Significant Habitats
in the Town of North East, Dutchess County, New York

Report to the Town of North East, the Millbrook Tribute Garden, the Dyson Foundation, and the Dutchess Land Conservancy

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EXECUTIVE SUMMARY

Hudsonia biologists identified and mapped the ecologically significant habitats in the Town of North East during the period January through November 2007. Through map analysis, aerial photograph interpretation, and field observations we created a large-format map showing the location and configuration of these habitats throughout the town. Some of these habitats are rare or declining in the region or support rare species of plants or animals, while others are high quality examples of common habitats or habitat complexes. Among our more interesting finds were 80 fens, almost 30 intermittent woodland pools, acidic bogs and an acidic bog lake, a circumneutral bog lake, many extensive wetland complexes, seven marble knolls, two cool ravines, large areas of upland meadow including 15 patches greater than 200 ac (ha), a forested area of the Taconic Mountains exceeding 2,900 ac (1,160 ha), and 14 additional forest areas greater than 200 ac (80 ha) each, including Winchell Mountain, Silver Mountain, and McGhee Hill. Of the total area in the township, 92% is composed of significant habitats.

In this report we describe each of the mapped habitat types, including their ecological attributes, some of the species of conservation concern they may support, and their sensitivities to human disturbance. We address conservation issues associated with these habitats, provide specific conservation recommendations, and delineate seven areas of North East that may serve as suitable units for conservation and planning efforts. We also provide instructions on how to use this report and the map, both to review site-specific proposals and as a guide for townwide conservation planning and decision making.

The habitat map, which contains ecological information unavailable from other sources, can help the Town of North East identify the areas of greatest ecological significance, develop conservation goals, and establish conservation policies and practices that will help to protect biodiversity resources while serving the social, cultural, and economic needs of the human community.

INTRODUCTION

Background

Rural landscapes in the Harlem Valley and surrounding areas are undergoing rapid change as farms, forests, and other undeveloped lands are converted to residential and commercial uses. The consequences of rapid land development include widespread habitat degradation, habitat fragmentation, and the loss of native biodiversity. Although many land use decisions in the region are necessarily made on a site-by-site basis, the long-term viability of biological communities, habitats, and ecosystems requires consideration of whole landscapes. The availability of general biodiversity information for large areas such as entire towns, watersheds, or counties will allow landowners, developers, municipal planners, and others to better incorporate biodiversity protection into day-to-day decision making.

To address this need, Hudsonia Ltd., a nonprofit scientific research and education institute based in Annandale, New York, initiated a series of extensive habitat mapping projects in Dutchess County in 2001. These projects demonstrate how Hudsonia's *Biodiversity Assessment Manual for the Hudson River Estuary Corridor* (Kiviat and Stevens 2001) can be used to identify important biological resources over large geographic areas and inform local communities about biodiversity conservation.

After Hudsonia completed its first townwide habitat map for the Town of East Fishkill (Stevens and Broadbent 2002), we received funding from the Millbrook Tribute Garden and the Dyson Foundation to produce habitat maps for five northeastern Dutchess County towns over a period of five years. North East is the fourth town we have mapped in this area; the towns of Washington (Tollefson and Stevens 2004), Stanford (Bell et al. 2005), and Amenia (Tabak et al. 2006) have also been mapped. We received strong support for the project from the North East Town Board, Planning Board, and Conservation Advisory Council, as well as from many local landowners.

Claudia Knab-Vispo (Biologist), Kristen Bell (Biodiversity Mapping Coordinator), and Gretchen Stevens (Director of Hudsonia's Biodiversity Resources Center) conducted the work

on this project from January 2007 through January 2008. Through map analysis, aerial photograph interpretation, and field observations we created a map of ecologically significant habitats in the Town of North East. Some of these habitats are rare or declining in the region, some may support rare species of plants or animals, while others are high quality examples of common habitats or habitat complexes. The emphasis of this project was on identifying and mapping general habitat types, rather than on conducting species-level surveys or mapping the known locations of rare species.

Hudsonia will soon be completing habitat mapping projects for other towns in Dutchess County, and we hope to extend the program to other parts of southeastern New York. To facilitate inter-municipal planning, we strive for consistency in the ways that we define and identify habitats and present the information for town use, but we also expect that our methods and products will improve as the program evolves. Many passages in this report relating to general habitat descriptions, general conservation and planning concepts, and other information applicable to the region as a whole are taken directly from the East Fishkill (Stevens and Broadbent 2002), Washington (Tollefson and Stevens 2004), Stanford (Bell et al. 2005), Fishkill and Sprout Creek Corridors (Sullivan and Stevens 2005), and Amenia (Tabak et al. 2006) reports without specific attribution. This report, however, addresses our findings and specific recommendations for the Town of North East. We intend for each of these projects to build on the previous ones, and believe that the expanding body of biodiversity information will be a valuable resource for site-specific, townwide, and region-wide planning and conservation efforts.

We hope that this map and report will help landowners understand how their properties fit into the larger ecological landscape, and will inspire them to implement habitat protection measures voluntarily. We also hope that the Town of North East will engage in proactive land use and conservation planning to ensure that future development is planned with a view to long-term protection of its considerable biological resources.

What is Biodiversity?

The concept of biodiversity, or biological diversity, encompasses all of life and its processes. It includes ecosystems, biological communities, species and their genes, as well as their interactions with each other and with the non-biological components of their environment, such as soil, water, air, and sunlight. Protecting biodiversity is thus considered an important component of any effort to maintain healthy, functioning ecosystems that sustain the human community and the living world around us. Healthy ecosystems make the earth habitable by moderating the climate, cycling essential gasses and nutrients, purifying water and air, producing and decomposing organic matter, and providing many other essential services. They also help to produce and sustain extractable and harvestable resources on which human economies are based.

The decline or disappearance of native species can be a symptom of environmental deterioration or collapses in other parts of the ecosystem. While we do not fully understand the roles of all organisms in an ecosystem and cannot fully predict the consequences of the extinction of any particular species, we do know that each organism, including inconspicuous organisms such as fungi and insects, plays a unique role in the maintenance of biological communities. Maintaining the full complement of native species in a region allows an ecosystem to withstand stresses and adapt to changing environmental conditions.

What are Ecologically Significant Habitats?

For the purposes of this project, a "habitat" is simply the place where an organism or population lives or where a biological community occurs, and is defined according to both its biological and non-biological components. Individual species will be protected for the long term only if their habitats remain intact. The local or regional disappearance of a habitat can lead to the local or regional extinction of species that depend on that habitat. Habitats that we consider to be "ecologically significant" include:

1. Habitats that are rare or declining in the region.
2. Habitats that support rare species and other species of conservation concern.

3. High-quality examples of common habitats (e.g., those that are especially large, isolated from human activities, old, lacking harmful invasive species, or those that provide connections between other important habitat units).
4. Complexes of connected habitats that, by virtue of their size, composition, or configuration, have significant biodiversity value.

Because most wildlife species need to travel among different habitats to satisfy their basic survival needs, landscape patterns can have a profound influence on wildlife populations. The size, connectivity, and juxtaposition of both common and uncommon habitats in the landscape all have important implications for biodiversity. In addition to their importance from a biological standpoint, habitats are also manageable units for planning and conservation at fairly large scales such as towns. By illustrating the location and configuration of ecologically significant habitats throughout the Town of North East, the habitat map that accompanies this report can serve as a valuable source of ecological information that can be incorporated into local land use planning and decision making.

Study Area

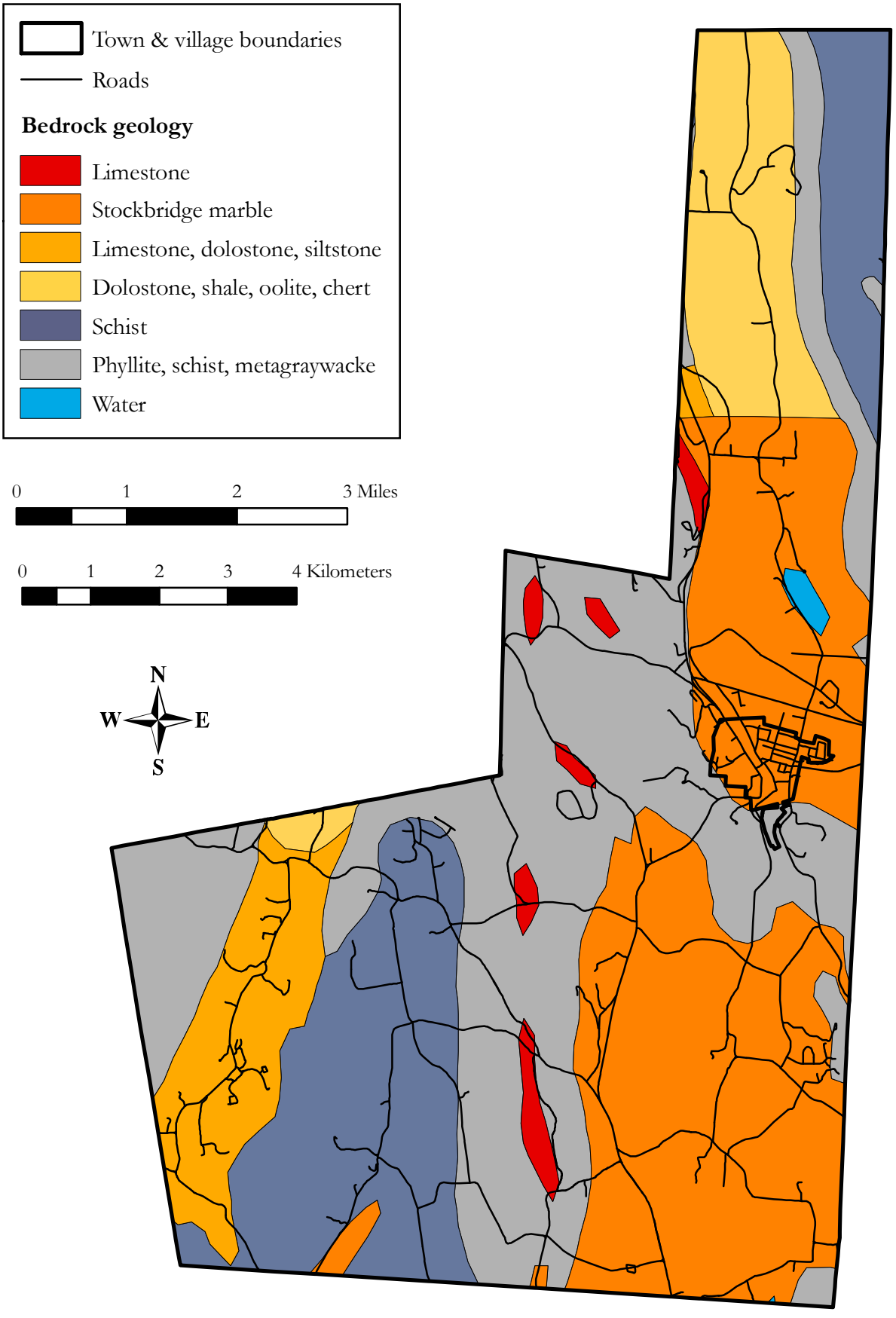
The Town of North East is located in North Eastern Dutchess County in southeastern New York. It is approximately 44 mi^2 (114 km^2) in area and has a population of roughly 2,077 residents (2000 Census). Most of the land in North East drains south, either into Webatuck Creek (eastern part) or Northeast Stream and Wassaic Creek (southern part). These are all tributaries of the Tenmile River, which flows into the Housatonic River in Connecticut. A smaller western part of the town drains into Shekomeko Creek, and the northernmost part of the panhandle drains north into the Noster Kill, both tributaries of the Roeliff-Jansen Kill, which ultimately flows into the Hudson River. Elevations in North East range from 520 ft (158 m) above mean sea level along Shekomeko Creek at the northwestern town boundary to 2,310 ft (704 m) on the top of Brace Mountain in the North Eastern corner of town. The high elevation areas include the Taconic Ridge north of Millerton, Winchell Mountain, Silver Mountain, and a few other areas west of Millerton. Large wetland complexes occur along Webatuck Creek between Route 22 and Boston Corners Road/Rudd Pond Road north of Millerton, north of

Downey Road ("Webatuck Marsh"), and north of Reagan Road (including "Coleman Station Fen"). Other large wetlands are located between Downey Road and Mill Road ("Dutchess Sedge Meadows"), along Shekomeko Creek, south of Route 44 east of Millerton, around Indian Lake, and north of Sharon Station Road.

North East's landscape of roughly north-south trending ridges and valleys reflects the strong influences of bedrock geology and glacier activity. The bedrock of the ridges is dominated by schist, phyllite, and meta-graywacke, with small inclusions of limestone in some places. The valleys are underlain by calcareous or partially calcareous bedrock, including Stockbridge marble, limestone, dolostone, shale, oolite, and siltstone (Fisher et al. 1970; Figure 1). The surficial material is primarily glacial till, and there are extensive areas of exposed or nearly exposed bedrock along the ridges. Valleys contain large wetland areas underlain by peat, muck, silt, and outwash sand and gravel. Recent alluvial deposits occur along Webatuck and Shekomeko creeks (Cadwell et al. 1989).

Prominent land uses in the Town of North East include farming, forestry for timber harvest, horse stables and pastures, state park land, nature preserves, hunting preserves for upland game and waterfowl, and residential and commercial land uses. Although the Harlem Valley was historically a dairy-farming region, many farms have been recently converted to residential uses, including many second homes. More than 2,600 ac (1,040 ha) is owned by the state, mostly in Taconic State Park. The Town of North East owns 38 ac (15 ha), including an old landfill, and the Village of Millerton owns 14 undeveloped acres (6 ha). Most privately owned parcels are 5 ac (2 ha) or less. Eight private landowners, however, own at least 300 ac (120 ha) each and approximately 50 landowners own over 100 ac (40 ha) each. The largest private landholding totals 910 ac (370 ha). Residences and their immediate surroundings are the most common type of developed area in North East. These are mainly concentrated in the Village of Millerton, several hamlets, and along the roads throughout the town. North East has large areas of undeveloped open space (see Figure 3). Almost the entire town of North East is located within two Significant Biodiversity Areas of southeastern New York—the Harlem Valley Calcareous Wetlands and the Taconic Mountains—identified by the New York State Department of Environmental Conservation (NYS DEC; Penhollow et al. 2006).

Figure 1. Generalized bedrock geology of the Town of North East, Dutchess County, New York. Warm colors indicate bedrock that is at least partially calcareous, and cool colors indicate predominantly acidic bedrock. Geology data from Fisher et al. 1970. Hudsonia Ltd., 2008.



METHODS

Hudsonia employs a combination of laboratory and field methods in the habitat identification and mapping process. Below we describe each phase in the Town of North East habitat mapping project.

Gathering Information and Predicting Habitats

During many years of habitat studies in the Hudson Valley, Hudsonia has found that, with careful analysis of map data and aerial photographs, we can accurately predict the occurrence of many habitats that are closely tied to topography, geology, and soils. Our first step in the habitat mapping process is to assemble all of the necessary and relevant maps, Geographic Information System (GIS) data, and existing published and unpublished information from biologists who have worked in the area. We then use combinations of map features (e.g., slopes, bedrock chemistry, and soil texture, depth, and drainage) and features visible on stereoscopic aerial photographs (e.g., exposed bedrock, vegetation cover types) to predict the location and extent of ecologically significant habitats. In addition to previous studies conducted by Hudsonia biologists in the Town of North East and biological data provided by the New York Natural Heritage Program, we used the following resources for this project:

- *1:40,000 scale color infrared aerial photograph prints* from the National Aerial Photography Program series taken in spring 1994, obtained from the U.S. Geological Survey. Viewed in pairs with a stereoscope, these prints ("stereo pairs") provide a three-dimensional view of the landscape and are extremely useful for identifying vegetation cover types, wetlands, streams, and cultural landscape features.

- *High-resolution (1 pixel = 7.5 in [19 cm]) true color and infrared digital orthophotos* taken in spring 2004, obtained from the New York State GIS Clearinghouse website (http://www.nysgis.state.ny.us; accessed January 2007). These digital aerial photos were used for on-screen digitizing of habitat boundaries.

- *U.S. Geological Survey topographic maps* (Copake and Millerton 7.5 minute quadrangles). Topographic maps contain extensive information about landscape features, such as elevation contours, surface water features, and significant cultural features. Contour lines on topographic maps can be used to predict the occurrence of such habitats as cliffs, intermittent woodland pools, other wetlands, intermittent streams, and seeps.

- *Bedrock and surficial geology maps* (Lower Hudson Sheets) produced by the New York Geological Survey (Fisher et al. 1970, Cadwell et al. 1989). Along with topography, surficial and bedrock geology strongly influence the development of particular soil properties and aspects of groundwater and surface water chemistry, and thus have important implications for the biotic communities that become established on any site.

- *Soil Survey of Dutchess County, New York* (Faber 2002). Specific attributes of soils, such as depth, drainage, texture, and pH, convey a great deal about the types of habitats that are likely to occur in an area. Shallow soils, for example, may indicate the location of crest, ledge, and talus habitats. Poorly and very poorly drained soils often indicate the location of wetland habitats such as swamps, marshes, and wet meadows. The location of alkaline soils can be used to predict the occurrence of fens and calcareous wet meadows.

- *GIS data*. A Geographic Information System enables us to overlay multiple data layers on the computer screen, greatly enhancing the efficiency and accuracy with which we can predict the diverse habitats that are closely linked to local topography, geology, hydrology, and soil conditions. GIS also enables us to create detailed, spatially accurate maps. We obtained most of our GIS data layers from the Dutchess County Environmental Management Council (EMC), including roads, soils, bedrock geology, surficial geology, and wetlands (National Wetlands Inventory data prepared by the U.S. Fish and Wildlife Service). We also obtained 10 ft (3 m) contour data for the Town of North East from the Dutchess Land Conservancy, and Town of North East tax parcel data from the Dutchess County Real Property Tax office.

Preliminary Habitat Mapping and Field Verification

We prepared a preliminary map of predicted habitats based on map analysis and stereo interpretation of aerial photographs. We digitized the predicted habitats onscreen over the orthophoto images using ArcView 9.2 (Environmental Systems Research Institute 2006) computer mapping software. With these draft maps in hand we conducted field visits to as many of the mapped habitat units as possible to verify their presence and extent, and to assess their quality.

We identified landowners using tax parcel data, and before going to the field sites we contacted property owners for permission to go on their land. We prioritized sites for field visits based both on opportunity (i.e., willing landowners) and our need to answer questions regarding habitat identification or extent that could not be answered remotely. For example, distinctions between habitats such as wet meadow and calcareous wet meadow, wet meadow and fen, and calcareous crest and acidic crest can only be made in the field. In addition to conducting fieldwork on private land, we also viewed habitats from adjacent properties, public roads, and other public access areas. Because the schedule of this project (and non-participating landowners) prevented us from conducting intensive field verification on every parcel in the town, this strategy increased our efficiency while maintaining a high standard of accuracy.

Ultimately we field checked approximately 46% of the undeveloped land area in North East (11,770 ac [4,700 ha]). Areas that could not be field checked show our remotely-mapped habitats. We assume that areas of the habitat map that were field checked are generally more accurate than areas we did not visit. Once we have conducted fieldwork in one area, however, we are able to extrapolate our findings to adjacent parcels and similar settings.

Defining Habitat Types

Habitats are useful for categorizing places according to apparent ecological function, and are manageable units for scientific inquiry and land use planning. We classify broad habitat types that are identifiable primarily by their vegetation and visible physical properties. In reality, habitats exist as part of a continuum of intergrading resources and conditions, and it is often difficult to draw a line to separate two habitats. Additionally, some distinct habitats are intermediates between two defined habitat types, and some habitat categories can be considered complexes of several habitats. At least one of our habitats (crest/ledge/talus) occurs within other habitats. In order to maintain consistency within and among habitat mapping projects, we have defined certain mapping conventions (or rules) that we use to delineate habitat boundaries. Some of these conventions are described in Appendix A. Because much of the area in North East was only mapped remotely, all of our mapped habitat boundaries should be considered approximations.

Each habitat profile in the Results section describes the ecological attributes of places that are included in that habitat. Developed areas and other areas that we consider non-significant habitats (e.g., structures, paved roads and driveways, other impervious surfaces, and small lawns and woodlots) are shown as white (no symbol or color) on the habitat map. Areas that have been developed since 2004 (the orthophoto date) were identified as such only if we observed them in the field. For this reason, it is likely that we have somewhat underestimated the extent of developed land in the town.

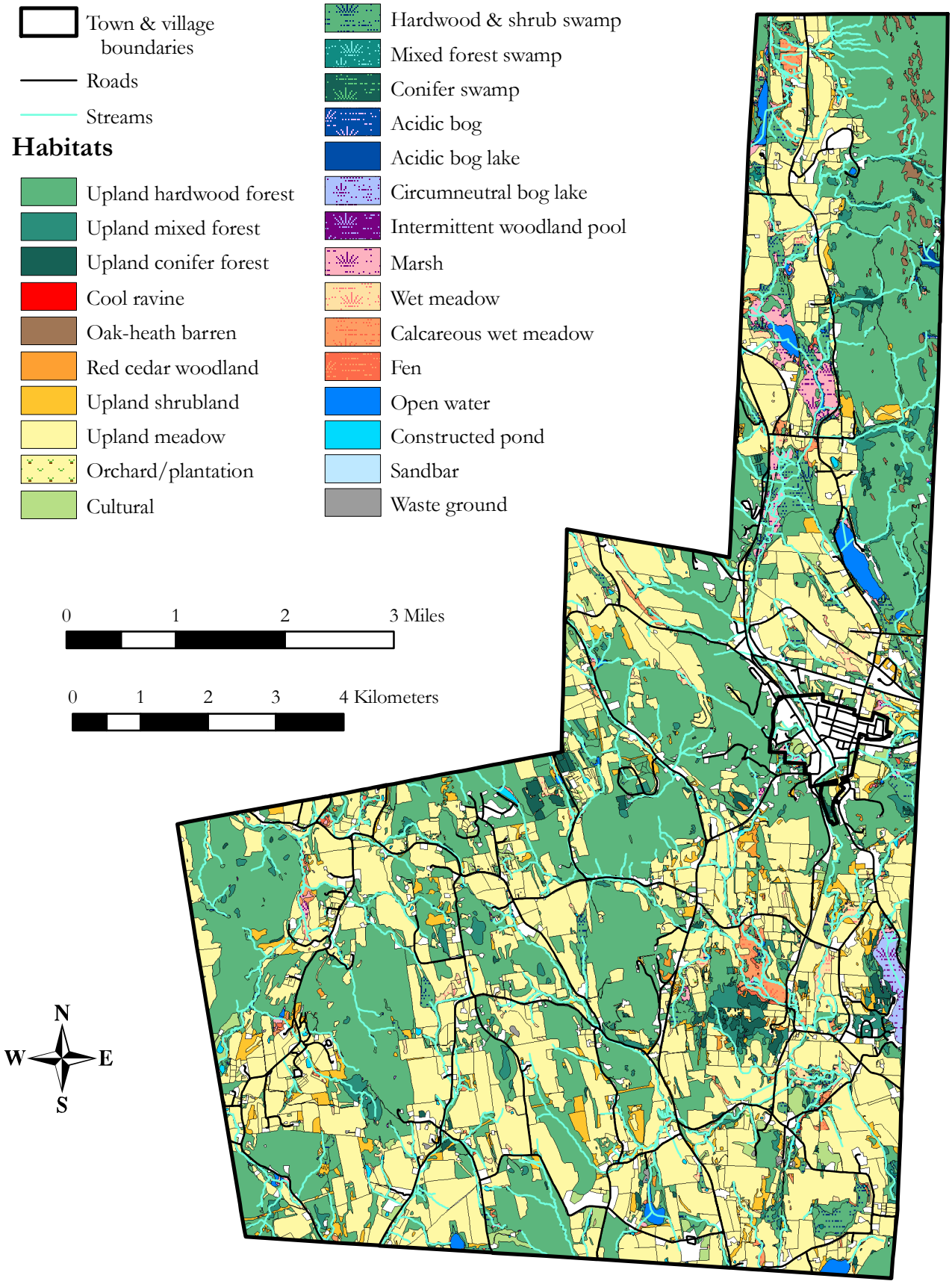
Final Mapping and Presentation of Data

We corrected and refined the preliminary map on the basis of our field observations to produce the final habitat map. We produced the final large-format habitat map on three sheets (36 x 44 or 46 inches) at a scale of 1:10,000, using a Hewlett Packard DesignJet 800PS plotter. We also printed the entire town map on a single sheet (36 x 46 inches) at a scale of 1:19,000. The GIS database that accompanies the map includes additional information about many of the mapped habitat units, such as the dates of field visits (including observations from adjacent properties and roads) and some of the plant and animal species observed in the field. The habitat map, GIS database, and this report have been presented to the Town of North East and the Dutchess

Land Conservancy for use in conservation and land use planning and decision making. We request that any maps printed from this database for public viewing be printed at scales no larger than 1:10,000, and that the habitat map data be attributed to Hudsonia Ltd. Although the habitat map was carefully prepared and extensively field checked, there are inevitable inaccuracies in the final map. Because of this, we request that the following caveat be printed prominently on all maps:

> *"This map is suitable for general land use planning, but is unsuitable for detailed planning and site design or for jurisdictional determinations. Boundaries of wetlands and other habitats depicted here are approximate."*

Figure 2. A reduction of the map illustrating the ecologically significant habitats in the Town of North East, Dutchess County, New York, identified and mapped by Hudsonia Ltd. in 2007. Developed areas and other non-significant habitats are shown in white. The large-format map is printed in three sections at a scale of 1:10,000.



RESULTS

Overview

The large-format Town of North East habitat map illustrates the diversity of habitats that occur in the town and the complexity of their configuration in the landscape. A reduction of the completed habitat map is shown in Figure 2. Of the total 44 mi^2 (114 km^2) area comprising the Town of North East, approximately 92% is undeveloped (i.e., without structures, paved roads, manicured lawns, etc.). The existing development is somewhat dispersed through the town so that undeveloped land has been fragmented into discontinuous patches. Figure 3 shows blocks of contiguous undeveloped habitat within the town that are <500, 500-1,000, and >1,000 ac (<200, 200-400, and >400 ha, respectively). Several types of common habitats cover extensive areas within these blocks. For example, approximately 41% of the town is forested, 36% is open meadow (active agricultural areas and other managed and unmanaged grassland habitats), and 10% is wetland. Some of the smaller, more unusual habitats we documented include acidic bogs, an acidic bog lake, a circumneutral bog lake, fens, and oak-heath barrens. In total, we identified 32 different habitat types in the Town of North East that we consider to be of potential ecological importance (Table 1).

