forests that are regenerating from a recent disturbance (e.g., cutting, fire). Canopy closure is often less than mature forests and understory species may be sparse in dense, regenerating stands of

pole-sized trees. Species composition will depend on a number of factors such as soil texture, hydrology, and elevation. Trees that frequently occur in this community fall into two groups. Those species that are capable of long distance wind-dispersal due to their fruits having a wing or tufts of hairs (e.g., quaking aspen, white birch, red maple), or those species with extremely long-lived fruits that lie dormant in the seed bank, awaiting disturbance (e.g., black cherry, pin cherry). The shrub stratum may be comprised of both tree saplings and willows (e.g., beaked willow, pussy willow, and heart-leaved willow in wetter areas), as well as red raspberry and common blackberry, which are colonizing shrub species with long-lived fruits. Bracken fern can persist as a buried rhizome for extended periods until a canopy opening is created. Additional herbaceous plants include Canada bluegrass, common scouring-rush, early goldenrod, common St. Johnswort, Glaucous king devil, sweet-clover, yarrow, cypress-spurge, cow vetch and squarrose white aster. Many of these species are non-native and common to disturbed areas with exposed soil.

Several herpetiles can be observed traveling within the successional northern hardwoods community. Wood frog adults and juveniles (the latter during exodus) often must pass through the open, young forest to reach closed canopy forests. Painted turtles may use the sand substrate in the forest and open areas for nesting (presumably due to ease of excavation). Common birds include gray catbird, downy woodpecker, eastern towhee, and American robin.

Rich, Mesic Forest

This forest type is found where surface or subsurface high-pH bedrock is located. Most sites occur on or at the base of slopes where groundwater flows over bedrock, or down slope movement of organic matter creates a nutrient rich environment. Sites also tend to occur in concave coves or valleys and frequently have an east-facing aspect (south and west aspects are often too dry and north aspects are often dominated by conifer). State-wide, rich, mesic forests are identified by a combination of sugar maple, white ash, bitternut hickory, and basswood in the canopy with a characteristic herb flora. Spring ephemeral species are common to this community (see high-terrace floodplain forest).

Occurrences of this community are primarily found at the base of steep (i.e., greater than 25 degrees), rocky slopes. Sugar maple and white ash are the most frequently encountered trees in the rich, mesic forests of the ROR study area. Basswood is also present, with scattered eastern hemlock on some slopes. Shrubs are variable, with choke cherry and alternate-leaved dogwood being locally common. Herbaceous species can be diverse, but one or more of the following species are typically dominant at each site: plantain-leaved sedge, wide-leaved sedge, maidenhair fern, toothwort, early blue cohosh, bloodroot, round-lobed hepatica, wild ginger, Dutchman's breeches, squirrel corn, and wild leek. All of these species are spring-flowering, with the latter three mostly disappearing by mid-summer.

Rich, mesic forest is a community of state conservation concern in Massachusetts. American toads and garter snakes are common herpetiles. Birds include those that use intact hardwood forests, such as wood thrush, rose-breasted grosbeak, and blue-headed vireo. Eastern chipmunks and gray squirrels may be routinely observed. Black bears may also occur in this community.

Cultural Grassland

This habitat can be described as an open, upland community that is periodically maintained by active practices (e.g., mowing, burning). This community therefore includes pastures, airports, cemeteries, wide power line clearings, and athletic fields. Cultural grassland, as its name implies, tends to be dominated by grass-like plants, though many broad-leaved herbs are also present.

Those grasslands associated with agriculture tend to have more non-native species than grasslands associated with airports. Species composition is highly dependent on site hydrology (i.e., how wet or dry the soil is). Reed fescue, timothy, and Kentucky bluegrass are common non-native grasses found on mesic substrates. Drier sites will be vegetated with a greater proportion of poverty grass and little bluestem. Broad-leaved herbs common to cultural grasslands include tall goldenrod, common milkweed, wild carrot, common evening primrose, spreading dogbane, common flat-topped goldenrod, and spotted knapweed. The latter species can be invasive on some nutrient poor sites.

Shrubs do occur in and along the edges of cultural grasslands, particularly when disturbances are widely spaced in time. Pussy willow, beaked willow, meadowsweet, and red-osier dogwood are common species. Stag horn sumac invades some fields that are no longer actively managed.

Northern leopard frogs use mesic cultural grasslands during the summer season. American kestrels and other raptors use cultural grasslands for hunting and brood rearing. Large flocks of Canada geese are frequently seen in this community type during the fall migration, especially in fields previously used for corn or hay production. Common songbirds include bobolink, eastern kingbird, and American robin. Gray squirrels, cottontails, and American crows utilize corn and other fruits that were left behind from fall harvests during the winter season. Big brown bats are also known to feed over this habitat.

4.0 Developed Communities

Developed communities are those areas that have recent and on-going human modification. These communities, such as residential and business lots, roadways, and intensely managed fields, are substantially different from regional pristine sites. Absence of forest canopy, large areas of impervious surface, and prevalence of non-native colonizing plants serve to identify developed communities in the absence of obvious indicators such as buildings, paved roads, and recreational fields.

4.1 Agricultural Lands

Significant portions of the Housatonic River floodplain have been used for food and hay production. Those areas that are still in use are considered here. Areas no longer managed for food production, though potentially mowed on an annual basis, are described as wet meadow or cultural grassland, depending on site hydrology. Corn is a major crop plant in the Housatonic River valley, along with pumpkin and squash. This community generally resembles a monoculture of the target food species, with non-native species occupying the edge of the tilled ground. Horse-nettle, oak-leaved goosefoot, pigweed, and alfalfa are commonly seen near agricultural fields and rarely elsewhere in

the study area. Use of agricultural fields has affected the condition of remaining natural communities. Non-native species that become established in agricultural fields are able to colonize disturbed areas in adjacent natural communities. Pumpkins, for example, can be observed growing on riverine point bar and beaches. Animals can be directed away from natural communities during certain seasons based on the availability of refuse crops. American crows, gray squirrels, and Canada geese, in particular, utilize agricultural fields during fall and winter rather than exclusively natural communities.

4.2 Residential, Commercial, and Public Development

This community is characterized by homes, lawns, buildings, and paved lots. Its influences on the natural communities of the Housatonic River are apparent. Many species of ornamental shrubs have escaped and now occur as a non-native presence in the riparian forests. These plants include European spindle-tree, Chinese spindle-tree, Morrow's honeysuckle, goutweed, and common privet. Clearing of floodplain forests, channelization of the river, and the filling of former oxbow ponds are additional impacts of public development on local natural communities. Accumulation of trash and discarded debris is also apparent in some areas of the Housatonic River.

4.3 Transportation

Transportation in the ROR study area largely consists of roads, both paved and gravel, and rail lines. Both of these communities form bisecting paths through riparian and upland communities. Maintenance of these passages disturbs soil and provides colonization sites for non-native species. Morrow's Honeysuckle, for example, is most common, and sometimes dominant, within 100 m of the main roads. Beyond this distance, the species becomes scarce or absent. The rail line system has a characteristic flora that grows on the xeric, crushed stone substrate. Spotted knapweed, thyme, purple lovegrass, common mullein, and tower-mustard are species commonly observed along railroad systems that are not seen in undisturbed communities.

4.4 Recreational Facilities

Several types of outdoor enthusiasts utilize the Housatonic River and the associated riparian communities. Paddlers are frequent on sections of the river, and boat launches have been constructed, in part, for this purpose. Hunters and anglers also use these boat launches, as well as informal landings, to access waterfowl and fish resources. Several trails and the rail line are used by people for walking and bird watching.

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Chapter 2 Macroinvertebrates

1.0 Introduction

The macroinvertebrate community within the ROR study area includes a large number of taxa with immense diversity. This report is not intended to address every species that could potentially occur in the study area. Rather it is intended to give an overview of the major invertebrate families occurring there, provide information regarding common species, and address rare, threatened, and endangered species that are known or suspected to occur. Aquatic macroinvertebrates are the primary focus, including common groups such as mussels, crayfish, dragonflies and damselflies, and benthic insects.

2.0 Methods

2.1 Species:Habitat Association

The principle goal of the invertebrate community characterization was to identify species that could reasonably be expected to occur in the ROR study area, the habitats they would use, and when they would use them. The foundation for this work included a review of relevant literature on the populations in western Massachusetts and Connecticut.

2.2 Literature Review

As part of this effort, local and regional experts were consulted to obtain unpublished records regarding the historic occurrence of some species in the area. For example, the Massachusetts Natural Heritage and Endangered Species Program (MNHESP), the Massachusetts Division of Fisheries and Wildlife (MDFW), the CDEP, and the U.S. Fish and Wildlife Service (USFWS) were contacted to identify any records of historic occurrences. Historical reports from studies conducted along the Housatonic River were also reviewed. Information received from these agencies, organizations, and individuals was then incorporated into this report.

Local and regional references were first used to identify the species whose range encompassed the study area. General and technical references on the habitat

requirements and use, seasonality of occurrence, and relative abundance in the region were then used to refine the list and to include only those species whose preferred habitats are within the study area. In addition, regional guides on the distribution and ecology of freshwater mussels (Clarke 1981, Fichtel and Smith 1995, Smith 1995, Strayer and Jirka 1997, Nedeau *et al.* 2000) and various scientific journals were reviewed to identify the ecology, habitat requirements, and natural history of mussel species occurring in the study area.

3.0 Aquatic Macroinvertebrates

3.1 Mussels

Historical records indicate that the Housatonic River drainage once had a relatively diverse assemblage of 12 freshwater mussel species (Table 2-1). Five of those species have not been found in Connecticut since their original documented reports by Linsley and Jacot in the mid-1800s and early 1900s (Smith 1999). Seven of the twelve species were only known from the lower part of the drainage in Connecticut and New York.

Table 2-1 Freshwater mussels of the Housatonic River drainage.

Scientific Name	Common Name	MA State Status	CT State Status	Federal Status	Notes**
Alasmidonta heterodon	Dwarf wedgemussel	E	E	E	Known only from 1840s records from CT.
Alasmidonta undulata	Triangle floater	SC			Populations known from MA and CT.
Alasmidonta varicosa	Brook floater	E	E		Known only from 1920s records from CT.
Anodonta implicata	Alewife floater				Known only from 1840s records from CT.
Elliptio complanata	Eastern elliptio				Populations known from MA and CT.
Lampsilis cariosa	Yellow lampmussel	E	SC		Known only from 1840s records from CT. Believed to be extirpated in CT.
Lampsilis radiata	Eastern lampmussel				Extant populations in drainage in CT and NY.
Leptodea ochracea	Tidewater mucket	SC	T		Known only from 1840s records from CT.
Ligumia nasuta	Eastern pondmussel	SC	SC		Extant populations in the drainage in NY.
Margaritifera margaritifera	Eastern pearlshell		SC		A population in Stockbridge, MA, was reported in 1998 but was not verified during field investigations.
Pyganodon cataracta	Eastern floater				Populations known from MA and CT
Strophitus undulatus	Creeper	SC			Populations known from MA and CT.
Sources: Strayer and Jirka 1997, Smith 1995 E = Endangered, T= Threatened, SC = Special Concern					

Mussel surveys conducted in 1998 in southern Berkshire County, Massachusetts, near Stockbridge and Great Barrington recorded eastern elliptio, eastern floater, creeper, and the triangle floater. These sites consisted of packed gravel and sand habitat with occasional gravel and cobble riffles. Of the four species found near Great Barrington, triangle floater shells were the most abundant (15 shells), followed by the creeper (8), eastern floater (2), and eastern elliptio (1). At Konkapot Brook in Stockbridge, more than 50 live eastern elliptios were recorded. Konkapot Brook is a small tributary to the Housatonic River in Stockbridge that averages 1 – 1.5 m wide and 15 – 40 cm deep. The live elliptios was found approximately 450 m from the confluence of the river and Konkapot Brook, and relic shells were found in the brook within 45 m of the confluence (Woodlot Alternatives, Inc. 2002). Surveys conducted from West Cornwall to New Milford, Connecticut, during 1997 and 1998 recorded five mussel species. The most abundant mussel recorded from this stretch of the Housatonic was the eastern lampmussel (118) followed by eastern elliptio (10), triangle floater (3), creeper (3), and eastern floater (3) (NUSCO 1998).

The eastern floater is a common mussel in the northeast, occurring mostly in soft silt and muck substrates and firmer silt loam banks with occasional rocks and gravel deposits. It prefers slow moving water and is one of the few species commonly found in the deeper water of lakes, ponds, and impoundments. Host fish for the eastern floater include common carp, white sucker, threespine stickleback, bluegill sunfish, and pumpkinseed sunfish (Clarke 1981, Martin 1997, Nedeau *et al.* 2000). All but the stickleback are known to occur within the Housatonic River.

The eastern lampmussel is a common species in the southern Housatonic River drainage. This mussel occupies a variety of habitats from small streams to large rivers, ponds, lakes, and impoundments. It prefers sand and gravel but can be found on a variety of substrates. Known host fish for this species include the yellow perch, largemouth bass, smallmouth bass, black crappie, and pumpkinseed sunfish (Martin 1997, Strayer and Jirka 1997, Nedeau *et al.* 2000). All of these species are known to occur in the ROR study area.

The eastern elliptio is also a common species in the Housatonic River. This mussel is one of the few species in North America whose populations are currently stable or increasing, likely due to its broad habitat requirements. The eastern elliptio can be found in almost every aquatic habitat except deep soft silt bottoms, deeper portions of lakes, and rocky bottoms of high-gradient mountain streams. The eastern elliptio has a high tolerance for pollution and disturbance, allowing it to inhibit sites unsuitable for many other mussel species. Known host fish for the eastern elliptio include yellow perch, largemouth bass, banded killifish, and several species of sunfish (Clarke 1981, Martin 1997, Strayer and Jirka 1997, Nedeau *et al.* 2000), all of which have been currently or historically documented in the Housatonic River,

The triangle floater (also known as the heavy-toothed wedgemussel) is another common mussel found in the southern portion of the ROR study area; however, it is listed as a species of Special Concern in Massachusetts (MNHESP 1999). This mussel occurs in a variety of substrates and aquatic settings, but is most often found in sand and gravel in moderate currents. Known host fish for this species include the common shiner, longnose and blacknose dace, white sucker, pumpkinseed sunfish, fallfish, largemouth bass, and slimy sculpin (Martin 1997, Strayer and Jirka 1997, Nedeau *et al.* 2000). All of these have been recently or historically documented to occur in the ROR study area.

The creeper (formerly known as the squawfoot) is another species of Special Concern in Massachusetts (MNHESP 1999). This mussel is typically found in sand and fine gravel substrates in streams and rivers, but occasionally in lakes. It can tolerate a range of flow conditions but is rarely found in high-gradient streams. Its known host fish include the creek chub, largemouth bass, yellow perch, fallfish, spotfin shiner, golden shiner, common shiner, plains killifish, fathead minnow, longnose dace, bluegill, green sunfish, walleye, slimy sculpin, and the black and yellow bullhead (Clarke 1981, Strayer and Jirka 1997, Nedeau *et al.* 2000). However, it is believed that the creeper is one of the few species of freshwater mussel that has a free-living larval stage that is not dependant on a host fish (Strayer and Jirka 1997).

A population of eastern pearlshells was reported at Konkapot Brook in 1998, the first confirmed record of this species within the Housatonic River drainage in Massachusetts

(pers. comm., D. Smith of University of Massachusetts, Amherst, to R. Roy of Woodlot, August 1998). This is a species is of Special Concern in Connecticut (CDEP 1998). The eastern pearlshell is found in streams and small rivers that are cool enough to support salmonids (trout and salmon), which are the host species for this mussel. The eastern pearlshell is typically found on firm sand, gravel, and cobble substrates, and is one of the few species in the northeast that is able to inhabit high-gradient mountain streams (Clarke 1981, Strayer and Jirka 1997).

Many natural factors can limit the occurrence and distribution of freshwater mussels. Rivers of the North Atlantic Slope (i.e., Housatonic River to Atlantic Canada) have low mussel diversity compared to those of southern Atlantic and interior (Mississippian) watersheds, due to limited refugia during the last glaciation (Smith 1982, Strayer 1990, Strayer and Jirka 1997). The Taconic Mountains and the southern Green Mountains form the divide between the species-depauperate northeastern watersheds and the species-rich Mississippian and South Atlantic Slope watersheds, the latter of which includes the nearby Hudson River drainage (Smith 1982).

Mussel diversity also tends to decrease in low order (i.e., upstream) portions of a watershed (Strayer 1983, Mackie and Topping 1988), and rivers that are hydrologically unstable (i.e., prone to frequent flooding) typically have fewer species than river systems that are more stable (Strayer 1993, Di Maio and Corkum 1995). This helps explain some of the present distribution of mussels in the Housatonic River drainage. For example, rich species assemblages in the Housatonic River drainage were historically known only from high order (downstream) portions of the watershed, while portions of the drainage further upstream had lower diversity (Smith 1999).

A number of natural predators of are known to feed on freshwater mussels, including muskrats, raccoons, river otters, and birds (Strayer and Jirka 1997). Among these, muskrat predation can have the greatest effect on local mussel populations (Neves and Odom 1989). While any of these natural factors could have affected the freshwater mussel community in the ROR study area, human-induced impacts have also occurred. River channelization and realignment is common in urban areas and has the potential to destroy individual mussels and create unsuitable habitats such as well armored banks of

boulders, rubble, and other hard materials. Floodplain clearing and conversion to agricultural lands can increase erosion and sedimentation into a river because of less stable banks, and the decrease in bank shading tends to increase water temperature (Strayer and Jirka 1997). In addition, dams can flood riffle habitats, accumulate soft sediments, impede the movement of suitable host fish, and scour suitable habitats below the dam (Strayer 1993, Martin 1997). All of these types of disturbances can be detrimental to mussel populations and have occurred in the study area.

Associated with past land uses and urban development is decreased water quality resulting from biological and chemical pollutants. Freshwater mussels are filter feeders and have the ability to filter large amounts of water. Strayer *et al.* (1994) found that some freshwater mussel beds can filter anywhere from 0.1 – 2.0 cubic meters of water per square meter of substrate per day. Uptake of biological or chemical pollutants in the water, such as agricultural herbicides and pesticides, sewage and wastewater treatment effluent, and industrial pollution, can occur during the course of normal feeding and can significantly affect mussel populations (Metcalfe and Charlton 1990, Goodreau *et al.* 1993).

It is likely that many of these environmental and anthropogenic factors identified above have helped shape the current freshwater mussel community within the Housatonic River watershed.

3.2 Dragonflies and Damselflies

There are currently 164 Odonate species recorded in Massachusetts, including 115 species of dragonflies and 49 species of damselflies. In Berkshire County, 97 of these species occur, including 70 species of dragonflies and 27 species of damselflies (Leahy *et al.* 2000). An estimated 147 Odonate species occur in Connecticut; 99 dragonflies and 48 damselflies. Litchfield County has the most diverse Odonate community in the state with 109 species. New Haven and Fairfield Counties are also diverse, with 101 and 89 species respectively. Twelve species are listed as species of conservation concern, with as much as 31.9% of Connecticut's Odonate fauna being uncommon to rare (Wagner and Thomas 1999).

Connecticut's northwest highland encompasses Litchfield County and northern Fairfield and New Haven Counties. This region contains some of Connecticut's finest examples of sphagnum bogs, fens, and calcareous wetlands. These habitats are critical to many of the State's rare Odonate fauna, including the tiger spiketail, ski-tailed emerald, and crimson-winged whiteface. Several northern species, such as the taiga bluet, variable darner, and beaverpond clubtail, reach the southern limit of their range here among the coldwater streams and wetlands.

Opportunistic collection of exuvia and adult dragonflies from Threemile Pond near Great Barrington, Massachusetts, documented 12 dragonfly species and 4 damselfly species (Table 2-2). Due to taxonomic uncertainty within the scientific community concerning the status of the meadowhawks, specimens collected during that study were grouped at the genus level. This grouping represents a potential of three separate meadowhawk species.

Table 2-2 Dragonflies and damselflies from Threemile Pond.

Common Name	Scientific Name
familiar bluet	*Enallagma civile*
skimming bluet	*Enallagma geminatum*
eastern forktail	*Ischnura verticalis*
common green darner	*Anax junius*
halloween pennant	*Celithemis eponina*
delta-spotted spiketail	*Cordulegaster diastatops*
racket-tailed emerald	*Dorocordulia libera*
chalk-fronted skimmer	*Libellula julia*
widow skimmer	*Libellula luctuosa*
common whitetail	*Libellula lydia*
twelve-spotted skimmer	*Libellula pulchella*
eastern amberwing	*Perithemis tenera*
Williamson's emerald	*Somatochlora williamsoni*
arrow clubtail	*Stylurus spiniceps*
cherry-faced meadowhawk[1] ruby meadowhawk Jane's meadowhawk	*Sympetrum internum* *Sympetrum rubincundulum* *Sympetrum janae*
yellow-legged meadowhawk	*Sympetrum vicinum*

[1] Due to taxonomic uncertainty within the scientific community concerning the status of the meadowhawks, specimens collected during this study were grouped at the genus level.

Habitat loss and alteration through development, damming, and pollution pose the major threats to the Odonate populations in the ROR study area. As much as 74 percent of Connecticut's wetlands have been drained and filled, ranking Connecticut among the most impacted states in regard to wetlands (Wagner and Thomas 1999). Damming streams and rivers reduces the amount of riffle and pool habitats that are utilized by rare stream species, and often results in their being replaced by common pond species. Dense shoreline vegetation is a critical habitat requirement for many dragonfly species, and reservoirs with fluctuating water levels prevent aquatic plants from establishing along the shorelines. Erosion, siltation, eutrophication, contamination, and other causes of habitat and water quality degradation also threatens the Odonate community. Many Odonate species have low survival rates in the presence of fish. The introduction of insectivorous fish to ponds, small lakes, and creeks where they were historically absent may reduce local Odonate populations by 80 – 90 percent (Dunkle 2000). Heavy boat traffic and recreational use of lakes and sandy riverine shorelines pose a threat, as emerging adults may be swamped by boat waves or trampled (Wagner and Thomas 1999).

3.3 Benthic Macroinvertebrates

Many benthic macroinvertebrates, which are an important component of the aquatic ecosystem, may occur in the ROR study area. These macroinvertebrates play a vital roll as decomposers of detrital organic matter. They provide a food source for many fish, herpetile, and avian species, and play an important role in the food chain as intermediates between microscopic plankton and larger carnivores. Table 2-3 shows the benthic macroinvertebrate families that may occur within the Housatonic River and the habitats in which they could occur. Due to the large number of species potentially occurring, detailed discussions of each species or species group are not provided.

Table 2-3 Benthic macroinvertebrates potentially occurring in the Housatonic River and associated pools.