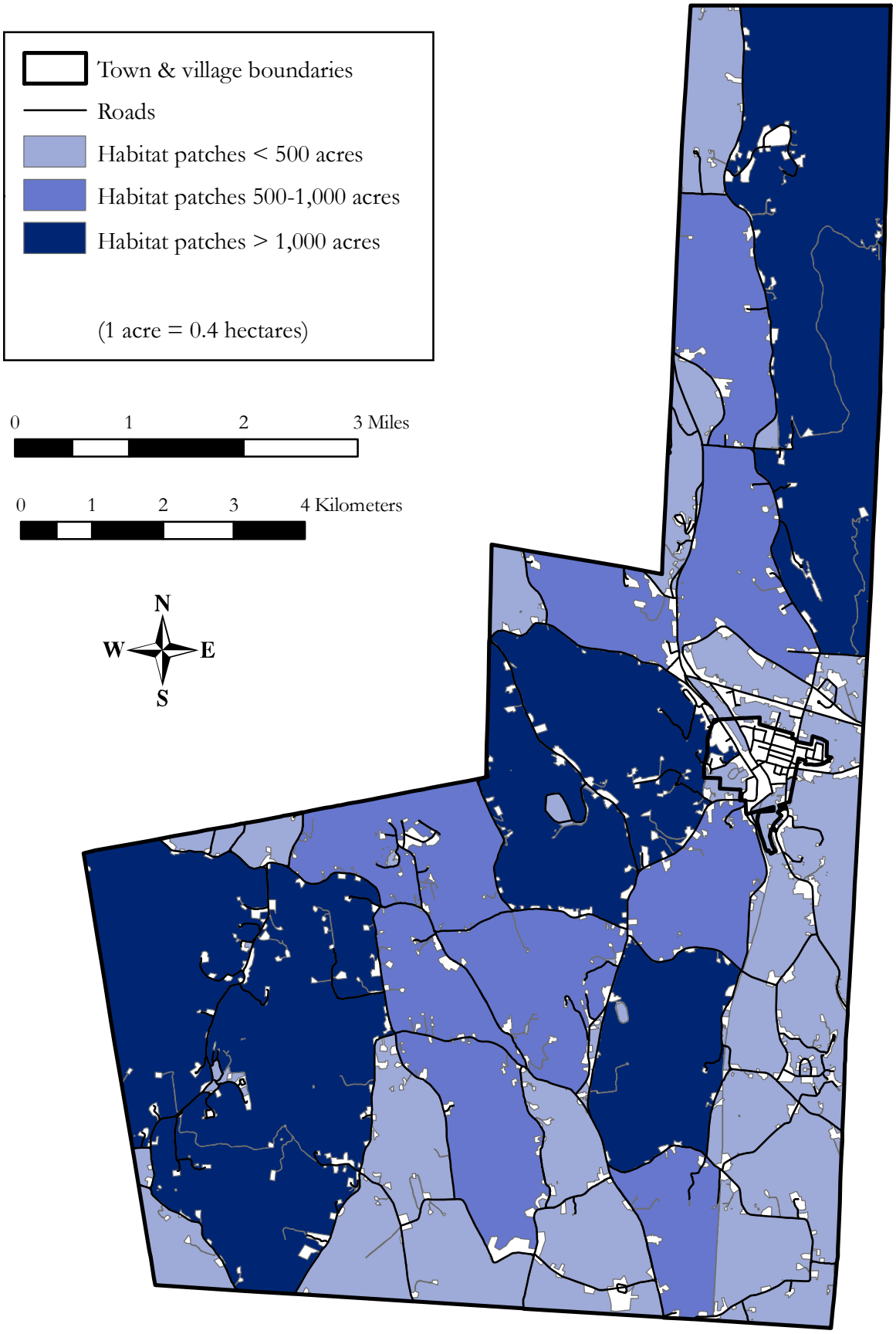
Although the mapped areas represent ecologically significant habitats, all have been altered to various degrees by past and present human activities. Most or all areas of upland forest, for example, have been logged repeatedly in the past 250 years, and many forested areas lack the structural complexity of mature forests. Many of the wetlands in the town have been extensively altered by human activities such as damming, filling, and railroad and road construction. Purple loosestrife, one of the most widespread plants in marshes and wet meadows throughout the town, was introduced to the region in the 1800s and has since displaced many native wetland species. Although we have documented the location and extent of important habitats within the Town of North East, only in some cases have we provided information on the quality and condition of these habitats.

Table 1. Ecologically significant habitats documented by Hudsonia in the Town of North East, Dutchess County, New York, 2007.

Upland Habitats	Wetland Habitats
Upland hardwood forest	Hardwood & shrub swamp
Upland conifer forest	Kettle shrub pool[2,3]
Upland mixed forest	Heath swamp[2,3]
Cool ravine	Conifer swamp
Red cedar woodland	Mixed forest swamp
Upland shrubland	Marsh
Cinquefoil shrubland[1,3]	Wet meadow
Upland meadow	Calcareous wet meadow
Crest/ledge/talus	Fen
Calcareous crest/ledge/talus	Intermittent woodland pool
Oak-heath barren	Circumneutral bog lake
Marble knoll[3]	Acidic bog
Orchard/plantation	Acidic bog lake
Cultural	Open water
Waste ground	Constructed pond
	Spring/seep
	Stream

[1] described as a subcategory of upland shrubland
[2] described as subcategories of hardwood & shrub swamp
[3] shown with stars on the large habitat map; not shown in Figure 2

Figure 3. Contiguous habitat patches in the Town of North East, Dutchess County, New York. Developed areas and other non-significant habitats are shown in white. Hudsonia Ltd., 2008.



HABITAT DESCRIPTIONS

In the following pages we describe some of the ecological attributes of the habitats identified in the Town of North East, and discuss some conservation measures that can help to protect these habitats and the species of conservation concern they may support. We have assigned a code to each habitat type (e.g., upland conifer forest = ucf; marsh = ma) that corresponds with the codes appearing on the large-format (1:10,000 scale) Town of North East habitat map sheets. We have indicated species of conservation concern (those that are protected by state agencies or considered rare by non-government organizations) by placing an asterisk (*) after the species name. Appendix B provides a more detailed list of rare species associated with each habitat, including their statewide and regional conservation status. The letter codes used in Appendix B to describe the conservation status of rare species are explained in Appendix C. Appendix D gives the common and scientific names of all plants mentioned in the report.

UPLAND HABITATS

UPLAND FORESTS

Ecological Attributes

We classified upland forests into just three general types for this project: hardwood forest, conifer forest, and mixed forest. We recognize that upland forests are in fact much more variable, with each of these three types encompassing many distinct biological communities. However, our broad forest types are useful for general planning purposes, and are also the most practical for our remote mapping methods.

Upland Hardwood Forest (uhf)

Upland hardwood forest is the most common habitat type in the region, and includes many different types of deciduous forest communities. Upland hardwood forests are used by a wide range of common and rare species of plants and animals. Common trees of upland hardwood forests include maples (sugar, red), oaks (black, red, chestnut, white), hickories (shagbark, pignut), white ash, and black birch. Common understory species include maple-

leaf viburnum, witch-hazel, serviceberry (or shadbush), mountain laurel, and a wide variety of wildflowers, sedges, ferns, lichens, and mosses. On rocky, exposed ridgetops, forests may be dominated by stunted chestnut oak and scrub oak, representing a regionally uncommon type of upland hardwood forest, the crest oak woodland. Eastern box turtle* spends most of its time in upland forests and meadows, finding shelter under logs and organic litter. Many snake species forage widely in upland forests and other habitats. Upland hardwood forests provide important nesting habitat for raptors, including red-shouldered hawk,* Cooper's hawk,* sharp-shinned hawk,* broad-winged hawk,* and barred owl,* and many species of songbirds including warblers, vireos, thrushes, and flycatchers. American woodcock* forages and nests in young hardwood forests. Acadian flycatcher,* wood thrush,* cerulean warbler,* Kentucky warbler,* and scarlet tanager,* are some of the birds that may require large forest-interior areas to nest successfully. Large mammals such as black bear,* bobcat,* and fisher* also require large expanses of forest. Many small mammals are associated with upland hardwood forests, including eastern chipmunk, southern flying squirrel, white-footed mouse, and New England cottontail.* Hardwood trees greater than 5 inches (12.5 cm) in diameter (especially those with loose platy bark such as shagbark hickory and black locust) can be used by Indiana bat* for summer roosting and nursery colonies. Upland hardwood forests are extremely variable in their species composition, size and age of trees, vegetation structure, soil drainage and texture, and other habitat factors. Many smaller habitats, such as intermittent woodland pools and crest, ledge, and talus, are frequently embedded within areas of upland hardwood forest.

Upland Conifer Forest (ucf)

This habitat includes pole-sized (approximately 5-10 in [12-25 cm] diameter at breast height) to mature conifer plantations and naturally occurring upland forests with more than 75% cover of conifer trees. Eastern hemlock and white pine are typical species of naturally occuring conifer stands in the area. Various native and non-native species are used in conifer plantations. In general, plantations are more uniform in size and age of trees, structure, and overall species composition than natural conifer stands. Conifer stands are used by many species of owls (e.g., barred owl,* great horned owl, long-eared owl,* short-eared owl*) and other raptors (e.g., Cooper's hawk* and sharp-shinned hawk*) for roosting and sometimes

nesting. Pine siskin,* red-breasted nuthatch,* black-throated green warbler,* evening grosbeak,* purple finch,* and Blackburnian warbler* nest in conifer stands. American woodcock* sometimes uses conifer stands for nesting and foraging. Conifer stands also provide important habitat for a variety of mammals, including eastern cottontail, red squirrel, and eastern chipmunk (Bailey and Alexander 1960). Some conifer stands provide winter shelter for white-tailed deer and can be especially important for them during periods of deep snow cover.

Upland Mixed Forest (umf)

The term "upland mixed forest" refers to non-wetland forested areas with both hardwood and conifer species, where conifer cover is 25-75% of the canopy. In most cases, the distinction between conifer and mixed forest was made by aerial photograph interpretation. These areas are less densely shaded at ground level and support a higher diversity and greater abundance of understory species than pure conifer stands.

Occurrence in the Town of North East

Figure 4 illustrates the location of forested areas (including both forested wetlands and uplands) in the Town of North East, and the distribution of forest patches that were <100, 100-500, 500-1,000, and >1,000 ac (<40, 40-200, 200-400, and >400 ha, respectively). The largest areas of forest were in the Taconic Mountains (a total of approx. 2,900 ac (1,160 ha), bisected only by a narrow gravel road). Six contiguous forest areas, each between 500 and 1,000 ac (200 and 400 ha), were located west and east of Shekomeko (dissected by Route 83), and in the Winchell and Silver Mountain region. Fourteen additional large forest areas covered between 100 and 500 ac (40 and 200 ha) each.

Upland hardwood forest was the most widespread habitat type in the Town of North East, accounting for 38% of the total land area. In some of these forests there were areas of "rich forest," which supported calcium-associated plant species. Near the exposed ridgetops in Taconic State Park, and on some other exposed ridges, the forest was dominated by stunted chestnut and red oak, with scrub oak, blueberry, and huckleberry in the understory. These crest oak woodlands often surrounded oak-heath barrens, another habitat type described below. We

presume that virtually all forests in the Town of North East have been cleared or logged in the past and that no "virgin" stands remain. Large forest areas on steep slopes of the Taconic Mountain range may have been logged selectively, but they seem to have never been completely cleared by humans and were remarkably free of invasive species. The town may also have small old-growth forest stands that were not observed during fieldwork.

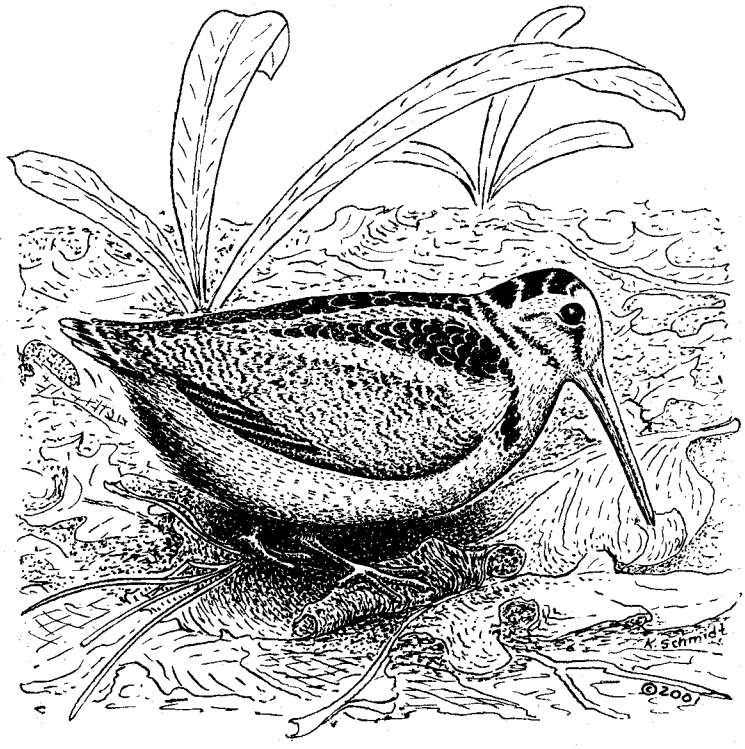
Most upland conifer and mixed forest patches were smaller than 10 acres (4 ha) and were distributed throughout the town within upland hardwood tracts. Most of the natural conifer forests were composed of white pine, eastern hemlock, and/or eastern red cedar, and these were often embedded within more extensive areas of mixed forest. Eastern hemlock stands were found most commonly on acidic ridges, in ravines, and along perennial streams. White pine was widespread and occurred in a variety of ecological settings (but generally on well-drained upland soils). Eastern red cedar stands were characteristic of early-successional forests on abandoned pasture or farmland. Planted conifer stands often consisted of Norway spruce or white pine.

Sensitivities/Impacts

Forests of all kinds are important habitats for wildlife. Extensive forested areas that are unfragmented by roads, trails, utility corridors, or developed lots are especially important for certain organisms, but are increasingly rare in the region. Primary sources of forest fragmentation include roads and driveways, residential lots, and agricultural areas. New development located along roads may block important wildlife travel corridors between forested blocks. New houses set back from roads by long driveways further add to the fragmentation of core forest areas. Both paved and unpaved roads act as barriers that many species either do not cross or cannot safely cross, and many animals avoid breeding near traffic noise (Forman and Deblinger 2000, Trombulak and Frissell 2000).

In addition to fragmentation, forest habitats can be degraded in several other ways. Clearing the forest understory destroys habitat for birds such as wood thrush* which nests in dense understory vegetation, and black-and white warbler* which nests on the forest floor. Selective logging can also damage the understory and cause soil erosion and sedimentation of streams.

Soil compaction and removal of dead and downed wood and debris has several negative impacts, including the elimination of habitat for mosses, lichens, fungi, cavity-users, amphibians, reptiles, small mammals, and insects. Where dirt roads or trails cut through forest, vehicle, horse, and pedestrian traffic can harm tree roots and cause soil erosion, and the roadway itself can provide access to interior forest areas for nest predators (such as raccoon and opossum) and the brown-headed cowbird (a nest parasite). Runoff from roads can pollute nearby areas with road salt, heavy metals, and sediments (Trombulak and Frissell 2000), and mortality from vehicles can significantly reduce the population densities of amphibians (Fahrig et al. 1995). Forests are also susceptible to invasion by shade-tolerant non-native herbs and shrubs, and this susceptibility is increased by development-related disturbances. Human habitation has also led to the suppression of naturally occurring wildfires which can be important for some forest species. See the Conservation Priorities section for recommendations on preserving the habitat values of large forests.



American woodcock

COOL RAVINE (cr)

Ecological Attributes

The habitat that we identify as a "cool ravine" is a narrow ravine with steep, high, rocky walls flanking a rocky perennial or intermittent stream. The ravine walls are commonly forested with a mixture of hardwoods and conifers, usually including eastern hemlock. The physical and biological structure of this habitat creates an unusually shady, cool, moist microclimate that supports plants of more northern affinities, such as striped maple, fly honeysuckle,* mountain maple,* American yew,* yellow birch, red-berried elder, and hobblebush.* Bryophyte cover (mosses and liverworts) is often extensive. Other characteristic plants include mountain laurel and lowbush blueberry. Ferns such as ebony spleenwort, walking fern,* and purple cliffbrake* may be present if the rocks are calcareous.

Cool ravine

The fauna of cool ravine habitats is not well known. Stream salamanders such as northern dusky* and northern two-lined salamander are likely to use cool ravine habitats. Northern slimy salamander* may use the rocky ravine wall areas, and other terrestrial-breeding salamanders may be abundant there and in the surrounding forest. Rare and uncommon birds such as winter wren,* Acadian flycatcher,* Blackburnian warbler,* and black-throated green warbler* often breed in these habitats. Mammals may include woodland jumping mouse* and southern redback vole, and small-footed bat* may roost in talus of cool ravines.

Occurrence in North East

Cool ravines were found west of Route 83 in the southwest corner of town, and near the bottom of Kaye Road in Taconic State Park (Figure 11).

Sensitivities/Impacts

These scenic areas often attract recreational use which can result in trampling, littering, soil erosion, and noise disturbance to nesting birds and other wildlife. Roads, substantial trails, or other clearings may also allow incursions by the brown-headed cowbird, a nest parasite that could pose a significant threat to the nesting success of cool ravine songbirds. Any clearing of trees and shrubs could alter the shade-tolerant plant community, cause soil erosion, and lead to elevated temperature in the stream and ravine bank habitats. Pollution of upstream waters can harm the stream habitats, and creation of reservoirs alters the habitat for aquatic and riparian biota. See the Conservation Priorities section for recommendations on preserving the habitat values of cool ravines.

RED CEDAR WOODLAND (rcw)

Ecological Attributes

Red cedar woodlands feature an overstory dominated by widely spaced eastern red cedar trees and grassy meadow remnants between them. Red cedar is one of the first woody plants to invade abandoned pastures on mildly acidic to alkaline soils in this region, and red cedar woodlands are often transitional between upland meadow and young forest habitats. The seeds of red cedar are bird-dispersed, and the seedlings are successful at becoming established in the

hot, dry conditions of old pastures (Holthuijzen and Sharik 1984). The cedar trees are often widely spaced in young stands and denser in more mature stands. They tend to grow in particularly dense stands in areas with calcareous soils. Other, less common saplings and small trees include gray birch, red maple, quaking aspen, and red oak. The understory vegetation is similar to that of upland meadow. Kentucky bluegrass and other hayfield and pasture grasses are often dominant in the understory, particularly in more open stands; little bluestem is often dominant on poorer soils. Red cedars can persist in these stands for many years even after a hardwood forest grows up around them. We mapped areas where abundant red cedar occurs under a canopy of hardwoods as "upland mixed forest."

Rare plants of red cedar woodlands in the region include Carolina whitlow-grass,* yellow wild flax,* and Bicknell's sedge.* The olive hairstreak* (butterfly) uses red cedar as a larval host. Open red cedar woodlands with exposed gravelly or sandy soils may be important nesting habitat for several reptile species of conservation concern, including wood turtle,* spotted turtle,* eastern box turtle,* and eastern hognose snake.* These reptiles may travel considerable distances overland from their primary wetland or forest habitats to reach the nesting grounds. Eastern hognose snake* may also use these habitats for basking, foraging, and over-wintering. Red cedar woodlands may provide habitat for roosting raptors, such as northern harrier,* short-eared owl,* and northern saw-whet owl.* Red cedar fruit is a food source for eastern bluebird,* cedar waxwing, and other birds. Many songbirds also use red cedar for nesting and roosting, including field sparrow,* eastern towhee,* and brown thrasher.* Insectivorous birds such as black-capped chickadee and golden-crowned kinglet forage in red cedar.

Occurrence in the Town of North East

Red cedar woodlands in the Town of North East ranged in size from 0.3 to 10 ac (0.1-4 ha). The distribution of red cedar woodlands in North East was closely related to the agricultural history of the town and the timing of pasture abandonment, and thus these woodlands were mostly found in the valley areas. Red cedar woodlands were often associated with calcareous habitats such as marble knoll and fen.

Sensitivities/Impacts

Extensive occurrences of red cedar woodlands are limited in Dutchess County, and in North East they are often associated with less common habitat types. Red cedar woodlands on abandoned agricultural lands are often considered prime development sites, and thus are particularly vulnerable to direct habitat loss or degradation. Woodlands on steep slopes with fine sandy soils may be especially susceptible to erosion from ATV traffic, driveway construction, and other human uses. Human disturbances may also facilitate the invasion of non-native forbs and shrubs that tend to diminish habitat quality by forming dense stands that displace native plant species. Wherever possible, measures should be taken to prevent the direct loss or degradation of these habitats and to maintain unfragmented connections with nearby wetlands, forests, and other important habitats.

Red cedar woodland

CREST/LEDGE/TALUS

Ecological Attributes

Rocky crest, ledge, and talus habitats often (but not always) occur together, so they are described and mapped together for this project. Crest and ledge habitats occur where soils are very shallow and bedrock is partially exposed at the ground surface, either at the summit of a hill (crest) or elsewhere (ledge). These habitats are usually embedded within other habitat types, most commonly upland forest. They can occur at any elevation, but may be most familiar on hillsides and hilltops in the region. Talus is the term for the fields of rock fragments of various sizes that often accumulate at the bases of steep ledges and cliffs. We also included large glacial erratics (glacially-deposited boulders) in this habitat type. Some crest, ledge, and talus habitats support well-developed forests, while others have only sparse, patchy, and stunted vegetation. Crest, ledge, and talus habitats often appear to be harsh and inhospitable, but they can support an extraordinary diversity of plants and animals. Some species, such as wall-rue,* smooth cliffbrake,* purple cliffbrake,* and northern slimy salamander* are found only in and near such habitats in the region. The communities and species that occur at any particular location are determined by many factors, including bedrock type, outcrop size, aspect, exposure, slope, elevation, biotic influences, and kinds and intensity of human disturbance.

Because distinct communities develop in calcareous and non-calcareous environments, we mapped calcareous bedrock exposures wherever possible. Calcareous crests often have trees such as eastern red cedar, hackberry,* basswood, and butternut; shrubs such as bladdernut, American prickly-ash, and Japanese barberry; and herbs such as wild columbine, ebony spleenwort, maidenhair spleenwort, maidenhair fern, and fragile fern. They can support numerous rare plant species, such as walking fern,* yellow harlequin,* and Carolina whitlow-grass.* Non-calcareous crests often have trees such as red oak, chestnut oak, eastern hemlock, and occasionally pitch pine; shrubs such as lowbush blueberries, chokeberries, and scrub oak; and herbs such as Pennsylvania sedge, little bluestem, hairgrass, bristly sarsaparilla, and rock polypody. Rare plants of non-calcareous crests include mountain spleenwort,* clustered sedge,* and slender knotweed.*

Northern hairstreak* (butterfly) occurs with oak species which are host plants for its larvae, and olive hairstreak* occurs on crests with its host eastern red cedar. Rocky habitats with larger fissures, cavities, and exposed ledges may provide shelter, den, and basking habitat for eastern hognose snake,* eastern wormsnake,* and copperhead.* Ledge areas with southern to southeastern and southwestern exposure may provide winter den and spring "basking rocks" for timber rattlesnake.* Northern slimy salamander* occurs in non-calcareous wooded talus areas. Breeding birds of crest habitats include Blackburnian warbler,* worm-eating warbler,* and cerulean warbler.* Bobcat* and fisher* use high-elevation crests and ledges for travel, hunting, and cover. Porcupine and bobcat use ledge and talus habitats for denning. Southern redback vole is found in some rocky areas, and small-footed bat* roosts in talus habitat.

Calcareous ledge

Occurrence in the Town of North East

Crest, ledge, and talus habitats occurred throughout the town in close association with hills and ridges (Figure 6). Extensive rocky areas were found on Brace Mountain and throughout Taconic State Park, on Winchell Mountain, Silver Mountain, Cascade Mountain, and other hills in the northwest corner of town, and scattered in smaller areas. Some of the high elevation crests of ridges in the town supported oak-heath barrens (described in the section below) and crest oak woodlands, a type of upland hardwood forest of stunted growth that is uncommon in the town and region. Smaller ridges and hills within the valley areas tended to have calcareous rock outcrops (also see marble knoll section below). Calcareous ledge and talus were also found at several locations on the forested lower slopes of the Taconic Mountains.

Sensitivities/Impacts

Crest, ledge, and talus habitats often occur in locations that are valued by humans for recreational uses, scenic vistas and house sites. Construction of trails, roads, and houses destroys crest, ledge, and talus habitats directly, and causes fragmentation of these habitats and the forested areas of which they are a part. Rare plants of crests are vulnerable to trampling and collecting; rare snakes are susceptible to road mortality, intentional killing, and collecting; and rare breeding birds of crests are easily disturbed by human activities nearby. The shallow soils of these habitats are susceptible to erosion from construction and logging activities, and from foot and ATV traffic. See the Conservation Priorities section for recommendations on preserving the habitat values of crest, ledge, and talus habitats.

OAK-HEATH BARREN (ohb)

Ecological Attributes

A special subset of rocky crest habitat (see above), oak-heath barren occurs on ridgetops and shoulders with exposed noncalcareous bedrock, shallow, acidic soils, and vegetation dominated by some combination of pitch pine, scrub oak, other oaks, and heath (Ericaceae) shrubs. Schist, gneiss, and quartzite are among the common types of exposed bedrock. The soils are extremely thin, excessively well drained, and very nutrient poor. Due to the open canopy, oak-heath barrens tend to have a much warmer microclimate than the surrounding forested habitat,

especially in the spring and fall. The exposed nature of these habitats also makes them particularly susceptible to wind, ice, and, at least historically, fire disturbance. The droughty, infertile, and exposed conditions have a strong influence on the composition and structure of the plant community; trees are often sparse and stunted. Our definition corresponds to Edinger et al.'s (2002) "pitch pine-oak forest" and "pitch pine-oak-heath rocky summit." There may be a continuous canopy of pitch pine or pitch pine-oak with a scrub oak understory, or the shrub layer (predominately scrub oak and heath shrubs) may dominate, with only scattered pines. Dominant trees include pitch pine, chestnut oak, red oak, and scarlet oak; the shrub layer may include scrub oak, eastern red cedar, blueberries, black huckleberry, deerberry, and sweetfern. Common herbs include Pennsylvania sedge, poverty-grass, common hairgrass, little bluestem, and bracken. Lichens and mosses are sometimes abundant. Included with our oak-heath barrens are some patches of sedge-dominated rocky summit grassland found on Brace Mountain. These grasslands are surrounded by and interspersed with the more typical oak-heath barrens and seem to provide a similar habitat for plants and animals.

Oak-heath barrens can have significant habitat value for timber rattlesnake* and copperhead.* Deep rock fissures can provide crucial shelter habitat for these species and the exposed ledges provide basking and breeding habitat in the spring and early summer. Birds of this habitat include common yellowthroat, Nashville warbler, prairie warbler,* field sparrow,* eastern towhee,* and whip-poor-will.* A number of rare butterflies that use scrub oak, little bluestem, lowbush blueberry, or pitch pine as their primary food plant tend to concentrate in oak-heath barrens, including Edward's hairstreak,* cobweb skipper,* Leonard's skipper,* and brown elfin. Oak-heath barrens also appear to be refuges for several rare oak-dependent moths. Rare plants of oak-heath barrens include clustered sedge,* mountain spleenwort,* dwarf shadbush,* three-toothed cinquefoil,* bearberry,* and rusty woodsia.*

Occurrence in the Town of North East

We mapped 67 oak-heath barren patches in the Taconic Mountains, the only area within the town where this habitat type occurred (Figure 6). Most were less than 1 ac (0.4 ha) in size; the largest covered 11 ac (4.4 ha).

Sensitivities/Impacts

Because most oak-heath barrens in the town are located within Taconic State Park, they have been largely protected from severe human disturbance. The most immediate threats to these fragile habitats are human foot traffic; barrens near trails are often visited for scenic views and for camping. Trampling, soil compaction, and soil erosion can damage or eliminate rare plants, discourage use by rare animals, and encourage invasions of non-native plants. These effects are even more marked in the small areas that have seen residential development on top of oak-heath barrens. Barrens on hilltops can also be disturbed or destroyed by the construction and maintenance of communication towers. Construction of roads and buildings in the areas between oak-heath barrens can fragment important migration corridors for snakes, lizards, and butterflies, thereby isolating neighboring populations and decreasing their long-term viability. Because rare snakes tend to congregate on oak-heath barrens at certain times of the year, the snakes are highly susceptible to killing or collecting by poachers.

Oak-heath barren

MARBLE KNOLL

Ecological Attributes

Marble knoll is an uncommon habitat type that is restricted in Dutchess County to the Harlem Valley region. It occurs primarily along the broad valley floor where Stockbridge Marble bedrock forms numerous knoll-like hills, usually with extensive marble outcrops. In addition to marble outcrops these hills usually have sandy or gravelly soils, which help to create a warm and dry microclimate (Kiviat 1988). Many marble knolls have been used for pasture within the last few decades, and they tend now to support red cedar woodlands with small meadow-like openings, with grasses such as little bluestem and Indian grass.* These open areas provide the best habitat for rare plants characteristic of marble knolls. We did not map densely forested knolls as marble knolls because they do not generally support the rare species listed below; these areas we mapped as calcareous crest, ledge, and talus. Marble knoll areas that have at least a partly open canopy can be important sites for rare plant species such as side-oats grama,* Bicknell's sedge,* Carolina whitlow-grass,* Torrey's mountain-mint,* yellow wild flax,* large twayblade,* green milkweed,* and northern blazing-star* (Kiviat 1988). These meadow-like openings also support many of the rare plants of other calcareous crests (see above). At least 19 plant species listed as Endangered, Threatened, or Rare in New York are known to occur in marble knoll habitats. Marble knolls provide habitat similar to crest, ledge, and talus for reptiles such as eastern hognose snake* and eastern wormsnake,* and may also be used by Fowler's toad.* Red cedar canopies on marble knolls may provide roosting habitat for northern saw-whet owl* (Kiviat 1988) among other raptor species (see the section on red cedar woodland above).

Occurrence in North East

Marble knolls often occurred within larger calcareous areas (including calcareous crest/ledge/talus, fens, and calcareous wet meadows) in the valleys of North East (Figure 7). We found marble knolls east of Route 83, west of Mill Road, and on the shore of Indian Lake. In some upland areas lacking very dry soils and exposed bedrock, we found plants characteristic of marble knolls (especially shrubby cinquefoil). These areas we mapped as "cinquefoil shrubland," and they are described below in the upland shrubland section.

Sensitivities/Impacts

Marble knolls may be desirable areas for mining, house construction, and other intensive uses. The calcareous sands on these hills are very susceptible to erosion. Removal of vegetation, use of pesticides, alteration of water runoff patterns, or soil disturbance by vehicles, foot traffic, or construction equipment could do great harm to rare plant communities. On the other hand, the rare plants of marble knolls may benefit from maintaining the meadow openings that might otherwise be overgrown by red cedars or other trees and shrubs. See the Conservation Priorities section for recommendations on preserving the habitat values of marble knolls.

UPLAND SHRUBLAND (us)

Ecological Attributes

We use the term "upland shrubland" to describe shrub-dominated uplands. In most cases, these are lands in transition between meadow and young forest, but they also occur along utility corridors maintained by cutting or herbicides, and in recently cleared areas. Recently cleared or disturbed sites often contain dense thickets of shrubs and vines, including the non-native Japanese barberry, Eurasian honeysuckles, and multiflora rose. Abandoned agricultural fields and pastures often support more diverse plant communities, including a variety of meadow grasses and forbs, shrubs such as meadowsweet, gray dogwood, northern blackberry, raspberries, and multiflora rose, and scattered seedlings and saplings of eastern red cedar, hawthorns, white pine, gray birch, red maple, quaking aspen, and oaks. Occasional large, open-grown trees (e.g., sugar maple, red oak, sycamore) left as shade for livestock may be present.

Rare butterflies such as Aphrodite fritillary,* dusted skipper,* Leonard's skipper,* and cobweb skipper* may occur in shrublands where their host plants are present (the fritillary needs violets and the skippers reproduce on native grasses, such as little bluestem). Upland shrublands and other non-forested upland habitats may be used by turtles (e.g., painted turtle, wood turtle,* spotted turtle,* and eastern box turtle*) for nesting. Many bird species of conservation concern nest in upland shrublands and adjacent upland meadow habitats, including brown thrasher,*

blue-winged warbler,* golden-winged warbler,* prairie warbler,* yellow-breasted chat,* clay-colored sparrow,* field sparrow,* eastern towhee,* and northern harrier.* Extensive upland shrublands and those that form large complexes with meadow habitats may be particularly important for these breeding birds. Several species of hawks and falcons use upland shrublands and adjacent meadows for hunting small mammals such as meadow vole, deer mouse, eastern cottontail, and New England cottontail.*

A few species of rare plants are known from calcareous shrublands in the region, such as stiff-leaf goldenrod,* butterflyweed,* and shrubby St. Johnswort.* In highly calcareous areas, shrubby cinquefoil may dominate the shrub community. We mapped several such areas in North East as "cinquefoil shrubland." We believe these areas may well support rare plants and invertebrates similar to those found on marble knolls or in fens.

Occurrence in the Town of North East

Upland shrublands were widely distributed throughout agricultural parts of the Town of North East, and ranged in size from 0.03 to 20 ac (0.01-8 ha), for a total of 730 ac (295 ha). The largest shrublands were groups of abandoned pastures. Cinquefoil shrublands were identified on both sides of Route 83 in the southern part of town (Figure 7).

Sensitivities/Impacts

Shrublands and meadows are closely related plant communities. Having a diversity of ages and structures in these habitats may promote overall biological diversity, and can be achieved by rotational mowing and/or brush-hogging. To reduce the impacts of these management activities on birds, mowing should be timed to coincide with the post-fledging season for most birds (e.g., September and later) and only take place every few years, if possible. As in upland meadows, soil compaction and erosion caused by ATVs, other vehicles, and equipment can reduce the habitat value for invertebrates, small mammals, nesting birds, and nesting turtles. If shrublands are left undisturbed, most will eventually become forests, which are also valuable habitats.

UPLAND MEADOW (um)

Ecological Attributes

This broad category includes active cropland, hayfields, pastures, equestrian fields, abandoned fields, and other upland areas dominated by herbaceous vegetation. Upland meadows are typically dominated by grasses and forbs, with less than 20% shrub cover. The ecological values of these habitats can differ widely according to the types of vegetation present and varying disturbance histories (e.g., tilling, mowing, grazing, pesticide applications). Extensive hayfields or pastures, for example, may support grassland-breeding birds (depending on the mowing schedule or intensity of grazing), while other intensively cultivated crop fields may have comparatively little wildlife habitat value. We mapped these distinct types of meadow as a single habitat for practical reasons, but also because after abandonment these open areas tend to develop similar general habitat characteristics and values. Undisturbed meadows develop diverse plant communities of grasses, forbs, and shrubs and support an array of wildlife, including invertebrates, reptiles, mammals, and birds. It is for both present and potential future ecological values that we consider all types of meadow habitat to be ecologically significant.

Several species of rare butterflies, such as Aphrodite fritillary,* dusted skipper,* Leonard's skipper,* and swarthy skipper,* use upland meadows that support their particular host plants (violets for the fritillary and native grasses, such as little bluestem, for the skippers). Upland meadows can be used for nesting by wood turtle,* spotted turtle,* box turtle,* painted turtle, and snapping turtle. Grassland-breeding birds, such as northern harrier,* upland sandpiper,* grasshopper sparrow,* vesper sparrow,* savannah sparrow,* Henslow's sparrow,* eastern meadowlark,* and bobolink,* use extensive meadow habitats for nesting and foraging. Upland meadows often have large populations of small mammals (e.g., meadow vole) and can be important hunting grounds for raptors, foxes, and coyote.

Occurrence in the Town of North East

Upland meadow was the second most common habitat type in the Town of North East, accounting for 36% of the total land area. Figure 5 illustrates the location and distribution of contiguous meadow habitat in the town (including upland meadow, wet meadows, and fen),

showing those areas that were <25, 25-50, 50-100, 100-200, and >200 ac (<10, 10-20, 20-40, 40-80, and >80 ha). This figure does not include areas of upland shrubland that in some cases had large patches of herbaceous cover. In North East, large areas of open meadow were located in the main valleys (e.g., along Wassaic and Shekomeko creeks and along Webatuck Creek north and south of Millerton), as well as the western plateaus (e.g., Winchell Mountain, Silver Mountain) where agricultural land use was most extensive. Fences and hedgerows dividing fields can significantly alter the habitat value for many birds; if these are treated as fragmenting features, then the largest meadows were 132 and 122 ac (53 and 49 ha; Figure 5). The most common kinds of upland meadow in the town were row crops, hayfields, pastures, and equestrian fields. Less intensively managed upland meadows were much less common. Although we did not designate them as a separate habitat, some upland meadows in North East were calcareous, with species such as wild bergamot, little bluestem, wild thyme, and marjoram.

Sensitivities/Impacts

Principle causes of meadow habitat loss in the region are the intensification of agriculture, regrowth of shrubland and forest after abandonment, and residential and commercial development. The dramatic decline of grassland-breeding birds in the North East has been attributed to the loss of large patches of suitable meadow habitat; many of these birds need large meadows that are not divided by fences or hedgerows, which can harbor predators (Wiens 1969). Another threat to upland meadow habitats is the soil compaction and erosion caused by ATVs, other vehicles, and equipment, which can reduce the habitat value for invertebrates, small mammals, nesting birds, and nesting turtles. Destruction of vegetation can affect rare plants and reduce viable habitat for butterflies, and mowing of upland meadows during the bird nesting season can cause extensive mortality of eggs, nestlings, and fledglings. Farmlands where pesticides and artificial fertilizers are used may have a reduced capacity to support biodiversity. See the Conservation Priorities section for recommendations for maintaining high-quality large meadow habitats.

ORCHARD/PLANTATION (or/pl)

This habitat type includes actively maintained or recently abandoned fruit orchards, Christmas tree farms, and plant nurseries. Conifer plantations with larger, older trees were mapped as "upland conifer forest." Christmas tree farms are potential northern harrier* breeding habitat. Fruit orchards with old trees are potential breeding habitat for eastern bluebird* and may be valuable to other cavity-using birds, bats, and other animals. The habitat value of active orchards or plantations is often compromised by frequent mowing, application of pesticides, and other human activities; we considered this an ecologically significant habitat type more for its future ecological values after abandonment than its current values. These habitats have some of the vegetation structure and ecological values of upland meadows and upland shrublands, and will ordinarily develop into young forests if they remain undisturbed after abandonment. In the Town of North East, orchard/plantation areas ranged from 0.1 – 9 ac (0.05 - 4 ha). Most were Christmas tree plantations, orchards, and plant nurseries. Abandoned apple orchards that had lost their ordered structure were mapped either as upland hardwood forest or as upland shrubland depending on their characteristics.

CULTURAL (c)

We define "cultural" habitats as areas that are significantly altered and intensively managed (e.g., mowed), but are not otherwise developed with pavement or structures and are adjacent to ecologically valuable habitat, i.e., not entirely surrounded by developed areas. In the Town of North East, cultural habitats included large gardens, playing fields, riding rings, cemeteries, and large lawns. We mapped this as an ecologically significant habitat type more for its potential future ecological values rather than its current values, which are reduced by frequent mowing, application of pesticides, or other types of management and intensive human uses. Nonetheless, eastern screech owl* and barn owl* are known to nest and roost in cultural areas. American kestrel, spring migrating songbirds, and bats may forage in these habitats, and wood duck* may nest here. Ornamental trees can provide microhabitats for cavity-nesting birds, bats (including Indiana bat*), and other animals. Many cultural areas have "open space" values for the human community, and some provide important ecological services such as buffering less

disturbed habitats from human activities, and linking patches of undeveloped habitat together. Because cultural habitats are already significantly altered, however, their habitat value is greatly diminished in comparison to relatively undisturbed habitats.

WASTE GROUND (wg)

Waste ground is a botanists' term for land that has been severely altered by previous or current human activity, but lacks pavement or structures. Most waste ground areas have been stripped of vegetation and topsoil, or filled with soil or debris, but remain substantially unvegetated. This category encompasses a variety of highly impacted areas such as active and abandoned gravel mines, rock quarries, mine tailings, dumps, unvegetated wetland fill, landfill cover, construction sites, and abandoned lots. Although waste ground often has low habitat value, there are notable exceptions. Several rare plant species are known to inhabit waste ground environments, including rattlebox,* slender pinweed,* field-dodder,* and slender knotweed.* Rare lichens may potentially occur in some waste ground habitats. Several snake and turtle species of conservation concern, including eastern hognose snake* and wood turtle,* may use the open, gravelly areas of waste grounds for burrowing, foraging, or nesting habitat. Bank swallow* and belted kingfisher sometimes nest in the stable walls of inactive soil mines or piles of soil or sawdust. Bare, gravelly, or otherwise open areas provide nesting grounds for spotted sandpiper, killdeer, and possibly common nighthawk.* The biodiversity value of waste ground will often increase over time as it develops into a higher quality habitat. However, on sites where species of conservation concern are absent or unlikely, waste ground may have a low habitat value compared to relatively undisturbed habitats.

WETLAND HABITATS

SWAMPS

Ecological Attributes

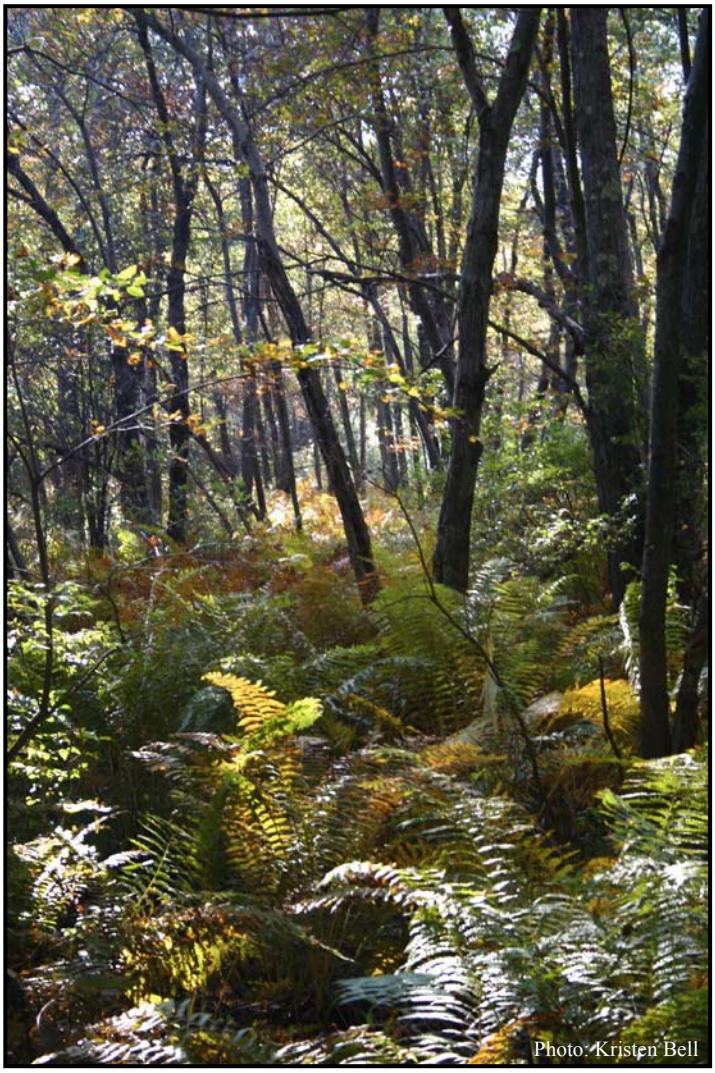
A swamp is a wetland dominated by woody vegetation (trees or shrubs). We mapped three general types of swamp habitat in the Town of North East: hardwood and shrub swamp, conifer swamp, and mixed swamp.

Hardwood and Shrub Swamp (hs)

We combined deciduous forested and shrub swamps into a single habitat type because the two often occur together and can be difficult to separate using remote sensing techniques. Red maple, black ash, green ash, American elm, slippery elm, and swamp white oak are common trees of hardwood swamps in the region. Typical shrubs include silky dogwood, alder, shrubby willows, winterberry holly and northern arrowwood. Tussock sedge and skunk cabbage are two common herbaceous species of these swamps.

Conifer Swamp (cs)

Conifer swamp is a type of forested swamp where conifer species occupy 75% or more of the upper tree canopy. Conifer species that can tolerate wetland conditions include eastern hemlock, red cedar, and eastern tamarack. The dense canopy has a strong influence on the understory plant community and structure of these swamps. The shrub and herbaceous layers are typically sparse and low in species diversity. Shading also creates a cooler microclimate, allowing snow and ice to persist longer into the early spring growing season. Conifers growing in wetlands frequently have very shallow root systems and are therefore prone to wind-throw. The resulting tip-up mounds, root pits, and coarse woody debris all contribute to the habitat's complex structure and microtopography.



Hardwood swamp

Mixed Forest Swamp (ms)

Mixed forest swamps have a canopy composed of 25-75% conifers. This habitat has characteristics intermediate between those of hardwood and conifer swamps, and shares many of the ecological values of those habitats.

Swamps are important to a wide variety of birds, mammals, amphibians, reptiles, and invertebrates, especially when swamp habitats are contiguous with other wetland types or embedded within large areas of upland forest. Swamp cottonwood* is a very rare tree of deeply-flooding hardwood swamps, known from only five or six locations in the Hudson Valley; there are no known records of this species from the Harlem Valley, but it may occur in the region. Hardwood and shrub swamps along the floodplains of clear, low-gradient streams can be an important component of wood turtle* habitat. Other turtles such as spotted turtle* and box turtle* frequently use swamps for summer foraging, drought refuge, overwintering, and travel corridors. Pools within swamps are used by several breeding amphibian species, and are the primary breeding habitat of blue-spotted salamander.* Four-toed salamander,* believed to be regionally rare, uses swamps with rocks and abundant moss-covered downed wood or woody hummocks. Red-shouldered hawk,* barred owl,* great blue heron,* wood duck,* prothonotary warbler,* Canada warbler,* and white-eyed vireo* potentially nest in hardwood swamps.

Among the hardwood and shrub swamps that we visited, we noted two particular types with exceptional habitat value: heath swamp and kettle shrub pool. Both are more or less hydrologically isolated wetlands that may be valuable habitat for pool-breeding amphibians and other animals that depend on intermittent woodland pools. The structural differences among these swamps, however, may have implications for some species that use them (for more information on these habitats see Kiviat and Stevens 2001 and Bell et al. 2005). The heath swamp and kettle shrub pool we mapped in North East should be considered examples of these habitats rather than a complete inventory; there may be other swamps which we did not visit that fall into these categories.

- *Heath swamps* typically have deep water, moss-covered woody hummocks, a significant shrub layer dominated by highbush blueberry, winterberry holly, and/or swamp azalea, and high plant diversity. The heath swamp mapped in North East is exceptional in having a continuous red maple canopy, while other heath swamps we have observed in the Hudson Valley lack significant tree cover. Heath swamps can sometimes be acidic, with mountain laurel and large areas of *Sphagnum*. Most of the heath swamps in our region, however, appear to be calcareous, supporting plants such as buttonbush, poison sumac, and *Riccia fluitans* (an aquatic liverwort). The example mapped in North East had abundant buttonbush, dwarf raspberry, and a few other calcicoles. Heath swamps are often found in depressions isolated from other wetlands, and can provide excellent habitat for uncommon plants (we found swamp lousewort* and lopseed* at the edge of the heath swamp in North East), pool-breeding amphibians, and other species of conservation concern.

- *Kettle shrub pools* are seasonally or permanently flooded, shrub-dominated pools, with buttonbush normally the dominant plant (although buttonbush may appear and disappear over the years in a given location). Other shrubs such as highbush blueberry, swamp azalea, and willows may also be abundant. In some cases, a shrub thicket in the middle of the pool is entirely or partly surrounded by an open water moat. Kettle shrub pools may have some small trees such as red maple or green ash in the pool interior, but usually lack a forest canopy. They are located in glacial kettles—depressions formed by the melting of stranded blocks of glacial ice—and are underlain by a deep layer of organic soil. Standing water is normally present in winter and spring but often disappears by late summer, or remains only in isolated puddles. Hudsonia has found two state-listed rare plants (spiny coontail* and buttonbush dodder*) and three regionally-rare plants (the moss *Helodium paludosum*,* short-awn foxtail,* and pale alkali grass*) in kettle shrub pools in nearby towns. The organic muck is good overwintering habitat for several turtle species.

Occurrence in the Town of North East

Hardwood and shrub swamp is by far the most extensive wetland habitat type in the Town of North East (Figure 10), with a total of 1,343 ac (544 ha). Swamps ranged in size from <0.1 to 99 ac (<0.04-40 ha), with an average extent of about 3 ac (1.2 ha). They were often contiguous with other wetland habitats such as marsh, wet meadow, and open water (including beaver ponds). Large swamps were located along Webatuck Creek north of Millerton, south of Rudd Pond, south of Route 44 straddling the state line with Connecticut, and north of Sharon Station Road. Smaller swamps were widely scattered throughout the town. The two conifer swamps were hemlock-dominated, and mixed forest swamps had a significant component of either hemlock or red cedar. We found one large heath swamp (65 ac [26 ha]) in the southeastern part of town and one kettle shrub pool of 5 ac (2 ha) west of the Rail Trail just north of Coleman Station.

Swamps occurred in a variety of settings, such as on seepy slopes, along streams, in depressions, and as part of large wetland complexes. Some were shrub-dominated (native or exotic), while others had a full canopy of maple and ash. Water depth ranged greatly, with some swamps drying completely in the summer months while others retained relatively deep pools. Swamps that were isolated from streams and other wetlands (isolated pools) may have ecological roles similar to those of intermittent woodland pools, providing a seasonal source of water with fewer aquatic predators, breeding habitat for amphibians, and refuge for turtles. Although we did not designate them as a separate habitat, some swamps in North East were calcareous and supported the associated plant species of calcareous wetlands.

Sensitivities/Impacts

Some swamps may be protected by federal or state laws, but that protection is usually incomplete or inadequate, and most swamps are still threatened by a variety of land uses. Small swamps embedded in upland forest are often overlooked in wetland protection, but can have extremely high biodiversity value, and play similar ecological roles to those of intermittent woodland pools (see intermittent woodland pool section). Many of the larger swamps are located in low-elevation areas where human land uses are also concentrated. They can easily be damaged by alterations to the quality or quantity of surface water runoff, or by

disruptions of the groundwater sources feeding them. Swamps that are surrounded by agricultural land are subject to runoff contaminated with agricultural chemicals, and those near roads and other developed areas often receive runoff high in nutrients, sediment, and toxins. Polluted runoff and groundwater degrade the swamp's water quality, affecting the ecological condition (and thus habitat value) of the swamp and its associated streams, and the quality of drinking water if the swamp is connected to a public water supply. Maintaining flow patterns and water volume in swamps is important to the plants and animals of these habitats. Connectivity between swamp habitats and nearby upland and wetland habitats is essential for amphibians that breed in swamps and for other resident and transient wildlife of swamps. Direct disturbance, such as logging, can damage soil structure, plant communities, and microhabitats, and provide access for invasive plants. Ponds for ornamental or other purposes are sometimes excavated in swamps, but the loss of habitat values of the pre-existing swamp usually far outweighs any habitat value gained in the new, artificial pond environment. See the Conservation Priorities section for recommendations on preserving the habitat values of isolated pools and swamps within larger wetland complexes.

MARSH (ma)

Ecological Attributes

A marsh is a wetland that has standing water for most or all of the growing season and is dominated by herbaceous (non-woody) vegetation. Marshes often occur at the fringes of deeper water bodies (e.g., lakes and ponds), or in close association with other wetland habitats such as wet meadows or swamps. The edges of marshes, where standing water is less permanent, often grade into wet meadows. Cattail, tussock sedge, arrow arum, broad-leaved arrowhead, water-plantain, and purple loosestrife are some typical emergent marsh plants in this region.

Several rare plant species are known from marshes in the region, including spiny coontail* and buttonbush dodder.* Marshes are also important habitats for reptiles and amphibians, including eastern painted turtle, snapping turtle, spotted turtle,* green frog, pickerel frog, spring peeper, and northern cricket frog.* Numerous bird species, including marsh wren,* common

moorhen,* American bittern,* least bittern,* great blue heron,* Virginia rail,* king rail,* sora,* American black duck,* and wood duck* use marshes for nesting or as nursery habitat. Many raptor, wading bird, and mammal species use marshes for foraging.

Occurrence in the Town of North East

We mapped 106 marshes in the Town of North East, covering a total of 299 ac (121 ha). Marshes were frequently found along the margins or embedded in hardwood and shrub swamps or wet meadows. Because it was sometimes difficult to distinguish marsh from shrub swamp or wet meadow on aerial photographs, all mapped marsh boundaries should be considered approximate. Most marshes we observed in the field were dominated by purple loosestrife, common reed, or cattail, and many were influenced by beaver activity. In some cases we mapped areas of open water within marshes as a distinct habitat (see open water below). In areas where beavers are active, the location and extent of open water areas likely changes from year to year. While most of the mapped marshes within the town were small (<4 ac [1.6 ha]), four large ones (22-58 ac [8.8-23.2 ha]) were found in the valley north of Millerton.

Sensitivities/Impacts

In addition to direct disturbances such as filling or draining, marshes are subject to stresses from offsite (upgradient) sources. Alteration of surface water runoff patterns or groundwater flows can lead to dramatic changes in the plant and animal communities of marshes. Polluted stormwater runoff from roads, parking lots, lawns, and other surfaces in developed landscapes carries sediments, nutrients, toxins, and other contaminants into the wetland. Nutrient and sediment inputs and human or beaver alteration of water levels can also alter the plant community, and facilitate invasion by non-native plants such as purple loosestrife and common reed. Purple loosestrife and common reed have displaced many of the native wetland graminoids in recent decades and are now the dominant plants in many of the marshes in the Town of North East. Noise and direct disturbance from human activities can discourage breeding activities of marsh birds. Because many animal species of marshes depend equally on surrounding upland habitats for their life history needs, protection of the ecological functions of

marshes must go hand-in-hand with protection of surrounding habitats. See the Conservation Priorities section for recommendations on preserving the habitat values of marshes within larger wetland complexes.