Phylum	Class	Order (suborder)	Family	Common name	Habitat
Cnidaria	Hydrozoa	Hydrodia	Hydridae	Hydras	Variety of aquatic habitats, attached to vegetation,substrate
Platyhelminthes	Tubellarian	Macroturbellarians (Tricladida)	Planariidae	Flatworm	Nearly every aquatic habitat, associated with substrate
Nematoda				Roundworm	Variety of habitats
Mollusca	Gastropoda	Basomnatophora	Ancylidae	Snail	River, lakes, ponds
			Lymnaeidae	Pond snail	River, lakes, ponds
			Hydrobiidae	Little pond snail	River, lakes, ponds
			Physidae	Pouch snail	River, lakes, ponds
			Planorbidae	Orb snail	River, lakes, ponds
		Mesogastropoda	Valvatidae	Snail	River, lakes, ponds
	Bivalvia		Sphaeriidae	Mussel	Variety of aquatic habitats, substrates
Annelida	Oligochaeta	Lumbriculida	Lumbriculidae	Aquatic earthworm	Soft mud, muck substrates
		Tubificida	Naididae	Sludge worm	Soft mud, muck substrates
			Tubificidae	Tube worm	Soft mud, muck substrates
	Hirudinea	Arhynchobdellida	Haemopidae	Leech	Lakes, ponds, rivers
			Erpobdellidae	Leech	Lakes, ponds, rivers
		Rhynchobdellida	Glossiphoniidae	Leech	Lakes, ponds, rivers
			Piscicolidae	Leech	Lakes, ponds, rivers
	Arachnida	Acari	Hydrachnidae	Water mites	Still habitat containing aquatic vegetation

Phylum	Class	Order (suborder)	Family	Common name	Habitat
			Hydryphantidae	Water mites	Variety of aquatic habitats
			Pionidae	Water mites	Temperary pools, ponds
			Sperchonidae	Water mites	Variety of aquatic habitats
		Oribatei	Eremaeidae	Mites	Variety of habitats
	Collembola	Sminthuridae	Bourletiella	Springtails	Variety of aquatic habitats
Arthropoda	Insecta (Pterygota)	Coleoptera	Ciculionidae	Tiger beetles	Open sandy beaches, mudflats
			Dryopidae	Long-toed water beetles	Semi-aquatic, found on vegetation in well-aerated streams
			Dytiscidae	Predaceous diving beetle	Small, shallow bodies of water
			Elmidae	Riffle beetle	Found on aquatic vegetation and debris in streams.
			Gyrinidae	Whirligig beetle	Streams, rivers, ponds, lakes near shore
			Haliplidae	Crawling water beetle	Streams, ponds, lakes in running and still water, especially on vegetation
			Hydrophilidae	Water scavenger beetle	Quiet pools, lakes, streams with abundant vegetation
			Noteridae	Burrowing water beetle	Weedy ponds and lakes
			Ptilodactylidae	Ptilodactylid beetle	On shoreline vegetation of wooded streams, ponds, lakes, swamps
			Psephenidae	Water-penny beetle	On stones in clear streams with gravel and cobble bottoms
			Scirtidae	Marsh beetle	Marshy areas
		Diptera	Athericidiae		
			Ceratopogonidae	Biting midges	Streams, ponds, pools, may live as parisites on body of other insects
			Chaoboridae	Phantom midge	Streams, ponds, pools

Phylum	Class	Order (suborder)	Family	Common name	Habitat
			Chironomidae	Midge	Streams, ponds, pools
			Culicidae	Mosquito	Ponds, pools, containers of water
			Dxidae	Dixid midgess	Surface of pools and ponds
			Dolichopodidae	Long-legged flies	Marshy areas, wet meadows
			Empididae	Dance flies	Larvae found in water, damp soil, decaying vegetation
			Muscidae	Muscid flies	Larvae occur in decaying vegetation
			Psychopodidae	Moth flies	Adults near water, drains, and sewers; larvae on decaying vegetation and moist soil
			Simuliidae	Black flies	Swift, cool streams
			Stratiomyidae	Soldier flies	Larvae occur in pools, swamps
			Tabanidae	Deer flies	Larvae occur in pools, swamps
			Tanyderidae	Primitive crane fly	Adults in dense streamside vegetation, larvae in wet sandy stream shores
			Tipulidae	Crane fly	Streams, ponds, lakes with abundant vegetation
		Ephemeroptera	Baetidae	Small mayflies	Riffles and rapids of fast-flowing streams, occasionally lakeshores, quiet water
			Baetiscidae	Mayflies	
			Caenidae	Mayflies	Among vegetation of slow-moving streams, lakes, ponds
			Ephemeridae	Burrowing mayflies	Burrowing in substrates of lakes and rivers
			Ephemerellidae	Mayflies	Clings to vegetation, rocks of streams and rivers
			Heptageniidae	Stream mayflies	Clings to undersides of stones, debris in fast-flowing streams
			Leptophlebiidae	Mayflies	Variety of fast and slow-moving water

Phylum	Class	Order (suborder)	Family	Common name	Habitat
			Oligoneuriidae	Mayflies	Variety of fast and slow-moving water
			Potamanthidae	Mayflies	Variety of fast and slow-moving water
			Siphlonuridae	Mayflies	Quiet waters of rivers, lakes, ponds
			Tricorythidae	Mayflies	Silted areas of streams and rivers
		Hemiptera	Belostomatidae	Water bugs	Ponds and pools
			Corixidae	Water boatman	Ponds and pools
			Gerridae	Water stridder	Slow-moving streams and ponds
			Notonectidae	Backswimmers	Ponds and pools
			Ochteridae	Velvety shore bugs	Shores of ponds and slow-moving streams
			Pleidae	Pygmy backswimmer	Ponds and pools
			Saldidae	Shore bugs	Grassy shorelines
			Veliidae	Ripple bugs	Riffles of streams
		Lepidoptera	Pyralidae	Pyralid moths	Some larvae aquatic
		Megaloptera	Corydalidae	Fishfly	Streams, generally under stones
			Sialidae	Alderfly	Ponds and streams
		Neuroptera	Sisyridae	Spongilla flies	Lakes, ponds, slow-moving streams
		Odonata (Anisoptera)	Aeshnidae	Darner	Bogs, swamps, ponds, lakes, streams, rivers
			Cordulegastridae	Spiketails	Seepages, springs, forest streams
			Corduliidae	Emeralds	Bogs, fens, boggy edges of lakes and ponds
			Corduliidae	Baskettails	Lakes, ponds, slow-moving streams

Phylum	Class	Order (suborder)	Family	Common name	Habitat
			Gomphidae	Clubtail	Flowing water
			Libellulidae	Skimmers and Meadowhawks	Permanent marshes, ponds, lakes, slow-moving streams and rivers
			Macromiidae	Cruisers	Sandy bottom, slow-moving streams, rivers, and lakes
		Odonata (Zygoptera)	Calopterygidae	Jewelwings	Quiet streams and rivers
			Coenagrionidae	Dancers and Bluets	Lakes, ponds, streams, rivers
			Lestidae	Spreadwing Damselfly	Bogs, swamps, lakes, ponds, slow-moving rivers
		Plecoptera	Capniidae	Small winter stoneflies	Small streams
			Chloroperlidae	Green stoneflies	Small streams
			Leactridae	Rolled-winged stoneflies	Small streams in mountainous areas
			Nemouridae	Spring stoneflies	Small streams with sandy bottoms
			Peltoperlidae	Roachlike stoneflies	Streams
			Perilidae	Common stoneflies	Surface of still water
			Perlodidae	Perodid stoneflies	Medium to large-sized streams
			Pteronarcidae	Giant stoneflies	Medium to large rivers in aquatic vegetation
		Trichoptera	Brachycentridae	Brachycentrids	Streams, commonly beneath stones
			Glossosomatidae		
			Helicopsychidae	Snail-case caddisflies	Clear, cool, slow-moving streams with sandy bottoms
			Hydropsychidae	Net-spinning caddisflies	Streams
			Hydroptilidae	Micro-caddisflies	Ponds and streams
			Lepidostomatidae	Lepidostomatids	Streams and springs

Phylum	Class	Order (suborder)	Family	Common name	Habitat
			Limnephilidae	Northern caddisflies	Ponds, low-gradient streams
			Molannidae	Molannids	Variety of aquatic habitats
			Odonoceridae	Odontocerids	Riffles of streams
			Philopotamidae	Finger-net caddisflies	High-gradient streams
			Phryganeidae	Large caddisflies	Marshes and ponds
			Psychomiidae	Tube-making caddisflies	Variety of running water habitats
			Rhyacophilidae	Primitive caddisflies	High-gradient streams
			Seriocostomatidae	Seriocostomatids	Sandy lakes and streams
Arthropoda (Crustacean)	Branchipoda	Anostraca	Chirocephalidae	Fairy shrimp	Vernal pools
		Cladocera		Water flea	Variety of aquatic habitats
		Conchostraca		Clam shrimp	Variety of aquatic habitats
	Malacostraca (Peracarida)	Amphipoda	Crangonyctidae	Scuds	Nearly every aquatic habitat
			Hyalellidae	Aquatic sow bug	Variety of aquatic habitats
		Isopoda	Asellidae	Isopod	Nearly every aquatic habitat
	Malacostraca (Eucarida)	Decopoda	Cambaridae	Crayfish	Rivers, streams, lakes, ponds
	Copepoda			Copepod	Variety of habitats, associated with plankton, littoral, and benthic
	Ostracoda			Seed shrimp	Nearly every aquatic habitat

4.0 Rare, Threatened, and Endangered Macroinvertebrates

Numerous rare, threatened, and endangered invertebrate species could potentially occur in the ROR study area. Table 2-4 lists these species, their state and federal status, and the habitats in which they occur. Surveys targeting mussels and dragonflies were conducted in sections of the ROR study area and further information regarding these species is given below.

Mussels

Seven species of freshwater mussels historically known from the Housatonic River drainage are currently species of conservation concern in Massachusetts and six are of concern in Connecticut. However, five of these species—the dwarf wedgemussel, brook floater, yellow lampmussel, tidewater mucket, and alewife floater—have not been seen in Connecticut since they were first documented in the mid-1800s and early 1900s. Several populations of the brook floater, an Endangered species in both states, are known from Massachusetts but most populations are quite small. In Massachusetts, the yellow lampmussel and dwarf wedgemussel were both historically known to occur in the Connecticut River but are currently believed to be extirpated, as the last live individuals were recorded in 1976 and 1983, respectively (MNHESP 1991a, 1991b). The eastern pond mussel, a species of Special Concern in both Massachusetts and Connecticut, has not been documented from the Housatonic River drainage in either state but populations are known from the drainage in southeastern New York. The remaining two species, the triangle floater and creeper, have recently been documented in the ROR study area.

Many relic shells of the triangle floater, a species of Special Concern in Massachusetts, were found from the Housatonic River in Great Barrington, Massachusetts, near the confluence of the Green River. The triangle floater is found in most Atlantic Coast drainages from North Carolina to Nova Scotia, west to the tributaries of the lower St. Lawrence River. It occurs in every New England state and is listed as Special Concern in Maine (Nedeau *et al.* 2000). The triangle floater has relatively broad habitat requirements and can occur in slow to fast rivers, in lakes, and on substrates ranging from

fine shifting sands to mixed aggregates of boulders, cobble, and gravel (Clarke 1981, Fichtel and Smith 1995, Strayer and Jirka 1997). In Great Barrington, Massachusetts, the substrate was mostly packed gravel. Relic shells were only found in shallow water (i.e., less than 50 cm deep). No live animals were observed, as most areas were too deep to survey with viewing buckets. Triangle floaters were also found at several locations in Connecticut; upstream of the Boardman Road Bridge in New Milford, near the Old Kent Bridge in Kent, and near the Cornwall Covered Bridge in West Cornwall (NUSCO 1998).

Eight creeper shells were found near the mouth of the Green River in Great Barrington, Massachusetts. The creeper is the most widely distributed species in the United States, occurring throughout the Mississippi, Great Lakes, and St. Lawrence drainages and all major Atlantic Coast drainages. It occurs in every New England state and is listed as Special Concern in Massachusetts (MNHESP 1999). The creeper typically occurs in streams and rivers but occasionally in lakes, and occurs in variable substrates, although it is usually most common in aggregates of gravel and sand (Clarke 1981, Fichtel and Smith 1995, Strayer and Jirka 1997). Where it was found in Great Barrington, Massachusetts, the substrate was mostly packed gravel with moderate flows. In Connecticut, this species was found near the Old Kent Bridge on Rt. 341 in Kent and near the Cornwall Covered Bridge in West Cornwall (NUSCO 1998).

Dragonflies

Fifteen rare, threatened, and endangered species of dragonflies and damselflies occur in Connecticut. However many of these species are coastal plain species that would not be expected to occur on the Housatonic River or have populations known only from the Connecticut River. Five species, the superb jewelwing, tiger spiketail, slender emerald, crimson-ringed whiteface, and golden-winged skimmer, may occur on the Housatonic River (Wagner 1999). Ten state-listed Odonate species have been recorded from Berkshire County, including two Endangered, two Threatened species, and six Special Concern species. The Special Concern species are the tule bluet, skillet clubtail, brook snaketail, ringed emerald, slender emerald, and beaverpond clubtail. Threatened species are the riffle snaketail and the arrow clubtail. Endangered species are the harpoon clubtail

and the zebra clubtail (MNHESP 1999). A list of rare, threatened and endangered Odonate species potentially occurring in the study area, their habitat, and flight dates, are provided in Table 2-4.

Table 2-4 Rare, threatened, and endangered macroinvertebrates.

Species	*Scientific Name*	CT State Status	MA State Status	Federal Status	Recently Observed from Housatonic	Habitat
Virginia River snail	*Elimia virginica*	E			No	Cobble, gravel, stony shallows of large rivers
Lymnaeid snail	*Fossaria rustica*	SC			No	Slow-moving streams, lakes, ponds, mudflats
Aquatic snail	*Gyraulus circumstriatus*	SC			No	Lakes, ponds, slow-moving rivers
Slenderwalker snail	*Pomatiopsis lapidaria*	SC	E		No	Riverbanks
Pilsbry's spire snail	*Pyrgulopsis lustrica*		E		No	Shallow edges of lakes, ponds, rivers
Lymnaeid snail	*Stagnicola catascopium*	SC			No	Lakes, ponds, rivers
Boreal turret snail	*Valvata sincera*		E		No	Deep lakes, among rooted aquatic vegetation
Turret snail	*Valvata tricarinata*	SC			No	Slow rivers, lakes, ponds, marshes
Dwarf wedge mussel	*Alasmidonta heterodon*		E	E	No	Known only from 1840s records from CT
Triangle floater	*Alasmidonta undulata*				Yes	Lakes and rivers with substrates ranging from fine sands to cobble and gravel
Brook floater	*Alasmidonta varicosa*		E		No	Known only from 1920s records from CT
Yellow lampmussel	*Lampsilis cariosa*		E		No	Known only from 1840s records from CT
Tidewater mucket	*Leptodea ochracea*		SC		No	Known only from 1840s records from CT
Eastern pond mussel	*Ligumia nasuta*		SC		No	Extant populations in the drainage in NY
Creeper	*Strophitus undulatus*		SC	No	Yes	Streams and rivers on variable substrate
Appalachian brook crayfish	*Cambarus bartonii*		SC		No	Upland and mountain streams in northwestern MA
Northern spring amphipod	*Gammarus pseudolimnaeus*		SC	No		Alkaline spring streams, among moss and vegetation roots
Piedmont groundwater amphipod	*Stygobromus tenuis*	SC	SC		No	Caves, springs, underground water sources
Tule bluet	*Enallagma carunculatum*		SC			Lakes and rivers, preferring oligotrophic lakes with modest shoreline vegetation

Species	*Scientific Name*	CT State Status	MA State Status	Federal Status	Recently Observed from Housatonic	Habitat
Skillet clubtail	*Gomphus (Gomphurus) ventricosus*		SC			Turbid rivers with mud bottom
Beaverpond clubtail	*Gomphus (Gomphus) borealis*		SC		No	Mud-bottom ponds, lakes, slow streams
Harpoon clubtail	*Gomphus (Gomphus) descriptus*		E		No	Clear, rapid streams and rivers with sand and silt bottoms
Brook snaketail	*Ophiogomphus aspersus*		SC		No	Cold, clean brooks and streams with sandy bottoms
Riffle snaketail	*Ophiogomphus carolus*		T		Yes	Clear, rapid streams with sandy and rocky bottoms
Zebra clubtail	*Stylurus scudderi*		E		Yes	Sunny stretches of streams and rivers with riffles and sandy bottoms
Arrow clubtail	*Stylurus spiniceps*	SC	T	No	Yes	Large rivers with sandy bottoms, rarely streams or lakes
Lake emerald/ ringed emerald	*Somatochlora cingulata*		SC		No	Lakes and large rivers
Slender emerald	*Somatochlora elongata*					Slow- to moderate-flowing rivers, marshy ponds, and lake inlets or outlets
Mayfly	*Anthopotamus verticis*	SC			No	Silt and sand substrate of fast-flowing streams
Mayfly	*Baetisca laurentina*	SC			No	Stream and rivers with sand, gravel, and cobble
Mayfly	*Cinygmula subaequalis*	SC			No	Erosional streams
Mayfly	*Leptophlebia bradleyi*	SC			No	Streams and rivers with sediment and detrital substrate
Mayfly	*Paraleptophlebia assimilis*	SC			No	Streams and rivers with sediment and detrital substrate
Mosquito	*Toxorhynchites rutilus*	SC			No	Standing water in rock holes and artificial containers
Tabanid fly	*Atylotus ohioensis*	SC			No	Littoral sediments
Horse fly	*Goniops chrysocoma*	SC			No	Ponds, swamps, marshes
Horse fly	*Hybomitra frosti*	T			No	Ponds, swamps, marshes
Horse fly	*Hybomitra longiglossa*	E			No	Ponds, swamps, marshes
Horse fly	*Hybomitra lurida*	SC			No	Ponds, swamps, marshes

Species	*Scientific Name*	CT State Status	MA State Status	Federal Status	Recently Observed from Housatonic	Habitat
Horse fly	*Hybomitra trepida*	SC			No	Ponds, swamps, marshes
Horse fly	*Hybomitra typhus*	SC			No	Ponds, swamps, marshes
Tabanid fly	*Merycomia whitneyi*	SC			No	lentic- littoral lotic - deposital
Soldier fly	*Sargus fasciatus*	SC			No	Emergent vegetation of lakes, ponds
Tabanid fly	*Stonemyia isabellina*	SC			No	Ponds, swamps, marshes
Horse fly	*Tabanus fulvicallus*	SC			No	Ponds, swamps, marshes
Spongillafly	*Sisyra fuscata*	SC			No	Freshwater sponges
Ground Beetle	*Agonum mutatum*	SC			No	Woodlands
Ground beetle	*Amara chalcea*	SC			No	Fields
Ground beetle	*Badister transversus*	SC			No	Marshes
Ground beetle	*Bembidion pseudocautum*	SC			No	Sandy, muddy riverbanks
Ground beetle	*Bembidion quadratulum*	SC			No	Sandy, muddy riverbanks
Ground beetle	*Bembidion semicinctum*	SC			No	Sandy, muddy riverbanks
Twelve-spotted tiger beetle	*Cicindela duodecimguttata*		SC		No	Pond and stream banks of mud, sand, and fine gravel
Big sand tiger beetle	*Cicindela formosa generosa*	T			No	Dry upland sand
Hairy-necked tiger beetle	*Cicindela hirticollis*	SC			No	Sandy beaches near large bodies of water
Tiger beetle	*Cicindela marginata*	SC			No	
Puritan tiger beetle	*Cicindela puritana*	E	E	T	No	Sandy deposits along large rivers, known only from CT River
Purple tiger beetle	*Cicindela purpurea*		SC		No	Bare clay soils in upland fields
Oblique-lines tiger beetle	*Cicindela tranquebarica*	SC			No	Various clay and sandy soils, sand pits, sand dunes
Elderberry long-horned beetle	*Desmocerus palliatus*		SC		No	Elderberry bushes
Ground beetle	*Loxandrus velocipes*	SC			No	

Species	*Scientific Name*	CT State Status	MA State Status	Federal Status	Recently Observed from Housatonic	Habitat
Ground beetle	*Tetragonoderus fasciatus*	SC			No	
Roadside skipper	*Amblyscirtes vialis*	SC			No	Open areas in or near woods
Northern metalmark	*Calephelis borealis*	E			No	Small stream valleys amid shale, limestone, serpentine barrens
Appalachian blue	*Celastrina neglectamajor*	SC			No	Rich deciduous woods
Early hairstreak	*Erora laeta*		T		No	Deciduous or mixed woods, often in openings
Columbine duskywing	*Erynnis lucilius*	SC			No	Riverines or gullies in rich deciduous or mixed woods
Persius duskywing	*Erynnis persius persius*	E	T		No	Open areas, marshes, seeps
Two-spotted skipper	*Euphyes bimacula*	T			No	Wet sedge meadows, marshes, bogs
Sedge skipper	*Euphyes dion*	T			No	Open marshes, bogs, swamps
Henry's elfin	*Incisalia henrici*	SC			No	Edges and openings of wooded swamps
Frosted elfin	*Incisalia irus*	SC			No	Edges of woods, shrubby fields
Bog copper	*Lycaena epixanthe*	SC			No	Acid bogs
Bronze copper	*Lycaena hyllus*	SC			No	Marshes, bogs, seeps, wet meadows
Giant swallowtail	*Papilio cresphontes*	SC			No	Rocky and sandy exposed hillsides
Mustard white	*Pieris napi oleracea*		SC		No	Rich woods of beech, maple, hemlock
Eyed brown	*Satyrodes eurydice*	SC			No	Marshes, sedge meadows, slow-moving streams, ditches
Noctuid moth	*Anarta luteola*	E			No	
Noctuid moth	*Apamea burgessi*	SC			No	Meadows, sedge marshes
New Jersey tea inchworm	*Apodrepanulatrix liberaria*	SC			No	Mixed and hardwood forests
Noctuid moth	*Cucullia speyeri*	SC			No	Meadows
Noctuid moth	*Eucoptocnemis fimbriaris*	SC			No	

Species	*Scientific Name*	CT State Status	MA State Status	Federal Status	Recently Observed from Housatonic	Habitat
Pitcher plant moth	*Exyra rolandiana*	SC			No	Bogs
Bog tiger moth	*Grammia speciosa*	E			No	Bogs, wet meadows, seeps
William's tigermoth	*Grammia williamsii*				No	Deciduous woodlands
Pitcher pant bored moth	*Papaipema appassionata*	E	SC		No	Peat bogs with pitcher plants
Goldenrod stem borer	*Papaipema duovata*	SC		No	No	Meadows, forest clearings containing goldenrod
Columbine borer	*Papaipema leucostigma*				No	Columbine
Ostrich fern bored moth	*Papaipema sp.**					Ostrich ferns
Labrador tea tentiform Leafminor	*Phyllonorycter ledella*	E			No	
Noctuid moth	*Psectraglaea carnosa*	SC			No	
Orange sallow moth	*Rhodoecia aurantiago*	SC	T		No	Meadows seeps, bogs containing gerardia
Noctuid moth	*Schinia spinosae*	SC			No	Meadows, woodland edges containing asters and goldenrods
Clemen's Hawkmoth	*Sphinx luscitiosa*		SC		No	Deciduous woodlands
Noctuid moth	*Zale curema*	SC			No	
Noctuid moth	*Zale obliqua*	SC			No	Pine forests
Noctuid moth	*Zale submediana*	T			No	

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Chapter 3 Fish

1.0 Introduction

Fish are found at the upper trophic levels of the aquatic food web, functioning as predators, foragers, and bottom feeders. Given this trophic status, as well as their role as prey for certain mammals and birds, fish are an important component of the study of PCB contamination in the Housatonic River (Beach *et al.* 2000).

A literature review was conducted on the fish species historically present in the ROR study area. Multiple fish surveys (see McCabe 1943, Bergin 1971, Stewart Laboratories 1982, Chadwick & Associates 1993 and 1994, NUSCO 1998) have included areas within the ROR study area. The results of these surveys are summarized and used to describe the composition of the fish community.

2.0 Methods

The fish community within the ROR study area has been characterized using the following methods:

- Development of a species:habitat association matrix
- Review of existing fisheries data

2.1 Species:Habitat Association

Natural communities have been identified as part of the qualitative review of the ROR study area. There are three major communities, or habitat types, in the riverine portions of the study area: (1) moderately alkaline lake/pond; (2) medium-gradient stream, and (3) low-gradient stream. Moderately alkaline lake/ponds can be described as open-water habitat greater than 2 m deep. Within the ROR, this community is essentially limited to head ponds of various impoundments along the Housatonic River. Medium-gradient streams can be generally described as moderate-flowing water with sand and gravel substrate and sparse aquatic vegetation, while low-gradient streams can be generally described as slow-moving water with silt and muck substrate, often with abundant

aquatic vegetation (see Section III, Chapter 1, Section 3.0 Natural Community Descriptions). The fish species known or expected to occur within each of the three major riverine communities are identified in Attachment A, a species:habitat matrix that also includes a list of special habitat requirements for each species.

2.2 Existing Fisheries Data

Hartel *et al.* (1996) have annotated a working list of the inland fishes of Massachusetts that references both historic and recent scientific investigations of the distribution of fish in the state and within the Housatonic drainage. Whitworth's (1996) publication, *Freshwater Fishes of Connecticut* identifies the fish historically and currently present in the Housatonic River.

Results from previous surveys are presented in Table 3-1 and are outlined below. Britton McCabe (1943) surveyed streams in western Massachusetts, including the Housatonic River, in 1940 between Pittsfield, Massachusetts, and the Massachusetts-Connecticut border, and collected 25 species. Bergin (1971) surveyed the Housatonic River and its tributaries and collected 20 species from the mainstem river between Lee and Great Barrington, Massachusetts. Stewart Laboratories (1982) and Chadwick & Associates (1993, 1994) completed fish investigations in the Housatonic River for the General Electric Company. Stewart Laboratories collected 12 species from surveys conducted in Massachusetts and Connecticut, while Chadwick & Associates collected 23 species from the ROR study area in Massachusetts. The CDEP conducted fish surveys throughout the ROR study area between 1975 and 1998, as reported by Northeast Utilities Service Company (NUSCO 1998), yielding 34 species.

Table 3-1 Historic fish communities of the Housatonic River.

Species Name	Source						
	McCabe	Bergin	Stewart	Chadwick	CDEP	Woodlot	NUSCO
American eel [N]					X		X
Alewife [N]					X		X
Goldfish [I]		X			X		
Common carp [I]				X	X	X	X
Cutlips minnow [N]					X		X
Common shiner [N]	X	X		X	X		X
Golden shiner [N]	X	X		X	X	X	X
Bridle shiner [N]	X						
Spottail shiner [N]		X		X	X	X	X
Bluntnose minnow [I]				X	X		X
Fathead minnow [I]					X		X
Blacknose dace [N]	X	X		X	X		X
Longnose dace [N]	X	X		X	X		X
Creek chub [N]	X	X		X	X		X
Fallfish [N]	X	X		X	X		X
Longnose sucker [N]	X	X		X			
White sucker [N]	X	X		X	X	X	X
Creek chubsucker [N]	X						
White catfish [I]					X		X
Yellow bullhead [I]					X		X
Brown bullhead [N]	X	X		X	X	X	X
Channel catfish [I]							
Redfin pickerel [N]	X						
Northern pike [I]					X	X	
Chain pickerel [N]	X	X		X	X		X
Rainbow trout [I]	X	X	X		X		X
Brown trout [I]	X	X	X	X	X		X
Brook trout [N]	X		X				X
Trout perch [N]	X						

Species Name	Source						
	McCabe	**Bergin**	**Stewart**	**Chadwick**	**CDEP**	**Woodlot**	**NUSCO**
Banded killifish [N]				X	X		X
Killifish sp. [N]		X					
Slimy sculpin [N]	X						
White perch [N]					X		X
Rock bass [I]	X	X	X	X	X	X	X
Redbreast sunfish [N]	X				X		X
Green sunfish [I]			X				
Pumpkinseed [N]	X	X	X	X	X	X	X
Bluegill [I]	X	X	X	X	X	X	X
Sunfish hybrid [?]					X		X
Redear sunfish [?]			X				
Smallmouth bass [I]	X		X	X	X		X
Largemouth bass [I]	X	X	X	X	X	X	X
Black crappie [I]			X	X	X	X	X
Tessellated darter [N]				X	X		X
Yellow perch [N]	X	X	X	X	X	X	X
Species Richness	**25**	**20**	**12**	**23**	**34**	**12**	**33**

References:

McCabe (1943)
Bergin (1971)
Stewart Laboratories, Inc. (1982)
Chadwick & Associates, Inc. (1993, 1994)
Connecticut Department of Environmental Protection (CDEP) (Surveys 1975-1998)
Woodlot Alternatives, Inc. unpublished data (Survey 1998)
Northeast Utilities Service Company (NUSCO) (1998)

[I] Introduced species
[N] Native species
[?] Status uncertain

As part of a fish characterization study supporting the ecological characterization of the Housatonic River in Massachusetts, Woodlot Alternatives, Inc., conducted fish surveys in Rising Pond, Great Barrington, Massachusetts, in 1998. This survey collected 12 species, and has not been published in a report. NUSCO (1998) collected 33 species within the ROR study area in 1997 and 1998, as part of licensing activities for hydro-electric developments it owns and operates in Connecticut. These surveys were conducted in the mainstem of the Housatonic River, Bulls Bridge bypass, and Lake Zoar. NUSCO also conducted an extensive literature survey regarding fish community composition and historic fish surveys completed in the ROR in Connecticut (NUSCO 1998). Information on fish abundance and distribution within the Housatonic River was available from the CDEP as reported in NUSCO (1998). These existing fisheries data were reviewed as part of the effort to characterize the fish community in the ROR study area. Other surveys have been conducted focusing on tissue collection for chemical analyses from target species from within the study area. The Academy of Natural Sciences (ACNS) collected tissue samples from four species of fish for analysis for General Electric between 1984 and 1998 (ACNS 1999). These ACNS surveys and similar surveys, conducted to target specific species from specific locations, were reviewed for content but not included in this summary.

3.0 Fish Community Description

There are 32 families, encompassing 98 species, of native and introduced inland fishes known to currently occur in Massachusetts (Hartel *et al.* 1996). There are 58 families, with 159 species, of native and introduced freshwater fishes in Connecticut (Whitworth 1996). Forty-six species potentially occur within the ROR study area (Attachment A). Forty-five of these species, encompassing 13 families have been reported from the ROR study area between 1940 and 1998. Of the 45 species, 26 are considered native, 16 are considered introduced, and 3 are of unknown status. Furthermore, 10 species are predators, 9 are bottom feeders, and 26 are forage species.

The trout species present in Connecticut support an important sport recreational fishery in the Housatonic River (Orciari and Leonard 1990). In 1981, the CDEP implemented the

Housatonic River Trout Management Area, a 14-dm stretch of river under year-round catch-and-release regulations (Hyatt *et al.* 1999). This managed area is located in the northern portion of the ROR study area in Connecticut and is stocked with adult and/or juvenile trout (Orciari and Leonard 1990).

NUSCO reported that their 1997 and 1998 fish surveys found the species composition in the Housatonic River to be typical of other similar-sized rivers in Connecticut and in New England (NUSCO 1998). They report that the fish community of the Housatonic River above the impoundments at Lake Lillinonah and Lake Zoar was dominated numerically by smallmouth bass, white sucker, and minnows, including longnose dace, fallfish, cutlips minnow, and bluntnose minnow; however, smallmouth bass and white sucker comprised the majority of biomass from those collection areas. Based on survey data from the CDEP, they found the fish communities of Lake Lillinonah and Lake Zoar have been dominated by white perch and various sunfishes. The mainstem river had fishes typical of present-day cool-water New England rivers, including longnose dace, fallfish, white sucker, brown trout, and smallmouth bass. In quieter waters, fish such as cutlips minnow, spottail shiner, bluntnose minnow, rock bass, redbreast sunfish, largemouth bass, and tessellated darter became more abundant. The catadromous American eel was the only highly migratory species found in the river, and its distribution above Lake Zoar is limited. The large impoundments found in the lower Housatonic River basin had populations more typical of lakes and reservoirs, including landlocked alewife, common carp, spottail shiner, golden shiner, several species of bullhead catfishes and sunfishes, white perch, smallmouth and largemouth bass, and yellow perch.

4.0 Rare, Threatened, and Endangered Fish

Three species state-listed as conservation concern in either Massachusetts or Connecticut could potentially occur with the ROR study area: the bridle shiner, longnose sucker, and burbot. The trout-perch has recently been declared extirpated from Massachusetts, but was last found in 1940 by McCabe (1943) at the confluence of the Green River and the Housatonic River in Great Barrington, Massachusetts (Hartel *et al.* 1996).

The bridle shiner is a small warm-water minnow of creeks, ponds, rivers, and lakes with clear to moderately stained water. In Massachusetts, it is listed as a species of Special Concern (MNHESP 1999). The bridle shiner is discontinuously distributed along the middle Atlantic coastline, from Virginia to southern Maine and inland through New York, where its range extends to Lake Ontario and the upper St. Lawrence River (Page and Burr 1991). McCabe (1943) documented the bridle shiner in the Housatonic, but it has not been found in subsequent fisheries surveys in the upper reaches of Housatonic River in Massachusetts (Bergin 1971, Stewart Laboratories 1982, Chadwick & Associates 1993 and 1994). Whitworth (1996), however, states that it is found in all major drainages of Connecticut, including the Housatonic River.

Longnose suckers are a species of Special Concern in Massachusetts and Connecticut (MNHESP 1999, CDEP 1998). Longnose suckers are found in cool upper sections of streams and rivers in the western part of Massachusetts, and were reported in Connecticut from a tributary of the upper Housatonic River in 1992 (MNHESP 1994, Whitworth 1996).

The burbot is a species of Special Concern in Massachusetts and Endangered in Connecticut (MNHESP 1999, CDEP 1998). In Massachusetts, burbot are known from four records, of which two occurred in the Housatonic drainage near the Connecticut border (Hartel *et al.* 1996). The burbot has become established at two locations within tributaries of the upper Housatonic River in Connecticut, though no specimens have been reported at other locations within the Housatonic River basin in Connecticut (NUSCO 1998).

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Chapter 4 Reptiles and Amphibians

1.0 Introduction

The herpetile community in the ROR study area includes three groups of reptiles—lizards, snakes, and turtles—and several groups of amphibians—toads, frogs, and salamanders. This diverse group of animals includes both terrestrial and aquatic species. The herpetile community was characterized by conducting a literature review of local species and populations.

2.0 Methods

2.1 Species:Habitat Association

The principle goal for the characterization of the herpetile community was to identify all species that could reasonably be expected to occur in the study area, the habitats they would use, and when they would use them. The foundation of this work included a review of relevant literature on the herpetile populations in Massachusetts and Connecticut. Local and regional references on reptile and amphibian communities were first used to identify the species whose range encompassed the ROR study area (Klemens 1993, Conant and Collins 1998, DeGraaf and Yamasaki 2001). General and technical references on the habitat requirements and use, seasonality of occurrence, and relative abundance in the region were then used to refine the list and build a matrix to include only those species whose preferred habitats are within the ROR study area (Klemens 1993, Hunter *et al.* 1999, DeGraaf and Yamasaki 2001).

As part of this effort, local and regional experts were consulted to obtain unpublished records regarding the historic occurrence of some species in the area. For example, the MNHESP, the MDFW, the CDEP, the USFWS were contacted to identify any historic herpetile occurrences. Information received from these agencies, organizations, and individuals was then incorporated into the species matrix.

3.0 Reptile and Amphibian Community Descriptions

Herpetile populations in the ROR study area are diverse. Based on range, habitat requirements, and habitat availability, 20 reptile and 19 amphibian species could potentially occur.

3.1 Reptiles

The reptile community within the ROR study area consists of 12 snake species, 1 lizard, and 7 turtle species. Of the snake species, the garter snake is most abundant and likely to be seen in many of the habitat types. The snapping turtle and painted turtle are the two most common turtles seen in riverine and wetland habitats.

3.1.1 Lizards

The five-lined skink is the only lizard species that occurs along the Housatonic River. Five-lined skinks reach their northern limit in New England and populations are uncommon and localized in the region. They can be found in western Connecticut, western Vermont, and eastern New York north to Lake George. Five-lined skinks are a Threatened species in Connecticut due to their rare and localized populations (see Section 4.0). Five-lined skinks inhabit steep, rocky areas with patchy tree and shrub cover. These areas are typically dry, sunny microsites surrounded by mesic deciduous forest. Five-lined skinks may also be found in residential and agricultural areas, particularly around old, derelict buildings (DeGraaf and Yamasaki 2001). In the ROR study area, two populations have been documented on the bluffs bordering the Housatonic River in Litchfield County, Connecticut. Populations have also been recorded from New Haven County, Connecticut, on the ledges above the Housatonic River (Klemens 1993).

Five-lined skinks spend the majority of their time under the cover of logs and rock slabs, but will bask for brief periods during warm weather. Fecal analysis from populations in Connecticut found flies, wood roaches, beetles, ants, spiders, and reptile scales (likely from ingestion of shed skin) (Klemens 1993). The peak activity of five-lined skinks is from April to June, which coincides with their May breeding period. Six weeks after breeding, females lay 4 to 20 (typically 9 to 12) eggs under rocks, rotting logs, and loose

soil. Females guard their eggs during the month-long incubation period (CDEP 2000). Five-lined skinks hibernate in decaying logs or below the frost line from October to mid-March.

3.1.2 Snakes

Fourteen snake species, in two families, potentially occur in the ROR study area (Attachment A). The eastern worm snake, northern black racer, black rat snake, eastern hognose snake, northern water snake, northern brown snake, northern redbelly snake, common garter snake, eastern ribbon snake, northern ringneck snake, eastern smooth green snake, and eastern milk snake are members of the Colubridea family. Two venomous species, the northern copperhead and timber rattlesnake, members of the Viperidae family, could also potentially occur in the ROR study area.

The common garter snake is likely the most common snake species, as it is ubiquitous and found in a wide variety of wetland and terrestrial habitats. This species is abundant throughout New England and can be commonly observed at the edges of isolated pools, in transitional floodplain forest, red maple swamp, shrub swamp, and in most of the terrestrial community types. Earthworms make up as much as 80 percent of a garter snake's diet, with amphibians also being important prey items (DeGraaf and Yamasaki 2001).

The ribbon snake, a close relative of the garter snake, may also occur within the ROR study area. Ribbon snakes are uncommon and localized in southern New England, thus are a species of Special Concern in Connecticut (see Section 4.0). This species is semi-aquatic, favoring shallow aquatic habitats such as wet meadows, shrub swamps, vernal pools, bogs, and fens. Ribbon snakes are typically found at elevations below 275 m (900 feet), but have been documented in wetlands higher than 488 m (1,600 feet), such as Mt. Washington, Massachusetts (Klemens 1993). Amphibians, especially young metamorphosing individuals, make up 90 percent of a ribbon snake's diet, with small mammals and insects occasionally being taken (DeGraaf and Yamasaki 2001).

The northern water snake is abundant in suitable habitat and is likely common in the Housatonic River. Northern water snakes have been observed in Woods Pond, within the

PSA. This species occurs in aquatic habitats such as rivers, streams, lakes, marshes, wet meadows, bogs, and fens. It is commonly observed near bridges and spillways where rocks provide abundant basking sites. Northern water snakes are uncommon in wooded swamps and other areas with deep shade, likely due to lack of basking sites (DeGraaf and Yamasaki 2001). Fish typically make up the greatest percentage of the northern water snakes diet with amphibians making up the remainder. Insects, crayfish, and small mammals may occasionally be taken when available.

The remaining snake species tend to favor terrestrial or upland sites; however, they can be found in wetland habits such as swamps, shallow marshes, wet meadows, bogs, and fens. Northern black racers prefer open to lightly wooded areas and may be found in both moist and dry areas, including old fields, wet meadows, shrub swamps, marshes, woodland edges, and rocky slopes. They thrive in areas that are periodically cleared or mowed such as cultural grasslands, power line rights-of-way, and roadsides (Klemens 1993). They are also commonly found in residential and agricultural areas near abandoned buildings, stone fences, and farm outbuildings.

Northern ring neck snakes and eastern milk snakes are found in a variety of habitats, especially moist, brushy woodlands with abundant cover such as logs, stumps, and rocks. These species are often common in agricultural areas among brushy fence rows, old stone fences, and brush piles, and in barns and other outbuildings. Northern redbelly snakes are found in a variety of moist upland habitats, primarily moist woods but also shrub swamps, wet meadows, bog edges, and pond margins. The eastern smooth green snake prefers grassy, upland habitats such as meadows, mountaintop balds, and open transitional forests. They may occasionally occur in sphagnum bogs, fens, and marshes. Eastern worm snakes and eastern hognose snakes are found in well-drained, sandy soils often near deciduous woodlands. Both are species of conservation concern (see Section 4.0). Klemens (1993) occasionally found worm snakes in wetland habitats, but surrounding soil was usually porous and sandy.

Northern brown snakes are common in urban and rural areas, particularly disturbed habitats such as vacant lots, trash piles, parks, roadsides, and railroad tracks. Black rat snakes, northern copperheads, and timber rattlesnakes are most commonly found on

steep, forested slopes with ledges, rocky outcroppings, and rock slides. All three species may also be found in a variety of other habitats, including woodlands, swamps, field edges, marshes, and stream bottoms. The black rat snake and northern copperhead are Endangered in Massachusetts and the timber rattlesnake is Endangered in both Massachusetts and Connecticut (see Section 4.0).

3.1.3 Turtles

Seven turtle species potentially occur in the ROR study area: common snapping, common musk (or stinkpot), spotted; wood, bog, eastern box, and painted turtle (Attachment A). Of these, snapping and painted turtles are likely the most common in the Housatonic River, adjacent backwaters, and pools. Snapping and painted turtles are largely associated with aquatic communities, being found in nearly every aquatic habitat within the PSA. They are most often observed in low-gradient streams, impoundments, and deep emergent marshes, particularly those with soft, muddy bottoms. These turtles can be found in more terrestrial habitats, particularly while nesting or traveling to temporary feeding areas, such as vernal pools. The seasonal abundance of invertebrates and, perhaps more importantly, amphibian larvae likely attract turtles to these areas.

The common musk is a common species in southern New England and likely occurs in the ROR study area. These turtles are typically found in slow-moving water and muddy-bottomed riparian habitat. They are especially common in shallow, weedy edges of small reservoirs (Klemens 1993). Spotted turtles, a species of Special Concern in both Massachusetts and Connecticut (see Section 4.0), may also occur in the ROR study area. Spotted turtles can be found in a variety of shallow bodies of water, such as woodland streams, emergent marshes, wet meadows, fens, bogs, vernal pools, and woodland swamps. They prefer areas with aquatic vegetation and mud or detrital bottoms. Elevation is a limiting factor in their distribution, as they are typically found below 213 m (700 feet) (DeGraaf and Yamasaki 2001).

Bog turtles occur in southern Berkshire County, Massachusetts, and western Connecticut. Their occurrence is directly related to the distribution of calcareous wetlands, as their primary habitat requirement is open, calcareous wet meadows and fens (DeGraaf and

Yamasaki 2001). The bog turtle is an Endangered species in both Massachusetts and Connecticut, and is a federally Threatened species (see Section 4.0). In New England, this species is restricted to a series of calcareous bedrock valleys located between the Housatonic and Hudson Rivers (Klemens 1993).

The wood turtle and eastern box turtle are also species of Special Concern (see Section 4.0). The wood turtle is a semi-aquatic species found primarily in riparian areas, preferring slow-moving streams with sandy bottoms and heavily vegetated banks. Several wood turtles were documented from 1998 – 2000 in the PSA, in Lenox and Pittsfield, Massachusetts. They can also be found in other wetland types, such as wet meadows, fens, vernal pools, and woodland swamps. During the spring and summer, wood turtles make long daily movements through both upland and wetland habitats, searching for mates, traveling to nesting sites, and foraging. During these seasons, wood turtles can be found in woodlands, old fields, agricultural lands, railroad beds, power line cuts, and roadsides (Klemens 1993). Wood turtles can often be found in vernal pools during the spring, where they take advantage of the abundant food items. The eastern box turtle is the most terrestrial turtle potentially occurring in or near the ROR study area. This species favors old field habitat and open, early successional deciduous forest, including power line cuts and logged-over woodlands. Although terrestrial, this species is often found near streams and small ponds, and the young are semi-aquatic (DeGraaf and Yamasaki 2001).

3.2 Amphibians

Ten salamander and nine toad and frog species could potentially occur in the ROR study area (Attachment A). Leopard frogs, green frogs, bullfrogs, and red-spotted newts are likely the most common species within the Housatonic River and the associated semi-permanent pools and backwaters. Wood frogs and spotted salamanders are likely the most common breeding amphibians within temporary vernal pools in the river's floodplain and adjacent forests.

3.2.1 Toads and Frogs

Wood frogs and American toads are likely common in nearly all the terrestrial and wetland habitats in the ROR study area. Spring peepers and gray treefrogs are expected to be common in a variety of habitats, predominately floodplain forest vernal pools and shallow emergent marshes. Northern leopard frogs and pickerel frogs are semi-terrestrial and can be observed in most of the wetland habitats, predominately emergent marsh communities during the breeding season and wet meadows during the summer. Green frogs are abundant in backwaters and pools throughout the Housatonic River. Bullfrogs are also expected to be common throughout the ROR study area, being most abundant in large, open wetlands and impoundments with submerged and emergent aquatic vegetation.

American toads are the most common toads likely to be observed in the ROR study area. Fowler's toads could potentially occur but are less common in the region and tend to prefer drier, sandy habitats (Klemens 1993). American toads are relatively uncommon in the open and forested wetland communities of the Housatonic River floodplain, but are more common in adjacent terrestrial habitats. American toad eggs and tadpoles are found in a variety of aquatic habitats, including vernal pools, semi-permanent pools, shallow riverine backwaters, and marshes, but are most common in warm, shallow pools not utilized by other amphibian species.

Wood frogs are one of the most abundant amphibians throughout New England and can be found in nearly every forested habitat within the ROR study area. Wood frogs are terrestrial except during the breeding season, when they congregate in small, usually temporary pools. Wood frogs are explosive breeders, arriving at breeding pools in mass, mating, laying eggs, and returning to their terrestrial habitat within a matter of days. This explosive breeding occurs late March to early April in the ROR study area. Egg masses are usually laid in a communal aggregation in an open, sunny area of the pool. After hatching, tadpole metamorphosis occurs in 6 – 15 weeks, depending upon site conditions.

Spring peepers are common in nearly all the habitat types in the ROR study area. Breeding populations are densest in semi-permanent, shallow emergent marshes,

temporary pools, and shallow backwater edges. They can also be found breeding in wet meadows, bogs, and fens (DeGraaf and Yamasaki 2001). Peepers forage among the leaf litter, woody debris, tree bark, and vegetation near the forest floor. Small spiders are the common prey item, making up more than 48 percent of the diet (Knox 1999a). Mites, ants, beetles, ticks, leafhoppers, nematode worms, and caterpillars are also commonly eaten.

The gray treefrog is less common than the spring peeper and more difficult to observe. They most commonly occur in moist deciduous forested areas near shallow water and shrub swamps. Except for their breeding season, gray treefrogs spend most of their time hidden among the bark and cavities of trees, where they feed on a variety of small insects. Gray treefrogs commonly breed in the same pools as spring peepers.

The northern leopard frog and the pickerel frog are two closely related semi-terrestrial frogs found in the ROR study area. Pickerel frogs are the more common of the two species throughout New England, but the leopard frog may be more abundant in localized areas. Klemens (1993) documented leopard frogs from the Housatonic River as occurring mainly in Massachusetts and northern Connecticut, while pickerel frogs are documented throughout the Housatonic River valley. The pickerel frog is closely related to the leopard frog and these two species generally have similar habits and life history. Both species breed in ponds, marshes, shallow slow-moving streams, bogs, and semi-permanent and temporary pools in April and May. These frogs are commonly found in terrestrial habitats during the summer, especially open grassy habitats. Metamorphs are commonly seen in the late summer crossing a variety of riparian habitats.

Two taxa of leopard frogs are formally recognized: northern and southern. Within New England, the northern leopard frog is found from Maine south into Massachusetts and Connecticut along the Housatonic and Connecticut River valleys. Southern leopard frogs occur immediately south of New England and to the west in eastern New York. Within this region, northern and southern leopard frogs are difficult to distinguish by visual observation alone and populations may overlap. Klemens (1993) reports that these species can be separated based on dissection and presence or absence of vestigial oviduct in the males. He found that leopard frogs collected from the Housatonic watershed more

closely resembled southern leopard frogs (that former taxon is now a species called *Rana utricularia*) collected in northern New Jersey and southeastern New York than other northern leopard frogs in New England. Individuals from the Housatonic River might be more accurately placed within the southern leopard frog taxon, they might belong to a unique taxon, or they might be a hybrid population. In any case, further research is needed to accurately place this population. For the purposes of this investigation, the common consensus of available literature is that the population within the ROR study area consists of northern leopard frogs.

Green frogs are most abundant in the aquatic habitats in the ROR study area, where they occupy a wide variety of permanent and semi-permanent communities. During the summer months they also utilize vernal pools in transitional floodplain forests and red maple swamps as summer foraging grounds because of the abundance of prey. Green frogs breed in permanent pools and ponds filled with deep and shallow emergent marsh vegetation. Green frog egg masses contain up to 5,000 eggs in a large flat mass floating on the water surface among aquatic vegetation. Characteristic egg mass locations for green frogs consist of shallow water in permanent water bodies, likely because the larval period, at least in the northern parts of its range, lasts for at least one full year (Stockwell 1999).

Bullfrogs are closely related to green frogs and share many similar traits. They are the largest North American frog, with adults commonly exceeding 20 cm (8 inches) in length (snout to vent length). Bullfrogs are highly aquatic and rarely found away from water. They are most common in impoundments and large backwaters along the Housatonic River. However, they commonly travel from the river to nearby vernal pools in transitional floodplain forests and red maple swamps, where they take advantage of the high densities of prey items. Breeding occurs from late May to July in deep, permanent water with emergent vegetation and less commonly in semi-permanent pools.

3.2.2 Salamanders

Ten species of newts and salamanders may occur in the ROR study area (Attachment A). Four of the salamanders potentially occurring in the ROR study area—spotted, Jefferson,

blue-spotted, and marbled salamanders—are members of the Ambystomatid family, commonly known as the mole salamanders because of their burrowing habits. These relatively large, robust salamanders occur in forested habitats throughout the eastern United States. All of these species breed in temporary vernal pools, but show slightly different breeding habits. Spotted salamanders are the only member of the group that is common, with the remainder being species of conservation concern. The remaining salamanders expected to occur in the vicinity of the ROR study area include northern dusky, northern two-lined, spring, four-toed, and redback salamander, which are all members of the Plethodontid family. These salamanders have no lungs and absorb oxygen through their moist skin and membranes in their throat. Their physiology requires them to inhabit cool, moist habitats. They mostly use terrestrial habitats, such as mesic upland forests or small, high-gradient streams on rocky slopes, and would not be expected to be common in the Housatonic River or its associated floodplains.

Red-spotted newts are common throughout the eastern United States and are abundant in backwaters, oxbows, backwater channels, and permanent pools associated with the river throughout the ROR study area, as well as in the river itself. Red-spotted newts prefer sunny, shallow, slow-moving waters with abundant aquatic vegetation. Red efts, the juvenile, terrestrial stage of the red-spotted newt, are found in a variety of deciduous and coniferous forests, as well as in open areas bordering woodlands, such as pastures and meadows (Klemens 1993). Newts are unique in that they are the only eastern salamander that has three distinct stages in their life cycle. Breeding occurs in the spring in shallow bodies of water with soft bottoms and vegetation. The larvae spend 5 – 7 months in aquatic habitats during which time they have a keeled tail and external gills. The gills shrink throughout the summer, until they disappear completely during fall metamorphosis, when the newts take on the color and body shape of the terrestrial juvenile stage, known as the red eft stage. The efts leave the water for terrestrial woodland habitats, where they spend the next 3 – 7 years. A second metamorphosis then occurs when the red efts become sexually mature, at which time they migrate back to aquatic habitats, where they take on the characteristics of the adult form, and spend the remainder of their life in the water.

Spotted salamanders are found in a wide variety of habitats, preferring forested areas. They are most frequently observed in undisturbed forests with moist soils and rural areas with light development. This salamander can, however, be found in residential and urban sites if suitable breeding habitat is present. Spotted salamanders are usually identified as an obligate vernal pool species—species that presumably breed only in the absence of fish in temporary pools. Klemens (1993), however, identifies a number of other habitats used for breeding, including floodplain swamps, marshes, bogs, margins of lakes and reservoirs, and beaver ponds.

During the breeding period, male spotted salamanders migrate to breeding pools first followed by females a few days later. This usually occurs at the very beginning of April in southern New England. Both sexes may travel as far as 122 m (400 feet) from nonbreeding territory to a breeding pool (Madison 1997). Spotted salamanders show a high degree of fidelity to breeding pools, returning to the same location year after year. Whitford and Vinegar (1966) reported that 86 percent of marked spotted salamanders returned to the same pool after 1 year and 77 percent returned the second year, with an estimated annual mortality of 10.5 percent.

Jefferson and blue-spotted salamanders are less common than spotted, and both are species of Special Concern in Massachusetts and Connecticut. Regionally, Jefferson salamanders occur in western Vermont, Massachusetts, and Connecticut, while blue-spotteds are found in Maine, New Hampshire, Connecticut, and eastern Massachusetts. Klemens (1993) documents both species and their hybrids from the Housatonic River in northern Connecticut. The Jefferson salamander, blue-spotted salamander, and their hybrids form a group known as the Jefferson complex (see Section 4.0). Visually, these species and hybrids are difficult to distinguish and electrophoretic evidence is often the only method to identify an individual with certainty. However, in general, Jefferson salamanders are uniformly grayish brown, and have larger, sausage-shaped egg masses. Blue-spotted salamanders and the hybrids usually have varying amounts blue flecks and deposit their eggs singularly or in small groups of 2 – 4 (Knox 1999b). The hybrids, which usually have varying amounts of faint blue flecks or undertones, tend to produce intermediate-sized egg masses. The timing of breeding and breeding habitat

requirements for Jefferson complex salamanders is very similar to spotteds, although Jeffersons usually show up a few days before spotteds. Blue-spotted salamanders are more likely to use forested swamps and marshes for breeding than are other mole salamanders (Klemens 1993).

Marbled salamanders are unique among the mole salamanders in the ROR study area in that they breed in the fall (September to October). Marbled salamanders congregate in dry vernal pools and courtship takes place under the leaf litter. The eggs are then deposited individually in a nest, usually in a small cavity under a log or leaf litter. The female remains to guard her eggs until fall rainwater floods the pools, inundating the eggs. Hatching is triggered by inundation and occurs a few days after the pool fills with water. Marbled salamander eggs are able to withstand extended desiccation without mortality and in some cases, when the pool fails to flood in the autumn, eggs may be able to overwinter and hatch in the spring (Klemens 1993). Marbled salamanders are a Threatened species in Massachusetts and occur primarily in the eastern part of the state. They are more widespread in Connecticut and have been documented from several locations along the southern portions of the Housatonic River. In general, marbled salamanders are absent from calcareous areas (Klemens 1993).

All adult mole salamanders, when not breeding, are terrestrial, spending their lives predominately underground in burrows or beneath large, decaying logs and rocks. They often utilize small mammal tunnels and burrows but will excavate their own if necessary. A study in New York found that 80 percent of the small mammal tunnels utilized by spotted salamanders during the summer were short-tailed shrew burrows, but overwintering sites were either white-footed mice burrows or rock recesses (Madison 1997). Their home ranges are small, but largely unreported. One tracking study found spotted salamanders using an area of only 0.03 m^2 (0.3 ft^2) around their burrows (DeGraaf and Yamasaki 2001). Burrows are located within the proximity of breeding pools, usually within 213 m (700 feet) (Kleeberger and Werner 1983, Madison 1997, Semlitsch 1998). Mole salamanders spend most of the year within their burrows, foraging nocturnally for earthworms, snails, slugs, and larval and adult insects, particularly beetles. Mole salamanders may occasionally forage aboveground, under the

leaf litter during rainy periods, but stay within close proximity to their burrows. The only aboveground travel done by mole salamanders is during the spring or fall migration to and from breeding pools and by newly metamorphosed juveniles dispersing from the pools.

The northern redback salamander, the only entirely terrestrial salamander in New England, is the most common Plethodontid salamander in the ROR study area. In many forested communities these small salamanders make up a large percentage of the total vertebrate biomass. In the Hubbard Brook Experimental Forest in New Hampshire, red-backed salamanders have a biomass of 1,770 g/ha (Burton and Likens 1975) and densities of approximately one per m^2 have been reported from southern Maine (Witham 1999). They are most abundant in well-drained upland habitats and typically avoid wet bottomland areas. They are most commonly found among moist leaf litter and under the cover of decaying logs, stones, and bark.