WET MEADOW (wm)

Ecological Attributes

A wet meadow is a wetland dominated by herbaceous (non-woody) vegetation and lacking standing water for most of the year. Its period of inundation is longer than that of an upland meadow, but shorter than that of a marsh. Some wet meadows are dominated by purple loosestrife, common reed, reed canary-grass, or tussock sedge, while others have a diverse mixture of wetland grasses, sedges, forbs, and scattered shrubs. Bluejoint, mannagrasses, woolgrass, soft rush, blue flag, sensitive fern, and marsh fern are some typical plants of wet meadows.

Wet meadows with diverse plant communities may have rich invertebrate faunas. Blue flag and certain sedges and grasses of wet meadows are larval food plants for a number of regionally-rare butterflies. Wet meadows provide nesting and foraging habitat for songbirds such as sedge wren,* wading birds such as American bittern,* and raptors such as northern harrier.* Wet meadows that are part of extensive meadow areas (both upland and wetland) may be especially important to species of grassland-breeding birds. Large and small mammals use wet meadows and a variety of other meadow habitats for foraging.

Occurrence in the Town of North East

Wet meadows were widely distributed primarily in the valleys in North East, and commonly occurred along the margins of swamps and marshes, and in low-lying areas within upland meadows. We mapped almost 350 wet meadows, for a total of 425 ac (172 ha) in the town. Most wet meadows were smaller than 2 ac (0.8 ha). The largest wet meadows occurred along Webatuck Creek south of Downey Road.

Sensitivities/Impacts

Some wet meadows are able to withstand light grazing by livestock, but heavy grazing can destroy the structure of the surface soils, eliminate sensitive plant species, and invite non-native weeds. Frequent mowing causes similar negative consequences. It is less damaging to the plant community to mow when soils are dry, e.g., in late summer (see the section on large meadows in the Conservation Priorities section for general recommendations about mowing practices). Wet meadows that are part of larger complexes of meadow and shrubland habitats are prime sites for development or agricultural use, and are often drained or excavated. Because many wet meadows are omitted from state, federal, and site-specific wetland maps, they are frequently overlooked in environmental reviews of development proposals. See the conservation priorities section for recommendations on preserving the habitat values of wet meadows within larger wetland complexes.

Calcareous wet meadow

CALCAREOUS WET MEADOW (cwm)

Ecological Attributes

A calcareous wet meadow is a specific type of wet meadow habitat (see above) that is strongly influenced by calcareous (calcium-rich) groundwater or soils. These conditions favor the establishment of a calcicolous plant community, including such species as sweetflag, lakeside sedge, New York ironweed, rough-leaf goldenrod, blue vervain, and small-flowered agrimony.* The vegetation is often lush and tall. Calcareous wet meadows often occur adjacent to fens and may contain some similar plant species, but can be supported by water sources other than groundwater seepage (see below). Fens and calcareous wet meadows may be distinguished by a combination of factors, such as hydrology (including beaver flooding and abandonment in calcareous wet meadows), vegetation structure, and plant community.

High quality calcareous wet meadows with diverse native plant communities are likely to support species-rich invertebrate communities, including phantom cranefly* and rare butterflies such as Dion skipper,* two-spotted skipper,* and Baltimore.* Eastern ribbonsnake* and spotted turtle* use calcareous wet meadows for basking and foraging. Bog turtles* use calcareous wet meadows that are adjacent to fens for summer foraging and even nesting habitat. Many common wetland animals, such as green frog, pickerel frog, red-winged blackbird, and swamp sparrow use calcareous wet meadows.

Occurrence in the Town of North East

We documented 127 calcareous wet meadows in the Town of North East (Figure 7), totaling 319 ac (129 ha), which is almost as large an area as that covered by non-calcareous wet meadows. Most of the calcareous wet meadows were smaller than 2 ac (0.8 ha). "Dutchess Sedge Meadows," located south of Downey Road and west of Mill Road, is 87 ac (34.8 ha) and the largest calcareous wet meadow in the town. Calcareous wet meadows cannot be distinguished from other wet meadows by remote sensing because indicator plants must be identified in the field. Therefore it is likely that some of the mapped "wet meadows" we did not visit were actually calcareous wet meadows. Most of the calcareous wet meadows in North East were contiguous with swamps, upland meadows, or fens.

Sensitivities/Impacts

Calcareous wet meadows have similar sensitivities to disturbance as other wet meadows (see above) and fens (see below). They are particularly vulnerable to nutrient enrichment and siltation, which often facilitate the spread of invasive species. Like other small wetland habitats, they are often omitted from wetland maps and consequently overlooked in the environmental review of development proposals. Where calcareous wet meadows occur adjacent to fens used by bog turtles,* the turtles use both habitats. Therefore, calcareous wet meadows near suitable fens deserve the same level of protections as fens for potential bog turtle habitat. See the Conservation Priorities section for recommendations on preserving the habitat values of fens and calcareous wet meadows.

FEN (f)

Ecological Attributes

A fen is a low shrub- and herb-dominated wetland that is fed by calcareous groundwater seepage. Fens almost always occur in areas influenced by carbonate bedrock (e.g., limestone and marble), and are identified by their low, often sparse vegetation and their distinctive plant community. Tussocky vegetation and small seepage rivulets are often present, and some fens have substantial areas of bare mineral soil or organic muck. Typical plants of fens include shrubby cinquefoil, alder-leaf buckthorn,* red-osier dogwood, autumn willow, sage-leaved willow, spike-muhly, sterile sedge, porcupine sedge, yellow sedge, woolly-fruit sedge, Kalm's lobelia, grass-of-Parnassus,* and bog goldenrod.

Fen is a rare habitat type because of the limited distribution of carbonate bedrock, soils, and groundwater seepage, as well as the historic alteration of wetlands. Fens support many species of conservation concern, including rare plants, invertebrates, reptiles, and breeding birds. More than 12 state-listed rare plants are found almost exclusively in fen habitats, including handsome sedge,* Schweinitz's sedge,* ovate spikerush,* bog valerian,* scarlet Indian paintbrush,* spreading globeflower,* and swamp birch.* Rare butterflies such as Dion skipper* and black dash,* as well as rare dragonflies such as forcipate emerald* and Kennedy's emerald,* are

largely restricted to fen habitats. Other uncommon invertebrates, including phantom cranefly,* can also be found in fens. Fens comprise the core habitat for the endangered bog turtle* in southeastern New York. They are also used by other reptiles of conservation concern such as the spotted turtle* and eastern ribbonsnake.* The rare sedge wren* nests almost exclusively in shallow, sedge-dominated wetlands like fens. Large open fens, especially those associated with extensive meadow complexes, can also be important hunting grounds and potential nesting areas for northern harrier.*

Occurrence in the Town of North East

We mapped 80 fens in the Town of North East (Figure 7), which is an exceptionally large number for the size of the town. Most were less than 1 ac (0.4 ha), but the largest was more than 6 ac (2.5 ha). The quality of fens varied greatly: some were exemplary while others were being overgrown by tall forbs and shrubs. Fens were found throughout the calcareous valleys in the town, and some small ones were located on hillsides and ridges. Most were located within or along the margins of larger swamps, marshes, wet meadows, or calcareous wet meadows. Because fens are difficult to identify by remote sensing we expect there are additional fens that we did not map. Unmapped fens could occur in low-elevation areas with calcareous bedrock or soils, including edges or interiors of calcareous wet meadows, swamps, marshes, or wet meadows habitats, or upper edges of stream floodplains and at the bases of ridges. The apparent land use history in North East and property owners' accounts indicate that in some cases fens have regenerated following some disturbance.

Sensitivities/Impacts

Fens are highly vulnerable to degradation from direct disturbance and from activities in nearby upland areas. Nutrient and salt pollution from septic systems, fertilizers, or road runoff, disruption of groundwater flow by new wells or excavation, sedimentation from construction activity, or direct physical disturbance can lead to changes in the character of the habitat, including a decline in overall plant diversity and invasion by non-native species and tall shrubs (Aerts and Berendse 1988, Panno et al. 1999, Richburg et al. 2001, Drexler and Bedford 2002). Such changes can render the habitat unsuitable for bog turtle and other fen animals and plants that require the special structural, chemical, or hydrological environment of an intact fen. It is

likely that the fen habitats in the Town of North East have deteriorated due to many of these factors. Fens appear to be somewhat resilient if their chemical and hydrologic conditions are kept intact, which makes restoration of these habitats possible in some cases. See the Conservation Priorities section for recommendations on preserving the habitat values of fens and calcareous wet meadows.

Fen

INTERMITTENT WOODLAND POOL (iwp)

Ecological Attributes

An intermittent woodland pool is a small wetland partially or entirely surrounded by forest, typically with no surface water inlet or outlet (or an ephemeral one), and with standing water during winter and spring that dries up by mid- to late summer during a normal year. This habitat is a subset of the widely recognized "vernal pool" habitat, which may or may not be surrounded by forest. Despite the small size of intermittent woodland pools, those that hold water through early summer can support amphibian diversity equal to or higher than that of much larger wetlands (Semlitsch and Bodie 1998, Semlitsch 2000). Seasonal drying and lack of a stream connection ensure that these pools do not support fish, which are major predators on amphibian eggs and larvae. The surrounding forest supplies the pool with leaf litter, the base of the pool's food web; the forest is also essential habitat for adult amphibians during the non-breeding seasons.

Intermittent woodland pools provide critical breeding and nursery habitat for wood frog,* Jefferson salamander,* marbled salamander,* and spotted salamander.* Reptiles such as spotted turtle* use intermittent woodland pools for foraging, rehydrating, and resting. Wood duck,* mallard, and American black duck* use intermittent woodland pools for foraging, nesting, and brood-rearing, and a variety of other waterfowl and wading birds use these pools for foraging. The invertebrate communities of these pools can be rich, providing abundant food for songbirds such as yellow warbler, common yellowthroat, and northern waterthrush.* Springtime physa* is a regionally rare snail associated with intermittent woodland pools. Large and small mammals use these pools for foraging and as water sources. Featherfoil,* a NYS Threatened plant, occurs in intermittent woodland pools in the lower Hudson Valley.

Occurrence in the Town of North East

We mapped 28 intermittent woodland pools in the Town of North East (Figure 8). Pools were found in forested areas on ridges, on slopes, and in valleys. All the mapped intermittent woodland pools in the town were smaller than 0.3 ac (0.12 ha), with an average size of 0.1 ac

(0.04 ha). Because these pools are small and often difficult to identify on aerial photographs, we expect there are additional intermittent woodland pools that we did not map.

Sensitivities/Impacts

We consider intermittent woodland pools to be one of the most imperiled habitats in the region. Although they are widely distributed, the pools are small (often less than 0.1 ac [0.04 ha]) and their ecological importance is often undervalued. They are frequently drained or filled by landowners and developers, used as dumping grounds, treated for mosquito control, and sometimes converted into ornamental ponds. They are often overlooked in environmental reviews of proposed developments. Even when the pools themselves are spared in a development plan, the surrounding forest so essential to the ecological functions of the pools is frequently destroyed. Intermittent woodland pools are often excluded from federal and state wetland protection due to their small size, their intermittent surface water, and their isolation from other wetland habitats. It is these very characteristics of size, isolation, and intermittency, however, which make woodland pools uniquely suited to species that do not reproduce or compete as successfully in larger wetland systems. See the Conservation Priorities section for recommendations on preserving the habitat values of intermittent woodland pools.

Intermittent woodland pool

CIRCUMNEUTRAL BOG LAKE (cbl)

Ecological Attributes

A circumneutral bog lake is a spring-fed, calcareous water body that commonly supports vegetation of both acidic bogs and calcareous marshes. The bottom has a deep organic layer, and floating peat rafts are commonly present. These rafts may aggregate to form more permanent floating peat mats of vegetation that are insulated from the calcareous lake water, and thus may develop herbaceous and shrubby vegetation characteristic of acidic bogs, or dense stands of cattail or purple loosestrife. Open water often supports abundant pond-lilies and submerged aquatic vegetation; peat rafts and shoreline areas may support cattails, purple loosestrife, water-willow, alder, or leatherleaf. The lake may have swamps, calcareous wet meadows, or fens at its margin.

This is a rare habitat type in the region, and is known to support many rare and uncommon species of plants and animals. Several species of rare sedges and submerged aquatic plants occur in circumneutral bog lakes in Dutchess County. Rare fauna associated with circumneutral bog lakes include eastern ribbonsnake,* northern cricket frog,* spotted turtle,* blue-spotted salamander,* marsh wren,* and river otter.* These habitats have also been found to support diverse communities of mollusks, dragonflies, and damselflies. Information about a circumneutral bog lake in the Town of Pine Plains can be found in Busch (1976).

Occurrence in the Town of North East

We identified one circumneutral bog lake in the Town of North East, Indian Lake (Figure 9). The undeveloped northern and northwestern shore of Indian Lake comprised a mosaic of fen, marsh, shrub swamp, and upland habitats. Submerged and floating peat rafts covered the north end of the lake. At the time of our field visit in late September, none of these peat rafts had established vegetation growing on them, but we documented pioneering individuals of olivaceous spikerush.* Water-lilies and other aquatic plants were abundant, including two NYS Threatened species, Beck's water-marigold* and knotted spikerush.* We also observed a pair of pied-billed grebes* (listed as Threatened in New York and Endangered in Connecticut) on Indian Lake.

Sensitivities/Impacts

We believe that circumneutral bog lakes are extremely sensitive to changes in surface and groundwater chemistry and flows, and could be affected by any significant alterations to the watershed such as tree removal, soil disturbance, applications of fertilizers or pesticides, septic leachate, groundwater extraction, or altered drainage. Residential development along scenic lakeshores and agricultural uses within the watershed are common causes of these and other disturbances. Maintaining a forested buffer around the lake is critical for preserving habitat quality. Recreational uses such as boating, fishing, or hiking can be sources of garbage, pollutants, and disturbance, and should be managed carefully; use of motorized watercraft should be avoided. Mechanical disturbances in the lake or changes in surface water levels or chemistry could disrupt the peat rafts and floating vegetation mats. See the Conservation Priorities section for recommendations on preserving the habitat values of circumneutral bog lakes.

Indian Lake, a circumneutral bog lake

ACIDIC BOG (ab) and ACIDIC BOG LAKE (abl)

Ecological Attributes

An acidic bog is a rare wetland habitat that is perennially wet, very nutrient poor, and dominated by shrubs of the heath family and extensive carpets or floating mats of peat mosses (*Sphagnum*) and other vegetation. Bog soils consist of deep, partially decomposed peat mosses and other organic matter that isolate the bog from groundwater influence. Acidic bogs, therefore, are fed primarily by precipitation and by surface runoff from the immediate watershed. The insulation provided by the moss mats sometimes helps to preserve the underlying ice into late spring or early summer, thereby maintaining a cool microclimate that supports a boreal relict plant community. Leatherleaf, sheep laurel, swamp azalea, highbush blueberry, chokeberry, and peat mosses are typical bog plants in this region.

Rare and uncommon plants of acidic bogs in this region include pod-grass,* pitcher-plant,* round-leaf and narrow-leaf sundews,* rose pogonia,* grass pink,* dragon's mouth,* white-fringed orchid, * tussock cottongrass,* Virginia chain fern,* and cranberries.* Several insect species depend on rare bog plants. For example, the bog copper* is a butterfly that deposits its eggs exclusively on cranberries,* and pitcher plant* is the larval host of two moths, the pitcher plant borer* and the Exyra moth. Acidic bogs also seem to be the exclusive habitat of three rare dragonflies—subarctic darner,* ebony bog haunter,* and ringed bog haunter.* Four-toed salamander* may occur in bogs and other wetlands with deep mats of *Sphagnum* and other mosses on rocks, logs, and woody hummocks. Breeding birds of acidic bogs in the region include Nashville warbler,* golden-winged warbler,* northern waterthrush,* and eastern bluebird. Southern bog lemming* could occur in bogs and adjacent forests.

Acidic bog lakes are bodies of nutrient-poor, open water with patches of bog soils and vegetation present around the edges or on floating peat mats or islands.

Occurrence in the Town of North East

We documented five acidic bogs in North East, all on the Taconic Ridge (Figure 9). Four were part of one wetland complex that also included marsh, wet meadow, and shrub swamp. The

fifth was larger (3 ac [1.2 ha]) and located approximately 2000 ft (600 m) south of that wetland complex. All the bogs had a solid carpet of *Sphagnum*, and many also had large patches of haircap moss. Highbush blueberry, winterberry, and steeplebush dominated shrubby areas; other areas were open and sedge-dominated (primarily three-way sedge). Areas with hummocks had roundleaf sundew,* and in some cases spatulate-leaved sundew* and small cranberry.* We classified Grass Pond, just to the north, as an acidic bog lake because it had very clear water, little aquatic vegetation, and small islets near the shore which supported pitcher-plant and round-leaf sundew. Sweet-gale, mountain laurel, and scrub oak lined its rocky shore.

Sensitivities/Impacts

Acidic bogs are very rare in Dutchess County. The biological communities of acidic bog habitats seem to be closely tied to the water chemistry, water temperature, and hydroperiods of these environments. Bog soils and vegetation are easily damaged by foot traffic and similar disturbances. Grazing, trampling, and alterations to the watershed (e.g., tree removal, soil disturbance, applications of fertilizers or pesticides, alterations to groundwater or surface water drainage) could adversely affect this habitat. Because bog ecology seems to depend on a cool microclimate and low nutrient availability, bogs are probably sensitive to removal of forest in surrounding areas and to nutrient pollution. Protection of large forested buffer zones around bogs would help to maintain the water quality essential to bog ecology, and to insulate the bog community from other aspects of human disturbance.

Sundew, a carnivorous bog plant

CONSTRUCTED POND (cp)

Ecological Attributes

Constructed ponds include those water bodies that have been excavated or dammed by humans, either in existing wetlands or stream beds, or in upland terrain. These ponds are deliberately created for such purposes as fishing, watering livestock, irrigation, swimming, boating, and aesthetics. Some ponds are constructed near houses or other structures to serve as a source of water in the event of a fire. We also included the water bodies created during mining operations in the constructed pond category. If constructed ponds are not intensively managed by humans, they can be important habitats for many of the common and rare species that are associated with natural open water habitats (see below).

Occurrence in the Town of North East

The majority of the water bodies we mapped in the Town of North East were constructed ponds. These ponds were most commonly maintained for ornamental purposes (and located within landscaped areas in close proximity to residences), used for agricultural purposes, or remain as a result of past mining activity. Overall, we mapped 159 constructed ponds within the town. All but four of these ponds were smaller than 2 ac (0.8 ha), and the largest was just over 7 ac (2.8 ha). Because of the potential value of constructed ponds as drought refuge and forage areas for turtles and other wildlife, we mapped constructed ponds within developed areas as well as those surrounded by intact habitats. Constructed ponds with substantial cover of emergent vegetation (e.g., cattail, purple loosestrife, common reed) were mapped as marsh.

Sensitivities/Impacts

The habitat value of constructed ponds varies depending on the landscape context and the extent of human disturbance. In general, the habitat value is higher when the ponds have undeveloped shorelines, are relatively undisturbed by human activities, have more vascular vegetation, and are embedded within a mosaic of intact habitat. Because many constructed ponds are not buffered by sufficient natural vegetation and soil, they are vulnerable to the adverse impacts of agricultural runoff, septic leachate, and pesticide or fertilizer runoff from lawns and gardens. We expect that many of those maintained as ornamental ponds are treated

with herbicides and perhaps other toxins, or contain introduced fish such as grass carp and various game and forage fishes. Since constructed ponds serve as potential habitat for a variety of common and rare species, care should be taken to minimize these impacts.

The habitat values of constructed ponds (and especially intensively managed ornamental ponds) do not ordinarily justify altering streams or destroying natural wetland or upland habitats to create them. In most cases, the loss of ecological functions of natural habitats far outweighs any habitat value gained in the new artificial environments.

OPEN WATER (ow)

Ecological Attributes

"Open water" habitats include naturally formed ponds and lakes, pools lacking floating or emergent vegetation within marshes and swamps, and ponds that may have originally been constructed by humans but have since reverted to a more natural state (e.g., surrounded by unmanaged vegetation). Open water areas are important habitat for many common species, including invertebrates, fishes, frogs, turtles, waterfowl, muskrat, beaver, and bats. Open water areas sometimes support submerged aquatic vegetation that can provide important habitat for additional aquatic invertebrates and fish. Spiny coontail* (NYS Threatened) is known from many calcareous ponds in Dutchess County. Spotted turtle* uses ponds and lakes during both drought and non-drought periods, and wood turtle* may overwinter and mate in open water areas. Northern cricket frog* may occur in circumneutral ponds. American bittern,* osprey,* bald eagle,* wood duck,* American black duck,* pied-billed grebe,* and great blue heron* may use open water areas as foraging habitat. Bats and river otter* also forage in open water habitats.

Occurrence in the Town of North East

Natural open water areas are almost as common as constructed ponds (see above) in the Town of North East. Of the 140 open water habitats we mapped, most were smaller than one acre (0.4 ha). Two of the larger open water areas were categorized as circumneutral bog lake (Indian Lake) and acidic bog lake (Grass Pond), described above. Rudd Pond (73 ac [30 ha])

was the largest area of open water in the town. There were two large open water areas in the wetland complex between Route 22 and Boston Corners Road north of Millerton (with almost 30 ac [12 ha] each). Many of the open water areas we mapped were created by beaver activity. Areas of open water within beaver wetlands are dynamic habitats that expand or contract depending on the degree of beaver activity, and these areas are often transitional to emergent marshes or wet meadows. Most of the open water habitats in the town were mapped from aerial photographs.

Sensitivities/Impacts

The habitat value of natural open water areas can be greater than that of constructed ponds if they are less intensively managed, less disturbed by human activities, and surrounded by undeveloped land. Open water habitats are, however, vulnerable to human impacts, such as shoreline development, aquatic weed control, and runoff from roads, lawns, and agricultural areas. Aquatic weed control, which may include harvesting, herbicide application, or introduction of grass carp, is an especially important concern in open water habitats, and the potential negative impacts should be assessed carefully before any such activities are undertaken (Heady and Kiviat 2000). Because they are often located within larger wetland and stream complexes, any disturbance to the open water habitat may also have far-reaching impacts in the watershed. To protect water quality and habitat values, broad zones of undisturbed vegetation and soils should be maintained around undeveloped ponds and lakes. If part of a pond or lake must be kept open for ornamental or other reasons, it is best to avoid dredging and to allow other parts of the pond to develop abundant vegetation. This can be accomplished by harvesting aquatic vegetation only where necessary to create open lanes or pools for boating, fishing, or swimming. See the Conservation Priorities section for recommendations on preserving the habitat values of open water within wetland complexes.

SPRINGS & SEEPS

Ecological Attributes

Springs and seeps are places where groundwater discharges to the ground surface, either at a single point (a spring) or diffusely (a seep). Although springs often discharge into ponds, streams, or wetlands such as fens, we mapped only springs and seeps that discharged conspicuously into upland locations. Springs and seeps originating from deep groundwater sources flow more or less continuously, while those from shallower sources flow intermittently. The habitats created at springs and seeps are determined in part by the hydroperiod and the chemistry of the soils and bedrock through which the groundwater flows before emerging. Springs and seeps help maintain the cool temperature of many streams, an important habitat characteristic for some rare and declining fish species. They also serve as water sources for animals during droughts and cold winters, when other water sources freeze over.

Very little is known, or at least published, on the ecology of seeps in the North East. Golden saxifrage is a plant more-or-less restricted to springs and groundwater-fed wetlands and streams. A few rare invertebrates are restricted to springs in the region, and the Piedmont groundwater amphipod* could occur in the area (Smith 1988). Gray petaltail* and tiger spiketail* are two rare dragonflies that are found in seeps. Springs emanating from calcareous bedrock or calcium-rich surficial deposits sometimes support an abundant and diverse snail fauna. Northern dusky salamander* and spring salamander* use springs and cold streams.

Occurrence in the Town of North East

Because the occurrence of springs and seeps is difficult to predict by remote sensing, we mapped only the very few we happened to see in the field and those that had a signature on one of our map sources. We expect there are many more springs and seeps in the town that we did not map. More detailed inventories of seeps and springs should be conducted as needed on a site-by-site basis. We did not map springs and seeps within fens, but all mapped fens had some groundwater source. Large areas of seepage occur in the calcareous valleys, and along the western slope of the Taconic Mountains.

Sensitivities/Impacts

Springs are easily disrupted by disturbance to upgradient land or groundwater, altered patterns of surface water infiltration, or pollution of infiltrating waters. Many springs have been modified for water supply, with constructed or excavated basins sometimes covered with spring houses. In many areas, groundwater has been polluted or drawn-down by pumping for human or livestock water supply, affecting the quality or quantity of water issuing from seeps and springs.

STREAMS & RIPARIAN CORRIDORS

Ecological Attributes

Perennial streams flow continuously throughout years with normal precipitation, but some may dry up during droughts. They provide essential water sources for wildlife throughout the year, and are critical habitat for many plant, vertebrate, and invertebrate species. We loosely define "riparian corridor" as the zone along a perennial stream that includes the stream banks, the floodplain, and adjacent steep slopes. We did not map riparian corridors but have defined them in this report as buffer zones of a set width on either side of streams. These zones represent a minimum area surrounding the stream that is needed for effective protection of stream water quality and wildlife (see streams & riparian corridors in the priority habitats section, and Figure 11). These do not necessarily cover the whole riparian corridor for any stream, however, which varies in width depending on local topography and the size of the stream's catchment area. We mapped large sand and gravel bars where we encountered them within a streambed.

Riparian zones tend to have high species diversity and high biological productivity, and many species of fish and wildlife depend on riparian habitats in some way for their survival (Hubbard 1977, McCormick 1978). We know of many rare plants of riparian zones elsewhere in the region, such as cattail sedge,* Davis' sedge,* goldenseal,* ostrich fern,* false-mermaid,* and may-apple.* The fish and aquatic invertebrate communities of perennial streams may be diverse, especially in clean-water streams with unsilted bottoms. Brook trout* and slimy sculpin* are two native fish species that require clear, cool streams for successful spawning. Wild brook trout, however, are now confined largely to small headwater streams in the region,

due to degraded water quality and competition from brown trout, a non-native species stocked in many streams by the NYS DEC and by private groups. Wood turtle* uses perennial streams with pools and recumbent logs, undercut banks, or muskrat or beaver burrows. Perennial streams and their riparian zones, including sand and gravel bars, provide nesting or foraging habitat for many species of birds, such as spotted sandpiper, belted kingfisher, tree swallow, bank swallow, winter wren,* Louisiana waterthrush, great blue heron,* and green heron. Red-shouldered hawk* and cerulean warbler* nest in areas with extensive riparian forests, especially those with mature trees. Bats, including Indiana bat,* use perennial stream corridors for foraging. Muskrat, beaver, mink, and river otter* are some of the mammals that use riparian corridors regularly.

Intermittent streams flow only during certain times of the year or after rains. They are the headwaters of most perennial streams, and are significant water sources for lakes, ponds, and wetlands of all kinds. The condition of these streams therefore influences the water quantity and quality of those larger water bodies and wetlands. Intermittent streams can be important local water sources for wildlife, and their loss or degradation in a portion of the landscape can affect the presence and behavior of wildlife populations over a large area (Lowe and Likens 2005). Plants such as winged monkey-flower,* may-apple,* and small-flowered agrimony* are associated with intermittent streams. Although intermittent streams have been little studied by biologists, they have been found to support rich aquatic invertebrate communities, including regionally rare mollusks (Gremaud 1977) and dragonflies. Both perennial and intermittent streams provide breeding, larval, and adult habitat for northern dusky salamander* and northern two-lined salamander. The forests and sometimes meadows adjacent to streams provide foraging habitats for adults and juveniles of these species.

Occurrence in the Town of North East

Perennial streams and their riparian corridors occupy the major valleys in the Town of North East. The largest streams in North East are Webatuck Creek, Wassaic Creek, and Northeast Stream, which all flow south into the Tenmile River, a tributary to the Housatonic River. Shekomeko Creek and Noster Kill, which drain the western and northern parts of the town, are

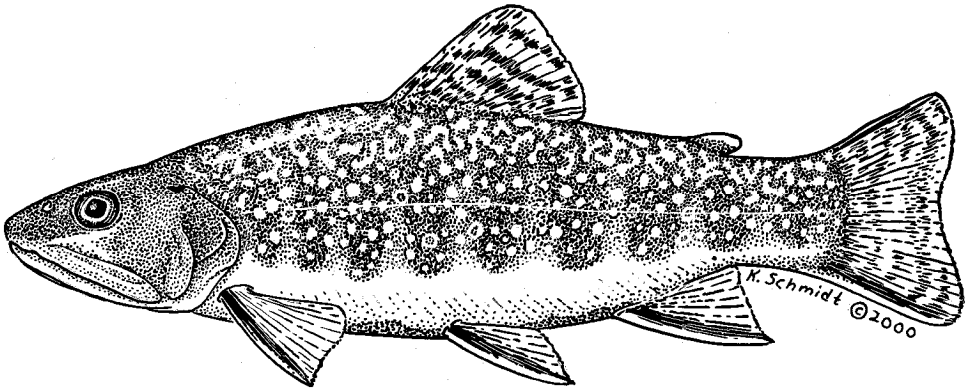
both tributaries of the Roeliff-Jansen Kill, which ultimately flows into the Hudson River. There were many intermittent streams in the town as well (Figure 11).

Sensitivities/Impacts

Removal of trees or other shade-producing vegetation along a stream can lead to elevated water temperatures that adversely affect aquatic invertebrate and fish communities. Clearing of floodplain vegetation can reduce the important exchange of nutrients and organic materials between the stream and the floodplain; it can also diminish the floodplain's capacity for floodwater attenuation, leading to increased flooding downstream, scouring and bank erosion, and sedimentation of downstream reaches. Any alteration of flooding regimes, stream water volumes, timing of runoff, and water quality can profoundly affect these habitats and species of streams and riparian zones. Hardening of the streambanks with concrete, riprap, gabions, or other materials reduces the biological and physical interactions between the stream and floodplain, and tends to be harmful both to stream and floodplain habitats. Removal of snags from the streambed degrades habitat for fishes, turtles, snakes, birds, muskrats, and their food organisms. Stream corridors are prone to invasion by Japanese knotweed, an introduced plant that is spreading in the region (Talmage and Kiviat 2004).

The habitat quality of a stream is affected not only by direct disturbance to the stream or its floodplain, but also by land uses throughout the watershed. (A watershed is the entire land area that drains into a given waterbody). Urbanization (including roads and residential and commercial development) has been linked to deterioration in stream water quality (Parsons and Lovett 1993). Activities in the watershed that cause soil erosion, changes in surface water runoff, reduced groundwater infiltration, or contamination of surface water or groundwater are likely to affect stream habitats adversely. For example, an increase in impervious surfaces (roads, parking lots, roofs) may elevate runoff volumes, leading to erosion of stream banks and siltation of stream bottoms, and degrading the habitat for invertebrates, fish, and other animals. Road runoff often carries contaminants such as petroleum hydrocarbons, heavy metals, road salt, sand, and silt into streams. Applications of fertilizers and pesticides to agricultural fields, golf courses, lawns, and gardens in or near the riparian zone can degrade the water quality and alter the biological communities of streams. Construction, logging, soil mining, clearing for

vistas, creating lawns, and other disruptive activities in and near riparian zones can hamper riparian functions and adversely affect the species that depend on streams, riparian zones, and nearby upland habitats. See the Conservation Priorities section for recommendations on preserving the habitat values of streams and riparian corridors.



Brook trout

CONSERVATION PRIORITIES IN NORTH EAST

PLANNING FOR BIODIVERSITY

Most local land use decisions in the Harlem Valley are made on a site-by-site basis, without the benefit of good ecological information about the site or the surrounding lands. The loss of biological resources from any single development site may seem trivial, but the cumulative effects of making decisions on a site-by-site basis have been serious. Regional impacts have included the disappearance of certain habitats from whole segments of the landscape, the fragmentation and degradation of many other habitats, the local extinction of species, and the depletion of overall biodiversity.

Because biological communities, habitats, and ecosystems do not respect property boundaries, the best approach to biodiversity conservation is from the perspective of whole landscapes. The Town of North East habitat map facilitates this approach by illustrating the location and configuration of significant habitats throughout the town. The map, together with the information included in this report, can be applied directly to land use and conservation planning and decision making at multiple scales. In the following pages, we outline recommendations for: 1) using the map to identify priorities for townwide conservation and land use planning; 2) using the map as a resource for reviewing site-specific land use proposals; and 3) developing general strategies for achieving conservation goals.

Using the Habitat Map for Townwide Conservation Planning

The Town of North East habitat map is useful for understanding the sizes of habitat units, the degree of connectivity between habitats, and the juxtaposition of habitats in the landscape, all of which have important implications for regional biodiversity. Habitat fragmentation is among the primary threats to biodiversity on a global scale (Davies et al. 2001). While some species and habitats may be adequately protected at a relatively small scale, many wide-ranging species, such as black bear,* barred owl,* and red-shouldered hawk,* require large, unbroken blocks of habitat. Many species, such as wood turtle* and Jefferson salamander,* need to

travel among different habitats to satisfy their basic needs for food, water, cover, nesting and nursery areas, and population dispersal. Landscapes that are fragmented by roads, railroads, utility corridors, and developed land limit animal movements and interactions, disrupting patterns of dispersal, reproduction, competition, and predation. Habitat patches surrounded by human development function as islands, and species unable to move between habitats are vulnerable to genetic isolation and possible extinction over the long term. Landscapes with interconnected networks of unfragmented habitat, on the other hand, are more likely to support a broad diversity of native species and the ecological processes and disturbance regimes that maintain those species. The Town of North East still contains many large habitat patches (see Figure 3) and careful siting of new development can protect these patches and maintain corridors between them.

The habitat map can also be used to locate priority habitats for conservation, including those that are rare or support rare species, or that otherwise are particularly important to regional biodiversity. For instance, fens and associated wetlands in North East may support some of the few remaining populations of bog turtle* in the region. Acidic bogs are regionally rare and are home to a number of plants (and potentially insects) that occur exclusively in this habitat. Figures 4-11 illustrate some of the areas we have identified as priority habitats and the "conservation zones" associated with those habitats. These places are especially valuable if they are located within larger areas of intact and connected habitat.

Finally, this report delineates seven Conservation Areas (Figure 12) which may serve as suitable units for conservation planning. The map and report are practical tools that will facilitate selecting areas for protection and identifying sites for new development where the ecological impacts will be minimized. As habitat maps are completed in adjacent towns, the maps can also be used for conservation planning across town boundaries.

Using the Habitat Map to Review Site-Specific Land Use Proposals

In addition to townwide land use and conservation planning, the habitat map and report can be used for reviewing site-specific development proposals and other land use proposals. The habitat map can provide ecological information about both the proposed development site and the surrounding areas that might be affected. We recommend that reviewers considering a new land use proposal at a particular site take the following steps to evaluate the impact of the proposed land use change on the habitats that may be present on and around the site:

1. Consult the habitat map to see which ecologically significant habitats, if any, are located on and near the site in question.
2. Read the descriptions of those habitats in this report.
3. Check to see if any of the habitats in the area of the proposal are described in the "Priority Habitats" section of this report, either individually or as part of a habitat complex, and note the conservation issues and recommendations for each.
4. Consider whether the proposed development project can be designed or modified to ensure that the habitats of greatest ecological concern, as well as the ecological connections between them, are maintained intact. Examples of design modifications include but are not limited to:

    - Locating human activity areas as far as possible from the most sensitive habitats.
    - Minimizing intrusions into large forested or meadow habitats.
    - Minimizing intrusions into forested areas that are within 750 ft (230 m) of an intermittent woodland pool.
    - Avoiding disturbances that would disrupt the quantity or quality of groundwater available to onsite or offsite fens or circumneutral bog lakes.
    - Channeling stormwater runoff from paved areas or fertilized turf through oil-water separators or into detention basins or "rain gardens" instead of directly into streams, ponds, or wetlands.
    - Locating developed features such that broad corridors of undeveloped land are maintained between habitats.

Because the habitat map has not been 100% field checked we emphasize that at the site-specific scale, it should be used strictly as a general guide for land use planning and decision making. Site visits by qualified professionals should be an integral part of the review process for any proposed land use change.

General Strategies for Achieving Conservation Goals

We hope that the Town of North East habitat map and this report will help landowners understand how their land fits into the larger ecological landscape, and will inspire them to voluntarily adopt habitat protection measures. We also hope that the town will engage in proactive land use and conservation planning to ensure that future development is planned with a view to long-term protection of the tremendous biological resources that still exist within the town.

A variety of regulatory and non-regulatory means can be employed by a municipality to achieve its conservation goals, including volunteer conservation efforts, master planning, zoning ordinances, tax incentives, land stewardship incentives, permit conditions, land acquisition, conservation easements, and public education. Section 4 in the *Biodiversity Assessment Manual* (Kiviat and Stevens 2001) provides additional information about these and other conservation tools. Several recent publications of the Metropolitan Conservation Alliance, the Pace University Land Use Law Center, and the Environmental Law Institute describe some of the tools and techniques available to municipalities for conservation planning. For example, *Conservation Thresholds for Land-Use Planners* (Environmental Law Institute 2003) synthesizes information from the scientific literature to provide guidance to land use planners interested in establishing regulatory setbacks from sensitive habitats. A publication from the Metropolitan Conservation Alliance (2002) offers a model local ordinance to delineate a conservation overlay district that can be integrated into a Comprehensive Plan and adapted to the local zoning ordinance. The *Local Open Space Planning Guide* (NYS DEC and NYS Department of State 2004) describes how to take advantage of laws, programs, technical assistance, and funding resources available to pursue open space conservation, and provides contact information for relevant organizations.

In addition to regulations and incentives designed to protect specific types of habitat, the town can also apply some general practices on a townwide basis to foster biodiversity conservation. The examples listed below are adapted from the *Biodiversity Assessment Manual* (Kiviat and Stevens 2001).

- Protect large, contiguous, undeveloped tracts wherever possible.
- Plan landscapes with interconnected networks of undeveloped habitats (preserve links and create new links between natural habitats on adjacent properties). When considering protection for a particular species or group of species, design the networks according to the particular needs of the species of concern.
- Preserve natural disturbance processes such as fires, floods, seasonal drawdowns, landslides, and wind exposures wherever possible.
- Restore and maintain broad buffer zones of natural vegetation along streams, shores of water bodies and wetlands, and around the perimeter of other sensitive habitats.
- Direct human uses toward the least sensitive areas, and minimize alteration of natural features, including vegetation, soils, bedrock, and waterways.
- Encourage development of altered land instead of unaltered land. Promote redevelopment of brownfields and previously altered sites, "infill" development, and re-use of existing structures wherever possible.
- Preserve farmland potential wherever possible.
- Encourage and provide incentives for developers to consider environmental concerns early in the planning process, and to incorporate biodiversity conservation principles into their choice of development sites, their site design, and their construction practices.
- Concentrate development along existing roads; discourage construction of new roads in undeveloped areas. Promote clustered and pedestrian-centered development wherever possible to maximize extent of unaltered land and minimize expanded vehicle use.

- Minimize the area of impervious surfaces (roads, parking lots, sidewalks, driveways, roof surfaces) and maximize onsite runoff retention and infiltration to help protect groundwater recharge and surface water quality and flows.
- Restore degraded habitats wherever possible, but do not use restoration projects as a license to destroy existing habitats. Base any habitat restoration on sound scientific principles and research so that it ultimately has the intended positive impacts on biodiversity.

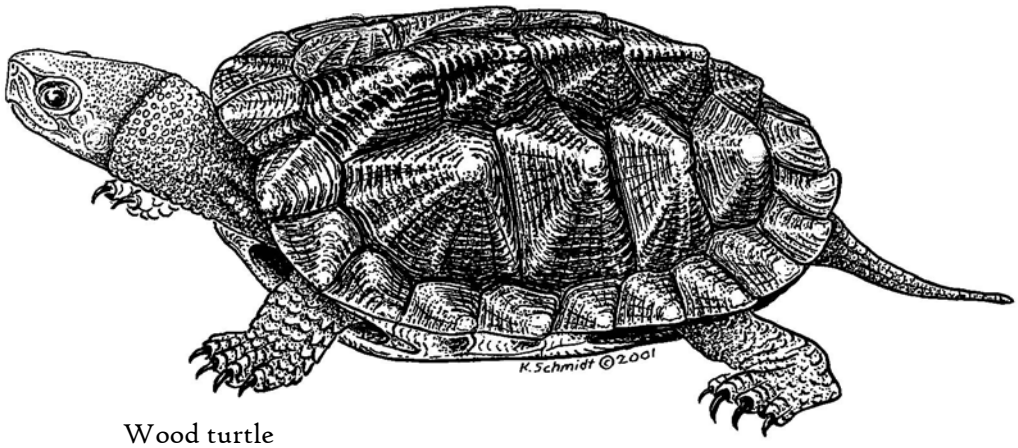
PRIORITY HABITATS IN NORTH EAST

Although a certain amount of land in North East has been developed for residential and other uses (about 8%), large areas of high-quality habitat still remain. This fact is of regional importance, because almost the entire town of North East is located within the Harlem Valley Calcareous Wetlands and Taconic Mountains areas, which are recognized by the New York State Department of Environmental Conservation as two Significant Biodiversity Areas of southeastern New York (Penhollow et al. 2006).

By employing a proactive approach to land use and conservation planning, the Town of North East has the opportunity to protect the integrity of its remaining biological resources for the long term. With limited financial resources to devote to conservation purposes, municipal agencies must decide how best to direct those resources to maximize conservation results. While it may be impossible to protect all significant habitats, there are reasonable ways to prioritize conservation efforts using the best available scientific information. Important considerations in prioritizing such efforts include preserving sensitive habitat types, high quality habitats, and a variety of habitats well-connected and well-distributed over the landscape. Below we highlight some habitat types that we consider "priority habitats" for conservation in the Town of North East. While we hope this information will help the town think strategically about future land uses, it must be understood that this is not an exhaustive list of important habitats.

We used the requirements of a selected group of species to help identify some of the areas where conservation efforts might yield the greatest return for biological diversity. We chose several species or groups of species that have large home ranges, specialized habitat needs, or acute sensitivity to disturbance (see Table 2). Many are rare or declining in the region or statewide. Each of these species or groups requires a particular habitat type for a crucial stage in its life cycle (e.g., hibernation, breeding), and those "core habitats" typically form the hub of the animal's habitat complex. The various other habitats required during other life cycle stages are typically located within a certain distance of the core habitat. This distance defines the extent of the species' habitat complex and, therefore, the minimum area that needs to be

protected or managed in order to conserve the species. We call this the "conservation zone" and discuss the size of this zone in the "Recommendations" subsection for each priority habitat. We used findings in scientific literature to estimate the priority conservation zone for the species or species group of concern (Table 2). If the habitats of the highly sensitive species of concern are protected, many other rare and common species that occur in the same habitats will also be protected.



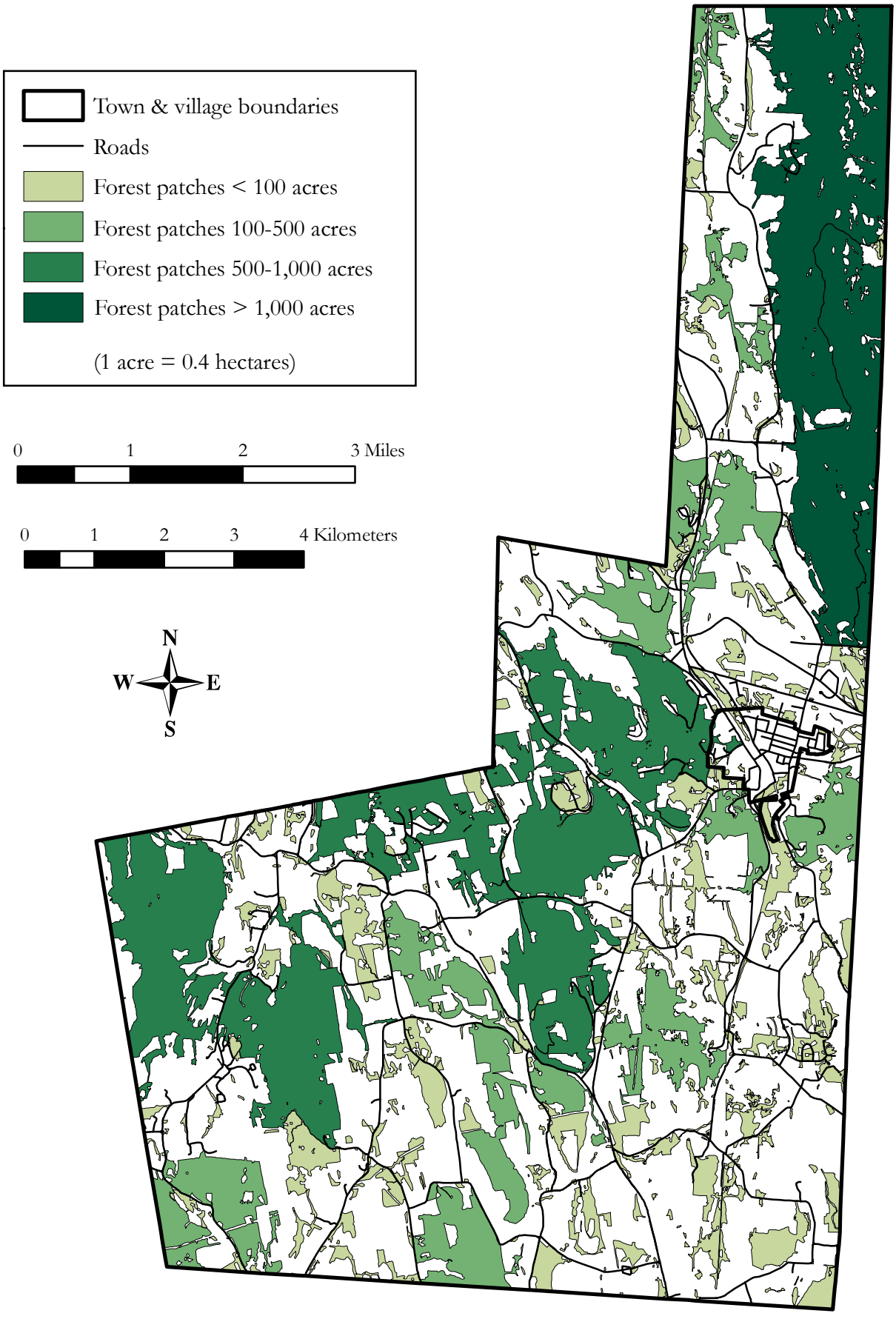
Wood turtle

Table 2. Priority habitats, species of concern, and associated priority conservation zones identified by Hudsonia in the Town of North East, Dutchess County, New York.

Priority Habitat	Associated Species or Group of Concern	Priority Conservation Zone	Rationale	References
Extensive forest	Forest interior-breeding birds	Unfragmented patches of 100-300+ ac (40-120+ ha).	Required for high probability of supporting breeding scarlet tanagers and forest thrushes in a 30-40% forested landscape.	Rosenberg et al. 1999, Rosenberg et al. 2003
Cool ravine	Acadian flycatcher*	Unfragmented forest patches of 100+ ac (40+ ha).	A conservative estimate of minimum forested area required for successful breeding populations.	Robbins 1979, Robbins et al. 1989, Whitehead and Taylor 2002
Extensive meadow	Grassland-breeding birds	Unfragmented patches of 25-500+ ac (10-200+ ha).	Required for successful breeding and maintenance of viable populations.	Vickery et al. 1994
Oak-heath barren	Timber rattlesnake*	1.5 mi (2.4 km) from winter den.	A minimum radius of intact habitat from the den needed to protect all but the farthest ranging males	Brown 1993
Marble knoll	Rare plants	Entire knoll, connections between knolls.	Needed to preserve rare plant communities and to allow for propagule dispersal between knolls.	Not available
Fen (and calcareous wet meadow)	Bog turtle*	2500 ft (750 m) from fen.	Represents the reported overland distance traveled between wetlands within a habitat complex; encompasses the recommended "Bog turtle Conservation Zone" aimed at protecting habitat integrity.	Eckler and Breisch 1990, Klemens 2001
Intermittent woodland pool	Pool-breeding amphibians	750 ft (230 m) from pool.	Encompasses non-breeding season foraging and refuge habitats and most dispersal routes between pools.	Madison 1997, Semlitsch 1998, Calhoun and Klemens 2002
Circumneutral bog lake	Rare plants	Watershed of lake.	Needed to protect hydrology and water chemistry, on which calcium- and acid-loving plant communities depend.	Not available
Acidic bog and acidic bog lake	Rare plants	Watershed of bog and bog lake.	Needed to protect hydrology and water chemistry, on which bog plants and associated species depend.	Not available
Wetland complex	Spotted turtle*	Minimum upland buffer of 395 ft (120 m) beyond outermost wetlands in a complex.	Corresponds to maximum reported distance of nests from the nearest wetland.	Joyal et al. 2001
Perennial stream	Wood turtle*	650 ft (200 m) from stream.	Encompasses most of the critical habitat including winter hibernacula, nesting areas, spring basking sites, foraging habitat, and overland travel corridors.	Carroll and Ehrenfeld 1978, Harding and Bloomer 1979, Buech et al. 1997, Foscarini and Brooks 1997

* Species of statewide conservation concern. See Appendix B.

Figure 4. Contiguous forest patches (including hardwood, conifer, and mixed forests in uplands and swamps) in the Town of North East, Dutchess County, New York. Hudsonia Ltd., 2008.



LARGE FORESTS

Target Areas

In general, forested areas with the highest conservation value include large forest tracts, mature and relatively undisturbed forests, and those with a lower proportion of edge to interior habitat. Smaller forests that provide connections between other forests, such as linear corridors or patches that could be used as "stepping stones," are also valuable in a landscape context. The largest forest areas are illustrated in Figure 4. By far the most extensive continuous forest was found along the Taconic Ridge north of Millerton, where approximately 2,900 ac (1,160 ha) of forest were bisected only by a narrow gravel road. This area is particularly valuable for conservation, because it is contiguous with large forested areas beyond the northern and eastern boundaries of the town. It belongs to one of the Significant Biodiversity Areas identified by the NYS DEC (Penhollow et al. 2006). Six contiguous forest areas, each 500–1,000 ac (200-400 ha), were located west and east of Shekomeko (bisected by Route 83) and in the Winchell and Silver Mountain region (dissected by roads into four large forest blocks). Eight additional large forest areas covered 200–500 ac (80–200 ha), including a patch south of Millerton contiguous with the extensive forests of Indian Mountain in Connecticut, the forest north of Winchell Mountain Road, a wooded swamp north of Millerton, an area in the southwestern corner of the town east of Route 83, and three large patches west of the axis formed by Silver Mountain Road, Cooper Road and Perry Corners Road, the southernmost of which is contiguous with a large forest in Amenia. Extensive areas of forested crest, ledge, and talus occurred in most of the forests on mountains or hills, while smaller areas of calcareous outcrops were generally found in valleys and along the lower slope of the Taconic Range. The North East habitat map does not take into account the actual size of forest patches that extend beyond North East's boundary, but this is an important consideration in understanding the habitat value of these patches. Hudsonia published habitat maps for the towns of Washington, Stanford, and Amenia between 2004 and 2006, and is now mapping habitats in Pine Plains. This growing regional map will enable town officials and private landowners to plan strategically across town boundaries to ensure that large forested areas are conserved.

Conservation Issues

Loss of forest area and fragmentation of remaining forest are the two most serious threats facing forest-adapted organisms. The decline of extensive forests has been implicated in the declines of numerous "area-sensitive" species, which require many hundreds or thousands of acres of contiguous forest to survive and successfully reproduce in the long term. These include large mammals such as black bear and bobcat (Godin 1977, Merritt 1987), some raptors (Bednarz and Dinsmore 1982, Billings 1990, Crocoll 1994), and many migratory songbirds (Robbins 1980, Ambuel and Temple 1983, Wilcove 1985, Hill and Hagan 1991). In addition to a loss of total area, fragmented forest has an increased proportion of edge habitat. Temperature, humidity, and light are altered near forest edges. Edge environments favor a set of disturbance-adapted species, including many predators and a nest parasite (brown-headed cowbird) of forest-breeding birds (Murcia 1995). The nesting success of many species of forest birds is reduced by forest fragmentation (Lampila et al. 2005). Large forests, particularly those that are more round and less linear, support forest species that are highly sensitive to disturbance and predation along forest edges. In landscapes with 30-40% forest cover such as the Town of North East, scarlet tanager requires patches of at least 100 ac (40 ha) for high quality breeding habitat (Rosenberg et al. 1999); wood thrush needs a minimum of about 200 ac (80 ha) and hermit thrush requires around 300 ac (120 ha) of intact forest to have a high probability of supporting persistent breeding populations (Rosenberg et al. 2003). Forested rocky crests provide habitat for several rare reptiles (see section on oak-heath barrens and other crest, ledge, and talus below).

Forest fragmentation can also hamper or prevent animals from moving across the landscape, and can result in losses of genetic diversity and local extinctions in populations from isolated forest patches. For example, some species of frogs and salamanders are unable to disperse effectively through non-forested habitat due to desiccation and predation (Rothermel and Semlitsch 2002). Additionally, road mortality of migrating amphibians and reptiles can result in decreased population densities (Fahrig et al. 1995) or changes in sex ratios in nearby populations (Marchand and Litvaitis 2004).

The hemlock woolly adelgid is an aphid-like insect causing widespread loss of hemlock forests in the Hudson Valley. We did not encounter any large scale infestations during our field work in North East, but the threat is imminent. Such an infestation could eliminate North East's hemlock forests within a few years, with devastating consequences to the biological communities of hemlock-associated habitats. It is important to protect healthy hemlock stands, in the hope that some will escape adelgid infestation and also to provide a seed source for regeneration.