The northern dusky salamander, northern two-lined salamander, and northern spring salamander require undisturbed high-gradient stream or spring communities. These species may also be found in cool, clear bogs, fens, and riverside seeps. They are not likely to occur in the Housatonic River but are likely to be found in its high-gradient tributaries. The dusky and two-lined salamanders are common throughout New England. The northern spring salamander, however, is uncommon and is a species of conservation concern in Massachusetts and Connecticut (see Section 4.0). Each of these species breed in cold, clear streams where they lay their eggs in underground recesses and cavities under stones, logs, and other cover.

The final salamander, the four-toed salamander, is uncommon to rare in New England. It is a species of Special Concern in Massachusetts. Along the Connecticut portion of the Housatonic River, populations are known only from Sharon and Cornwall townships (Klemens 1993). This species is typically found in wet forests and bogs and is especially associated with sphagnum moss. It breeds in small pools or slow-moving streams in boggy, mossy areas, where it lays its eggs, sometimes communally. Four-toed salamanders are identified by their four toes and slight constriction, or narrowing, at the

base of the tail. This constriction allows individuals to drop their tail, a habit characteristic of this species as predator defense.

4.0 Rare, Threatened, and Endangered Reptiles and Amphibians

Four turtle species, one lizard, six snakes, and five salamander species are of conservation concern in Massachusetts, Connecticut, or both. Of these species, only one—the bog turtle—is a federally listed species. Of the total number that are expected to occur in the ROR study area, 55 percent of the reptile species and 50 percent of the salamander species are of conservation concern. The snake and lizard species are of conservation concern primarily due to persecution and because these species reach their northernmost limits in the southern New England region. The turtle and salamanders species are often of concern due to the loss and degradation of their specialized wetland habitats.

4.1 Reptiles

Five-lined skinks are Threatened species in Connecticut, and while historical populations had been recorded from Massachusetts during the late 1800s, they are currently believed to be extirpated from the state (Klemens 1993). Five-lined skinks are known to occur at only a few locations in New England: Rutland County, Vermont, and western Connecticut. Locations in Connecticut are from the bluffs and ledges overlooking the Housatonic River in Kent, Southbury, and Oxford Townships and one isolated population in Hartford County (Klemens 1993). Due to the steep, inaccessible habitat of this species they have not been exploited for the pet trade, nor is their habitat threatened by development. The main threat to this species is their small, isolated populations, which leaves them vulnerable to natural catastrophes. For example, Klemens (1993) notes that after fires swept through the Hartford population's habitat, no juveniles were recorded that season and fire-killed adults were observed. Loss of juveniles was likely due to the fact that fire consumed most of the downed wood, which are favored breeding sites of five-lined skinks.

The timber rattlesnake is Endangered in both Massachusetts and Connecticut. The timber rattlesnake is uncommon in many parts of its range due to extermination by human activities. Historical records indicate that rattlesnakes once occurred throughout New England; however, timber rattlesnakes presently are known from only a few isolated locations in western Vermont, southern New Hampshire, Massachusetts, and Connecticut. Rattlesnakes are most common in the rugged, mountainous terrain of southern Berkshire County, Massachusetts, and northern Litchfield County, Connecticut, where several large den sites are known to occur (Klemens 1993). Humans are the main threat to timber rattlesnakes. Historically, rattlesnakes were actively exterminated, with towns organizing hunts and paying bounties for these venomous snakes (Hunter *et al.* 1999). Populations have also been reduced by collection for the live animal trade. Collection is a particular problem at denning sites, where large numbers of individuals congregate, leaving them vulnerable to large-scale collection in the spring and autumn. Because the timber rattlesnake has a low reproductive rate, populations can take decades to recover from large-scale loss of individuals (Klemens 1993). Survival of timber rattlesnakes in New England requires a combination of land conservation, education of the general public, and prosecution of professional snake collectors.

The ribbon snake is a species of Special Concern in Connecticut. Ribbon snakes were historically present throughout southern New England but have declined and become extirpated in many areas (Klemens 1993). Current populations are uncommon and tend to be localized. Scattered populations are known from Berkshire County, Massachusetts, and Kent and Sharon Townships, Connecticut. Ribbon snakes are believed to be indicators of high quality wetland habitat. Loss of this wetland habitat is the major threat to this species.

The eastern hognose snake is also a species of Special Concern in Connecticut. This species occurs in open areas with sandy soils. Historically, hognose snakes were common along the coastal region; however, abundant development in these areas has destroyed much of the suitable habitat and has lead to the decline of this species in coastal areas. Currently, hognose snakes are most common among glacial sand and gravel deposits in rural and lightly developed areas of interior Connecticut. Hognose

snakes have been documented from several locations along the Housatonic River, but the number of individuals is low (Klemens 1993).

The eastern worm snake, black rat snake, and northern copperhead are Threatened or Endangered in Massachusetts. These listings are due to these species reaching their northernmost limit in Massachusetts and therefore having limited populations. These species are relatively common in Connecticut and may be abundant in southern portions of their range.

The eastern box turtle, spotted turtle, and wood turtle are listed as Special Concern in Massachusetts and Connecticut. Development and habitat fragmentation is the greatest threat to these species. Unnatural increase in predation due to human presence, road casualties, pollution of wetland habitats, wetland alteration, human disruption during nesting, and loss of terrestrial habitat are all major threats to these species. Collection for the pet trade is also a threat. These turtles take a long time to reach sexual maturity, usually greater than 10 years, with northern populations maturing slower than their southern counterparts. Individuals typically lay only a small number of eggs each breeding season (less than 10); nest success is low and juvenile survival is poor. These facts mean that turtles are dependent upon long-lived females to nest over successive years to sustain the population. Consequently, populations may take centuries to recover from large-scale loss of individuals, especially females. In addition, nesting females, particularly wood turtles, are extremely sensitive to human disturbance and will abandon nest excavation after minimal interuption. Therefore, recreationists may unwittingly lead to the decline of wood turtle populations. A study in Connecticut found that wood turtle populations in areas previously closed to the public were extirpated within 10 years after the areas were opened to recreation (Garber and Burger 1995). Spotted turtles and box turtles are better able to survive in small pockets of suitable habitat in close proximity to humans. However, recruitment of new individuals, necessary to maintain the exchange of genetic material, is a concern for these small isolated populations.

The bog turtle is a state Endangered species in Massachusetts and Connecticut and a federally Threatened species. In Connecticut, populations are known from only five townships, all east of the Housatonic River (Klemens 1993). In Massachusetts, this

species in known from only three sites in southern Berkshire County (Klemens 1993). The bog turtle has narrow habitat requirements

; unpolluted, open calcareous wet meadows and fens. The greatest threat to this species is the destruction, alteration, and fragmentation of its specialized wetland habitat. Bog turtles are sensitive to chemical and heavy metal pollution, as well as nutrient enrichment from fertilizers and septic runoff that often leads to accelerated succession into forested habitat (Klemens 1993). Historical decline of this species may be linked to beaver removal during early settlement, as beavers are important for maintaining open wetlands utilized by bog turtles (DeGraaf and Yamasaki 2001). Like many other turtle species, bog turtles are also threatened by collection for the pet trade.

4.2 Amphibians

Five salamanders of conservation concern potentially occur within or next to the ROR study area: Jefferson, blue-spotted, spring, four-toed, and marbled salamanders. The Jefferson, blue-spotted and spring salamanders are of conservation concern in both Massachusetts and Connecticut, while the marbled and four-toed salamanders are listed only in Massachusetts.

The Jefferson salamander, blue-spotted salamander, and their hybrids compose the Jefferson complex. Members of this complex form a continuum in appearance from the grayish-brown coloration, pale blue flecks, and wide snout of the Jefferson salamander to the bluish-black coloration, prominent blue spots, and narrow snout of the blue-spotted salamander. It is believed that these two species originated from a common ancestor during the last Ice Age when glaciers separated the two populations. After the glacier retreated, the two populations spread and eventually met in New England and the Great Lakes Region, where they commonly interbreed (Klemens 1993). The parent species normally has two sets of chromosomes, which is known as diploid. Their hybrids however have three sets of chromosomes, known as triploid, and are almost always females (Petranka 1998). The hybrids having two sets of Jefferson's genes and one set of blue-spotted genes are called the silvery salamander, while those hybrids having two sets of blue-spotted genes and one set of Jefferson's genes are called Tremblay's salamander.

These hybrids are not easily identified based on morphological characteristics, and laboratory tests are needed to positively identify them. One study conducted in Maine found that 70 percent of blue-spotted salamanders were hybrids (Knox 1999b). In areas where hybrids occur they usually outnumber the parent species two to one, resulting in females being twice as common as males. Hybrids are also commonly found in populations where only one of the parent species in known to occur.

The Jefferson salamander and its hybrids are listed a species of Special Concern. Populations are known primarily from western Massachusetts and Connecticut along the Connecticut and Housatonic River valleys (MNHESP 1994a). This species complex occurs from southern New Hampshire south through Massachusetts and Connecticut west of the Connecticut River, into southern New York, Pennsylvania, south into West Virginia, and west into Kentucky and southern Indiana (Petranka 1998). Jefferson salamanders range from locally common to rare in New England.

The blue-spotted salamander is listed as a species of Special Concern in Massachusetts and Connecticut. Ninety-nine populations have currently been documented in Massachusetts, predominately from east of the Connecticut River valley. Populations comprised of blue-spotted salamanders and their hybrids occur throughout Connecticut. Blue-spotted salamanders can be found discontinuously from the Gulf of Saint Lawrence across southern Canada to Lake Winnipeg and south throughout New England, New York, and northern Ohio, Indiana, and Illinois (Petranka 1998). The only known populations of genetically pure blue-spotteds in the northeast occur on Prince Edward Island, Canada, and on Long Island, New York. Though widely distributed, blue-spotted salamanders are locally uncommon and threatened in much of their southern range. Blue-spotted salamanders prefer moist, shaded northern hardwood and hemlock forests with shallow swamps and vernal pools for breeding.

The marbled salamander is currently listed as a Threatened species in Massachusetts. Forty-three current populations are known to exist in Massachusetts (MNHESP 1994b). Populations in Massachusetts occur primarily east of the Connecticut River and in the Berkshire Hills of western Massachusetts. This species occurs from southern New Hampshire and Massachusetts, west across southern New York and Pennsylvania to

Missouri, south into eastern Texas, the Mississippi basin, and the panhandle of Florida (Petranka 1998). The marbled salamander is uncommon throughout New England, primarily because it is at its northernmost limit here. This species is found in well-drained sandy and gravelly soil of mixed deciduous woodlands, especially oak-maple and oak-hickory. Populations are small and localized in New England, occurring in forested uplands within a 213-m (700-foot) radius of breeding pools (DeGraaf and Yamasaki 2001).

The northern spring salamander is a species of Special Concern in Massachusetts and is listed as Threatened in Connecticut. This species is uncommon thorough most of its range. It occurs from south-central Maine, New Hampshire, and Vermont, south through the Appalachian Mountains and foothills to northern Georgia and northeastern Mississippi, west to eastern Tennessee, Kentucky, and Ohio, with the exception of the Atlantic costal plain (Petranka 1998). Within Massachusetts 37 populations have been verified from the western two thirds of the state (MNHESP 1994c). In Connecticut, northern spring salamanders can be found in the northern parts of the state, primarily in the Housatonic and Connecticut River drainages (Klemens 1993). Northern spring salamanders are locally common in northwestern Berkshire County. These salamanders have no lungs and must absorb oxygen through their skin and membranes in their throat (Markowsky 1999). They are large salamanders and have a small surface area, relative to their mass, over which to absorb oxygen. This restricts northern spring salamanders to cold (<12º C) water bodies with a high degree of dissolved oxygen. Northern spring salamanders are found only in undisturbed areas, as they are especially susceptible to stream degradation.

The four-toed salamander is listed as a species of Special Concern in Massachusetts, Vermont, and Maine (The Natural Heritage Network 2000). This species is widespread in Massachusetts with records from over 40 locations throughout the state, but is considered relatively rare (MNHESP 1994d). The four-toed salamander occurs from southern Maine, New Hampshire, and Vermont west through New York, around the Great Lakes into Wisconsin, and south through the Appalachian Mountains to Georgia and Mississippi. The main habitat requirement for this species is wet moss in the vicinity

of open water for the larva stage. In the ROR study area, the most suitable habitats for four-toed salamanders are swamps dominated by red maple and white cedar, especially those where sphagnum moss is present. They prefer acidic environments but can occur in calcareous areas as well (Klemens 1993). Juveniles are found in pools, quiet streams, fens, and bogs with an abundance of moss. Due to the four-toed salamander's diminutive size, retiring habits, and nocturnal behavior, it is seldom observed and may therefore be more common than believed, especially considering the abundance of suitable habitat in New England (Burgason 1999).

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Chapter 5 Birds

1.0 Introduction

The avian community represents the largest vertebrate species group in the ROR study area. To characterize the community, a literature review of local and regional bird species and populations was conducted.

2.0 Methods

A list of the birds that could potentially occur in the ROR study area was identified using a variety of local and regional references on species' distributions in the Northeast (Andrle and Carroll 1984, Veit and Petersen 1993, Bevier 1994, DeGraaf and Yamasaki 2001). Local Breeding Bird Survey data available from the USGS were also used to compile the list of potentially occurring species (Sauer *et al.* 2000). The natural communities expected to occur in the ROR study area were then added to the list of potentially occurring species to form a matrix of species and habitats (Attachment A). General and technical references on the habitat requirements and use, seasonality of occurrence, and relative abundance in the region (Ehrlich *et al.* 1988, Sauer *et al.* 2000, DeGraaf and Yamasaki 2001) were then used to identify when each species would use each natural community.

As part of this effort, local and regional agencies were consulted to obtain unpublished records regarding the historic occurrence of some species in the area. For example, the MNHESP's Species Fact Sheets and the Connecticut Wildlife Division's Endangered and Threatened Species Fact Sheets were consulted to identify rare species known to occur in the ROR study area. A literature search was also conducted to locate scientific research that has been conducted in the vicinity of the ROR study area that would help characterize the bird community.

3.0 Bird Community Description

Very little published information on bird populations in the study area was readily available. Breeding Bird Survey results (Sauer *et al.* 2000) were available for two survey

routes located along or bisecting the ROR study area: the Sherman and Long Hill routes. The Sherman route runs parallel to the river, crossing it several times, from near Candlewood Lake to near Cornwall Bridge. A total of 108 species have been documented on the Sherman route since 1974. The Long Hill route crosses the Housatonic River only once, at Shepaug Dam. The results of the Long Hill route, therefore, are not reported here, as most observations occur in habitats well away from the river itself.

A total of 167 species were identified as potentially occurring in the vicinity of the ROR study area during the breeding and wintering periods[1] (Attachment A). Of these, 124 are passerines (songbirds and forest birds), 19 are raptors (hawks and owls), and 23 are water birds (wading, marsh, and shore birds, waterfowl, and gulls). Of those species expected to occur, 99 occur only during the breeding period, 57 occur year-round, and 10 only in winter. A variety of additional species are likely to occur during the migration period (Attachment C). This includes at least 34 species, making 201 the total number of species that could reasonably be expected to occur in the ROR study area. However, it is very likely that other occasional species, perhaps further out of their range, occasionally pass through the ROR study area. These infrequent occurrences are not possible to predict.

The total number of species expected to occur in the ROR study area is similar to that cited by NUSCO (1998). In Exhibit E of the license application for hydroelectric developments it owns and operates on the Housatonic River in Connecticut, NUSCO identifies 169 birds that are known or reasonably expected to occur along the river. They also identify the Shephaug Dam area as providing habitat for 201 bird species throughout the year, including migration.

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1 Species that would use the ROR study area only during migration are not included on the matrix due to: 1) the broad habitat requirements of some landbirds, 2) the difficulty in predicting the likelihood of use for each species breeding north of the ROR study area, and 3) the lack of field observations during bird migration seasons. However, it is likely that several species, such as loons, some waterfowl, and some warblers, consistently occur in the ROR study area during migration. These species have been listed in Attachment C.

Since birds represent such a large group, species by species discussions are not predictable. Instead, the general assemblages of species in each natural community and discussions of certain species groups are provided below.

The total number of bird species expected to occur in each natural community varies considerably based on plant species composition and structure. Anywhere from zero (high-gradient streams) to 96 (transitional floodplain forests) species potentially use the natural communities of the ROR study area. In general, natural communities that represent very small, localized communities provide habitat for the fewest species. These include vernal pools, cliffs, outcrops, and small streams. Large, water-dominated areas, such as lakes, ponds, and deep emergent marshes, also provide habitat for relatively few species.

The forested communities provide habitat for rich bird communities, largely due to the increased vertical structure that occurs in these habitats. Forested wetland and floodplain communities contain more species (81 – 96 species) than upland forests (73 – 86 species).

Open habitats have fewer birds associated with them, largely because of reduced structural diversity. An exception to this is the cultural grasslands, with 90 species potentially occurring. While this community type receives high bird use, relatively few birds nest in these areas. Birds that do nest there include killdeer, some sparrows, bobolinks, and, where shrubs are invading, some shrub-nesting species. Most of the bird use of this community type is for feeding during the growing season. A wide range of species can be observed feeding in these areas, from game birds (pheasant, bobwhite, turkey) to songbirds (robins, cardinals, sparrows), which feed on plant matter and terrestrial invertebrates, to swallows, hawks, and nightjars, which feed on flying insects and larger animal prey. The remainder of the open habitats (e.g., wet meadows, agricultural fields, and residential areas) tend to have fewer birds associated with them because of periodic or constant disturbances.

3.1 Carnivorous Birds

Carnivorous birds, those feeding almost exclusively on animal tissue, are represented by a wide range of species. The smallest avian carnivores, such as the swallows, flycatchers, and warblers, tend to feed on small insect prey while larger carnivores, such as hawks and owls, feed on larger invertebrate and vertebrate prey. Regardless of the target prey species, most species tend to be opportunistic while feeding and may take a wide range of animals.

3.1.1 Hawks and Owls

Only six raptor species (five hawks and one vulture) have been documented on the Sherman Breeding Bird Survey Route in Connecticut since 1974 (Sauer *et al.* 2000). These include turkey vulture, sharp-shinned hawk, Cooper's hawk, broad-winged hawk, red-tailed hawk, and American kestrel. However, many more species potentially occur. The species matrix (Attachment A) lists one vulture, twelve 12, and 6 owls that are likely to occur. Of these, two species in particular focus on aquatic habitats: osprey and bald eagle. Both species nest near water and feed on fish. A winter concentration of bald eagles occurs in the ROR study area, just downstream of the Shepaug Dam in Oakdale Manor, Connecticut (NUSCO 1998).

3.1.2 Wading Birds

Wading birds are common species in wetland and shoreline habitats. The most common species is probably the great blue heron, which is frequently observed in the Northeast. Other species that are common but less frequently observed due to coloration, behavior, and habitat use include the American bittern and green heron. Least bitterns and black-crowned night herons are expected to be relatively uncommon in the ROR study area. Most wading birds feed on small fish, amphibians, and aquatic insects. Some species, however, can be quite opportunistic when feeding, taking small mammals and snakes in addition to their normal prey.

3.1.3 Belted Kingfishers

Belted kingfishers are common birds of streams, rivers, ponds, and lakes in the Northeast. Kingfisher nests are typically excavated burrows located along eroding shorelines, road cuts, and gravel pits (Hamas 1994). They feed primarily on fish, but also take mollusks, crustaceans, insects, amphibians, reptiles, young birds, small mammals, and some berries (Hamas 1994).

3.1.4 Swallows

A variety of swallows potentially occur in the ROR study area. It is very likely that all five Northeastern species (tree, bank, rough-winged, barn, and cliff) use the ROR study area, along with the very similar purple martin. Swallows and martins are highly insectivorous birds. All of these species are expected to feed on aquatic invertebrates hatching from the river. Although nesting habitats of these species vary, most nest near the river, in eroded banks, under bridges, and in forested wetland communities.

3.1.5 Other Species

The wildlife species matrix (Attachment A) identifies a large number of additional species with carnivorous feeding habits. Most of these species are insectivorous forest songbirds. These species take predominantly flying insects using a variety of methods (active aerial pursuit by swallows and nightjars, sallying by flycatchers, and rapid capture and gleaning off leaves by vireos and warblers). Additionally, a number of species catch terrestrial invertebrates by actively searching the stems, branches, and foliage of plants, in forest leaf litter, and by probing the soil.

3.2 Omnivorous Birds

Relatively fewer birds have diets equally mixed of animal and plant materials. Of the birds that have an omnivorous feeding strategy, most utilize peaks of food abundance, as they are available. For example, in order to meet the nutritional demands of egg laying, many species of waterfowl time their migrations to arrive on breeding grounds when protein-rich aquatic invertebrates can form a high proportion of the diet of nesting hens

and developing young (Krapu and Reinecke 1992). They then switch their feeding to the fruits, seeds, and tubers of aquatic and emergent plants, as invertebrate populations decline and plant materials ripen or become available in late summer and fall.

3.2.1 Waterfowl

Seven species of swans, geese, and ducks potentially occur within the ROR study area during the nesting period (Attachment A) and another nine species potentially occur during migration (Attachment C). Nesting habitat for breeding species can vary markedly. Two species, the wood duck and hooded merganser, are cavity nesters. Most other species nest on the ground in herb-, shrub-, or tree-dominated areas. After nesting, most species rear their young, called a brood, in wetland habitats. When broods are particularly young, they tend to remain in fairly heavy cover of shrub swamps and well-vegetated shorelines. As the broods age and become more mobile, they begin to utilize more open deep emergent marshes and submerged aquatic vegetation that reaches the water surface. Canada geese are exceptions in that they spend considerable time in uplands feeding on the shoots of grasses, to the point where they have been classified as herbivores.

3.2.2 Marsh Birds

Relatively few marsh birds, including rails, sora, coots, and moorhens, occur in the northeast. These species are usually quite secretive and use dense emergent areas for nesting. They would be most common in quiet wet meadows and shallow and deep emergent marshes along the river.

3.2.3 Other Species

Very few other species or species groups are categorized as omnivorous birds. Included are the jays and crows, which have a varied diet of insects, bird eggs and young, carrion, and trash. Blue jays and American crows are common in the Northeast and have been documented using most of the available habitats.

3.3 Herbivorous Birds

Very few (only 10) species are solely herbivorous and, in the ROR study area, include geese, doves, ruby-throated hummingbirds, and the finches. These species occur within a variety of habitats, both aquatic and terrestrial.

4.0 Rare, Threatened, and Endangered Birds

Following are brief descriptions of state- and federal-listed birds that could potentially occur in the ROR study area.

Pied-billed Grebe

The pied-billed grebe is listed as Endangered by the MNHESP and the CDEP. This species inhabits freshwater ponds with large areas of emergent vegetation, marshes, and marshy inlets with areas of open water, marshy edges of rivers and lakes, and reed-bordered swamps with open water (DeGraaf and Yamasaki 2001).

American Bittern

The American bittern is listed as Endangered by the MNHESP and the CDEP. This species inhabits large freshwater or saltwater marshes, shrub swamps, emergent wetlands, and areas where tall, emergent vegetation is present (DeGraaf and Yamasaki 2001).

Least Bittern

The least bittern is listed as Endangered by the MNHESP and Threatened by the CDEP. This species is found in freshwater and brackish marshes with tall, dense vegetation. Nests are constructed from sticks, grass, and sedges in tall emergent vegetation, primarily in cattail marshes (DeGraaf and Yamasaki 2001, Ehrlich *et al.* 1988).

Blue-winged Teal

Nesting populations of blue-winged teal are listed as Threatened by the CDEP and typically are located in freshwater marshes, marshy edges of lakes, streams, ponds, sloughs, and sedge meadows (DeGraaf and Yamasaki 2001).

Bald Eagle

The bald eagle is listed as Threatened by the USFWS and Endangered by the MNHESP and the CDEP. Bald eagles are closely associated with aquatic habitats, usually nesting in large trees along shorelines and feeding on fish. A population winters below Shepaug Dam in Connecticut (NUSCO 1998).

Northern Harrier

Northern harriers are currently listed as Threatened by the MNHESP and Endangered by the CDEP. They typically nest on elevated ground in dense herbaceous vegetation of wet meadows, old fields, and shrublands (Ehrlich *et al.* 1988).

Sharp-shinned Hawk

The sharp-shinned hawk is presently listed as a species of Special Concern by the MNHESP and Endangered by the CDEP. Sharp-shinned hawks nest in coniferous, deciduous, and mixed woodlands where they constructs stick nests at heights of 3 – 18 m (10 – 60 feet) in deciduous and coniferous trees (Ehrlich *et al.* 1988, Palmer 1988). Palmer (1988) notes that the nest is typically in a stand of dense young conifers near a forest opening.

Cooper's Hawk

The Cooper's hawk is listed as a species of Special Concern in Massachusetts and Threatened in Connecticut. Cooper's hawks nest in forested habitats, particularly deciduous, riparian forest stands (DeGraaf and Yamasaki 2001), on a platform of sticks positioned in deciduous and coniferous trees at heights of 8 – 15 m (25 to 50 feet) (Ehrlich *et al.* 1988, Palmer 1988).

Red-shouldered Hawk

The red-shouldered hawk is listed as a species of Special Concern by the CDEP. This hawk favors extensive, mature, mixed deciduous-coniferous woodlands, especially bottomland hardwoods, riparian areas, and flooded deciduous swamps (Crocoll 1994).

American Kestrel

The American kestrel is listed as a species of Special Concern by the CDEP. This species is typically found in open or partly open habitats with scattered trees, cultivated fields, and urban areas (Ehrlich *et al.* 1988).

Peregrine Falcon

The peregrine falcon is listed as Endangered by the USFWS, the MNHESP, and the CDEP. This species inhabits open country, from coastal lowlands to mountainous high country, typically nesting on cliff ledges (CDEP 2000).

King Rail

The king rail is listed as Threatened by the MNHESP, and nesting populations are listed as Endangered by the CDEP. This species is found in coastal brackish and freshwater marshes and inland freshwater marshes with abundant vegetation (DeGraaf and Yamasaki 2001).

Common Moorhen

The common moorhen is listed as a species of Special Concern by the MNHESP and Endangered by the CDEP. Common moorhens inhabit fresh and brackish marshes, margins of lakes, ponds, slow-flowing rivers and streams, and sewage lagoons (DeGraaf and Yamasaki 2001).