Recommendations

We recommend that the remaining blocks of large forest within the Town of North East be considered priority areas for conservation, and that efforts be taken to fully protect these habitats wherever possible. If new development in forested areas cannot be avoided, it should be concentrated near forest edges and near existing roads and other development so that as much forest area as possible is preserved without fragmentation. New roads or driveways should not extend into the interior of the forest and should not divide the habitat into smaller isolated patches. Some general guidelines for forest conservation include:

1. **Protect large, contiguous forested areas** wherever possible, and avoid development in forest interiors.
2. **Protect patches of forest types that are less common in the town regardless of their size**. These include mature (and old-growth, if any is present) forests, natural conifer stands, forests with an unusual tree species composition, or forests that have smaller, unusual habitats (such as calcareous crest, ledge, or talus) embedded in them.
3. **Maintain or restore broad corridors of intact habitat between large forested areas.** For example, a forested riparian corridor or a series of smaller forest patches may provide connections between larger forest areas. Forest patches on opposite sides of a road may provide a "bridge" across the road for forest-dwelling animals.
4. **Maintain the forest canopy and understory vegetation intact**.
5. **Maintain standing dead wood, downed wood, and organic debris, and prevent disturbance or compaction of the forest floor**. Also leave hemlocks infested with wooly adelgid; cutting these trees does not slow the infestation's spread, but does interfere with natural forest succession.

COOL RAVINES

Target Areas

North East has several ravines with dense hemlock forest, but we identified just two of these as "cool ravines" based on their physical structure, vegetation, and cool microclimate (Figure 11). There could be other cool ravines that we missed, and all steep hemlock-forested areas are worthy of protection.

Conservation Issues

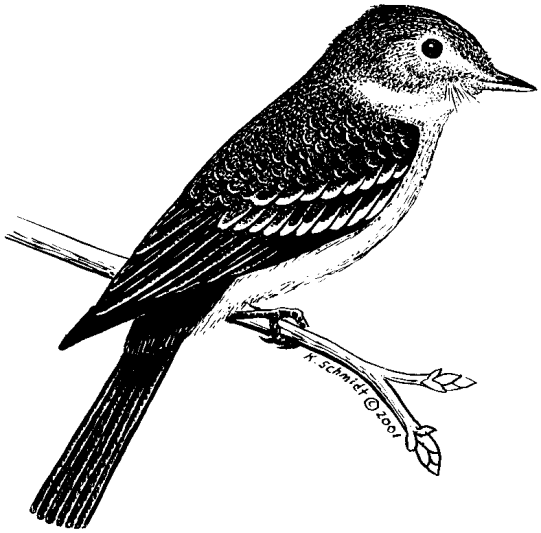
The rocky substrates and the cool, moist, deeply shaded conditions are essential to the unusual biological communities of cool ravine habitats. The plants and animals of cool ravines could be harmed by any activities in or near the ravines that would alter the stream water quality or flow, affect the light, air temperature, or soil conditions, disturb the vegetation, or disrupt the surrounding forest. At least some of the breeding birds of these habitats are likely to need large forested areas around the ravines (Robbins et al. 1989).

The ecological importance of cool ravines may be magnified as global climate warming progresses. The cool, moist conditions of these habitats may provide a temporary haven for plants and animals stressed by general warming trends.

Acadian flycatcher* can be used as a focal species for delineating conservation zones for cool ravines. This regionally rare songbird is listed by the US Fish & Wildlife Service as a Bird of Conservation Concern. It nests in cool ravines and other cool, moist, mature forest habitats (DeOrsey and Butler 2006). Each nesting pair may require at least 74 ac (30 ha) of forest around their nest site, but much larger forested areas are needed to sustain an Acadian flycatcher population in the long term (Robbins 1979, Freemark and Collins 1992, Robbins et al. 1989). Fragmentation of the forest increases the Acadian flycatcher's (and other forest birds') vulnerability to nest parasitism by the brown-headed cowbird and to nest predation (Robinson et al. 1995).

Recommendations

1. **Prevent any disturbance of soils or vegetation on the ravine walls**.
2. **Maintain an undisturbed zone of 650 ft (200 m) horizontal distance from the stream edge**. Within this zone, avoid any new construction of roads or buildings, and any new disturbance of soils or vegetation.
3. **Maintain quality and quantity of streamwater**. This includes maintaining seasonal fluctuations in stream flows, maintaining cool streamwater temperatures, and preventing siltation and other forms of pollution from upstream or upgradient sources.
4. **Minimize recreational uses during spring through mid-summer** to avoid disturbing nesting birds. Design any trails such that access to interior ravine areas is limited.
5. **Maintain a large forested area around the ravine** to help maintain stream water temperatures, to protect the ravine walls from erosion, and to protect the ravine nesting habitats for songbirds.



Acadian flycatcher

LARGE MEADOWS

Target Areas

Large and contiguous patches of meadow, particularly pasture, hayfields, and old fields, can be valuable wildlife habitats for rare and uncommon grassland-breeding birds. Corn and soybean fields, however, have little value as breeding habitat. In North East, the largest meadow complex, located in the southwest corner between Smithfield Road and Route 83, exceeded 400 ac (160 ha). Fifteen more large meadow complexes comprised 200–400 ac (80–160 ha) each (Figure 5a). The largest single meadow (in corn during 2007) was 132 ac (53 ha; Figure 5b). Smaller meadows that could potentially serve as wildlife travel corridors or "stepping stones" between nearby habitats are also important, as are small patches of wet meadow, and upland shrublands with relatively sparse shrub cover. By far the largest wet meadow (86 ac [34 ha]) was the Nature Conservancy site "Dutchess Sedge Meadows" south of Downey Road and west of Mill Road.

Conservation Issues

While there can be significant habitat value in small patches of upland meadow (e.g., for invertebrates and small mammals), large patches are especially important for grassland-breeding birds. Grassland-breeding birds in the North East have declined dramatically in recent decades due to habitat loss, as meadows are lost and fragmented by regrowth of forest, conversion of grasslands to row crops, and residential and commercial development (Askins 1993, Brennan and Kuvlesky 2005). These birds require large, undivided meadows (25 to 500 ac [10-200 ha]) to reproduce successfully (Vickery et al. 1994). Fences and hedgerows can reduce nesting success for grassland-breeding birds by providing cover and perching sites for raptors and other species that prey on the birds or their eggs (Wiens 1969). Figure 5b illustrates how meadow patch sizes differ when hedgerows and fences are taken into account. Although North East has over 10,000 ac (4,000 ha) of upland meadow, fewer than 100 of those are larger than 25 ac (10 ha), the minimum preferred area for savannah sparrow to nest, and just 31 are large enough to support vesper sparrow (50 ac [20 ha]). The largest single meadow is 132 ac (53 ha), which is below the typical size requirement for grasshopper sparrow and upland sandpiper, which prefer meadows of at least 250 and 500 ac (100 and 200 ha), respectively

(Vickery et al. 1994). Because grassland birds have very specific habitat requirements for breeding, their survival in the northeastern U.S. may ultimately depend on active farmland and open space management (Askins 1993).

Meadows are among the habitats most vulnerable to future development. In agricultural areas, for example, development is often an attractive alternative to the economic challenges faced by farmers. Even when development does not destroy the entire meadow habitat, the remaining fragments are usually small and have much lower biodiversity value. Development around meadows can promote increased predation on grassland-breeding bird nests by human-subsidized predators such as raccoons and domestic cats. Grasslands and the rare species they support are also highly susceptible to other human activities such as mowing, conversion to row crops, application of pesticides, and ATV traffic.

Recommendations

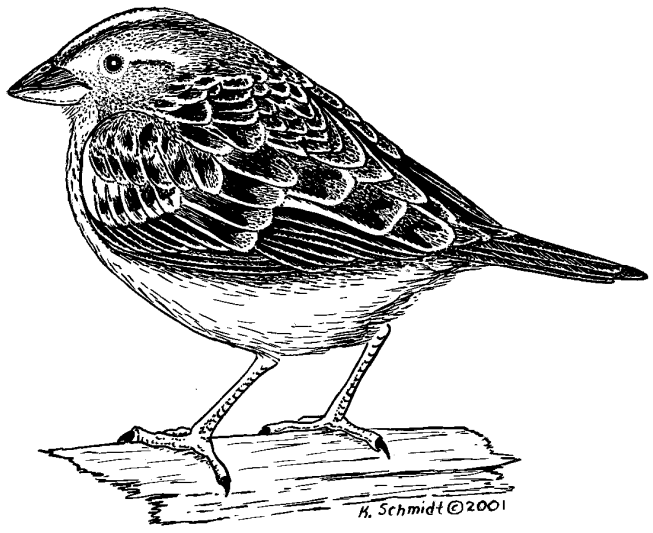
The habitat value of upland meadows in North East could be substantially increased by converting large cornfields to permanent grasslands. In cases where grassland owners have flexibility in their mowing and grazing practices, Massachusetts Audubon (http://www.massaudubon.org) has the following management suggestions for maximizing the success of grassland birds in meadows in the northeastern U.S.:

1. **Mowing after August 1** helps to ensure fledging of nestling birds; if mowing must occur before then, leave some unmowed strips or patches.
2. **Mowing each field only once every 1-3 years**, or doing rotational mowing so that each part of a field is mowed once every 3 years, provides good habitat for birds and butterflies.
3. **On an active farm, leaving some fields out of production each year** provides wildlife habitat. Alternatively, hayfields mowed early in the season can be rotated annually with those that are mowed late in the season.
4. **Removing fences or hedgerows between smaller fields** enlarges the habitat area for breeding birds.
5. **Raising mower blades six inches or more, using flushing bars, and avoiding night mowing** when birds are roosting all help reduce bird mortality.
6. **Light grazing**, if livestock are rotated among fields throughout the season, can be beneficial.

7. **If planned and executed carefully, burning grasslands every two to six years** improves habitat quality.

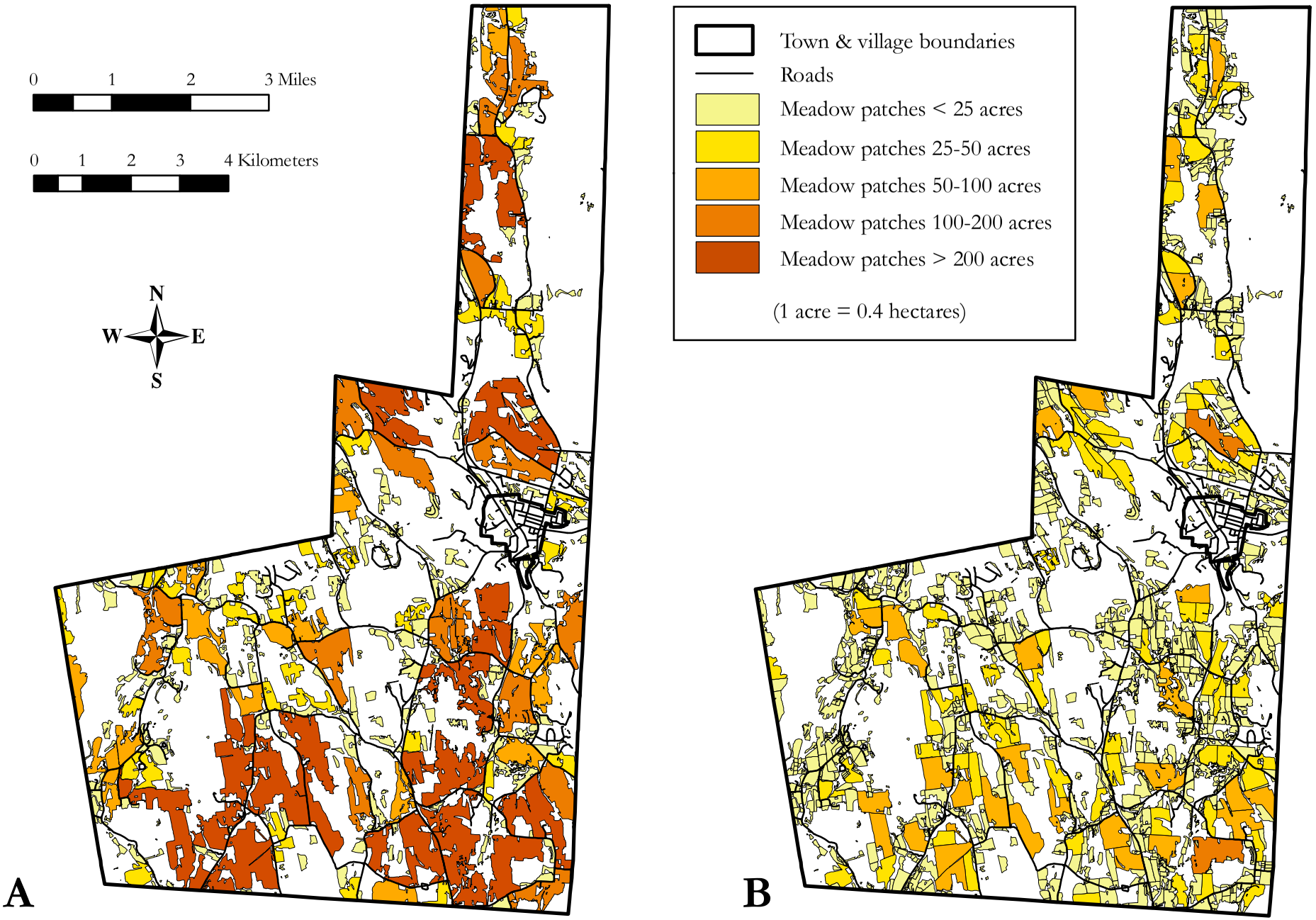
While the ecological values of upland meadows are diverse and significant, it is important to remember that most upland meadows in this area were once areas of upland forest, another very valuable habitat type in our region. Therefore, while focusing on the conservation of existing upland meadows with high biodiversity value, the town should also consider avoiding further conversion of forest to meadow and perhaps even allowing some meadows (particularly smaller ones, or those that are contiguous with areas of upland forest) to revert to forest cover.

The Town of North East has a tremendous opportunity to conserve large expanses of upland meadow habitat. Beyond the ecological values, there are many other compelling reasons to conserve active farmland and land with agricultural potential. From a cultural and economic standpoint, maintaining our ability to produce food locally has obvious advantages in the face of unstable and unpredictable energy supplies. Active farms also contribute to the local economy and to the character of the town's landscape.



Grasshopper sparrow

Figure 5. Contiguous meadow patches (including upland meadows, wet meadow, calcareous wet meadows, and fens) in the Town of North East, Dutchess County, New York. A) Contiguous meadow patches without consideration of hedgerows and fences; B) contiguous meadow patches shown with hedgerows and fences as fragmenting features. Both maps include active agricultural areas and other managed and unmanaged meadow habitats. Hudsonia Ltd., 2008.



OAK-HEATH BARREN, and other Crest/Ledge/Talus

Target Areas

We mapped 67 patches of oak-heath barren on the Taconic Ridge, the only area in the town where this habitat occurs. Extensive areas of other crest, ledge, and talus occur on the ridges and slopes of the Taconics, as well as on the hills in the southwestern part of the town. Calcareous outcrops are most concentrated along Route 83 and on both sides of Route 22 south of Millerton, but are also found at the base of the Taconic Range and Indian Mountain, as well as in other scattered locations (Figure 6).

Conservation Issues

Oak-heath barrens are uncommon in the Hudson Valley and may provide core habitat for several rare reptiles that require rocky outcrops and exposed conditions at crucial stages in their life cycle. Timber rattlesnake,* a Threatened species in New York State, has been reported from North East. However, populations of timber rattlesnake have been declining in the northeastern U.S. due to loss or disturbance of habitat, collection of the snakes for live trade, and malicious killing (Brown 1993, Klemens 1993). The protection of this species in the Taconic Range is important for the species' viability in the northeastern U.S. (Klemens 1993). Timber rattlesnakes den in ledge and talus areas in somewhat open deciduous forests, such as oak-heath barrens and crest oak woodlands. Male snakes migrate widely from the den during the summer, while females travel shorter distances from the den. Males have been reported to travel distances over 4 mi (6.4 km) from the den, but the average travel distance is closer to 2 mi (3.2 km). To protect most of the snakes in a given population, protection of undisturbed habitat within a minimum radius of 1.5 mi (2.4 km) from the den is recommended (Brown 1993). Other snakes, such as copperhead,* eastern ratsnake,* and eastern racer* may use these open rocky habitats only at key times of the year, including for spring basking and breeding, but may use other ledgy habitats for winter hibernacula.

In the past, oak-heath barrens and other rocky crests were not often threatened by development because the steep rocky terrain made the construction of houses, roads, and other structures too expensive. Recently, however, increasing numbers of houses are being constructed on or near crests. Barrens occurring on hill summits and ridge tops are also viewed as prime sites for communication (cell) towers. Because most oak-heath barrens in North East occur in the Taconic State Park, the most immediate threat to these delicate habitats comes from park visitors using trails, scenic viewpoints, and campsites. Intensive foot traffic (especially along established trails) can severely degrade the fragile vegetation of oak-heath barrens and expose rare reptiles to fatal human encounters. Perhaps one of the greatest threats to the long-term viability of the rare animals associated with oak-heath barrens is the fragmentation of habitat complexes. The construction of houses, roads, and other structures in these areas can isolate habitat complexes and the animal populations they support by preventing migration, dispersal, and genetic exchange. This, in turn, can limit the ability of these populations to adapt to changing climatic or environmental conditions and make them more prone to local extinction.

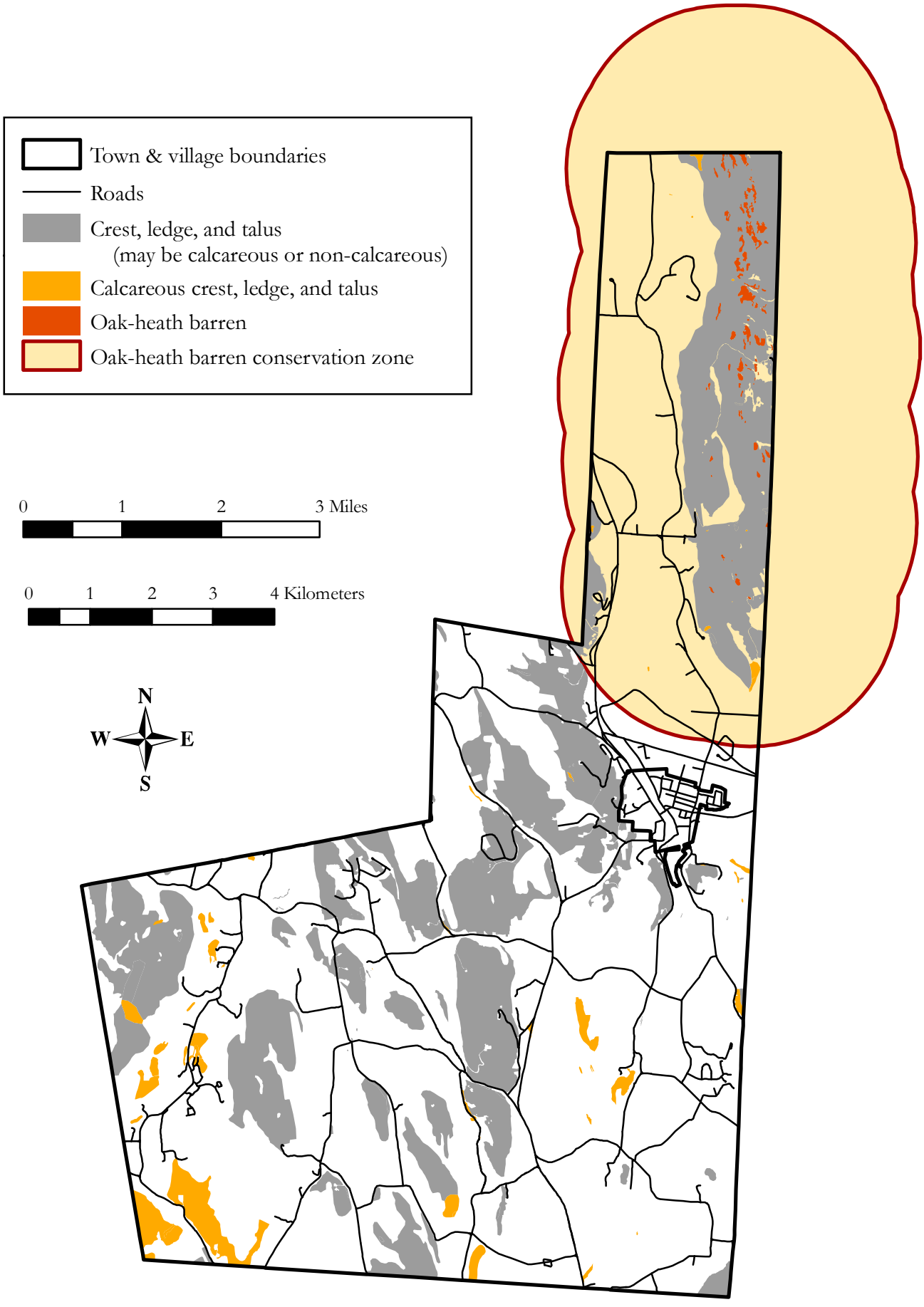
Because of their landscape position (at lower elevations) and bedrock composition, calcareous crest, ledge, and talus areas have generally been subjected to more regular disturbances and development pressures than the high ridges. Both forested and grassy calcareous rocky areas provide habitat for rare plants and animals, but in disturbed places they often support dense populations of non-native plants. The marble bedrock weathers to form sandy soils, which make these areas highly susceptible to erosion. For further information see marble knoll section (below).

Recommendations

To help protect oak-heath barren habitats and their associated rare species, we recommend the following measures:

1. **Protect oak-heath barren habitats.** All oak-heath barrens and their closely associated crest, ledge, and talus habitats should be protected from disturbances of any kind including, but not limited to, the construction of communication towers, mining, housing and road construction, and high intensity human recreation. Posting cautionary signs that warn of the fragile nature of the habitat may be an important first step (Kiviat 2001).
2. **Protect oak-heath barrens from disturbances associated with high intensity human recreation.** Locate any new trails distant from oak-heath barrens.
3. **Protect critical adjoining habitats within 1.5 mi (2.5 km) of the barrens.** As discussed above, to protect a population of timber rattlesnake, undisturbed habitat within a minimum radius of 1.5 miles (2.4 km) from the den must be protected (Brown 1993). Habitats within this zone should be considered critical components of the barren habitat "complex." As much as possible, avoid new development of any kind, including roads and driveways within this 1.5-mi zone. If development cannot be avoided, it should be concentrated in a manner that maximizes the amount and contiguity of undisturbed habitat. Special measures may also need to be taken (in consultation with the NYS DEC) to restrict the potential movement of rare snakes into the newly developed areas, thereby minimizing the likelihood of human-snake encounters (which are often fatal for the snake) and road mortality. Protecting large areas of contiguous habitat surrounding oak-heath barrens will not only protect potential foraging habitats and travel corridors, but may also help support the ecological and natural disturbance processes (e.g., fire) that help sustain the barrens habitats.
4. **Maintain corridors between oak-heath barren habitat complexes.** It is important that the intervening areas between habitat complexes remain intact to provide long-distance migration corridors for timber rattlesnake and other species for population dispersal and to accommodate snakes displaced from degraded habitats.
5. **Avoid direct disturbance to timber rattlesnake dens**, and restrict nearby logging to the winter months when the snakes are hibernating (Brown 1993).
6. **Consult with the Endangered Species Unit of the NYS DEC** about any activity proposed in the vicinity of a timber rattlesnake habitat.

Figure 6. Generalized distribution of calcareous and non-calcareous crest, ledge, and talus habitats, oak-heath barrens, and oak-heath barren conservation zones in the Town of North East, Dutchess County, New York. Locations identified from field observations and inferred from areas of shallow soils on steep slopes. Oak-heath barren conservation zones measure 1.5 mi (2.4 km) from each barren. Hudsonia Ltd., 2008.



MARBLE KNOLLS

Smooth-stemmed cliffbrake

Target Areas

We mapped seven marble knolls in the valleys of North East (Figure 7), and we expect there are several more, especially on both sides of Route 22 south of Millerton, in places we were not able to field check. Some of these possible locations have been flagged with question marks on the map.

Conservation Issues

Marble knolls are unusual habitats known to support many rare species of plants and animals (Kiviat 1988). Many of North East's marble knolls are in transition from agricultural uses (mostly grazing) to forested habitats, but still retain some meadow areas and openings within the developing shrub thickets and young forest. The meadow openings and the exposed bedrock areas are the primary habitats for the rare plants of marble knolls. Coarse sandy soils in the openings can also provide good nesting habitat for box turtle,* spotted turtle,* wood turtle,* eastern hognose snake,* and other reptiles. Some of these animals may need to travel long distances from their primary wetland or forest habitats to reach the marble knoll nesting grounds. Maintaining intact habitats and corridors around the knolls will allow these animals safe movement between habitats, and will also facilitate dispersal of plant propagules (seeds, spores, etc.) and repopulation of plant communities.

Recommendations

1. **Protect marble knolls from disturbances** such as the construction of communication towers, construction of buildings or roads, mining, and high intensity human recreation.
2. **Protect intact habitats around marble knolls** to allow safe movement of mobile wildlife using habitat complexes.

3. **Maintain corridors between marble knolls**. Protecting intact habitats in the intervening areas between marble knolls will allow for plant and animal movement and dispersal between knolls. This may be especially important for plants such as yellow wild-flax* and Carolina whitlow-grass,* two annuals that must continually reestablish themselves by seed dispersal.
4. **Maintain open areas**. Use light grazing, occasional mowing, or occasional manual removal of tall woody plants (e.g., eastern red cedar) where necessary to maintain meadow habitats for the rare plants of marble knolls, and to maintain unshaded reptile nesting areas.
5. **Consult with the New York Natural Heritage Program** about any activity proposed in the vicinity of a marble knoll habitat.