Barn Owl

The barn owl is listed as a species of Special Concern by the MNHESP and Endangered by the CDEP. The barn owl inhabits open areas, including grassy fields, old fields, wet meadows, and wetland edges around farms and rural towns (CDEP 2000).

Long-eared Owl

The long-eared owl is listed as a species of Special Concern by the MNHESP and Endangered by the CDEP. This species inhabits thick woods and shrub swamps, roosting in dense stands of evergreens or vine-covered thickets (CDEP 2000). This owl breeds in

dense coniferous or mixed forests or groves adjacent to open habitat (DeGraaf and Yamasaki 2001).

Northern Saw-whet Owl

The northern saw-whet owl is listed as a species of Special Concern by the MNHESP. This species is typically found in moist mature woods and dense forested wetlands, and is also common at forest edges (DeGraaf and Yamasaki 2001).

Common Nighthawk

The common nighthawk is listed as Threatened by the CDEP and prefers open habitats such as grasslands, cultivated fields, burned-over woodlands, large woodland clearings and rocky outcrops (DeGraaf and Yamasaki 2001).

Whip-poor-will

The whip-poor-will is listed as a species of Special Concern by the CDEP and is typically found in open arid and humid woodlands, from lowland moist and deciduous forests to montane forests and pine-oak woodlands (Ehrlich *et al.* 1988).

Red-headed Woodpecker

The red-headed woodpecker is listed as Endangered by the CDEP. This species occurs in open woodlands, groves of large trees in old fields, and wooded swamps and favors nesting in cavities of snags (CDEP 2000).

Alder Flycatcher

The alder flycatcher is listed as a species of Special Concern by the CDEP and favors low, damp, swamp habitats, especially alder and willow thickets (Ehrlich *et al.* 1988).

Common Raven

The common raven is listed as a species of Special Concern by the CDEP. It is often found in a variety of habitats, including open woodlands, clearings, open montane forests, steep canyons, and boreal forests (DeGraaf and Yamasaki 2001).

Horned Lark

The horned lark is listed as Threatened by the CDEP. This species inhabits large fields, open areas, shoreline beaches, grasslands, and agricultural areas (CDEP 2000).

Purple Martin

The purple martin is listed as a species of Special Concern by the CDEP. It inhabits open country near water, including fields, parks, farmlands, meadows, freshwater marsh edges, and open shores of lakes and ponds (DeGraaf and Yamasaki 2001).

Sedge Wren

The sedge wren is listed as Endangered by the MNHESP and the CDEP. This species breeds in fresh or brackish sedge meadows and shallow sedge marshes with scattered shrubs and little or no standing water, along with upper margins of coastal marshes, ponds, or wetlands (DeGraaf and Yamasaki 2001).

Brown Thrasher

The brown thrasher is listed as a species of Special Concern by the CDEP and commonly inhabits dry thickets in wooded areas, second growth, brushy fields, hedgerows, forest edges, and clearings (DeGraaf and Yamasaki 2001).

Golden-winged Warbler

The golden-winged warbler is listed as Endangered by the MNHESP and Threatened by the CDEP. This species is often found in early-successional openings in deciduous forests that follow fire or logging, and also in second growth woods, dense shrubby thickets, and brush-bordered lowland areas (DeGraaf and Yamasaki 2001).

Yellow-breasted Chat

The yellow-breasted chat is listed as Endangered by the CDEP and inhabits woodland edges, dense thickets, shrubby old fields, stream thickets, and swamp margins (CDEP 2000).

Savannah Sparrow

The savannah sparrow is listed as a species of Special Concern by the CDEP and is often found in hayfields, meadows, lightly grazed pastures, salt marshes, sand dunes, and agricultural fields (DeGraaf and Yamasaki 2001).

Grasshopper Sparrow

The grasshopper sparrow is listed as Threatened by the MNHESP and Endangered by the CDEP. This species is typically found in grasslands, pastures, and old fields (CDEP 2000).

Henslow's Sparrow

The Henslow's sparrow is listed as Endangered by the MNHESP and Special Concern by the CDEP and prefers moist fields and meadows containing grasses and scattered shrubs (DeGraaf and Yamasaki 2001).

Eastern Meadowlark

The Eastern meadowlark is listed as a species of Special Concern by the CDEP. It inhabits large grassy fields of intermediate height, grassy meadows, hay fields, tallgrass prairies, agricultural fields, and open weedy orchards (DeGraaf and Yamasaki 2001).

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Chapter 6 Mammals

1.0 Introduction

The mammalian community in the ROR study area is a diverse community that includes a variety of carnivorous, omnivorous, insectivorous species. This animal community was characterized by conducting a literature review of local species and populations.

2.0 Methods

2.1 Species:Habitat Association

The principle goal for the characterization of the mammal community was to identify all species that could reasonably be expected to occur in the ROR study area, the habitats they would use, and when they would use them. The foundation of this work included a review of relevant literature on the mammal populations in western Massachusetts. Local and regional references on mammal communities were first used to identify the species whose range encompassed the ROR study area. General and technical references on the habitat requirements and use, seasonality of occurrence, and relative abundance in the region were then used to refine the list and build a matrix to include only those species whose preferred habitats are within the ROR study area (Kurta 1995, Whitaker and Hamilton 1998, DeGraaf and Yamasaki 2001).

As part of this effort, local and regional experts were consulted to obtain unpublished records regarding the historic occurrence of some species in the area. For example, the MNHESP, the MDFW, the CDEP, and the USFWS were contacted to identify any historic mammal occurrences and to review historic trapping records from the area. Information received from these agencies, organizations, and individuals was then incorporated into the species matrix.

3.0 Mammal Community Description

Fifty-three mammal species may potentially occur in the ROR study area. Many species are quite common and expected to be observed throughout the ROR study area in a

variety of habitats. These species tend to be ones with more cosmopolitan habitat requirements, such as the white-footed mouse, meadow vole, short-tailed shrew, little brown bat, cottontail, gray squirrel, raccoon, red fox, coyote, and white-tailed deer, all of which can be observed in forested and non-forested habitats as well as riverine, shoreline, wetland, upland, and residential habitats. Other species that utilize primarily riverine and wetland habitats, such as muskrat and beaver, are also common.

3.1 Carnivorous Mammals

3.1.1 Piscivorous Mammals

Two piscivorous mammals, river otter and mink, occur in the Housatonic River. Piscivorous mammals are of special interest because of their diet and habitat usage. The aquatic nature of these mammals, river otter being almost entirely aquatic and mink being semi-aquatic, results in these species having greater exposure to water-bore contaminants then most other mammals. The diets of mink and river otter, consisting largely of aquatic organisms (i.e., fish, crayfish, amphibians, and waterfowl), makes them some of the highest tropic level aquatic predators in the ROR study area, thus increasing the potential for these species to bioaccumulate high levels of environmental contaminants. PCB concentrations in fish tissue have been shown to be positively correlated with levels of PCBs in mustelid species (Foley *et al.* 1988). Many studies have shown that the concentrations of PCBs in wild mink accumulate to levels that are harmful in experimental animals (Auerlich *et al.* 1971, Bleavins *et al.*1980, Foley *et al.* 1988, Heaton *et al.* 1995, Wren *et al.* 1987). Less is known about the accumulation of PCBs and their effects in the river otter. Concentrations of PCBs were higher in river otters than in mink when these animals were collected from the same locations (Foley *et al.* 1988); mink, however, are believed to be more sensitive to PCBs (Heaton *et al.* 1995). Organ (1989) found that otters from the Housatonic River watershed had the highest level of PCBs of any otters in Massachusetts.

3.1.1.1 River Otter

Trapping data from the Massachusetts Division of Fisheries and Wildlife show that river otters have been present in the Housatonic River watershed for nearly every year with available data (1977 – 1999) (pers. comm. S. Langlois of MDFW). However, it is not known if these individuals were captured from the Housatonic River or other bodies of water within the watershed.

The river otter's diet consists of aquatic animals, especially fish. However other prey are also taken, including crayfish, amphibians, turtles, and insects. Birds, especially young waterfowl, and small mammals are occasionally taken and small amounts of plant material, such as blueberries and rose hips, are eaten (Whitaker and Hamilton 1998). Liers (1951) observed free-ranging captive river otters digging into the mud to remove frogs and turtles from hibernacula. River otters have been shown to prefer to forage in shallow water and eat primarily slow-moving, shallow-dwelling fish, such as chubs, suckers, catfish, daces, darters, and schooling fish such as bluegill and other sunfish (Whitaker and Hamilton 1998, Sheldon and Toll 1964). When studying river otters in the Adirondacks, Hamilton (Whitaker and Hamilton 1998) found fish in 70 percent of their stomachs, of which 5 percent were trout.

River otter habitat is often associated with beaver activity; beaver ponds provide an abundant supply of prey, stable water levels, den sites, and escape cover (Newman and Griffin 1994). Along with beaver activity, vertical banks, rock formations, and backwater sloughs have been shown to be associated with denning sites for river otters. Points of land, tributary streams, fallen logs, log jams, conifer trees, and pools have all been correlated with river otter latrines (Sheldon and Toll 1964, Dubuc *et al.* 1990, Newman 1990, Swimley *et al.* 1998). The Housatonic River offers an abundance of habitats that fit these characteristics. River otters are highly mobile. They are not territorial, but instead, tend to mutually avoid adjacent territories (Lariviere and Walton 1998). Home ranges may be quite large, up to 230 km^2 (90 square miles), and extend along nearly 80 km (50 miles) of waterway shoreline (Lariviere and Walton 1998, DeGraaf and Yamasaki 2001).

3.1.1.2 Mink

Mink occur in a variety of wetland habitats, but their populations are greatest in marshes (Whitaker and Hamilton 1998). Mink typically forage within sight of open water, although during the winter when water freezes over, mink will often forage farther inland (Kurta 1995). Mink have variable home range sizes, often with an average diameter of 3 – 5 km (2 – 3 miles) (DeGraaf and Yamasaki 2001). Linear distances along shorelines have been reported to be from 1.6 to 3.6 mink per mile of shoreline (DeGraaf and Yamasaki 2001).

The mink's diet varies considerably with prey availability but consists largely of fish, crayfish, frogs, small mammals, and birds. Melquist *et al.* (1981) found that fish (mostly cyprinids 7 – 12 cm long) made up 59 percent of the mink's diet in Idaho. In prairie marshes of North Dakota, birds (mostly waterfowl), mammals, amphibians, and reptiles accounted for 78, 19, 2, and 1 percent of mink diet respectively, with the amount of prey taken closely paralleling prey availability (Eberhardt and Sargeant 1977). Other studies have also found waterfowl to be an important component of the mink's diet during the spring and early summer when young waterfowl are abundant (Melquist *et al.* 1981, Talent *et al.* 1983). Crayfish have been found to be a large component of the mink's diet in areas where these prey are abundant (Burgess 1978, Melquist *et al.* 1981, Allen 1986). During the winter, mammals are the primary food source for mink. In areas where muskrats are abundant, male mink may feed heavily on them (Allen 1986). Female mink are smaller and thus tend to take smaller mammals such as mice, voles, and young rabbits (Kurta 1995, Whitaker and Hamilton 1998).

3.1.2 Insectivorous Mammals

3.1.2.1 Bats

The big brown bat, little brown bat, silver-haired bat, red bat, hoary bat, eastern pipistrelle, northern myotis, small-footed myotis and Indiana bat may occur within the ROR study area. The little brown bat and big brown bat are likely the two most common species, as they are very common throughout the Northeast. Most bat species have

experienced a rapid decline in their number in recent years due to insecticide poisoning, control measures in buildings, disturbance in wintering colonies, and general habitat loss. Little brown bats and big brown bats, however, have remained abundant and even increased their populations in some areas. The success of these two species is likely due to their adaptability to human presence and their reliance upon man-made structures, such as attics, barns and bridges, for roosting sites. The remaining species are generally uncommon to rare in the Northeast. The hoary bat, red bat, silver-haired bat, and small-footed myotis are all species of Special Concern in Connecticut, and the small-footed myotis is of special concern in Massachusetts. The Indiana bat is the rarest bat species found the region; it is a federal and state listed endangered species.

The little brown bat is probably the most common species in the RORstudy area. This bat is abundant throughout New England. Studies conducted in Maine, New Hampshire, and Massachusetts found the little brown bat to be the most abundant species present (Woodlot Alternatives, Inc. 2002, Krusic *et al.*1996, Buresch 1999, Zimmerman and Glanz 2000). These small bats can often be seen feeding in large swarms directly above the river channel, as they prefer to feed over and close to the water surface (Whitaker and Hamilton 1998). Little brown bats feed on a variety of small insects, with midges (Diptera, Chironomidea) being the staple food source. Males consume about 1.22 g of food a day and females consume 0.93 g (Coutts *et al.* 1973). After evening feeding, these bats return to communal roost sites where elevated temperatures aid in digestion and energy conservation. Little brown bats are active from April to October, after which they migrate to their hibernacula, traveling as much as 300 km from their summer habitat. These bats hibernate in small clusters in caves, abandoned mines, and less commonly in man-made structures.

Big brown bats are most abundant in agricultural and residential areas, where they feed over open fields, among scattered trees, along tree lined streets, and around city street lights (DeGraaf and Yamasaki 2001). The many agricultural, residential, and urban areas along the Housatonic River provide abundant habitats for this species. Big brown bats are beetle specialists, but will consume a wide variety of insects. They roost in man-made structures like the little brown bats, but are seldom found with little brown bats

because they prefer cooler roost sites. Big brown bats, unlike most species, do not migrate south to hibernate. They seldom travel more than 80 km to reach winter hibernacula and will often hibernate in buildings in close proximity to their summer roost sites (DeGraaf and Yamasaki 2001, Kurta 1995). Big brown bats are active for more of the year (i.e., March to November) than any other bat species found in the ROR study area and are occasionally seen during mild periods throughout the winter.

The northern myotis may be locally common in New England but is irregularly distributed throughout the region. Mist netting surveys in Maine found northern myotis to be the second most common species, making up 39 percent of the captures (Zimmerman and Glanz 2000). Krusic *et al.* (1996) also found this bat to be the second most common species, but it made up only 1 percent of the individuals captured due to high numbers of little brown bats. Summer roost sites are most commonly found in forested landscapes but residential and agricultural areas may also be used, especially by singly roosting males. Females roost in communal maternity colonies in cavities of large, dead hardwoods, predominately beech, maple, and yellow birch (DeGraaf and Yamasaki 2001). These bats are highly maneuverable, allowing them to forage in dense forest habitat. They commonly forage below the tree canopy but above the shrub layer, as well as in forest clearings and above forested waterways. Their winter hibernacula include caves, abandoned mine shafts, and hydroelectric dams with temperatures between 2 and 7° C (Kurta 1995). Like the little brown bat and big brown bat, the northern myotis does not make long distance migrations to hibernacula and may often be found hibernating in mixed groups with other bat species.

The silver-haired bat and eastern pipistrelle are generally uncommon summer residents in New England (DeGraaf and Yamasaki 2001). Recent studies have routinely recorded their presence, especially during fall migration when they travel from their summer habitat of northern hardwood and mixed-wood forests to winter hibernacula in the southern United States, but generally report low numbers of individuals (Krusic *et al.* 1996, Buresch 1999). Bat surveys of the Housatonic River in Pittsfield and Lenox, Massachusetts, however, found silver-haired bats to be the second most commonly recorded species (Woodlot Alternatives, Inc. 2002). The ROR study area offers prime

habitat for these bats, as they prefer to feed above watercourses on emerging aquatic insects (DeGraaf and Yamasaki 2001). Eastern pipistrelles forage along forest edges, in forest clearings, and fields, avoiding dense forested areas. Both the silver-haired bat and the eastern pipistrelle roost in tree cavities, under loose bark, and in furrowed bark folds, preferring willow, maple, and ash (Kurta 1995). The abundance of large silver maples in the floodplain forests, with optimal roost sites in close proximity to preferred feeding habitat, may explain why silver-haired bats were found to be common in the Housatonic River area.

Red bats and hoary bats are also typically uncommon in the region. Both species are forest dwelling bats, preferring older age-class forests (DeGraaf and Yamasaki 2001). Red bat roost sites are selected in dense foliage of hardwood trees or large shrubs, such as elm, maple, cherry, and walnut, with shade above and to the side but open below. Hoary bats prefer coniferous trees but will utilize deciduous trees as well. Roost sites will differ day to day but are often in close proximity to one another. In Autumn, both these species migrate in small groups to winter hibernacula in the southern United States and Central America (typically below 40° N) (DeGraaf and Yamasaki 2001). The ROR study area provides optimal habitat for both feeding and roosting locations. Feeding territories are established over still water or along forest edges and clearings, within 1.2 km (0.75 mile) from roost sites. These bat species feed on a wide variety of insects, but prefer larger insects such as moths, beetles, and cicadas (DeGraaf and Yamasaki 2001).

Bats in general have few predators, owls and hawks being the most common. Bats are most vulnerable in their roosts where snakes, predaceous birds, and mammals (especially blue jays, cats, and raccoons) will prey upon them. Highest mortality rates are among the young, and falling from maternity sites is also the greatest cause of death for young. Poisoning from insecticide ingestion is a common cause of mortality (Whitaker and Hamilton 1998). Bats are also at risk of bioaccumulating environmental contaminants, such as PCB and dichlorodiphenyldichloroethylene (DDE), which reduce reproductive success and cause tremoring and mortality (Clark and Lamont 1976, Clark and Stafford 1981, Clark 1978). Prolonged tremoring, which is characteristic of organochlorine poisoning, can be especially lethal to bats because it can reduce fat stores needed to

survive hibernation (Clark and Stafford 1981). Any disturbance during hibernation uses fat stores and reduces survival. Many bat populations have been reduced due to repeated disturbances from human recreation in caves. Some species, such as the Indiana bat, that have large percentages of their entire population hibernating in only a few caves are at greatest risk from this type of disturbance (Whitaker and Hamilton 1998).

3.1.2.2 Shrews

The masked shrew, smoky shrew, northern short-tailed shrew, and northern water shrew are all species that could occur in the ROR study area. The short-tailed shrew and masked shrews are likely to be common. The smoky shrew may be locally common in cool, damp upland forests. The northern water shrew is uncommon in New England (DeGraaf and Yamasaki 2001).

The northern short-tailed shrew is a large shrew commonly found throughout the northeastern United States. It uses a wide variety of habitat types from open meadows to forests, although its primary habitat requirement is cool, moist soil (Whitaker and Hamilton 1998). Short-tailed shrews feed primarily on invertebrates, with earthworms as the most important food, followed by slugs and snails (DeGraaf and Yamasaki 2001). Amphibians, mice, and birds are occasionally eaten. The short-tailed shrew consumes some plant material (i.e., roots, nuts, berries, and fungi), especially during the winter when caches of such food help to maintain energy resources. Populations of this shrew show high annual variation with densities ranging from 1.6 – 121 individuals per ha, but averaging 2.5 (Whitaker and Hamilton 1998, DeGraaf and Yamasaki 2001). Northern short-tailed shrews typically breed after their first year and have three litters a year ranging in size from 1 – 7 young (Whitaker and Hamilton 1998).

The masked shrew is commonly encountered in habitats ranging from moist, grassy fields to dense boreal forests. It can be found in most of the wetland and terrestrial habitat types within the ROR study area. This tiny shrew is the smallest mammal occurring in the study area. Individuals captured during small mammal surveys in Massachusetts ranged from 92 – 107 mm long and weighed only 3.4 – 3.7 grams (Woodlot Alternatives, Inc. 2002). Masked shrews feed on small insects, mollusks, annelids, and the dead

bodies of larger animals. Ants often make up a large portion of the diet, as do beetle larvae, slugs, snails, and spiders (Whitaker and Hamilton 1998). Masked shrews have home ranges of 0.04 ha (0.10 acres) per individual and densities of 9 individuals per acre with large annual variation (DeGraaf and Yamasaki 2001). Masked shrews reach sexual maturity at four months, after which they have up to three litters, averaging seven in size, each year.

The smoky shrew prefers shady, damp northern forests with dense ground cover and an abundance of moss-covered logs and boulders. It can, however, be found in a variety of habitats, including bogs, swamps, talus slopes, and stream banks. Smoky shrews feed on small leaf-litter invertebrates, earthworms, and small salamanders. Population densities of 12 – 35 per ha are most common, though densities as high as 143 per ha have been reported (Whitaker and Hamilton 1998).

The northern water shrew is a species of conservation concern in Massachusetts and is uncommon throughout New England (see Section 4.0). The northern water shrew occurs in wet habitats, especially grass-sedge marshes and shrub communities along streams. It is most common in swift-flowing, coldwater mountain streams with boulders, woody debris, and tree roots to provide cover. Like all shrews, the northern water shrew is insectivorous, with stonefly, mayfly, and caddisfly larvae making up the largest part of its diet. It also consumes a variety of other invertebrates, small fish, and amphibians.

3.1.2.3 Moles

Three mole species potentially occur in the ROR study area: the hairy-tailed mole, eastern mole, and star-nosed mole. The star-nosed mole is likely the most common mole species found in the ROR study area, as the hairy-tailed mole and eastern mole prefer well-drained upland soils. The star-nosed mole prefers wet areas and is an adept swimmer, with its burrows often leading directly into a stream or pool. It can commonly be found utilizing swamps, wet meadows, and woodland vernal pools. The eastern mole is common throughout the Atlantic coastal plain and the central United States in well-drained, open grasslands. This mole may be more common in the upland, agricultural, and residential habitats within the ROR study area. The hairy-tailed mole may be found

along the Housatonic River in Massachusetts and into northern Connecticut. This species prefers well-drained soils and is found primarily in forests, but also in open grasslands that support some shrubs (DeGraaf and Yamasaki 2001).

Earthworms are the most important food source for all of the moles. Other insects such as beetles, their larvae, snails, slugs, centipedes, millipedes, ants, and spiders are taken in smaller quantities. Plant matter will occasionally be taken and the eastern mole in particular may feed heavily on vegetable matter at times. The star-nosed mole will forage under water and take aquatic insects, mollusks, crustaceans, and occasionally fish (DeGraaf and Yamasaki 2001, Whitaker and Hamilton 1998).

3.1.3 Other Carnivorous Mammals

A wide variety of carnivorous mammals occur in the ROR study area. Coyotes and foxes are the most common because they utilize a wide variety of habitat types and have adapted well to human presence. Other mammalian carnivores occurring in the study area include bobcats, fishers, and the terrestrial mustelid species.

3.1.3.1 Canine

Coyotes and foxes are common canine carnivores found in the ROR study area. Coyotes have very broad habitat requirements and occupy a variety of habitats from open fields and agricultural lands to forested communities. In winter, coyotes readily use river and marsh communities for travel and hunting. Coyotes prey upon a variety of mammals, birds, herpetiles, and insects, with small mammals and rabbits being the most important food sources. Seasonally, their diet can be quite omnivorous, as they often eat berries in summer and early fall. Larger game, such as deer, is occasionally taken when the pack hunts cooperatively. Coyote ranges in the northeast are highly variable, depending upon food resources, but average 52 and 48 km^2 for males and females, respectively (DeGraaf and Yamasaki).

Two fox species, red and gray, may occur in the ROR study area, with the red fox being the more common. Alhough both fox species can occupy a variety of habitats, the red fox prefers open areas such as agricultural land and forest edges, while the gray fox is

more common in thickets and densely forested areas. Foxes feed primarily on small mammals, rabbits, squirrels, herpetiles, birds, and insects. While being largely carnivorous, their diet may be more omnivorous based upon the seasonal availability of insects, fruits, and nuts (DeGraaf and Yamasaki 2001). Foxes form small family units during breeding season but, unlike coyotes, remain solitary for the majority of the year. They vigorously defend small territories averaging 100 ha in size.

3.1.3.2 Feline

Bobcats are the only feline known to occur in the ROR study area, but are not common. Bobcats inhabit mixed-wood forests, brushy rocky woodlands, and dense regenerating stands (DeGraaf and Yamasaki 2001). The rocky ledges amid forests along the Housatonic River are prime habitat for bobcats.

3.1.3.3 Mustelid

Several members of the mustelid family may occur in the ROR study area. The mink and river otter are discussed above. The terrestrial mustelid species, including the short-tailed weasel, long-tailed weasel, and fisher are addressed here. These mustelid species are all carnivores, preying upon a variety of small mammals. The weasel species are smaller and rely primarily upon mice, voles, shrews, squirrels, rabbits, and occasionally insects, birds, and amphibians. Fisher also take small mammals but their diet contains larger prey items, such as snowshoe hare, porcupine, raccoons, and even deer. Fisher will also consume nuts, seeds, and fruits. Fisher populations have been reduced due to human tapping for the fur trade, but habitat protection and stricter trapping laws have allowed populations to increase in recent years (Whitaker and Hamilton 1998).

3.2 Omnivorous Mammals

Omnivorous mammals are one of the most abundant groups of mammals found in the ROR study area. Common omnivores in the study area include mice, raccoons, striped skunks, Virginia opossums, and black bears.

Black bears are the largest omnivore found in the ROR study area, typically weighting 50 – 227 kg (110 – 500 lbs), with males being the larger of the sexes (Whitaker and Hamilton 1998). Black bears use a variety of habitat types, including forested habitats, shrub swamp, shallow emergent marsh, and old-field. Black bears once occurred throughout the eastern United States but are now limited primarily to secluded northern forests of Maine, New Hampshire, Vermont, New York and south along the Appalachian Mountains into Georgia. Black bears are carnivores but can be largely omnivorous, with their diet depending upon seasonal and regional availability of food. They feed on buds, grasses, and forbs in the spring, fruit and mast during the summer and fall. Insects such as ants, wasps, bees, beetles, and their larvae make up the largest portion of animal matter in the black bear's diet (Whitaker and Hamilton 1998). Small mammals and fish are occasionally eaten and carrion is readily consumed.

The Virginia opossum, raccoon, and striped skunk are all common in the ROR study area. While all three have teeth designed for carnivory, the feeding habits of these species is opportunistic and consists of a wide range of plant and animal material. The raccoon is probably the most abundant of these omnivores. Raccoons occur throughout the United States, with the exception of the desert communities of the southwest, and are common to abundant throughout their range. They are found in forest communities interspersed with open fields and watercourses. Raccoon populations are often high in wetland communities, near streams, pools, and lakeshores, where they forage for crayfish, amphibians, and fish. Densities vary depending upon suitability of available habitat, ranging from one raccoon per 1.8 ha (4.4 acres) in suburban woodlands to one per 28 ha (68.4 acres) in agricultural areas (DeGraaf and Yamasaki 2001). Raccoons are opportunistic feeders consuming a wide variety of animal matter, vegetation, seeds, and berries depending upon availability. Crayfish, earthworms, amphibians, turtle eggs and young, bird eggs (especially eggs of cavity nesting waterfowl such as wood ducks), and carrion are common animal food types. In agricultural areas large amounts of corn, wheat, and other grains are consumed. Raccoons have adapted well to humans and are common in urban parks and residential areas, where they often become nuisances feeding on garbage. Raccoon are dormant throughout the winter, but do not enter true

hibernation. They rely mainly on fat stores throughout the winter, but will emerge from dens to forage during periods of mild weather.

Striped skunks are common throughout the eastern United States (Whitaker and Hamilton 1998). They can occur in a variety of habitats but prefer semi-open woods, meadows, and agricultural areas. Like the raccoon, striped skunks have adapted well to human presence and are often found in residential areas and trash dumps. Stripped skunks are truly omnivorous, with their diet typically containing insects, rodents, bird eggs, carrion, garbage, seeds, fruits, and nuts. During the spring and summer, insects are the most important prey items, making up as much as 43 percent of the diet (DeGraaf and Yamasaki 2001). Fruits, grains, and nuts become more important food items in the fall and winter. Skunks are mostly inactive during winter, relying on fat stores to meet their energy needs, which are reduced by communal denning, lowered body temperatures, and decreased activity.

Virginia opossums are somewhat uncommon in the New England region, as they reach their northern limit here. Virginia opossums can occur in a variety of habitats from forests to urban areas, and are often common in wet woods and swamps. Like raccoons and skunks, Virginia opossums are opportunistic feeders, taking a wide variety of plant and animal matter. They are also common in urban and residential areas, where they feed on garbage and are often killed by dogs and automobiles.

3.3 Herbivorous Mammals

3.3.1 Large Herbivores

White-tailed deer and moose are the only large herbivores found in the ROR study area. White-tailed deer are abundant throughout the study area. Moose have been found primarily in the higher-elevation habitat of north and central Berkshire County, Massachusetts; however, they are extending their range southward into Connecticut (DeGraaf and Yamasaki 2001). They are uncommon in Berkshire County but recent trends indicate an increasing population (Whitaker and Hamilton 1998). Deer are browsers that feed on grasses, forbs, and new leaves of woody plants during the summer.

They feed heavily on acorns, beechnuts, and other mast sources as they become available. During the winter they feed on the buds and twigs of woody plants. Moose are also browsers, though they tend to rely more upon trees and shrubs during the spring and summer than do deer. Moose are commonly found in lakes and ponds during the spring and early summer, where they feed on the aquatic vegetation.

3.3.2 Small Herbivores

Small terrestrial herbivores occurring in the ROR study area include snowshoe hare, cottontails, squirrels, eastern chipmunk, woodchucks, porcupine, mice, voles, and southern bog lemming. The two aquatic, herbivorous mammals occur in the study area are the American beaver and common muskrat.

The white-footed mouse, deer mouse, house mouse, meadow jumping mouse, woodland jumping mouse, Allegany woodrat, and Norway rat all potentially occur in the ROR study area. The white-footed mouse and deer mouse are two similar species that are common in the ROR study area. Both inhabit a wide variety of habitats, with the white-footed mouse being more common in deciduous and mixed forests while the deer mouse is more common in coniferous and mixed forests. Both species can be found along forest edges, brushy clearings, and hedgerows, and they occasionally venture into open grassland (DeGraaf and Yamasaki 2001). Woodland jumping mice typically occur in a variety of forest habitats, from spruce/fir to northern hardwoods. They are most commonly found in open, moist forests often near streams (Whitaker and Hamilton 1998). Meadow jumping mice typically occur in cultural grassland communities. Grassy clearings in forested regions may support small numbers of meadow jumping mice, and they are often found in early successional forests (Whitaker and Hamilton 1998). House mice and Norway rats are Old World species introduced into North America during early settlement and are now abundant in urban, residential, and agricultural areas throughout the country. These species can be encountered in natural communities as well, but are limited to locations in close proximity to human establishments (DeGraaf and Yamasaki 2001).

While traditionally considered to be herbivores, these mice and rat species' diets vary greatly depending upon seasonal and regional availability of food sources, and can include a high percentage of animal matter. Large amounts of insects (primarily ground beetles, caterpillars, cutworms, snails, and centipedes) are taken during the spring and summer. They will occasionally take small birds and other small mammals. As the season progresses, the diet of these mammals shifts more towards seeds, nuts, berries, and fungi. Tiny fungi of the genus *Endogone* can make up a major portion of the small mammal diet in spite of its microscopic size. Thirty-three percent of the stomach contents from woodland jumping mice in New York were fungi (Whitaker and Hamilton 1998). White-footed mice are active year-round and often cache large amounts of seeds and nuts to last throughout the winter.

Several species of voles and lemming occur in the ROR study area: meadow vole, southern red-backed voles, woodland vole, and southern bog lemming. Meadow voles are probably abundant in the ROR study area. These voles inhabit wet meadows, regenerating pastures with shrub colonies, and wet forest openings. Meadow voles eat large quantities of green vegetation—predominately grasses, sedges, and their seeds, fleshy rootstocks, and bark—often exceeding their own weight in a 24-hour period. They also re-ingest their feces to extract the vitamins and nutrients broken down in the later stages of digestion (i.e., they are coprophagic). Meadow voles are among the most abundant and prolific small mammals in the eastern United States. A single female can produce as many as 17 litters in a year, with each litter containing 1 – 11 young (Whitaker and Hamilton 1998). Southern red-backed voles are also common in New England. These voles are a forest species and are seldom found in open areas. Southern red-backed voles feed on a variety of nuts, seeds, berries, green vegetation, roots, and fungi, depending upon seasonal availability. They store large amount of seeds and nuts to provide food in the winter, as they are active year-round.

The woodland vole is the most fossorial of New England rodents, spending the majority of its time below ground in tunnel systems it excavates. Woodland voles favor well-drained upland soils and, therefore, are less likely than the other vole species to be found along the Housatonic River floodplain. This vole forages primarily on subterranean roots

and tubers of common forbs and grasses, but will also consume seeds, nuts, and berries (DeGraaf and Yamasaki 2001). Southern bog lemmings are a species of Special Concern in Massachusetts and Connecticut. These uncommon voles inhabit a variety of open and forested habitats, particularly those with moist soils, thick leaf molds, and sphagnum cover. This species tends to avoid interspecific encounters with other voles, and is outcompeted by meadow voles in extensive, open grassy areas.

Six members of the squirrel family—red squirrels, gray squirrels, northern flying squirrels, southern flying squirrels, eastern chipmunks, and woodchucks—could potentially occur in the ROR study area. All of the squirrels are forest-dwelling species, as trees are needed for nesting and food. The chipmunk is an exception to this; it requires burrows in the ground, under rocks, or in rotting stumps and logs, but will also utilize trees for foraging. The woodchuck is also a burrowing species, found in well-drained soils of open woodlands, meadows, and agricultural habitat. The eastern gray squirrel is abundant in the eastern United States in a variety of residential areas and forested landscapes containing mast-producing, deciduous trees. Red squirrels are more common in coniferous and mixed-wood forests, where they feed largely on coniferous seeds, buds, and sap. The two flying squirrel species are found in mature forests with cavity trees. Nuts, seeds, fleshy fruits, and buds are the primary food sources of the six squirrel-family species, with the exception of the woodchuck, which feeds on succulent green vegetation. These squirrels are also known to eat bird eggs, insects, and young vertebrates, with the red and southern flying squirrels being the most carnivorous.

The porcupine is another common species of the northern forests. Porcupines spend the majority of their time in trees, where they forage for leaves, buds, mast, and young twigs. Their diet is seasonal, with buds and young leaves being consumed in the spring and summer, mast in the fall, and the inner bark and young twigs in the winter. American beech, ash, basswood, apple, and aspen are the favored species, as they build up less tannin in their leaves than other species such as maple and oak. Spruce, pine, and eastern hemlock are also consumed in the winter. Porcupines have relatively small home ranges for their size, with summer ranges of 30 – 150 ha (75 – 370 acres) and a winter range of only 2.4 ha (6 acres) (Whitaker and Hamilton 1998).

Three lagomorph species—snowshoe hares, eastern cottontail, and New England cottontail—could potentially occur within the ROR study area. The snowshoe hare is a northern species that prefers dense coniferous forests and regenerating shrubs in mixed-wood forests. The eastern cottontail is likely the most abundant rabbit species found in the ROR study area. This species is commonly observed in many terrestrial habitats, floodplain forests, swamps, and wet meadows. Colonization of the eastern cottontail throughout the Northeast has lead to the decline of New England cottontail in much of its range. New England cottontails are now considered rare except for southern Maine, New Hampshire, and part of Massachusetts. New England cottontails and eastern cottontails cannot be distinguished by their tracks or scat. These two species can sometimes be separated visually based on the presence of a black patch between the ears of New England cottontail and the presence of a white patch on the forehead of eastern cottontail. The forehead patch, however, may be missing on approximately 50 percent of eastern cottontails (Godin 1977). All three lagomorph species feed heavily upon grasses and clover in the summer, and seeds and berries as they become available in the late summer and fall. Cottontails are likely to be seen foraging on residential lawns and in agricultural pastureland in the ROR study area. Buds and twigs of shrubs, stems of blackberries, and sapling sprouts are the primary food source in winter.

American beaver and common muskrat are the two aquatic, herbivorous mammals that occur in the ROR study area. Both are abundant throughout the study area. American beavers can be found throughout North America in any area where suitable rivers, streams, pond, or lakes exist. Their primary requirement is water deep enough to prevent ice from freezing to the bottom, which they often create by damming streams and seepages. They den by constructing large floating lodges, excavating bank dens, or combining these methods. The beaver is a generalist feeder, consuming whatever plants are available. During the summer, the diet is made up of aquatic plants, such as pond-lilies, bur-reed, cattails, pondweed, and algae. Bark, primarily from hardwoods, makes up the winter diet of beavers. Trees and shrubs are cut during the late summer and fall months and stored, or cached, for the winter by anchoring it underwater in mud near the lodge. Beavers are communal animals, sharing lodges, workloads, and food caches. A

typical colony consists of six individuals made up of a pair of adults, their recent young, and occasionally yearlings. Typical colony densities are 0.32 to 1.1 per mile of stream (Whitaker and Hamilton 1998).

Muskrats are also abundant throughout the ROR study area, primarily in deep emergent marshes. Roots and stalks of cattails (*Typha*), three-square grass (*Schoenoplectus*), and rushes (*Juncus*) are favorite food sources. Muskrats will eat a wide variety of aquatic plants and may invade nearby fields to feed on herbaceous vegetation. They often build an extensive system of channels to allow for easy winter access between food sources and lodges. Lodges are built of aquatic vegetation with underwater access holes. Muskrats are territorial, with a pair of muskrats defending a territory roughly 61 m (200 feet) in diameter around their lodge.

4.0 Rare, Threatened, and Endangered Mammals

Seven mammal species of conservation concern potentially occur in the study area. The Indiana bat is a Massachusetts, Connecticut, and Federal-listed Endangered species. The water shrew, small-footed myotis, and southern bog lemming are of species of Special Concern in Massachusetts. The small-footed myotis, silver-haired bat, hoary bat, red bat, and southern bog lemming are species of Special Concern in Connecticut (CDEP 1998, MNHESP 1999).

Indiana Bat

The Endangered status of the Indiana bat is due primarily to the limited number of winter hibernating sites. Eighty-five percent of Indiana bats hibernate in 7 caves located in Missouri, southern Indiana, and Kentucky, with 50 percent in just 2 of those (Kurta 1995). In addition, range-wide population levels of this species have decreased drastically since 1960 (Whitaker and Hamilton, 1998). In summer, Indiana bats range throughout much of the eastern United States, from southern New Hampshire south along the Appalachian Mountains to the panhandle of Florida and west into northeastern Oklahoma.

Historically, Indiana bats may have used much of Massachusetts and Connecticut during the summer breeding period. The floodplain forests of the ROR study are are suitable foraging habitat, and large silver maples with exfoliating bark could provide suitable maternity sites. Indiana bats forage primarily in upland and bottomland forests, with dense hillside and ridge forests their preferred location (LaVal *et al.* 1977). A variety of small insects are consumed, with moths taken most often, followed by Coleoptera and Diptera (Whitaker and Hamilton 1998). It was historically recorded in Berkshire, Hampden, and Worcester Counties; however, the Indiana bat is extremely rare in the northeast and has not been reported from Massachusetts since 1939 (MNHESP 1984).

Other Bats

The small-footed myotis is listed as a species of Special Concern by the MNHESP and CDEP. It ranges from Ontario and southern Quebec, down the Appalachian Mountains to northern Georgia, and west into Arkansas and Oklahoma. These bats usually occur in mountainous regions. Small-footed myotis utilize buildings, overhanging rocks, and caves as summer roost and maternity sites. Suitable summer habitat is present in and adjacent to the ROR study area and it is likely that the small-footed myotis occurs there. Little is known about its feeding habits, but they are believed to be similar to other *Myotis* species. Flies, beetles, bugs, leafhoppers, and flying ants have been found in their stomachs (Kurta 1995). They hibernate in caves and mines from November to March, usually in the foothills of mountains, up to 2,000 feet in elevation, in coniferous woodlands (DeGraaf and Yamasaki 2001).

The small-footed myotis has been recorded in western Massachusetts and has been documented twice since 1978 in Hampden County, Massachusetts (MNHESP 1984, Godin 1977), making its presence in the northern part of the ROR study area possible. The CDEP lists small-footed myotis as being extirpated from the state. Other studies conducted in Maine and New Hampshire have reported small-footed myotis observations (Zimmerman and Glanz 2000, Krusic *et al.*1996).

Silver-haired bats, red bats, and hoary bats are all listed as species of Special Concern in Connecticut. Low numbers of these species are attributed to a combination of summer

roosting habitat loss, disruption in winter hibernacula, and insecticide poisoning (DeGraaf and Yamasaki 2001).

Water Shrew

The water shrew is listed as a species of Special Concern by MNHESP. It occurs throughout much of Canada and the northeastern United States, from Maine to Connecticut, west to eastern New York and north-central Pennsylvania, extending south in the Appalachian Mountains. This species is also common in mountainous regions of western United States (Whitaker and Hamilton 1998).

Water shrews are usually found near open water. Their optimal habitats are small fast-flowing mountain streams with abundant cover provided by undercut banks, rocks, downed trees and debris. However, they can also less commonly be found in slow-moving streams, graminoid meadows, beaver impoundments, and temporary pools. Water shrews have historically been collected in Berkshire County, Massachusetts (Godin 1977), and the ROR study area contains suitable habitat for this species.

Southern Bog Lemming

The southern bog lemming is a species of Special Concern in Massachusetts and Connecticut. This species' range extends from Quebec, south through the Appalachians to the western Carolinas, west throughout the Great Lakes Region and into Kansas and Arkansas (Whitaker and Hamilton 1998). They are most abundant in the Great Lakes Region. Southern bog lemmings can be found in a variety of habitats ranging from forests to grasslands, although their primary habitat is sphagnum bogs and areas supporting thick mosses and deep leaf mold (DeGraaf and Yamasaki 2001, Kurta 1995). The chief requirement for southern bog lemmings is the presence of green, succulent monocots, primarily sedges and grasses that make up the majority of their diet. Some berries may be taken when in season, as well as fungi and mosses. The shrub swamp, wet meadow, and floodplain forests of the ROR study area offer potential habitat for the southern bog lemming, as do the mesic forest slopes of nearby mountains.

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SECTION IV ATTACHMENTS

Attachment A Species:Habitat Matrix

Attachment B List of Plant Names

Attachment C Birds potentially migrating through study area.

Attachment A Species:Habitat Matrix

Feeding Strategies
H - Herbivore
O - Omnivore
Ci - Primarily insectivore
Cp - Primarily piscivore
C - Carnivore

Status
E – Endangered
T – Threatened
SC - Special Concern

Season of Use
B = Breeding
M = Migration
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	Scientific name	Common name	Special Habitat Requirements	Feeding Strategy	Status			Natural and Developed Communities in the 100-year Floodplain for Rest of River																																				
								Lacustrine	Riverine			Palustrine											Terrestrial																						
					Massachusetts	Connecticut	Federal	Moderately alkaline lake/pond	High-gradient stream	Medium-gradient stream	Low-gradient stream	Riverside seep	Mud flat	Red maple swamp	Black ash-red maple-tamarack calcareous seepage swamp	Transitional floodplain forest	High-terrace floodplain forest	Shrub swamp	Deep emergent marsh	Shallow emergent marsh	Wet meadow	Calcareous sloping fen	Riverine pointbar and beach	High-energy riverbank	Riverside rock outcrop	Calcareous rock cliff	Spruce-fir-northern hardwood forest	Northern hardwoods-hemlock-white pine forest	Successional northern hardwood forest	Red oak-sugar maple transition forest	Rich, mesic forest	Cultural grassland	Agricultural cropland	Residential/industrial development	Woodland vernal pool [1]
Fish	*Anguilla rostrata*	American eel	Lakes and streams	O				Y	M	M	Y																														
Fish	*Alosa pseudoharengus*	Alewife	Lakes and rivers	Ci				Y	M	M	Y																														
Fish	*Carassius auratus*	Goldfish	Shallow lakes, muddy streams and backwaters	O				Y			Y																														
Fish	*Cyprinus carpio*	Common carp	Muddy lakes, rivers, and backwaters	O				Y			Y																														
Fish	*Exoglossum maxillingua*	Cutlips minnow	Small to medium rocky streams	Ci					Y	Y																														
Fish	*Luxilus cornutus*	Common shiner	Rocky pools and small to medium rivers, sometimes lakes	O				Y		Y	Y																														
Fish	*Notemigonus crysoleucas*	Golden shiner	Quiet, weedy waters of ponds and sluggish streams	O				Y			Y																														
Fish	*Notropis bifrenatus*	Bridle shiner	Lakes, low-gradient streams, often in vegetation	Ci	SC						Y																														
Fish	*Notropis hudsonius*	Spottail shiner	Clear rivers and lakes with gravel substrate	Ci				Y		Y	Y																														
Fish	*Pimephales notatus*	Bluntnose minnow	Ubiquitous, though found more commonly in rocky streams	Ci						Y	Y																														
Fish	*Pimephales promelas*	Fathead minnow	Muddy pools of streams and rivers, lakes	Ci				Y			Y																														
Fish	*Rhinichthys atratulus*	Blacknose dace	Rocky headwaters and small to medium rivers	Ci					Y	Y	Y																														
Fish	*Rhinichthys cataractae*	Longnose dace	Riffles of fast-flowing streams	Ci					Y	Y																														
Fish	*Semotilus atromaculatus*	Creek chub	Rocky and sandy streams and headwaters	O						Y																														
Fish	*Semotilus corporalis*	Fallfish	Gravel and cobble bottomed streams, lake margins	Ci				Y		Y	Y																														

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Fish	*Catostomus catostomus*	Longnose sucker	Lakes, streams, and small rivers, often clear and cold systems	O	SC	SC		Y		Y																																		
Fish	*Catostomus commersoni*	White sucker	Ubiquitous in lakes and streams	O				Y		Y	Y																																		
Fish	*Erimyzon oblongus*	Creek chubsucker	Sand and gravel bottomed pools in streams and small rivers	O						Y	Y																																		
Fish	*Ameiurus catus*	White catfish	Muddy bottomed, slow-moving streams, lakes, and backwaters	Ci						Y	Y																																		
Fish	*Ameiurus natalis*	Yellow bullhead	Muddy bottomed, slow-moving streams, lakes, and backwaters	Ci				Y		Y	Y																																		
Fish	*Ameiurus nebulosus*	Brown bullhead	Muddy bottomed, slow-moving streams, lakes, and backwaters	Ci				Y			Y																																		
Fish	*Ictalurus punctatus*	Channel catfish	Deep pools of streams and rivers, lakes	Ci				Y			Y																																		
Fish	*Esox americanus*	Redfin pickerel	Lakes, backwaters, and low-gradient streams with vegetation	Cp				Y			Y																																		
Fish	*Esox lucius*	Northern pike	Lakes, low-gradient streams, backwaters of medium rivers	Cp				Y			Y																																		
Fish	*Esox masquinongy*	Tiger muskellunge	Clear vegetated lakes, quiet pools and backwaters of creeks and rivers.	Cp							Y																																		
Fish	*Esox niger*	Chain pickerel	Quiet, shallow, weedy water, with mud substrate	Cp							Y																																		
Fish	*Oncorhynchus mykiss*	Rainbow trout	Cool, fast-flowing streams	Ci					Y	Y																																		
Fish	*Salmo trutta*	Brown trout	Lakes and medium- to high-gradient streams	Ci				Y	Y	Y																																		
Fish	*Salvelinus fontinalis*	Brook trout	Cold, clear streams and lakes	Ci				Y	Y	Y																																		
Fish	*Lota lota*	Burbot	Deep water of medium to large rivers and lakes	Cp	SC	E		Y			Y																																		

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Fish	*Fundulus diaphanus*	Banded killifish	Sand or mud-bottomed low-gradient streams and lakes	O				Y			Y																											
Fish	*Cottus cognatus*	Slimy sculpin	Rocky bottomed streams and lakes, springs	Ci				Y	Y	Y																												
Fish	*Morone americana*	White perch	Lakes and streams	O				Y			Y																											
Fish	*Ambloplites rupestris*	Rock bass	Rocky, flowing streams with dense aquatic vegetation	Ci						Y	Y																											
Fish	*Lepomis auritus*	Redbreast sunfish	Lakes, ponds, and moderately-flowing streams	Ci				Y		Y	Y																											
Fish	*Lepomis cyanellus*	Green sunfish	Large and small lakes, rivers, and streams	Ci				Y		Y	Y																											
Fish	*Lepomis gibbosus*	Pumpkinseed	Quiet, slow-moving water with aquatic vegetation	Ci				Y			Y																											
Fish	*Lepomis macrochirus*	Bluegill	Quiet, warm, weedy water	Ci				Y			Y																											
Fish	*Lepomis microlophus*	Redear sunfish	Large, quiet waters	Ci				Y			Y																											
Fish	*Micropterus dolomieui*	Smallmouth bass	Cool, clear water, rocky substrate, scant vegetation	Ci					Y	Y																												
Fish	*Micropterus salmoides*	Largemouth bass	Warm, shallow, weedy water with mud substrate	C				Y			Y																											
Fish	*Pomoxis annularis*	White crappie	Silty rivers and lakes	Ci				Y			Y																											
Fish	*Pomoxis nigromaculatus*	Black crappie	Quiet, weedy waters of low-gradient streams and ponds	O				Y			Y																											
Fish	*Etheostoma olmstedi*	Tessellated darter	Sandy or muddy bottomed streams, pools, and lakes	O				Y		Y	Y																											
Fish	*Perca flavescens*	Yellow perch	Weedy areas of lakes and slow-moving streams	Ci				Y			Y																											

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Fish	*Stizostendion vitreum*	Walleye	Lakes, pools, and backwaters of medium to large rivers	C				Y			Y																										
Reptile		Common snapping turtle	Aquatic habitat; sandy, gravely soil	O				Y		Y	Y	B	B		B			B	B	B	B	B	B	B	B												B
Reptile		Spotted turtle	Variety of aquatic habitats, including slow streams, marshes, and floodplains	O	SC	SC					B	B						Y	Y	Y	B	B	B	B	B							B	B				B
Reptile		Bog turtle	Wet meadows, fens	O	E	E	T				B			Y	Y	B	B	Y	Y	Y	B	Y									Y	Y				B
Reptile		Wood turtle	Wooded river or stream banks	O	SC	SC				Y	Y	B		B	B	B	B	B	B	B	B	B	B	B	B	B							B				B
Reptile		Eastern box turtle	Old fields, clearings, sandy soil	O	SC	SC						Y	Y								Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y				B
Reptile		Painted turtle	Ponds with projecting or floating logs	O				Y		Y	Y	B	B					B	B	B		B	B	B	B												B
Reptile		Common musk turtle	Permanent water bodies	C						Y	Y	B										B	B	B	B							B	B				
Reptile	*Eumeces fasciatus*	Five-lined skink	Steep, rocky woodlands with sparse vegetation	C		T																		Y	Y	Y	Y	Y		Y						
Reptile		Northern water snake	Variety of aquatic habitats, including lakes, impoundments, and marshes	C						B	B	B	B					B	B	B	Y	B	B	B	B												
Reptile		Northern brown snake	Damp woods, swamps, bogs, open fields	C										Y	Y	Y	Y	B	Y	Y	Y						Y	Y	Y	Y	Y	Y	Y	Y		B
Reptile		Northern redbelly snake	Moist woods, hillsides with surface debris	Ci														B			B						Y	Y	Y	Y	Y	Y	Y			
Reptile		Eastern garter snake	Moist areas, forest edges, stream edges, swamps	C						B	B	B	B	Y	Y	Y	Y	B	B	B	Y	B	B	B	B		Y	Y	Y	Y	Y	Y	Y	Y		B
Reptile		Eastern ribbon snake	Mesic woods with aquatic habitat	C		SC						B		Y	Y	Y	Y	Y	Y	Y	Y	B	B	B	B						Y					B
Reptile		Eastern hognose snake	Sandy soils, open woodlands.	C		SC																						Y	Y			Y	Y			

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Reptile		Northern ringneck snake	Mesic areas with abundant cover	C																							Y	Y	Y	Y	Y	Y				
Reptile		Eastern worm snake	Well-drained, loose soils, with cover objects	C	T											Y	Y										Y	Y	Y	Y	Y	Y	Y			
Reptile		Northern black racer	Wooded areas, fields, swamps, marshes	C										Y	Y	Y	Y	Y		B						Y	Y	Y	Y	Y	Y	Y	Y			
Reptile		Eastern smooth green snake	Upland grassy openings	Ci																B								Y			Y	Y			
Reptile	*Elaphe o. obsoleta*	Black rat snake	Steep, rocky terrain in a variety of forested areas	C	E												Y								Y	Y		Y	Y	Y	Y	Y			
Reptile	*Lampropeltis t. triangulum*	Eastern milk snake	Slash, woodpiles, debris, loose soil for laying eggs	C																							Y	Y	Y	Y	Y	Y	Y		
Reptile	*Agkistrodon contortrix*	Northern copperhead	Ridges, ledges, and talus slopes	C	E											Y	Y								Y	Y		Y	Y	Y	Y				
Reptile	*Crotalus horridus*	Timber rattlesnake	Ledges and talus slopes	C	E	E										Y	Y								Y	Y		Y	Y	Y	Y				
Amphibian		Marbled salamander	Woodland ponds or swamps for breeding	Ci	T													Y										Y		Y				B
Amphibian		Jefferson salamander	Temporary pools for breeding. Mature, deciduous, rocky forests	Ci	SC	SC								Y	Y		Y	Y	B	B	Y	Y						Y		Y				B
Amphibian		Blue-spotted salamander	Ponds or semi-permanent water for breeding	Ci	SC	SC/ T [2]								Y	Y		Y	Y	Y	Y								Y	Y		Y				B
Amphibian		Spotted salamander	Mesic woods, semi-permanent water for breeding	Ci					Y		B			Y	Y		Y	B	B	B							Y	Y	Y	Y	Y				B
Amphibian		Red-spotted newt	Water with aquatic vegetation for adults	Ci				Y			Y	Y	Y					Y	Y	Y		Y	Y	Y	Y		Y	Y	Y	Y	Y				B
Amphibian		Northern dusky salamander	Permanent or intermittent streams or seeps in woodlands	Ci								B										B					Y	Y	Y	Y	Y				
Amphibian		Northern redback salamander	Wide variety of terrestrial habitats, mostly forested	Ci										Y	Y	Y	Y										Y	Y	Y	Y	Y				B