FENS AND CALCAREOUS WET MEADOWS

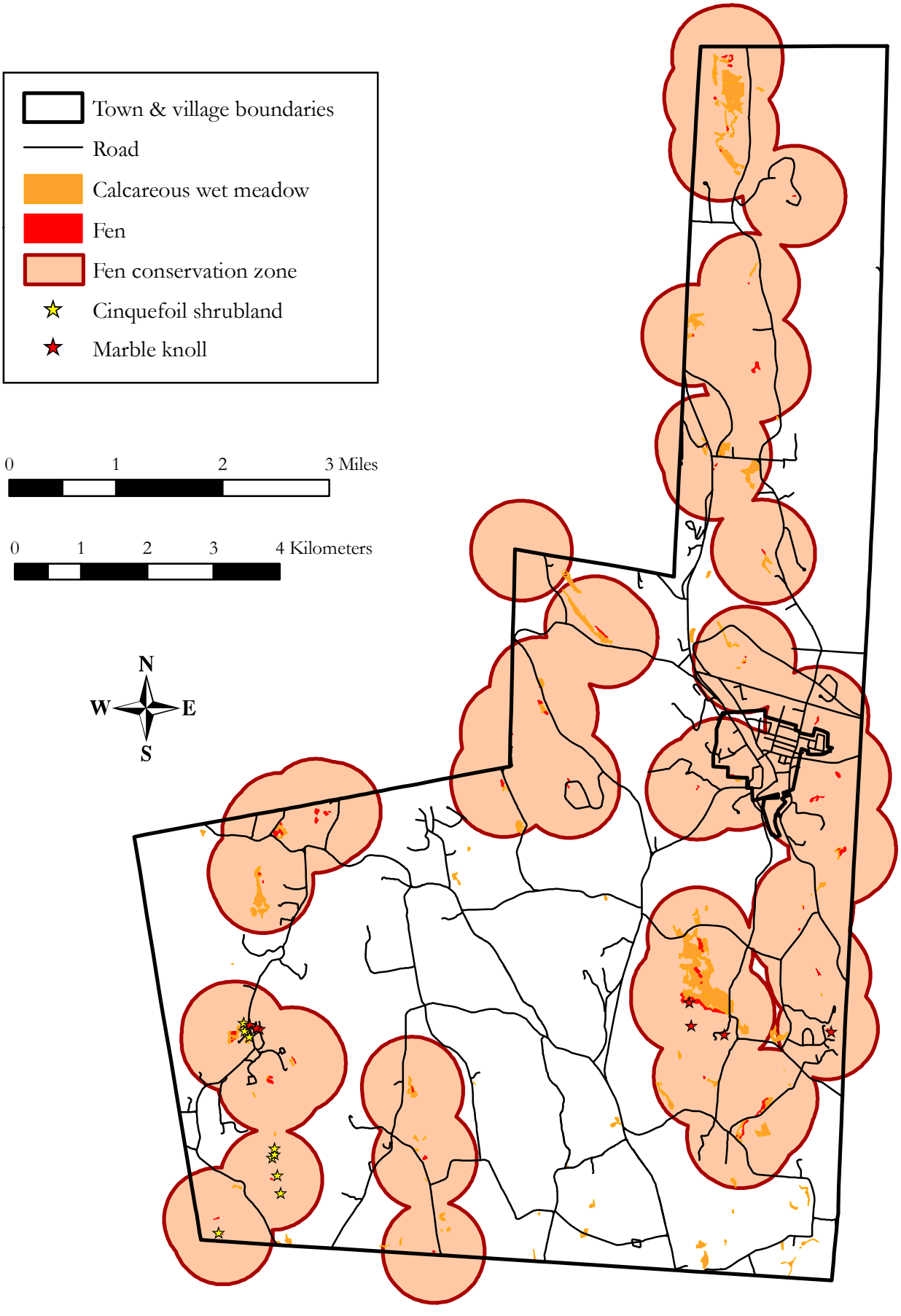
Target Areas

We mapped 80 fens and 127 calcareous wet meadows in the Town of North East (Figure 7). This number is probably an underestimate, since these habitats can only be positively identified in the field. We have flagged some possible additional fen locations with question marks on the map. Because extensive calcareous bedrock underlies the valleys of North East, the town contains an exceptionally high number of these regionally uncommon habitats. A large part of North East is included in the Harlem Valley Calcareous Wetlands, a Significant Biodiversity Area recognized by the NYS DEC (Penhollow et al. 2006).

Conservation Issues

Fens and calcareous wet meadows are uncommon in the northeastern U.S. and many provide important habitat for plant and animal species of conservation concern (see Appendix A). One of the most imperiled species associated with fens in Dutchess County is the bog turtle,* listed as Endangered in New York and Threatened on the federal list. Fens are the core habitat of bog turtle in Dutchess County, and the entire wetland matrix in which some fens occur is considered an important part of its habitat. Few of the remaining fens in this region currently support bog turtle populations, which may be due to habitat loss and degradation. Bog turtle has been rediscovered recently in Orange County, but is believed to be extinct (or nearly so) in Westchester and Rockland counties. Any of the high-quality fens in the Town of North East

Figure 7. Calcareous habitats in the Town of North East, Dutchess County, New York, including fens and associated conservation zones, calcareous wet meadows, cinquefoil shrublands, and marble knolls. Fen conservation zones measure 2,500 ft (750 m) from the fen edge. Hudsonia Ltd., 2008.



could be potential bog turtle habitat. We recommend, therefore, that all fens and calcareous wet meadows be considered potential bog turtle habitat and that the special protective measures discussed below be implemented to safeguard the integrity of these sensitive areas.

Fens are maintained by calcareous groundwater seepage. Alterations to the quality or quantity of groundwater or surface water feeding the fen can alter the soil characteristics, vegetation structure, or plant community composition, and can render the habitats unsuitable for bog turtle and other species of conservation concern. Thus, even if the fen itself is not disturbed, activities in areas surrounding a fen can affect the fen habitat. Furthermore, although bog turtles spend most of their lives in fens and associated wetlands, they also require safe travel corridors between fens for dispersal and other long-term movements. In New York, bog turtles may travel overland 2,500 ft (750 m), or nearly one-half mile, between individual wetlands within a habitat complex (Eckler and Breisch 1990). Maintaining connections to other wetland habitats within a one-half mile (0.8 km) radius of a known or potential bog turtle habitat may be crucial to sustaining the long-term genetic viability of bog turtle populations and the ability of individuals to relocate as habitat quality changes.

Recommendations

The Town of North East has an unusual number of fens, and is thus in a position to implement a conservation plan with far-reaching consequences for biodiversity in the region. Conservation of fens requires attention not only to the fen itself, but also to surrounding land uses. Because some of the high quality fen complexes (and their associated conservation zones) in the Town of North East cross multiple privately owned parcels, fen conservation also requires coordinating across property boundaries. Fens that are known to harbor the bog turtle, or may serve as potential habitat for the turtle, require special protective measures. The US Fish and Wildlife Service (Klemens 2001) recommends not only protecting the actual wetland complex, but also prohibiting disturbance and development within a 300 ft (90 m) distance from the wetland boundary. This buffer may be crucial to safeguarding wetland habitat quality, hydrology, and turtle travel corridors. Moreover, we believe that maintaining safe travel corridors between suitable fen habitats is important for population dispersal and to

accommodate turtles displaced from degraded habitats. The US Fish and Wildlife Service recommends the following (excerpted from Klemens [2001]):

1. **Protect the wetland habitat**. The entire wetland, not just those portions that have been identified as, or appear to be, optimal for nesting, basking, or hibernating, should be protected from direct destruction and degradation. The following activities (not an inclusive list) should be avoided within the wetland:
    - Development of any kind.
    - Wetland draining, ditching, tiling, filling, excavation, stream diversion, or construction of impoundments.
    - Herbicide, pesticide, or fertilizer application (except as part of approved bog turtle management plan).
    - Mowing or cutting of vegetation (except as part of approved bog turtle management plan).
    - Delineation of lot lines for development, even if the proposed building or structure will not be in the wetland.
2. **Establish a 300 ft buffer zone**. A protective "buffer" 300 ft (90 m) wide should be established around known or potential bog turtle wetlands to help prevent or minimize the effects of human activities. Activities in this zone could indirectly destroy or degrade the fen habitat over the short or long term and should be thoroughly evaluated in consultation with the US Fish and Wildlife Service and the NYS DEC. Activities in this zone that may adversely impact bog turtles and their habitats include, but are not limited to, the following:
    - Development of roads, residences, driveways, parking lots, sewer lines, utility lines, stormwater or sedimentation basins, or other structures.
    - Mining.
    - Herbicide, pesticide, or fertilizer application.
    - Farming (with the exception of light to moderate grazing).
    - Stream bank stabilization (e.g., rip-rapping).
3. **Assess potential impacts within at least 2500 ft (750 m) of the fen**. Despite the distance, development activities occurring within the drainage basin of the fen or at least one-half mile (800 m) from the boundary of the buffer zone may adversely affect bog turtles and their habitat. Development within this area may also sever important travel corridors between wetlands occupied or likely to be occupied by bog turtles, thereby isolating populations and increasing the likelihood of road mortality as turtles attempt to disperse.

- Activities such as the construction of roads and other impervious surfaces, groundwater extraction (e.g., wells), septic/sewer facilities, and mining have a high potential to alter the hydrology and chemistry of the fen habitat.
- Construction of new roads and bridges should be avoided within this area.
- Existing roads with medium to high volume traffic may be ideal candidates for "turtle underpasses" that may provide safer travel passageways for this species.
- All activity proposed within this zone should be thoroughly reviewed in consultation with the Endangered Species Unit of the NYS DEC using the most up-to-date scientific information on this species and its sensitive habitats.

INTERMITTENT WOODLAND POOLS

Target Areas

We identified and mapped 28 intermittent woodland pools in the Town of North East (Figure 8), and there are likely to be others that we missed. Each intermittent pool is important to preserve, but groups or networks of pools are particularly valuable from a habitat perspective. Groups of pools can support metapopulations–groups of small populations that are able to exchange individuals and recolonize sites where the species has recently disappeared.

Conservation Issues

Because they lack fish and certain other predators, intermittent woodland pools provide crucial breeding and nursery habitat for several amphibian species that cannot successfully reproduce in other wetlands, including several of the mole salamanders (Jefferson salamander,* marbled salamander,* spotted salamander*) and wood frog.* During the non-breeding season, these amphibians are exclusively terrestrial and require the deep shade, deep leaf litter, uncompacted soil, and coarse woody debris of the surrounding upland forest for foraging and shelter. The upland forested area within a 750 ft (230 m) radius of the intermittent woodland pool is considered necessary to support populations of amphibians that breed in intermittent woodland pools (Calhoun and Klemens 2002). Disturbance of vegetation or soils within this area can have significant adverse effects on the amphibians, including the direct loss of pool and forest habitats, alteration of the pool hydroperiod, and degradation of pool water quality or forest floor habitat quality.

Pool-breeding amphibians are especially vulnerable to upland habitat fragmentation because of their annual movement patterns. Each year adults migrate to the intermittent woodland pools to breed, and then adults and (later) juveniles disperse from the pool to terrestrial habitats. The mole salamanders are known to migrate seasonally up to 2,050 ft (625 m) from their breeding pools into surrounding forests (Semlitsch 1998). A wood frog adult may travel as far as 3,835 ft (1,169 m) from a breeding pool (Calhoun and Klemens 2002). Both salamanders and frogs are vulnerable to vehicle mortality where roads or driveways cross their travel routes, and roads, especially dense networks of roads or heavily-traveled roads, have been associated with reduced amphibian populations (Fahrig et al. 1995, Lehtinen et al. 1999, Findlay and Bourdages 2000). Open fields and clearcuts are another barrier to forest-dwelling amphibians. Juveniles have trouble crossing open fields due to a high risk of desiccation and predation in that exposed environment (Rothermel and Semlitsch 2002).

Populations of these amphibian species depend not only on a single woodland pool, but on a forested landscape dotted with such wetlands between which individuals can disperse (Semlitsch 2000). A network of pools is essential to amphibians for several reasons. Each pool is different from the next in vegetation structure, plant community, and hydroperiod, so each may provide habitat for a different subset of pool-breeding species at different times. Also, different pools provide better or worse habitat each year, due to variations in precipitation and air temperatures. To preserve the full assemblage of species, a variety of pools must be present for animals to choose from (Zedler 2003). Nearby pools can also serve to "rescue" a population: if the population at one pool is extirpated, individuals from another pool can recolonize the site. This rescue effect is needed to maintain the population over the long term (Semlitsch and Bodie 1998). Thus, protecting the salamander and frog species associated with intermittent woodland pools requires protecting not only their core breeding habitat (i.e., an intermittent woodland pool), but also their key foraging and wintering habitats in the surrounding upland forests, and the forested migration corridors between individual pools and pool complexes (Gibbons 2003).

Recommendations

To help protect pool-breeding amphibians and the habitat complex they require, we recommend that the following protective measures be taken (adapted from Calhoun and Klemens 2002):

1. **Protect the intermittent woodland pool depression**. Intermittent woodland pools are often overlooked during environmental reviews of proposed development projects and are frequently drained, filled, or dumped in. We advise that intermittent woodland pools be permanently protected from development and disturbance of any kind including the construction of houses, roads, lawns, and permanent ponds within the pool depression. This zone of protection should include the pool basin up to the spring high water mark and all associated vegetation. The soil in and surrounding the pool should not be compacted in any manner and the vegetation, woody debris, leaf litter, and stumps or root crowns within the pool should not be removed.
2. **Protect all upland forest within 100 ft (30 m) of the intermittent woodland pool**. This zone provides important shelter for high densities of adult and recently emerged salamanders and frogs during the spring and early summer. The forest in this zone also helps shade the pool, maintains pool water quality, and provides important leaf litter and woody debris to the pool system. This organic debris constitutes the base of the pool food web and provides attachment sites for amphibian egg masses.
3. **Maintain critical terrestrial habitat within 750 ft (230 m) of the pool**. The upland forests within 750 ft (230 m) or more of a woodland pool are critical foraging and shelter habitats for pool-breeding amphibians during the non-breeding season. Roads, development, logging, ATV use, and other activities within this terrestrial habitat can crush many amphibians and destroy the forest floor microhabitats that provide them with shelter and invertebrate food. Development within this zone can also prevent dispersal and genetic exchange between neighboring pools, thereby making local extinction more likely. A minimum of 75% of this zone should remain in contiguous (unfragmented) forest with an undisturbed forest floor. Wherever possible, forested connections between individual pools should be identified and maintained to provide overland dispersal corridors.

We also recommend the following for all development activity proposed within the critical terrestrial habitat zone (750 ft [230 m]) of an intermittent woodland pool:

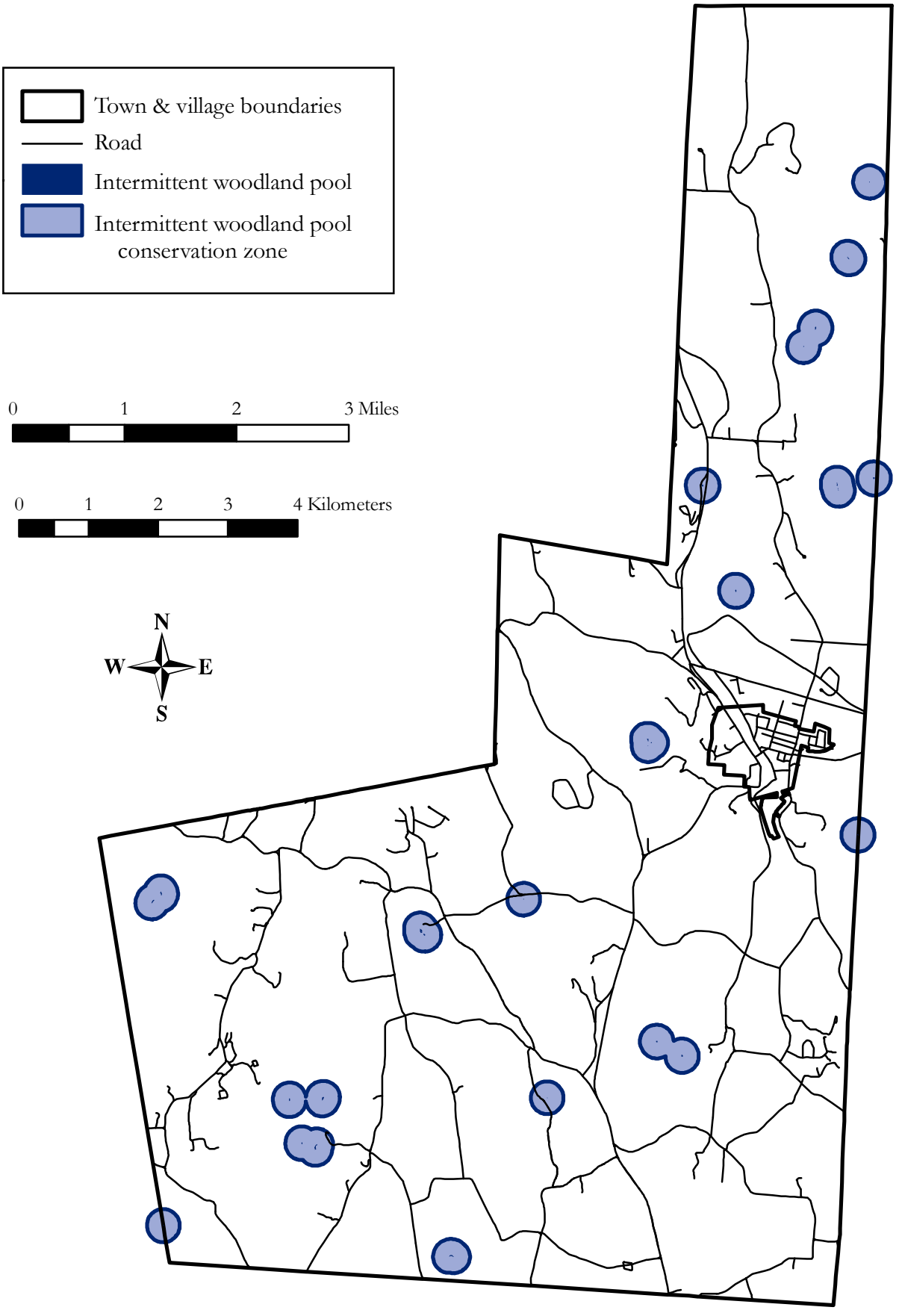
1. **Avoid or minimize the potential adverse affects of roads to the greatest extent possible**. Pool-breeding salamanders and frogs are especially susceptible to road mortality from vehicular traffic, predation, and desiccation. Curbs and other

structures associated with roads frequently intercept and funnel migrating amphibians into stormwater drains where they may be killed. To minimize these potential adverse impacts:

- Roads and driveways with projected traffic volumes in excess of 5-10 vehicles per hour should not be sited within 750 ft (230 m) of the pool.
- Regardless of traffic volumes, the total length of roads within 750 ft of a woodland pool should be limited to the greatest extent possible. This can be achieved, among other ways, by clustering development to reduce the amount of needed roadway.
- Gently sloping curbs or no-curb alternatives should be used to reduce barriers to amphibian movement.
- Oversized square box culverts (2 ft wide by 3 ft high [0.6 m x 0.9 m]) should be used near wetlands and known amphibian migration routes to facilitate amphibian movements under roads. These culverts should be spaced at 20 ft (6 m) intervals. Special "curbing" should also be used along the adjacent roadway to deflect amphibians into the box culverts.

2. **Maintain woodland pool water quality and quantity at pre-disturbance levels**. Development within a woodland pool's drainage basin can degrade pool water quality by increasing sediment, nutrient, and pollutant loading to the pool. Even slight increases in sediments or pollution can stress and kill amphibian eggs and larvae, and may have adverse long-term affects on the adults. Activities such as groundwater extraction (e.g., from wells) or the redirection of natural surface water flows can decrease the pool hydroperiod below the threshold required for successful egg and larval development. Increasing impervious surfaces or channeling stormwater runoff toward pools can increase pool hydroperiod, which can also adversely affect the ability of amphibians to reproduce successfully in woodland pools. Protective measures include the following:
    - Do not use intermittent woodland pools for storm water detention, either temporarily or permanently.
    - Aggressively treat stormwater using methods that allow for the maximum infiltration and filtration of runoff, including grassy swales, filter strips, "rain gardens," and oil-water separators in paved parking lots.
    - Avoid or minimize the use of pesticides, herbicides, and fertilizers within the woodland pool's drainage basin. If mosquito control activities are a necessity they should be limited to the application of bacterial larvicides, which appears at this time to have lesser negative impacts on non-target pool biota than other methods.

Figure 8. Intermittent woodland pools and their associated conservation zones in the Town of North East, Dutchess County, New York. Intermittent woodland pool conservation zones extend 750 ft (230 m) from wetland boundaries. Hudsonia Ltd., 2007.



- Maintain both surface water runoff and groundwater inputs to intermittent woodland pools at pre-construction levels. Avoid changes (either increases or decreases) in pool depth, volume, and hydroperiod.
- Minimize impervious surfaces including roads, parking lots, and buildings to reduce runoff problems and resulting stormwater management needs.

3. **Avoid creating stormwater detention basins and other artificial depressions** that intermittently hold water (e.g., vehicle ruts) within 750 ft (230 m) of an intermittent woodland pool or in areas that might serve as overland migration routes between pools. These "decoy wetlands" can attract large numbers of pool-breeding amphibians, but the eggs laid in them rarely survive due to the high sediment and pollutant loads and short hydroperiod.
4. **Design or modify potential pitfall hazards** such as swimming pools, excavations, window wells, or storm drain catch basins to prevent the entrapment and death of migrating amphibians.
5. **Schedule construction activities to occur outside the peak amphibian movement periods of spring and early summer**. If construction activity during this time period cannot be avoided, temporary exclusion fencing should be installed around the entire site to keep amphibians out of the active construction areas.

Spotted salamander

CIRCUMNEUTRAL BOG LAKES

Target Areas

Indian Lake is the only circumneutral bog lake we identified in North East (Figure 9). Route 62 skirts its eastern shore and the narrow strip of land between road and lake has dense residential development. Much of the western shore is also in residential use, leaving significant habitat only along the northern/northwestern shoreline and along the southern shore (in Connecticut). Indian Lake lacks public access within the Town of North East.

Conservation Issues

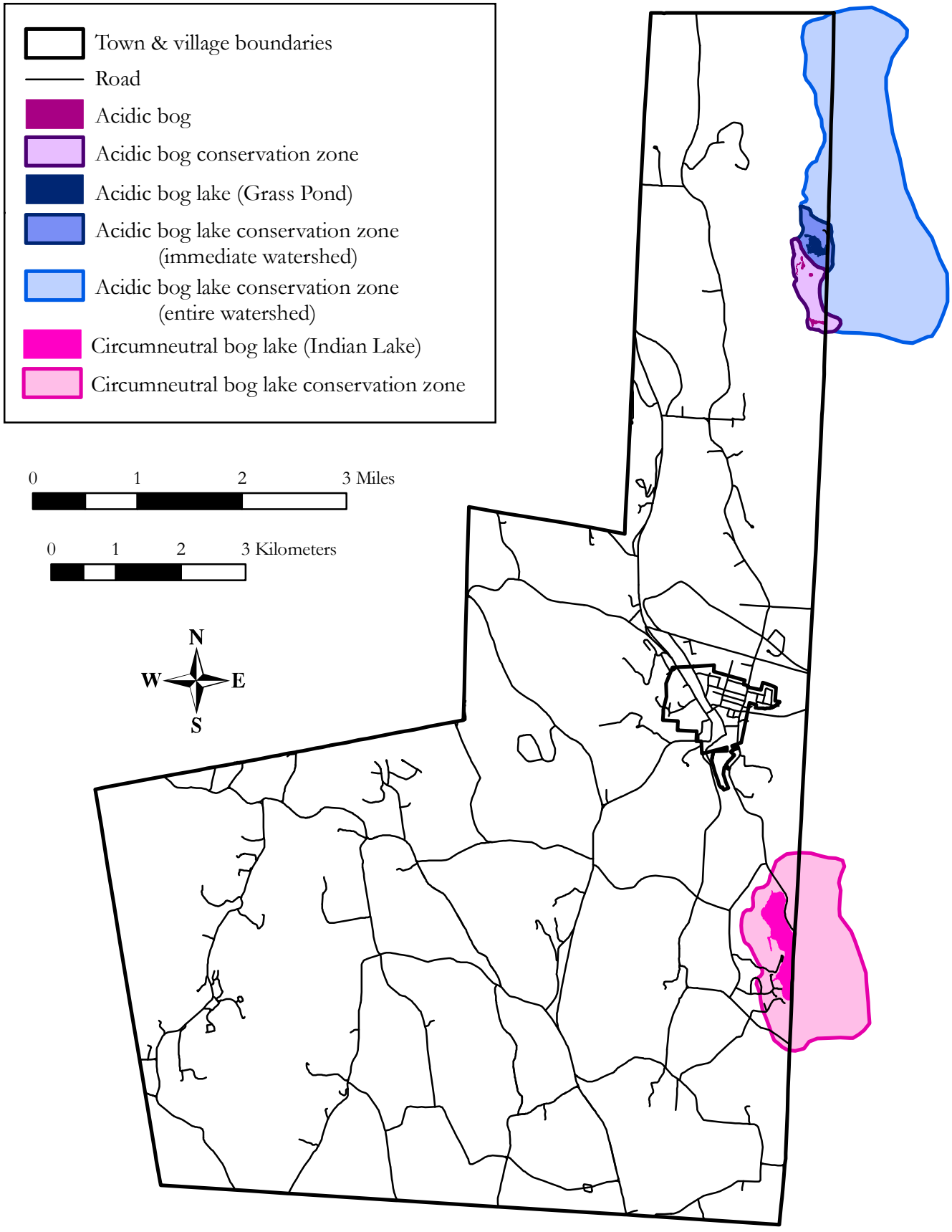
The unusual water chemistry, hydrology, and sediments of circumneutral bog lakes often combine to provide habitat for rare plants and animals. Indian Lake has abundant and diverse aquatic plants, including knotted spikerush* and Beck's water marigold* (both NYS Threatened) and other uncommon species that we observed nowhere else in the town. The clear water, diverse plant community, and floating peat mats create unusual habitat for fish, amphibians, reptiles, and invertebrates. Maintaining the quality and quantity of groundwater and surface water feeding the lake is probably critical to the very unusual lake habitats. Aquatic vegetation can be affected by herbicide application or herbicide-contaminated runoff into the lake, and water quality is degraded by fertilizers and other nutrient additions to the surrounding landscape, as well as sedimentation from silt-laden runoff.

Recommendations

1. **Maintain water quality**. Avoid the application of herbicides for the control of invasive aquatic plants. Consider mechanical harvesting of undesired species, such as Eurasian milfoil. Reduce or eliminate use of fertilizers and pesticides on lawns and nearby agricultural fields; minimize soil disturbance within the watershed of the circumneutral bog lake; upgrade nearby septic systems to prevent nutrient enrichment of the lake; minimize runoff from roads and other impervious surfaces.
2. **Maintain hydrology**. Avoid changing water levels or patterns of inflow and outflow. This requires attention to activities in the lake watershed such as road and building construction, stormwater management infrastructure, and groundwater extraction (e.g., wells).

3. **Maintain or restore a vegetated buffer of 300 ft (90 m) from the lake edge**. Leaving a broad buffer of undisturbed soils and vegetation may be crucial to safeguarding wetland habitat quality, hydrology, and potential northern cricket frog overwintering sites. The buffer zone along the eastern and southwestern shore of Indian Lake is compromised by residential areas and Route 62. To protect the lake habitat, discourage new development in this buffer area, and keep road treatments (such as salting or sanding) to a minimum.
4. **Protect habitats and assess potential impacts within the entire watershed of the lake** to protect hydrology and water quality for rare species.
5. **If any significant land use changes are proposed in the vicinity, conduct rare species surveys in the lake, adjacent wetlands, and surrounding forests early in the planning process**, so that development designs can accommodate the needs of sensitive species. Surveys should include rare plants, amphibians, reptiles, and breeding birds.
6. **Discourage use of motorized watercraft**. Motorized craft pollute water, create noise disturbance, physically damage plant and animal life, and may introduce non-native species.
7. **Avoid the introduction of non-native fish species that may disrupt the lake's food web**, including grass carp (used for biological weed control) or game fish.

Figure 9. Acidic bogs, acidic bog lake, circumneutral bog lake, and associated conservation zones in the Town of North East, Dutchess County, New York. The conservation zones for all three of these special habitats encompass their entire watersheds; in addition, we have shown a conservation zone for the immediate watershed of the acidic bog lake. Hudsonia Ltd., 2008.