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Amphibian		Four-toed salamander	Wet woodlands	Ci	SC									Y	Y		Y	Y		B	B	B					Y	Y	Y	Y	Y				B
Amphibian		Northern spring salamander	Cold streams (<12° C), seeps, or springs containing rock crevices	Ci	SC	T			Y	Y																	Y	Y			Y				
Amphibian		Northern two-lined salamander	Wide variety of habitats, including streams, floodplains, and swamps	Ci						Y	Y			Y													Y	Y	Y	Y	Y				
Amphibian		Eastern American toad	Moist upland woods	Ci							B			B	B	B	B	B	B	B	Y	Y					Y	Y	Y	Y	Y	Y	Y		B
Amphibian		Fowler's toad	Sandy soils, shallow water for breeding	Ci						B											Y	Y						Y	Y	Y	Y	Y	Y		B
Amphibian		Northern spring peeper	Pools for breeding	Ci							B			B	B	B	B	B	B	B							Y	Y	Y	Y	Y				B
Amphibian		Gray treefrog	Seeps, aquatic sites for breeding	Ci							B			Y	Y	Y	Y	B	B	B		B						Y	Y	Y	Y				B
Amphibian		Bullfrog	Deep water, floating and emergent vegetation	Cm				Y		Y	Y	B	B	B	B	B	B	B	Y	Y	B	B	B	B	B										B
Amphibian		Green frog	Riparian habitat	Ci				Y		Y		B	B	Y	Y	Y	Y	Y	Y	Y	B	B	B	B	B				W	W	W				B
Amphibian		Wood frog	Vernal woodland pools	Ci						B	B	Y	Y	Y	Y	Y	Y	B	Y	B	B	Y	Y	Y	Y		Y	Y	Y	Y	Y				B
Amphibian		Northern leopard frog	Wet meadows	Ci						Y	Y			B	B	B	B	B	Y	B	B	B							B	B	B	B	B		B
Amphibian		Pickerel frog	Shallow, clear water of bogs or woodland streams	Ci						Y	Y	B		B	B	B	B	B	B	B	B	B	B	B	B		B	B	B	B	B	B	B		B
Bird		Pied-billed grebe	Marshes with water and emergent vegetation	Ci	E	E				B	B								B	B															
Bird		American bittern	Undisturbed tall marsh vegetation	Cp	E	E					B	B	B					B	B	B	B	B	B	B											
Bird		Least bittern	Deep marshes with emergent vegetation	Cp	E	T												B	B																

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Bird		Great blue heron	Tall trees for nesting	Cp				B			B	B	B	B	B	B	B	B	B	B	B	B	B	B													B
Bird		Green heron	Shrub and forested wetlands	Cp				B			B	B	B	B	B	B	B	B	B	B	B	B	B	B													
Bird		Black-crowned night heron	Marshes and shores	Cp								M	M	B	B	B	B	M	M	M	M	B	M	M	M													
Bird		Turkey vulture	Forest openings, fields, large dead tree trunks	C										B	B	B	B	B			B							B	B	B	B	B	B				
Bird		Mute swan	Lakes, deep emergent marshes	H				B			B								B																		
Bird		Canada goose	Lakes, rivers, agricultural fields, and suburban parks	H				Y		Y	B	Y	Y	B	B	B	B	B	B	B	B	Y	Y	Y	Y										Y			
Bird		Wood duck	Trees >16" dbh with large cavities	O				B		Y	B	Y	Y	B	B	B	B	Y	Y	Y	B	Y	Y	Y	Y				B	Y	B						B
Bird		American black duck	Variety of aquatic habitats, prefers forested, rural areas	O						Y	B	Y	Y	B	B	B	B	Y	Y	Y	B	Y	Y	Y	Y				Y	Y	Y	Y	Y				B
Bird		Mallard	Variety of rural to urban aquatic habitats	O				Y		Y	Y	Y	Y					Y	Y	Y	Y	Y	Y	Y	Y				Y		Y	Y	Y				B
Bird		Blue-winged teal	Freshwater and brackish marshes along the coast	O		T [3]				B	B	B	B					B	B	B	B	B	B	B	B							B					
Bird		Hooded merganser	Wooded areas with cavity trees, clear fresh water	Cp				B		B	B	B	B	B	B	B	B	B	B	B		B	B	B	B						B						
Bird		Osprey	Clear lakes and rivers with fish	Cp				B		B	B	B	B									B	B	B	B												
Bird		Bald eagle	Large bodies of water with fish	C	E	E	T	Y		Y	Y	Y	Y									Y	Y	Y	Y												
Bird		Northern harrier	Marshes or open country with low vegetation	C	T	E													M	M	M	B										B	B				
Bird		Sharp-shinned hawk	Extensive, undisturbed open mixed woodlands	C	SC	E						Y	Y	Y	Y	Y	Y	Y				Y	Y	Y	Y		Y	Y	Y	Y	Y			Y			

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Bird		Cooper's hawk	Undisturbed forests	C	SC	T								B	B	Y	Y				B						B	Y	B	B	B		B		
Bird		Northern goshawk	Extensive, mature mixed woods	C										Y	Y	Y	Y									Y	Y	Y	Y	Y				
Bird		Red-shouldered hawk	Cool, moist, mature forests	C		SC								Y	Y	Y	Y				Y					Y	Y	Y	Y	Y				
Bird		Broad-winged hawk	Extensive woodlands with roads or clearings	C										B	B	B	B										B	B	B	B				
Bird		Red-tailed hawk	Mature forest-field ecotone	C								B	B	Y	Y	Y	Y				Y	B	B	B	B		Y	Y	Y	Y	Y	Y		
Bird		Rough-legged hawk	Open country	C																W	W										W	W		
Bird		American kestrel	Tall trees with cavities, open country	C		SC														Y	Y										Y	Y		
Bird		Peregrine falcon	Open country, nests on cliffs	C	E	E	E	B													B					B					B	B		
Bird		Ring-necked pheasant	Cultivated fields, farmland	O								Y	Y							Y	Y	Y	Y	Y	Y						Y	Y		
Bird		Ruffed grouse	Fallen logs amidst dense saplings	O										Y	Y	Y	Y									Y	Y	Y	Y	Y				
Bird		Wild turkey	Open, mast-producing woodlands	O										Y	Y	Y	Y				B						Y	Y	Y	Y	Y	Y		
Bird		Northern bobwhite	Brushy field edges, well-drained soils	H																											Y	Y		
Bird		King rail	Stable water levels	Ci	T	E [3]												B	B	B														
Bird		Virginia rail	Wetlands with sedge and cattails	Ci														B	B	B	B													
Bird		Sora	Emergent marshes	O														B	B	B	B													

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Bird		Common moorhen	Emergent vegetation in water 1-3 feet deep	O	SC	E		B		B	B							B	B	B																	
Bird		American coot	Shallow water with emergent vegetation	O				Y		B	B									B	B																	
Bird		Killdeer	Bare ground, sparse vegetation	Ci							B	B	B					B				B	B	B	B								B	B		B		
											B																							B				
Bird		Spotted sandpiper	Shorelines	Ci				B					B							B		B	B	B	B												
Bird		Common snipe	Moist, organic soils, large open spaces	Ci								B	B					B		B	B	B	B	B	B								B				
Bird		American woodcock	Moist soils, small clearings and dense swales	Ci										B	B	B	B	B		B	B							B	B	B	B	B					
Bird		Ring-billed gull	Rocky islets and isolated coasts	O				Y		Y		Y	Y									Y	Y	Y	Y								Y	Y				
Bird		Herring gull	Rocky and vegetated off-shore islands	O				Y		Y		Y	Y									Y	Y	Y	Y									Y				
Bird		Rock dove	Nests on cliffs, buildings, and other structures, common in residential areas	H																														Y	Y		
Bird		Mourning dove	Open land with bare ground	H										B	B	B	B			Y														Y	Y	Y	
Bird		Black-billed cuckoo	Low, dense thickets	Ci																							B	B	B	B	B	B				
Bird		Yellow-billed cuckoo	Low, dense thickets	Ci												B																	B				
Bird		Barn owl	Barns, deserted buildings, tree cavities	C	SC	E																											B	B	B		
Bird		Eastern screech-owl	Cavity trees >12" dbh	C																	Y													Y	Y		
Bird		Great horned owl	Large abandoned hawk nests, large tree cavities	C										Y	Y	Y	Y	Y			Y						Y	Y	Y	Y	Y	Y	Y	Y			

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Bird		Barred owl	Cool, damp lowlands, cavity trees >20" dbh	C										Y	Y	Y	Y									Y	Y	Y	Y	Y	Y			
Bird		Long-eared owl	Dense conifer thickets in open country	C	SC	E								Y	Y	Y	Y									Y	Y	Y	Y	Y	Y			
Bird		Northern saw-whet owl	Cavity trees >12" dbh	C		SC								Y	Y	Y	Y									Y	Y	Y	Y	Y		Y		
Bird		Common nighthawk	Feeds over water	Ci		T				B		B	B									B	B	B	B						B	B	B	
Bird		Whip-poor-will	Immature forests, woodlands, shrub areas	Ci		SC															B						B	B	B	B B				
Bird		Chimney swift	Chimneys, Feeds over water	Ci						B	B	B	B					B					B	B	B							B	B		
Bird		Ruby-throated hummingbird	Flowers, preferably red	H								B	B	B	B	B	B	B				B	B	B	B			B	B	B	B	B		B		
Bird		Belted kingfisher	Perches over streams, ponds, banks for nests	Cp				B		B	B	B	B					B	B	B		B	B	B	B											B
Bird		Red-headed woodpecker	Cavity trees in open country	O		E											B											B	B	B	B				
Bird		Red-bellied woodpecker	Mature woodlands with dead trees	O								Y	Y	Y	Y	Y	Y					Y	Y	Y	Y		Y	Y	Y	Y	Y				
Bird		Yellow-bellied sapsucker	Trees with >10" dbh	O										B	B	B	B										B	B	B	B	B				
Bird		Downy woodpecker	Trees, limbs with decay column >6" dbh	Ci										Y	Y	Y	Y									Y	Y	Y	Y	Y			Y		
Bird		Hairy woodpecker	Trees, limbs with decay column >10" dbh	CI										Y	Y	Y	Y									Y	Y	Y	Y	Y					
Bird		Northern flicker	Open areas, trees with heartrot	Ci										B	B	B	B									B	B	B	B	B	B	B			
Bird		Pileated woodpecker	Mature trees >20" dbh with decay	Ci										Y	Y	Y	Y									Y	Y	Y	Y	Y					

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Bird		Eastern wood-pewee	Mature deciduous and mixed conifer-hardwood forests, often with gaps	Ci										B	B	B	B										B	B	B	B	B	B	B			
Bird	*Empidonax virescens*	Acadian flycatcher	Riparian forests and forests bordering lakes	Ci										B	B	B	B		B												B					
Bird		Alder flycatcher	Thickets, low shrubs, clearings	Ci		SC								B	B	B	B	B			B															
Bird		Willow flycatcher	Low deciduous trees and shrubs with clearings	Ci								B	B	B	B	B	B	B		B		B	B	B	B			B	B		B					
Bird		Least flycatcher	Open deciduous or mixed forest, edges	Ci							B		B	B	B	B	B	B		B		B	B	B	B			B	B	B	B	B				
Bird		Eastern phoebe	Exposed perches in streamside clearings	Ci							B		B	B	B	B	B	B		B		B	B	B	B		B	B	B	B	B	B	B	B		
Bird		Great crested flycatcher	Mature cavity trees, deciduous forests, edges	Ci								B	B	B	B	B	B	B		B		B	B	B	B			B	B	B	B					
Bird		Eastern kingbird	Clearings, fields, edges. Fallen shoreline trees	Ci								B	B	B	B	B	B	B	B	B		B	B	B	B							B	B			
Bird		Northern shrike	Scattered trees or shrubs in open country	C														W														W	W	W		
Bird	*Vireo griseus*	White-eyed vireo	Forest and shrub edges bordering open areas (fields, roads, water)	Ci												B		B											B			B	B	B		
Bird		Yellow-throated vireo	Mature deciduous forest	Ci												B												B	B	B	B					
Bird		Blue-headed vireo	Mixed or predominantly coniferous forests	Ci										B	B	B	B										B	B		B	B					
Bird		Warbling vireo	Scattered deciduous trees	Ci										B	B	B	B	B										B	B	B	B					
Bird		Red-eyed vireo	Deciduous forests	Ci										B	B	B	B	B									B	B	B	B	B					
Bird		Blue jay	Variety of rural to urban habitats	O						Y				Y	Y	Y	Y	Y		Y							Y	Y	Y	Y	Y	Y	Y	Y	Y	

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Bird		American crow	Variety of rural to suburban habitats, open areas important	O								Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y													
Bird		Fish crow	Variety of habitats near fresh and salt water	O							Y					Y	Y																				
Bird	*Corvus corax*	Common raven	Cliffs and outcrops in rural areas	O		SC																			B	Y	Y	Y	Y	Y	Y	Y	Y		
Bird		Horned lark	Bare, exposed soil	O		T															Y											Y	Y		
Bird	*Progne subis*	Purple martin	Feed over water, nest in boxes	Ci		SC		B		B	B							B	B	B	B										B	B	B		
Bird		Tree swallow	Cavity trees >10" dbh, open areas	Ci				B			B							B			B											B	B		
Bird		Northern rough-winged swallow	Cut banks for nesting	Ci				B		B	B							B	B	B												B	B		
Bird		Bank swallow	Stabilized sandy or clay banks	Ci				B		B	B							B														B	B		
Bird		Cliff swallow	Open areas, mud, vertical wall with an overhang	Ci				B			B	B	B					B	B	B		B	B	B	B	B						B			
Bird		Barn swallow	Abandoned or little used buildings	Ci				B		B	B	B	B	B	B	B	B	B	B	B		B	B	B	B							B	B	B	
Bird		Black-capped chickadee	Cavity trees in small woodlands or clearings	O										Y	Y	Y	Y	Y		Y						Y	Y	Y	Y	Y	Y	Y	Y	Y	
Bird		Tufted titmouse	Cavity trees >8" dbh	O										Y	Y	Y	Y	Y								Y	Y	Y	Y	Y	Y	Y	Y	Y	
Bird		Red-breasted nuthatch	Cavity trees in mixed or coniferous woods	Ci										Y	Y	Y	Y									Y	Y						Y	Y	
Bird		White-breasted nuthatch	Cavity trees in hardwoods or mixed woods	Ci										Y	Y	Y	Y	Y									Y	Y	Y	Y			Y		
Bird		Brown creeper	Woodland trees with sloughing or loose bark	Ci										Y	Y	Y	Y									Y	Y	Y	Y	Y					

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Bird	*Thryothorus ludovicianus*	Carolina wren	Dense forest edges, shrub areas, shrub swamps	Ci							B							Y													Y	Y	Y	Y
Bird		House wren	Cavity trees, shrubs	Ci										B	B	B	B	B		B		B	B	B	B						B		B	B	B
Bird	*Troglodytes troglodytes*	Winter wren	Conifer forests near water, often in ravines and swamps	Ci												B	B																			
Bird		Sedge wren	Sedge meadows	Ci	E	E													B	B	B															
Bird	*Cistothorus palustris*	Marsh wren	Marshes	Ci															B	B	B															
Bird		Golden-crowned kinglet	Conifer and mixed conifer-hardwood forests	Ci										W	W	W	W	W									Y	Y					W		
Bird		Ruby-crowned kinglet	Variety of habitats during winter and migration	Ci							B			W	W	W	W				B						M	M							
Bird		Blue-gray gnatcatcher	Forests and forest fragments with significant hardwood proportion	Ci										B	B	B	B	B					B	B	B		B	B	B	B	B				B
Bird		Eastern bluebird	Low cavities, open country	O								Y									B	Y	Y	Y	Y						B	B			
Bird		Veery	Moist woodlands with understory	O										B	B	B	B	B									B	B	B	B	B				
Bird		Hermit thrush	Coniferous woodlands with dense understory	O										B	B	B	B										B	B							
Bird		Wood thrush	Cool, moist, mature deciduous or mixed forests	O										B	B	B	B	B										B	B	B	B				
Bird		American robin	Lawns, fields, agricultural areas, forest openings	O							B	B		B	B	B	B	B		B	B	B	B	B	B		B	B	B	B	B B	B	B	B	B
Bird		Gray catbird	Shrubs, thickets in open country	O												B		B				B	B	B	B							B	B	B	
Bird		Northern mockingbird	Low thickets, high perches, persistent fruits	O																	B											B	Y	Y	

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Bird		Brown thrasher	Hardwood forest-field ecotone	O		SC										Y	Y	Y									Y	Y	Y	Y	Y	Y	Y				
Bird		European starling	Cavity trees >10" dbh	O								Y	Y	B	B	B	B					Y	Y	Y	Y						Y	Y					
Bird		Cedar waxwing	Early successional forests, shrubs along streams, orchards	O						B	B	Y	Y	Y	Y	Y	Y	Y				Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y				
Bird		Blue-winged warbler	Old fields with scatted shrubs and small trees	Ci										B	B	B	B	B											B			B				
Bird		Golden-winged warbler	Open areas with saplings in deciduous woodlands	Ci	E	T												B			B							B	B	B	B				
Bird		Nashville warbler	Scattered trees interspersed with brush	Ci										B	B	B	B	B											B	B	B	B				
Bird		Yellow warbler	Scattered small trees or dense brush	Ci								B		B	B	B	B	B		B	B	B	B	B	B				B			B	B			
Bird		Chestnut-sided warbler	Brush at wood margins, hardwood seedling stands	Ci										B	B	B	B	B											B	B	B	B				B
Bird		Magnolia warbler	Young stands of spruce or fir	Ci																							B	B								
Bird		Black-throated blue warbler	Hardwoods with well-developed understory	Ci										B	B	B	B											B	B	B	B					
Bird		Yellow-rumped warbler	Coniferous trees, bayberry thickets	Ci										B	B	B	B	B									B	B		B						
Bird		Black-throated green warbler	Coniferous or mixed woodlands	Ci												B											B	B	B	B	B					
Bird	*Dendroica fusca*	Blackburnian warbler	Coniferous forests, mixed woodlands	Ci										B	B	B	B										B	B								
Bird		Pine warbler	Pine forests	Ci																							B									
Bird		Prairie warbler	Coniferous cover in old fields	Ci																												B	B			

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Bird	*Dendroica cerulea*	Cerulean warbler	Tall deciduous trees near water	Ci											B	B	B													B					
Bird		Black-and-white warbler	Deciduous or mixed conifer-hardwood forests	Ci										B	B	B	B	B		B								B	B	B	B				
Bird		American redstart	Forest and shrub habitats	Ci								B		B	B	B	B	B				B	B	B	B			B	B	B	B	B		B	B
Bird	*Helmitheros vermivorus*	Worm-eating warbler	Deciduous and mixed conifer-hardwood forests, often on slopes	Ci											B	B	B	B									B	B	B	B	B				
Bird		Ovenbird	Deciduous and mixed conifer-hardwood forests	Ci										B	B	B	B	B									B	B	B	B	B				
Bird		Northern waterthrush	Cool, shaded, wet ground with shallow pools	Ci										B	B	B	B	B																	B
Bird		Louisiana waterthrush	Woodlands with flowing water	Ci										B	B	B	B	B													B				
Bird		Common yellowthroat	Shrublands, dense forest edges, regenerating fields	Ci								B		B	B	B	B	B		B	B	B	B	B	B								B		
Bird	*Wilsonia citrina*	Hooded warbler	Forested and shrub swamps	Ci										B	B	B	B	B													B				
Bird		Canada warbler	Dense vegetation along streams and wet areas within woodlands	Ci										B	B	B	B	B										B							
Bird		Yellow-breasted chat	Dense thickets with young trees, often near water	O		E												B														B			
Bird		Scarlet tanager	Mature deciduous and mixed conifer-hardwood forests	O										B	B	B	B	B										B	B	B	B				
Bird		Eastern towhee	Dense brushy understory, well-drained soils	O														B			B						B	B				B	B		
Bird		American tree sparrow	Shrublands and forest edges during winter	O														W			W											W	W	W	
Bird		Chipping sparrow	Fields and lawns in close proximity to trees (often conifers)	O								B		B	B	B	B	B		B		B	B	B	B							B	B	B	

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Bird		Field sparrow	Old fields	O																	Y											Y	Y		
Bird		Savannah sparrow	Herbaceous cover of moderate height	O		SC														Y	Y											Y	Y		
Bird		Grasshopper sparrow	Dry grassy areas with conspicuous song perches	O	T	E																										B	B		
Bird		Henslow's sparrow	Damp, heavily overgrown fields	O	E	SC															B											B			
Bird		Song sparrow	Open shrub habitats, forest and wetland edges, yards	O								Y		Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y							Y	Y	Y	Y
Bird		Swamp sparrow	Variety of wetland and shoreline habitats	O								B		B	B	B	B	B		B	B	B	B	B	B										
Bird		White-throated sparrow	Shrublands and dense forest edges	O														Y		Y	Y						Y	Y	Y	Y	Y	Y	Y		
Bird		Dark-eyed junco	Mature conifer forests (often eastern hemlock)	O										Y	Y	Y	Y	Y									Y	Y	Y	Y	Y	Y	Y	Y	
Bird		Lapland longspur	Open fields, beaches, meadows during winter	O																W	W											W	W		
Bird		Snow bunting	Open fields, beaches, meadows during winter	O																W	W											W	W		
Bird		Northern cardinal	Thickets, vines	O										Y	Y	Y	Y	Y											Y	Y	Y	Y	Y	Y	
Bird		Rose-breasted grosbeak	Forest-field ecotones, thickets, sapling stands	O										B	B	B	B											B	B	B	B	B		B	
Bird		Indigo bunting	Forest-field ecotones	O													B															B	B		
Bird		Bobolink	Wide expanses of grasslands	O																	B											B	B		
Bird		Red-winged blackbird	Emergent marshes, often with robust, graminoid vegetation	O								B	B	B	B	B	B	B	B	B	B	B	B	B	B							B	B		

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Bird		Eastern meadowlark	Large, open areas with elevated perches (fence posts and trees)	O		SC					B									Y																
Bird		Rusty blackbird	Moist coniferous woodlands	O									B					B	B	B		B	B	B	B												
Bird		Common grackle	Conifers near water, stream and lake shores, fields and lawns	O								B	B	B	B	B	B	B		B	B	B	B	B	B	B								B	B		
Bird		Brown-headed cowbird	Forest edges, woodlands, early successional forests, fields	O										B	B	B	B	B		B						B	B	B	B	B	B	B				
Bird	*Icterus spurius*	Orchard oriole	Open areas with trees and forest patches	O										B		B	B											B	B		B					
Bird		Baltimore oriole	Tall scattered deciduous trees	O										B	B	B	B	B										B	B	B	B	B	B			
Bird		Pine grosbeak	Northern coniferous forest	H																						W	W						W			
Bird		Purple finch	Coniferous forest	H													Y	Y								Y	Y						Y			
Bird		House finch	Open ground with low seed-producing plants	H										Y	Y	Y	Y										Y				Y	Y	Y			
Bird		Common redpoll	Shrublands and forest edges during winter	O														W			W							W	W	W	W	W	W			
Bird		Pine siskin	Conifers	H																						W	W						W			
Bird		American goldfinch	Open, weedy fields with scattered small trees	H								Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y		Y
Bird		Evening grosbeak	Spruce and fir forest	O																						W	W						W			
Bird		House sparrow	Suburban and urban areas	O																												Y	Y			
Mammal	*Didelphis virginiana*	Virginia opossum	Hollow logs or tree cavities	O								Y		Y	Y	Y	Y	Y			Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y		Y

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Mammal		Masked shrew	Damp woodlands, ground cover	Ci									B	Y	Y	Y	Y	Y	Y		Y							Y	Y	Y	Y	Y			Y	Y
Mammal	*Sorex palustris*	Water shrew	Herbaceous cover, cold water, wetlands	Ci	SC					Y	Y	Y	B	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y				Y
Mammal	*Sorex fumeus*	Smokey shrew	Loose damp leaf litter	Ci										Y												Y	Y	Y	Y	Y				Y
Mammal		Northern short-tailed shrew	Low vegetation, damp, loose leaf litter	Ci										Y	Y	Y	Y	Y		Y	Y					Y	Y	Y	Y	Y	Y	Y	Y	Y
Mammal	*Cryptotis parva*	Least shrew	Open, grassy fields, salt marshes, woodland edges	Ci												Y	Y											Y			Y	Y	Y	
Mammal	*Parascalops brewer*	Hairy-tailed mole	Loose, moist, well-drained soil	Ci																						Y	Y	Y	Y	Y	Y	Y		
Mammal	*Scalopus aquaticus*	Eastern mole	Soft moist soil with earthworms	Ci										Y		Y										Y	Y	Y	Y	Y	Y	Y	Y	
Mammal	*Condylura cristata*	Star-nosed mole	Variety of open to forested, wet-mesic to hydric habitats	Ci										Y	Y	Y	Y	Y	Y	Y	Y													Y
Mammal	*Myotis lucifugus*	Little brown myotis	Dark, warm sites for maternity colonies	Ci						B	B			B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	Y	B
Mammal	*Myotis septentrionalis (keeni)*	Northern myotis	Caves with high humidity and calm air	Ci						B	B			Y	Y	Y	Y	B	B	B	B	B	B	B	B	B	B	B	B	B	B	Y	B
Mammal	*Myotis sodalis*	Indiana myotis	Hollow trees or loose bark in summer	Ci	E	E	E			B	B			B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Mammal	*Myotis leibii*	Small-footed myotis	Cold, dry hibernacula in winter	Ci	SC	SC				B	B			Y	Y	Y	Y	B	B	B	B	B	B	B	B	B	Y				B	B	Y	B
Mammal	*Lasionycteris noctivagans*	Silver-haired bat	Dead trees with loose bark; streams	Ci		SC				B	B			B	B	B	B	B	B	B	B	B	B	B	B		B	B	B	B	B	B	B	B
Mammal	*Pipistrellus subflavus*	Eastern pipistrelle	Warm, draft-free, damp sites for hibernation	Ci						B	B			Y	Y	Y	Y	B	B	B	B	B	B	B	B	B	Y	Y	Y	Y	Y	B	B	Y	B
Mammal	*Eptesicus fuscus*	Big brown bat	Cold, dry areas of caves	Ci						B	B			Y	Y	Y	Y	B	B	B	B	B	B	B	B	B	Y	Y	Y	Y	Y	B	B	Y	B

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Mammal	*Lasiurus borealis*	Red bat	Deciduous trees on forest edges for roosting	Ci		SC				B	B			B	B	B	B	B	B	B	B	B	B	B		B	B	B	B	B	B	B	B	B
Mammal	*Lasiurus cinereus*	Hoary bat	Edges of coniferous forests	Ci		SC				B	B			B	B	B	B	B	B	B	B	B	B	B		B	B	B	B	B	B	B	B	B
Mammal		Eastern cottontail	Brush piles, herbaceous and shrubby cover	H										Y	Y	Y	Y	Y			Y							Y	Y	Y	Y	Y	Y	Y	
Mammal	*Sylvilagus transitionalis*	New England cottontail	Young woodlands with thick cover	H										Y	Y	Y	Y	Y			Y							Y	Y	Y	Y		Y	Y	
Mammal	*Lepus americanus*	Snowshoe hare	Dense brushy or softwood cover	H										Y	Y	Y	Y	Y										Y	Y	Y	Y	Y	Y		
Mammal	*Lepus eupopaeus*	European hare	Open woodlands with low vegetation	H												Y	Y															Y	Y		
Mammal		Eastern chipmunk	Open, deciduous forests and edges	O										Y	Y	Y	Y											Y	Y	Y	Y	Y	Y	Y	
Mammal	*Marmota monax*	Woodchuck	Open land	H																										Y	Y	Y	Y	Y	
Mammal		Eastern gray squirrel	Tall trees for dens or leafnests	O										Y	Y	Y	Y	Y										Y	Y	Y	Y	Y		Y	
Mammal		Red squirrel	Woodlands with mature trees	O												Y												Y	Y	Y	Y	Y			
Mammal	*Glaucomys volans*	Southern flying squirrel	Mature woodlands with cavity trees	O																								Y	Y	Y	Y	Y			
Mammal	*Glaucomys sabrinus*	Northern flying squirrel	Mature trees with cavities, arboreal lichens	O																								Y	Y	Y	Y	Y			
Mammal		Beaver	Woodland streams, lack of disturbance	H				Y		Y	Y	Y	Y		Y	Y		Y	Y	Y		Y	Y	Y	Y				Y		Y				
Mammal		Deer mouse	Northern hardwoods or coniferous forests	O										Y	Y	Y	Y											Y	Y	Y	Y	Y			Y	
Mammal	*Neotoma magister*	Allegheny woodrat [4]	Cliffs, caves, and talus	O																					Y	Y		Y	Y	Y	Y					

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Mammal		White-footed mouse	Forest edges, openings, shrub borders, fields	O										Y	Y	Y	Y	Y		Y	Y						Y	Y	Y	Y	Y	Y	Y	Y	
Mammal		Southern red-backed vole	Springs, brooks, seeps, debris or slash cover	O									Y	Y	Y	Y	Y	Y			Y						Y								Y
Mammal		Meadow vole	Herbaceous vegetation, loose organic soils	O											Y	Y	Y	Y		Y	Y						Y	Y	Y	Y	Y	Y	Y	Y	
Mammal	*Microtus pinetorum*	Woodland vole	Forests	O												Y	Y											Y	Y	Y	Y	Y	Y	Y	
Mammal		Muskrat	Wetlands with dense emergent vegetation	H				Y		Y	Y	B	B					Y	Y	Y	B	B	B	B	B										
Mammal	*Synaptomys cooperi*	Southern bog lemming	Deciduous or mixed conifer-hardwood forests	O	SC	SC								Y	Y	Y	Y			Y	Y							Y	Y	Y	Y	Y			
Mammal	*Rattus norvegicus*	Norway rat	Buildings, dumps, loose soil for burrows	O										Y		Y																	Y	Y	
Mammal	*Mus musculus*	House mouse	Buildings in winter	O																												Y	Y	Y	
Mammal	*Zapus hudsonius*	Meadow jumping mouse	Herbaceous groundcover, loose soils	O										Y		Y				Y	Y											Y	Y		
Mammal	*Napaeozapus insignis*	Woodland jumping mouse	Moist, cool woodland, loose soils	O										Y	Y	Y	Y	Y									Y	Y	Y	Y	Y	Y			
Mammal	*Erethizon dorsatum*	Porcupine	Rock ledges or tree dens	H										Y	Y	Y	Y										Y	Y	Y	Y	Y	Y			
Mammal		Coyote	Forests, forest edges, agricultural land	C								Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y		
Mammal		Red fox	Forests, forest edges, agricultural land	C								Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y		
Mammal	*Urocyon cinereoargenteus*	Gray fox	Hollow logs, tree cavities, rock crevices	C										Y	Y	Y	Y	Y		Y	Y							Y	Y	Y	Y	Y			
Mammal		Black bear	Fallen trees, hollow logs, rock ledges, slash piles	O								B	B	Y	Y	Y	Y	B		B	B	B	B	B	B		Y	Y	Y	Y	Y				

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Mammal		Raccoon	Hollow trees	O							Y	B	B	Y	Y	Y	Y	Y			B	B	B	B		Y	Y	Y	Y	Y	Y			Y	Y
Mammal	*Martes pennanti*	Fisher	Coniferous and mixed conifer-hardwood forests	C							Y				Y		Y			Y	Y						Y	Y	Y	Y	Y				
Mammal	*Mustela erminea*	Ermine	Dense brushy cover	C									Y			Y	Y	Y				Y	Y	Y	Y		Y	Y	Y	Y	Y	Y			Y
Mammal	*Mustela frenata*	Long-tailed weasel	Diversity of forested and partially forested habitats and edges	C								Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y			Y
Mammal	*Mustela vison*	Mink	Hollow logs, natural crevices, riparian habitat	C				Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y				Y
Mammal		Striped skunk	Agricultural areas, open habitats, often in suburban areas	O								B	B				Y					B	B	B	B		Y	Y	Y	Y	Y	Y	Y	Y	
Mammal	*Lontra canadensis*	River otter	Bodies of water, such as streams, ponds, lakes, rivers	Cp				Y		Y	Y	Y	Y		Y	Y		Y	Y	Y	Y	Y	Y	Y	Y											
Mammal	*Lynx rufus*	Bobcat	Rock ledges, under windfalls, hollow logs	C										Y	Y	Y	Y	Y								Y	Y	Y	Y	Y	Y				
Mammal	*Odocoileus virginianus*	White-tailed deer	Softwood yarding cover in winter	H								Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y
				Fish	33	10	24	37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				Reptiles	2	0	6	8	9	5	6	7	9	10	11	9	11	10	10	9	9	13	5	6	13	14	11	13	15	13	5	9				
				Amphibians	3	1	9	10	6	4	14	13	9	13	14	12	13	10	12	5	5	5	0	11	14	17	14	18	4	4	0	16				
				Birds	22	0	24	25	50	39	87	88	97	95	88	29	56	57	50	50	50	50	3	50	73	70	68	69	90	79	48	20				
				Mammals	4	0	15	15	14	14	39	38	45	41	35	15	27	33	23	23	23	24	9	39	43	46	44	45	36	32	28	21				

[1] This habitat type was largely present within the 10-year floodplain in the upstream reaches
[2] Blue-spotted salamander "complex" is state-special concern; Blue-spotted salamander diploid populations are state-threatened
[3] Nesting populations only
[4] Considered a separate species from the eastern woodrat (*Neotoma floridana*) based on genetic and morphological characters

Attachment B List of Plant Names

Common Name	Scientific Name
alder-leaved buckthorn	*Rhamnus alnifolia*
alfalfa	*Medicago sativa*
alga pondweed	*Potamogeton confervoides*
alternate-leaved dogwood	*Cornus alternifolia*
American bur-reed	*Sparganium americanum*
American beech	*Fagus grandifolia*
American elm	*Ulmus americana*
American hazelnut	*Corylus americana*
American hornbeam	*Carpinus caroliniana*
American willow-herb	*Epilobium leptophyllum*
autumn willow	*Salix serissima*
awned nutsedge	*Cyperus squarrosus*
balsam fir	*Abies balsamea*
barnyard grass	*Echinochloa crus-galli*
basswood	*Tilia americana*
beaked hazelnut	*Corylus cornuta*
beaked sedge	*Carex utriculata*
beaked willow	*Salix bebbiana*
bellwort	*Uvularia sessilifolia*
big bluestem	*Andropogon gerardii*
bitternut hickory	*Carya cordiformis*
black ash	*Fraxinus nigra*
black bulrush	*Scirpus hattorianus*
black cherry	*Prunus serotina*
black willow	*Salix nigra*
bloodroot	*Sanguinaria canadensis*
blue-bead lily	*Clintonia canadensis*
bluebell	*Campanula rotundifolia*
blunt-lobed cliff fern	*Woodsia obtusa*
boneset	*Eupatorium perfoliatum*
bottlebrush grass	*Elymus hystrix*
box-elder	*Acer negundo*
bracken fern	*Pteridium aquilinum*
bristle-stalked sedge	*Carex leptalea*
bristly crowfoot	*Ranunculus pensylvanicus*
broad-leaved cattail	*Typha latifolia*
brome-like sedge	*Carex bromoides*
buckbean	*Menyanthes triofoliata*
bulblet-bearing water-hemlock	*Cicuta bulbifera*
bur oak	*Quercus macrocarpa*
buttonbush	*Cephalanthus occidentalis*
calico aster	*Symphyotrichum lateriflorum*
Canada bluegrass	*Poa compressa*

Common Name	Scientific Name
Canada bluejoint	*Calamagrostis canadensis*
Canada burnet	*Sanguisorba canadensis*
Canada elder	*Sambucus canadensis*
Canada goldenrod	*Solidago canadensis*
Canada lovegrass	*Eragrostis pectinacea*
Canada mayflower	*Maianthemum canadense*
Canada waterweed	*Elodea canadensis*
Carrion flower	*Smilax herbacea*
cherry birch	*Betula lenta*
Chinese spindle-tree	*Euonymus fortunei*
choke cherry	*Prunus virginiana*
Christmas fern	*Polystichum acrostichoides*
cinnamon fern	*Osmunda cinnamomea*
clearweed	*Pilea pumila*
Cluster sanicle	*Sanicula odorata*
common arrowhead	*Sagittaria latifolia*
common bladderwort	*Utricularia macrorhiza*
common buckthorn	*Rhamnus cathartica*
common cocklebur	*Xanthium strumarium*
common evening primrose	*Oenothera biennis*
common flat-topped goldenrod	*Euthamia graminifolia*
common hornwort	*Ceratophyllum demersum*
common horsetail	*Equisetum arvense*
common milkweed	*Asclepias syriaca*
common mullein	*Verbascum thapsus*
common pipewort	*Eriocaulon aquaticum*
common privet	*Ligustrum vulgare*
common reed	*Phragmites australis*
common scouring rush	*Equisetum hyemale*
common St. Johnswort	*Hypericum perforatum*
common water-nymph	*Najas flexilis*
common water-purslane	*Ludwigia palustris*
common yellow wood-sorrel	*Oxalis stricta*
cow vetch	*Vicia cracca*
Creeping bentgrass	*Agrostis stolonifera*
creeping crowfoot	*Ranunculus repens*
crisped pondweed	*Potamogeton crispus*
crooked-stem aster	*Symphyotrichum prenanthoides*
cuckoo-flower	*Cardamine pratensis var. pratensis*
cypress-spurge	*Euphorbia cyparissias*
dames-rocket	*Hesperis matronalis*
devil’s beggar ticks	*Bidens vulgata*
ditch-stonecrop	*Penthorum sedoides*

Common Name	Scientific Name
dock-leaved smartweed	*Persicaria lapathifolia*
dotted hawthorn	*Crataegus punctata*
downy wild-rye	*Elymus villosus*
drooping woodreed	*Cinna latifolia*
Dutchman's breeches	*Dicentra cucullaria*
early blue cohosh	*Caulophyllum giganteum*
early goldenrod	*Solidago juncea*
eastern black currant	*Ribes americanum*
eastern cottonwood	*Populus deltoides*
eastern hemlock	*Tsuga canadensis*
eastern white pine	*Pinus strobus*
Eurasian milfoil	*Myriophyllum spicatum*
European spindle-tree	*Euonymus europaea*
evening nightshade	*Solanum dulcamara*
evergreen wood fern	*Dryopteris intermedia*
false dragonhead	*Physostegia virginiana*
false hellebore	*Veratrum viride*
false nutsedge	*Cyperus strigosus*
false pimpernel	*Lindernia dubia var. dubia*
false Solomon's seal	*Maianthemum racemosum*
false water-pepper	*Persicaria hydropiperoides*
false-nettle	*Boehmeria cylindrica*
flatstem pondweed	*Potamogeton zosteriformis*
floating pondweed	*Potamogeton natans*
fox sedge	*Carex vulpinoidea*
foxtail sedge	*Carex alopecoidea*
fringed gentian	*Gentianopsis crinita*
fringed loosestrife	*Lysimachia ciliata*
garlic-mustard	*Alliaria petiolata*
giant bur-reed	*Sparganium eurycarpum*
glaucous king devil	*Hieracium piloselloides*
gold thread	*Coptis trifolia*
golden Alexanders	*Zizia aurea*
golden saxifrage	*Chrysosplenium americanum*
goutweed	*Aegopodium podagraria*
grass-leaved arrowhead	*Sagittaria graminea*
grass-of-Parnassus	*Parnassia glauca*
gray birch	*Betula populifolia*
gray goldenrod	*Solidago nemoralis*
Gray's sedge	*Carex grayi*
green ash	*Fraxinus pennsylvanica*
green-fruited bur-reed	*Sparganium emersum*
ground-pine	*Lycopodium obscurum*

Common Name	Scientific Name
hard-stem bulrush	*Schoenoplectus acutus*
hay-scented fern	*Dennstaedtia punctilobula*
heart-leaved willow	*Salix eriocephala*
hemlock-parsley	*Conioselinum chinense*
hemp dogbane	*Apocynum cannabinum*
highbush blueberry	*Vaccinium corymbosum*
hoary willow	*Salix candida*
hobblebush	*Viburnum lantanoides*
horse-nettle	*Solanum carolinense*
indian grass	*Sorghastrum nutans*
inland sedge	*Carex interior*
interrupted fern	*Osmunda claytoniana*
Japanese barberry	*Berberis thunbergii*
jointed rush	*Juncus articulatus*
jumpseed	*Persicaria virginiana*
Kentucky bluegrass	*Poa pratensis*
lady fern	*Athyrium filix-femina*
lady's thumb	*Persicaria maculosa*
lakeside sedge	*Carex lacustris*
large-leaved pondweed	*Potamogeton amplifolius*
larger straw sedge	*Carex normalis*
leatherleaf	*Chamaedaphne calyculata*
lemon thyme	*Thymus pulegioides*
lesser duckweed	*Lemna minor*
little bluestem	*Schizachyrium scoparium*
long-beaked sedge	*Carex sprengelii*
long-beaked sedge	*Carex sterilis*
long-beaked water crowfoot	*Ranunculus aquatilis var. diffusus*
long-stalked monkey flower	*Mimulus ringens*
long-stalked sedge	*Carex pedunculata*
lopseed	*Phryma leptostachya*
lurid sedge	*Carex lurida*
maidenhair fern	*Adiantum pedatum*
maidenhair spleenwort	*Asplenium trichomanes*
male-berry	*Lyonia ligustrina*
maple-leaved viburnum	*Viburnum acerifolium*
marginal wood fern	*Dryopteris marginalis*
marsh cinquefoil	*Comarum palustre*
marsh fern	*Thelypteris palustris*
marsh St. Johnswort	*Triadenum virginicum*
meadowsweet	*Spiraea alba var. latifolia*
moneywort	*Lysimachia nummularia*
Morrow’s honeysuckle	*Lonicera morrowii*

Common Name	Scientific Name
mountain ash	*Sorbus americana*
mountain laurel	*Kalmia latifolia*
mountain maple	*Acer spicatum*
mudflat spikesedge	*Eleocharis intermedia*
muskflower	*Mimulus moschatus*
narrow-leaved bur-reed	*Sparganium angustifolium*
needle spikesedge	*Eleocharis acicularis*
New York fern	*Thelypteris noveboracensis*
northern arrowwood	*Viburnum dentatum var. lucidum*
northern bladderwort	*Utricularia intermedia*
northern bog goldenrod	*Solidago uliginosa*
northern three-lobed bedstraw	*Galium trifidum*
northern water-horehound	*Lycopus uniflorus*
northern water-plantain	*Alisma triviale*
Oakes's pondweed	*Potamogeton oakesianus*
oak-leaved goosefoot	*Chenopodium glaucum*
oblong bulrush	*Schoenoplectus Xoblongus*
old-field cinquefoil	*Potentilla simplex*
ostrich fern	*Matteuccia struthiopteris*
painted trillium	*Trillium undulatum*
palmate hop-clover	*Trifolium aureum*
paper birch	*Betula papyrifera*
partridgeberry	*Mitchella repens*
pendulous bulrush	*Scirpus pendulus*
Pennsylvania sedge	*Carex pensylvanica*
Pennsylvania smartweed	*Persicaria pensylvanica*
pickerelweed	*Pontederia cordata*
pigweed	*Chenopodium album*
pitcher plant	*Sarracenia purpurea*
plantain-leaved sedge	*Carex plantaginea*
pointed broom sedge	*Carex scoparia*
porcupine sedge	*Carex hystericina*
poverty grass	*Danthonia spicata*
pubescent sedge	*Carex hirtifolia*
purple avens	*Geum rivale*
purple cliff-brake	*Pellaea atropurpurea*
purple loosestrife	*Lythrum salicaria*
purple lovegrass	*Eragrostis spectabilis*
purple trillium	*Trillium erectum*
purple-stemmed aster	*Symphyotrichum puniceum*
pussy willow	*Salix discolor*
quaking aspen	*Populus tremuloides*
red clover	*Trifolium pratense*

Common Name	Scientific Name
red maple	*Acer rubrum*
red oak	*Quercus rubra*
red pondweed	*Potamogeton alpinus*
red raspberry	*Rubus idaeus var. strigosus*
red spruce	*Picea rubens*
red-osier dogwood	*Cornus sericea*
reed canarygrass	*Phalaris arundinacea*
reed fescue	*Lolium arundinaceum*
ribbonleaf pondweed	*Potamogeton epihydrus*
rice cut-grass	*Leersia oryzoides*
river grape	*Vitis riparia*
river horsetail	*Equisetum fluviatile*
rough bedstraw	*Galium asprellum*
rough-leaved goldenrod	*Solidago patula*
rough-stemmed goldenrod	*Solidago rugosa ssp. rugosa*
round-lobed hepatica	*Anemone americana*
royal fern	*Osmunda regalis*
sand cherry	*Prunus pumila*
sensitive fern	*Onoclea sensibilis*
shining ground-fir	*Huperzia lucidula*
shrubby-cinquefoil	*Pentaphylloides floribunda*
silky dogwood	*Cornus amomum*
silky willow	*Salix sericea*
silver maple	*Acer saccharinum*
slender cliff-brake	*Cryptogramma stelleri*
slender mannagrass	*Glyceria melicaria*
smooth creeping lovegrass	*Eragrostis hypnoides*
smooth shadbush	*Amelanchier laevis*
snail-seed pondweed	*Potamogeton spirillus*
soft rush	*Juncus effusus*
southern running-pine	*Diphasiastrum digitatum*
southern water-plantain	*Alisma subcordatum*
speckled alder	*Alnus incana ssp. rugosa*
spiny-spored quillwort	*Isoetes echinospora*
spotted joe-pye weed	*Eupatorium maculatum*
spotted knapweed	*Centaurea maculosa*
spotted touch-me-knot	*Impatiens capensis*
spreading dogbane	*Apocynum androsaemifolium*
spring beauty	*Claytonia caroliniana*
squarrose white aster	*Symphyotrichum ericoides*
squirrel-corn	*Dicentra canadensis*
staghorn sumac	*Rhus hirta*
star duckweed	*Lemna trisulca*

Common Name	Scientific Name
steeplebush	*Spiraea tomentosa*
stinging nettle	*Urtica dioica*
stream bank wild-rye	*Elymus riparia*
striped maple	*Acer pensylvanicum*
sugar maple	*Acer saccharum*
swamp crowfoot	*Ranunculus hispidus*
swamp dewberry	*Rubus hispidus*
swamp milkweed	*Asclepias incarnata*
swamp saxifrage	*Saxifraga pensylvanica*
swamp white oak	*Quercus bicolor*
Swan's sedge	*Carex swanii*
sweet gale	*Myrica gale*
sweet-clover	*Melilotus officinalis*
sweet-flag	*Acorus calamus*
switchgrass	*Panicum virgatum*
tall flat-topped white aster	*Doellingeria umbellata*
tall goldenrod	*Solidago altissima*
tall meadow-rue	*Thalictrum pubescens*
tapegrass	*Vallisneria americana*
three-way sedge	*Dulichium arundinaceum*
Timothy	*Phleum pratense*
tiny pondweed	*Potamogeton pusillus*
toothwort	*Cardamine diphylla*
tower-mustard	*Turritus glabra*
trout lily	*Erythronium americanum*
tuckahoe	*Peltandra virginica*
tussock sedge	*Carex stricta*
variegated scouring-rush	*Equisetum variegatum*
virgin's bower	*Clematis virginiana*
Virginia waterleaf	*Hydrophyllum virginianum*
Wapato	*Sagittaria cuneata*
water lobelia	*Lobelia dortmanna*
water shield	*Brasenia schreberi*
water stargrass	*Zosterella dubia*
water-parsnip	*Sium suave*
water-pepper	*Persicaria hydropiper*
water-willow	*Decodon verticillatus*
white ash	*Fraxinus americana*
white bedstraw	*Galium mollugo*
white birch	*Betula papyrifera*
white snakeroot	*Ageratina altissima*
white spruce	*Picea glauca*
white water-lily	*Nymphaea odorata*

Common Name	Scientific Name
white wood aster	*Aster divaricatus*
wide-leaved sedge	*Carex platyphylla*
wild cucumber	*Echinocystis lobata*
wild ginger	*Asarum canadense*
wild leek	*Allium tricoccum*
wild sarsaparilla	*Aralia nudicaulis*
wild strawberry	*Fragaria virginiana*
wild-carrot	*Daucus carota*
wild-morning glory	*Calystegia spithamaea*
winged burning bush	*Euonymus alatus*
winterberry	*Ilex verticillata*
wintergreen	*Gaultheria procumbens*
wire sedge	*Carex lasiocarpa*
wirestem muhly	*Muhlenbergia frondosa*
witch-hazel	*Hamamelis virginiana*
wood bluegrass	*Poa nemoralis*
wood-nettle	*Laportea canadensis*
wool-grass	*Scirpus cyperinus*
yarrow	*Achillea millefolium*
yellow birch	*Betula alleghaniensis*
yellow iris	*Iris pseudacorus*
yellow sedge	*Carex flava*
yellow water-lily	*Nuphar variegatum*
zig-zag goldenrod	*Solidago flexicaulis*

Attachment C Birds potentially migrating through study area.

Scientific Name	Common Name	Special Habitat Requirements
Gavia immer	Common loon [1]	Lakes, large resevoirs
Podiceps grisegena	Red-necked grebe [1]	Freshwater marshes, wooded lakes, swamps
	Double-crested cormorant [1]	Nests along coast and coastal islands
	Black-crowned night heron [1]	Shorelines
	Snow goose [1]	Agriculutural fields, grasslands during migration
	Gadwall [1]	Freshwater marshes, wooded lakes, swamps
	Green-winged teal [1]	Wet meadows adjacent to marshes and open water
	American wigeon [1]	Freshwater marshes, wooded lakes, swamps
	Ring-necked duck [1]	Freshwater marshes, wooded lakes, swamps
	Canvasback [1]	Ponds, rivers, coastal bays
	Bufflehead [1]	Ponds, rivers, coastal bays
	Common goldeneye [1]	Ponds, rivers, coastal bays
	Common merganser [1]	Ponds, rivers, coastal bays
Falco columbarius	Merlin [2]	Migrant through open to semi-open mixed or coniferous forests
Tringa solitaria	Solitary sandpiper [1]	Streamsides, wooded swamps, marshes
	Semipalmated sandpiper [1]	Beaches, mudflats
	Least sandpiper [1]	Beaches, mudflats
	Olive-sided flycatcher [2]	Coniferous forest, migrates through broad range of forested habitats
	Yellow-bellied flycatcher [2]	Coniferous forest, migrates through broad range of forested habitats
Catharus ustulatus	Swainson's thrush [2]	Coniferous forest, migrates through broad range of forested habitats
Catharus minimus	Gray-cheeked thrush [2]	Coniferous forest, migrates through broad range of forested habitats
Catharus bicknelli	Bicknell's thrush [2]	Coniferous forest, migrates through broad range of forested habitats
Vireo philadelphicus	Philadelphia vireo [2]	Deciduous and coniferous forest, migrates through broad range of forested habitats

Scientific Name	Common Name	Special Habitat Requirements
	Tennessee warbler [2]	Brushy, semi-open habitat in coniferous or mixed forests
Parula americana	Northern parula [2]	Forested swamps
Dendroica tigrina	Cape May warbler [2]	Tall coniferous stands
	Palm warbler [2]	Variety of habitats during migration
Dendroica castanea	Bay-breasted warbler [2]	Second-growth boreal forests
	Blackpoll warbler [2]	Deciduous and coniferous stands during migration
Oporornis philadelphia	Mourning warbler [2]	Deciduous, shrubby, early successional growth
Wilsonia pusilla	Wilson's warbler [2]	Open, wet areas in early successional stands
Oporornis agilis	Connecticut warbler [2]	Shrub habitats
Passerella iliaca	Fox sparrow [2]	Dense shrubby undergrowth
Melospiza lincolnii	Lincoln's sparrow [2]	Low brushy thickets along edges of fields

[1] This species is likely to occur in or near streams and ponds during spring and fall migration
[2] This species is likely to occur in a broad range of forested habitat during spring and fall migration