ACIDIC BOGS AND ACIDIC BOG LAKES

Target Areas

We found five acidic bogs in remote locations along the ridgetop of the Taconic Range. They are part of two larger wetland areas surrounded by forest and inaccessible via established trails. All five acidic bogs are located within 350-800 ft (approx. 100-240 m) of Grass Pond, the only acidic bog lake documented in North East. Approximately 3,000 ft (1,000 m) of Grass Pond's shoreline in North East is free of development. Vacation homes dot the Connecticut shoreline and are clustered along the northern edge of the bay located within North East.

Conservation Issues

Acidic bogs and acidic bog lakes are very rare in Dutchess County, and are known to support rare species of plants and animals. Certain plant species, such as cranberries and pitcher plant, are seldom found outside of bog habitats in this region. In turn, the rare bog copper*(butterfly) depends on cranberries to reproduce, and the pitcher plant borer* and Exyra moth* are only found in the presence of their host, the pitcher plant. Bog communities are very sensitive to direct disturbance, such as trampling, and to indirect disturbances in the watershed—such as tree removal, soil disturbance, applications of fertilizers or pesticides, or alterations to groundwater or surface water drainage—that could alter the water chemistry, water temperature, or hydroperiod of the bog. Enrichment by nitrogen or phosphorus (typical nutrients in runoff from lawns, gardens, and agricultural fields) can kill or reduce the vigor of *Sphagnum* or allow it to be overtaken by other plants (Roy et al. 1997). Significantly raised water levels of long duration can drown the anchored *Sphagnum*, and lowered water levels can allow oxygenation and rapid decomposition of the peat (Crum 1988, Kulzer et al. 2001). A decaying bog could become a significant carbon source in the atmosphere (Moore 2002). Perhaps the best way to preserve bog habitat intact is to prevent direct human disturbance, and maintain a large buffer zone of undisturbed forest.

Recommendations

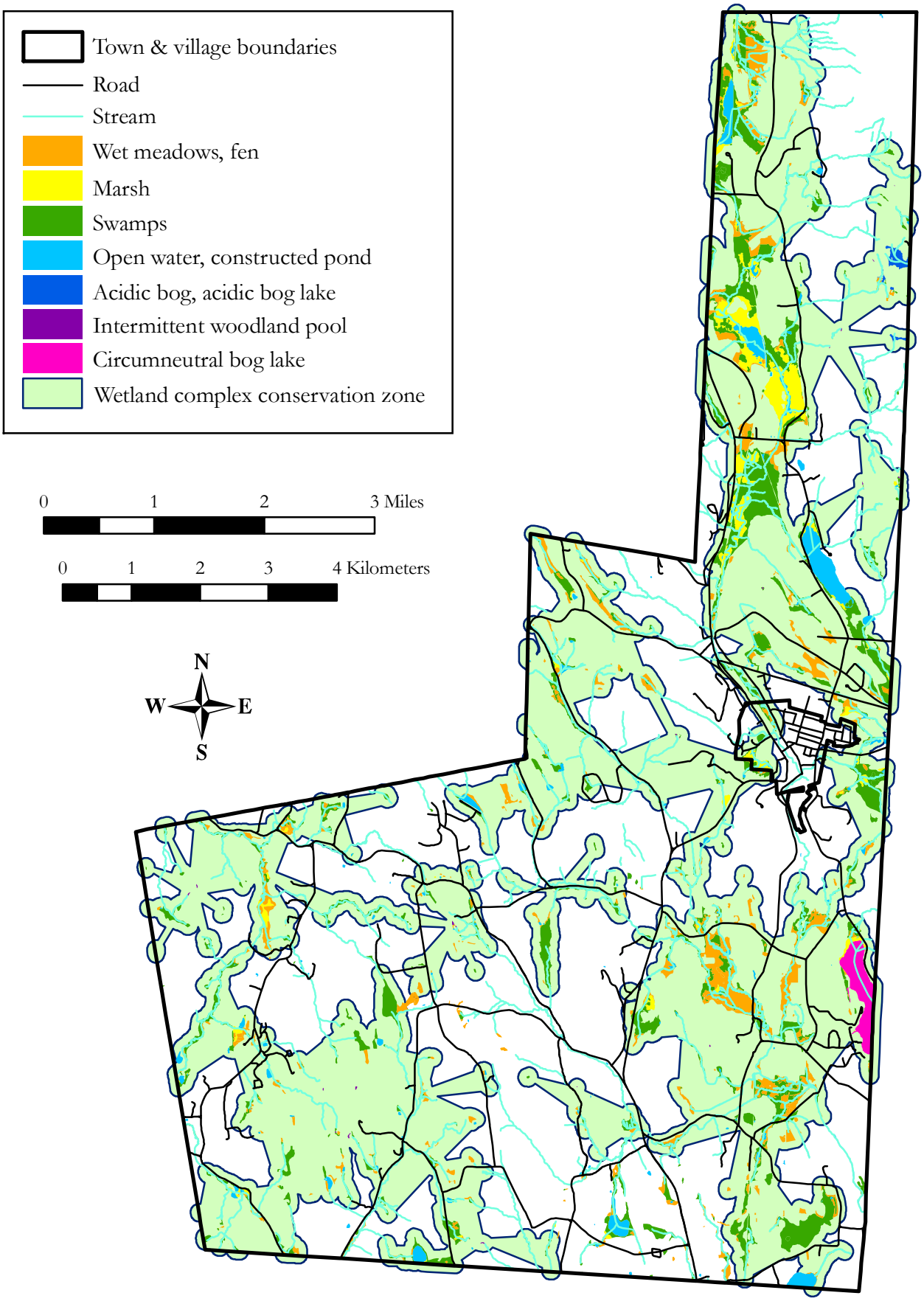
For acidic bogs:

1. **Protect the bog itself.**
   Limit human trampling and other direct disturbance of acidic bogs. If hiking trail access to one of these special areas is necessary, locate the trail so that the bog can be observed from the surrounding uplands. If applicable, consider signage to alert visitors to the sensitivity of bog environments.
2. **Establish a conservation zone that includes the bog's entire watershed.** Within this zone,
   - Maintain water quality. Avoid construction of buildings or roads, as well as alterations to groundwater or surface water drainage.
   - Maintain hydrology. Avoid changing water levels or patterns of inflow and outflow. This requires attention to activities in the bog's watershed such as road and building construction, stormwater management infrastructure, and groundwater extraction (e.g., wells).
   - Maintain microclimate. Protect forest cover as much as possible.

For acidic bog lakes:

1. **Protect the lake itself.**
   - Discourage use of motorized watercraft, which pollute water, create noise disturbance, physically damage plant and animal life, and may introduce non-native species.
   - Avoid the introduction of non-native fish species.
2. **Establish a conservation zone that includes the lake's immediate watershed.** Grass Pond is an arm of the larger Riga Lake. The immediate watershed includes land that directly drains into Grass Pond. Within this conservation zone:
   - Maintain or restore native vegetation.
   - Discourage additional development.
   - Minimize soil disturbance.
   - Minimize runoff from roads and other impervious surfaces.
   - Minimize or eliminate road treatments such as salting or sanding.
   - Maintain existing septic system in good working order to prevent nutrient enrichment to the lake.
   - Discourage the use of pesticides and fertilizers on lawns, gardens, and meadows.
3. **Establish a conservation zone that includes the lake's entire watershed.** This includes the entire watershed of Riga Lake, located mostly in Connecticut, but also includes the east side of Brace Mountain. Within this zone, maintain forest cover and minimize soil disturbance to avoid changes in quantity or quality of surface runoff into the lake.

Figure 10. Wetland habitats and wetland complex conservation zones in the Town of North East, Dutchess County, New York. Wetland complexes were defined as all swamp, marsh, and wet meadow habitats within 3,300 ft (1,000 m) of any intermittent woodland pool, kettle shrub pool, or fen; 390-ft (120-m) buffers around all these wetlands; and intervening upland habitats. Hudsonia Ltd., 2008.



WETLAND COMPLEXES

Target Areas

A wetland complex is any group of adjacent and nearby swamps, marshes, wet meadows, streams, or other wetland types. Wetland complexes with especially high habitat value include extensive complexes, those with a wide variety of wetland types, and those that have intact upland habitat between the wetlands. For example, the northern Webatuck Valley and adjacent hillsides form a large and variable wetland complex which includes hardwood swamps, mixed swamps, marshes, wet meadows, calcareous wet meadows, fens, open water, constructed ponds, intermittent woodland pools, and acidic bogs. An example of a smaller wetland complex occurs between Indian Lake Road and Reagan Road, and includes a kettle shrub pool, swamps, fens, and wet meadows. However, if the roads are not treated as boundaries, this complex includes the heath swamp, Indian Lake, and the large fen at Dutchess Sedge Meadows, and ultimately connects to the northern Webatuck Valley (Figure 10).

Conservation Issues

Many animals move among several types of wetland and upland habitats throughout the year. For instance, spotted turtle* is known to use marsh, fen, wet meadow, hardwood and shrub swamp, shrub pool, intermittent woodland pool, and open water habitats within a single year (Fowle 2001). Furthermore, although it depends on a large number of wetlands, spotted turtle may spend up to three-quarters of its time during the active season in uplands. This species follows an annual pattern of activity: it usually overwinters in bottomland hardwood swamps or wet meadows, spends spring and early summer in one to several seasonal and permanent pools, travels up to 1,870 ft (570 m) to nest in open upland habitat, and spends late summer aestivating (quiescent) in upland forest. It can travel 3,300 ft (1,000 m) or more between wetlands. Because of this intricate annual pattern of habitat use, whole complexes of wetland and upland habitats are required to support spotted turtle populations, including seasonal wetlands such as intermittent woodland pools (Joyal et al. 2001, Milam and Melvin 2001).

Recommendations

1. **Protect intermittent woodland pools, fens, acidic bogs, as well as the acidic and circumneutral bog lakes, and their conservation zones** as described in previous sections of this report. These are habitats used by spotted turtle especially in the summer.
2. **When the above habitats are located within 3,300 ft (1,000 m) of a swamp, marsh, or wet meadow (wintering habitat), protect the intervening upland habitats**. These upland areas encompass spotted turtle travel corridors, and nesting, aestivation, and basking sites.
3. **Spotted turtle nesting habitat within 390 ft (120 m) of all the wetlands should also be protected from disturbance**. Spotted turtle usually nests in open sites such as fields or lawns, but also in sedge tussocks in wetlands.

STREAMS AND RIPARIAN CORRIDORS

Target Areas

Webatuck Creek, Wassaic Creek, North East Stream, Shekomeko Creek, and Noster Kill were the major perennial waterways in North East. The town's widespread network of smaller perennial and intermittent streams is also important, both to the organisms that depend on the streams and to the health of their entire watersheds (Figure 11).

Conservation Issues

Low gradient, perennial streams can be essential core habitat for the wood turtle,* a Species of Special Concern in New York State. Wood turtles use streams with overhanging banks, muskrat burrows, or other underwater shelter for overwintering. In early spring, they use overhanging tree limbs and stream banks for basking. In late spring and summer, wood turtles (especially females) move into the surrounding riparian zone to bask and forage in a variety of wetland and upland habitats, and females may travel long distances from their core stream habitat to find open, sparsely vegetated upland nesting sites.

Conserving wood turtles requires protecting not only their core habitat of perennial streams, but also their riparian wetland and upland foraging habitats, upland nesting areas, and the upland migration corridors between these habitats. The wood turtle habitat complex can encompass the

wetland and upland habitats within 650 ft (200 m) or more of a core stream habitat (Carroll and Ehrenfeld 1978, Harding and Bloomer 1979, Buech et al. 1997, Foscarini and Brooks 1997). Development activity within this habitat complex can have significant adverse effects on wood turtles and their habitats. These effects include habitat degradation from stream alteration; habitat fragmentation from culverts, bridges, roads, and other structures; the direct loss of wetland habitat; degraded water quality from siltation, pesticides, fertilizers, sewage, and toxic compounds; increased nest predation by human-subsidized predators; disturbance from human recreational activities; and road mortality of nesting females and other individuals migrating between habitats.

Water quality in large streams depends in part on the water quality and quantity of the small, intermittent streams that feed them (Lowe and Likens 2005). In order to protect water quality and habitat in intermittent streams, the adjoining lands should be protected to at least 160 ft (50 m) on each side of the stream. This conservation zone provides a buffer for the stream and can help by filtering sediment, nutrients, and contaminants from runoff, stabilizing stream banks, contributing organic material, preventing channel erosion, regulating microclimate, and preserving other ecosystem processes (Saunders et al. 2002).

Recommendations

To help protect wood turtles and the habitat complexes they require, we recommend the following measures:

1. **Protect the integrity of stream habitats**.
    - Prohibit engineering practices that alter the physical structure of the stream channel such as stream channelization, artificial stream bank stabilization (e.g., rock rip-rap, concrete), construction of dams or artificial weirs, vehicle crossing (e.g., construction or logging equipment, ATVs), and the clearing of natural stream bank vegetation. These activities can destroy key hibernation and basking habitat.
    - Avoid direct discharge of stormwater runoff, chlorine-treated wastewater, agricultural by-products, and other potential pollutants.
    - Establish a stream conservation zone extending at least 160 ft (50 m) on either side of all streams in the watershed, including perennial and intermittent tributary streams, regardless of whether or not they are used by wood turtles.

These conservation zones should remain naturally vegetated and undisturbed by construction, conversion to impervious surfaces, agriculture and livestock use, pesticide and fertilizer application, and installation of septic leachfields or other waste disposal facilities.

2. **Protect riparian wetland and upland habitats.** All riparian wetlands adjacent to known or potential wood turtle streams should be protected from filling, dumping, drainage, impoundment, incursion of construction equipment, siltation, polluted runoff, and hydrological alterations. In addition, large, contiguous blocks of upland habitats (e.g., forests, meadows, shrublands) within 650 ft (200 m) of a core wood turtle stream should be preserved to the greatest extent possible to provide basking, foraging, and nesting habitat for this species. Special efforts may need to be taken to protect particular components of the habitat complex such as wet meadows and alder stands; wood turtle has been found to favor stands of alder, and wet meadows are often sought by wood turtles, especially females, for spring basking and foraging (Kaufmann 1992). These wetlands, however, are often omitted from state, federal, and site-specific wetland maps and are frequently overlooked in the environmental reviews of development proposals.

3. **Minimize impacts from new and existing stream crossings**. Stream crossings, particularly undersized bridges and narrow culverts, may be significant barriers to wood turtle movement along their core stream habitats. Wood turtles may shy away from entering such structures and choose an overland route to reach their destination. Typically, this overland route involves crossing a road or other developed area, often resulting in road mortality. If a stream crossing completely blocks the passage of turtles, individuals can be cut off from important foraging or basking habitats, or be unable to interbreed with turtles of neighboring populations. Such barriers could significantly diminish the long-term viability of these populations. If new stream crossings must be constructed, we recommend that they be specifically designed to accommodate the passage of turtles and other wildlife. The following prescriptions, although not specifically designed for wood turtles, may be an important first step to improving the connectivity of stream corridors (adapted from Singler and Graber 2005):
    - Use bridges and open-bottomed arches instead of culverts.
    - Use structures that span at least 1.2 times the full width of the stream so that one or both banks remain in a semi-natural state beneath the structure. This may promote the overland passage of turtles and other wildlife.
    - Design the structure to be at least 4 ft (1.2 m) high and have an openness ratio of at least 0.5 (openness ratio = the cross-sectional area of the structure divided by

its length, measured in meters). Higher openness ratio values mean that more light is able to penetrate into the interior of the crossing. Brighter conditions beneath a crossing may be more favorable for the passage of wood turtles and other animals.

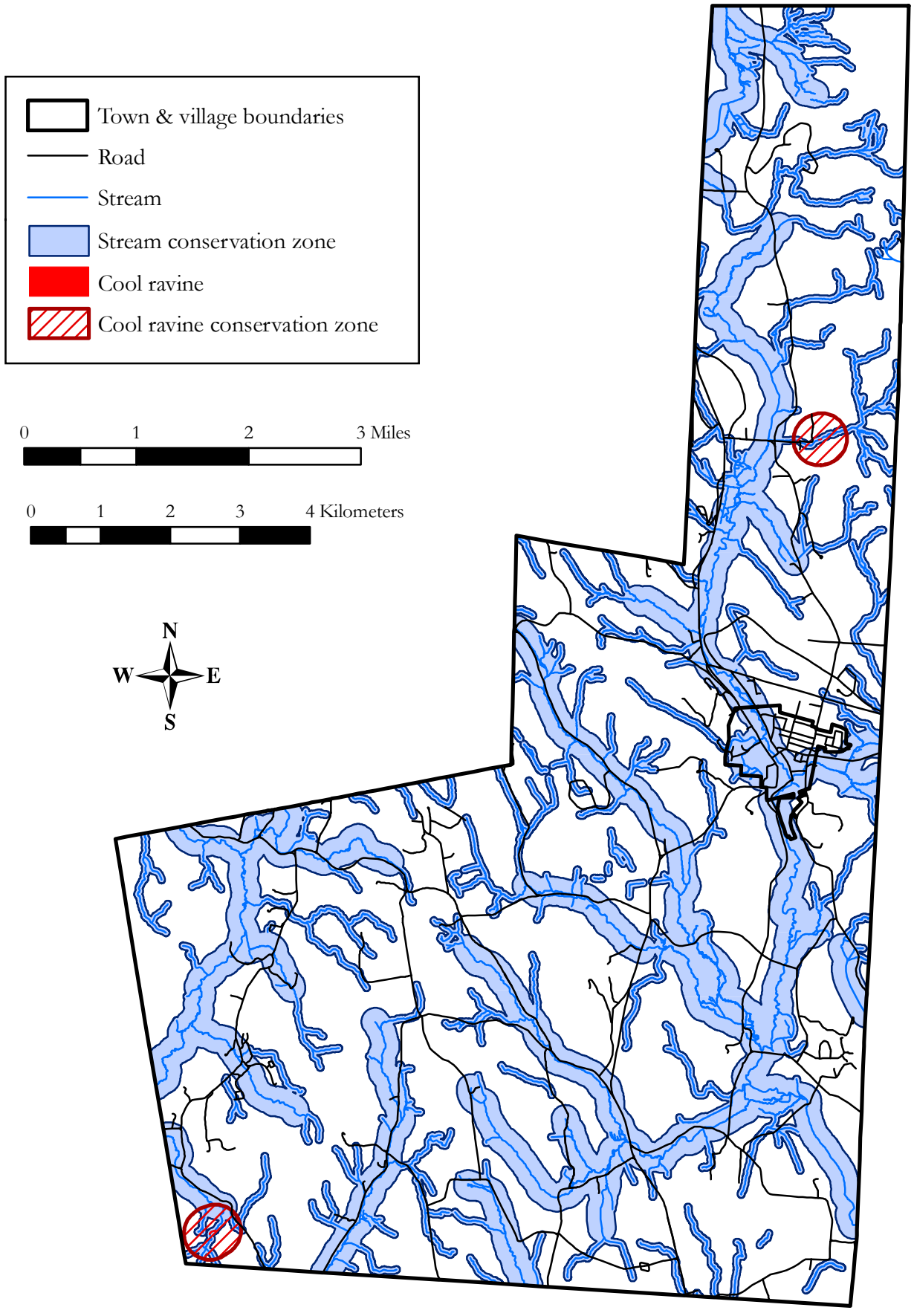
- Construct the substrate within the structure of natural materials and match the texture and composition of upstream and downstream substrates. If possible, crossings should be installed in a manner that does not disturb the natural substrate of the stream bed.
- If the stream bed must be disturbed during construction, design the final elevation and gradient of the structure bottom so as to maintain water depth and velocities at low flow that are comparable to those found in natural stream segments just upstream and downstream of the structure. Sharp drops in elevation at the inlet or outlet of the structure can be a physical barrier to wood turtle passage.

4. **Minimize impacts from new and existing roads**. Road mortality of nesting females and individuals dispersing to new habitats is one of the greatest threats to wood turtle populations. To help minimize the adverse effects of roads on this species, we recommend the following actions be undertaken within the 650 ft (200 m) wide stream conservation zone:
    - Prohibit the building of new roads crossing or adjoining wood turtle habitat complexes. This applies to public and private roads of all kinds, including driveways.
    - Keep vehicle speeds low on existing roads by installing speed bumps, low speed limit signs, and wildlife crossing signs.

5. **Maintain broad corridors between habitats and habitat complexes**. Broad, naturally vegetated travel corridors should be maintained between individual habitats within a complex (e.g., between core stream habitats, foraging wetlands, and nesting areas) and between neighboring habitat complexes.

6. **Protect nesting areas**. Wood turtles often nest in upland meadow or open shrublands, habitats that also tend to be prime areas for development. Construction of roads, houses, and other structures on potential nesting habitats could severely limit the reproductive success of the turtles over the long term. We recommend that large areas of potential nesting habitat within the 650 ft (200 m) stream conservation zone (e.g., upland meadows, upland shrublands, waste ground with exposed gravelly soils) be protected from development and other disturbance.

Figure 11. Streams, cool ravines, and associated conservation zones in the Town of North East, Dutchess County, New York. Streams have conservation zones extending at least 160 ft (50 m) on each side; large, perennial streams have conservation zones of 650 ft (200 m). Cool ravines have conservation zones of 1,200 ft (360 m). Hudsonia Ltd., 2008.



CONSERVATION AREAS IN NORTH EAST

The Town of North East has an exceptional diversity and quality of habitats distributed throughout the town. To synthesize the information presented in preceding chapters, and facilitate discussion of conservation priorities, we have divided the town into seven "conservation areas," each with its unique combination of priority habitats (Figure 12). We hope that this presentation of geographic groupings of priority habitats will help to put each specific location in North East within a larger context, to assist with townwide planning, and to focus local conservation efforts on those measures most appropriate to each conservation area. For discussion of conservation issues and recommendations for each habitat type, refer to the preceding sections.

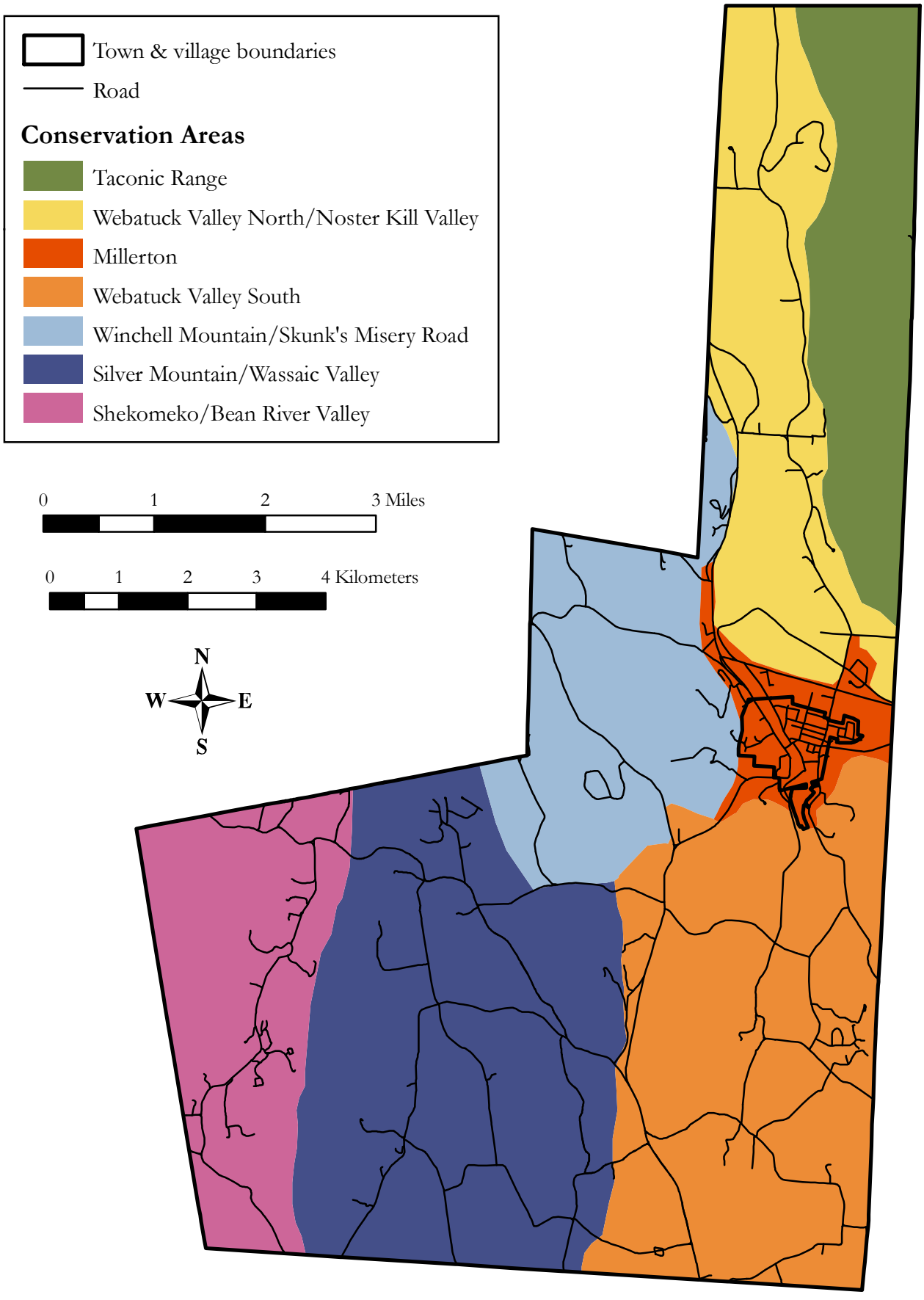
Taconic Mountains

The Taconic Mountains stretch along the eastern edge of North East's panhandle and extend north and east beyond the town's boundaries. This entire mountain range is recognized by the NYS DEC as a Significant Biodiversity Area, because it encompasses large areas of contiguous, high quality, northern hardwood forest (Penhollow et al. 2006). Within the Town of North East the Taconic Mountains are biologically unique. The bedrock is primarily schist, phyllite, and meta-graywacke, with small inclusions of limestone in some places and the terrain is very steep and rocky, with many exposed ledges, rocky crests, and waterfalls. The exposed bedrock and shallow soils on the crests lead to droughty conditions and stunted oak crest forests and oak-heath barrens—rare habitats in southeastern New York. The isolated wetlands on the ridges tend to be very acidic because they are fed primarily by rainwater and not buffered by calcareous bedrock. Many of the steep slopes may never have been completely cleared (by humans), and support forest communities with very few invasive species. Most of the more than 3,000-ac (1,200-ha) ridge area belongs to Taconic State Park, but approximately one third of the area is in private ownership. We recommend that the town strongly discourage further development within this area because of its exceptional importance for regional biological diversity.

Priority habitats in the Taconics were:

- Extensive upland hardwood, mixed, and conifer forest, the largest (approx. 2,900 ac [1,170 ha]) contiguous forest in the Town of North East. A variety of forest types are represented, depending on the altitude and aspect, the depth and chemical characteristics of the soil, and the disturbance history. In general, the forest along the lower edge of the ridge has a higher density of invasive species, probably due to the history of past disturbance (e.g., forest clearing, logging, grazing). The forests along the steep slopes and ridges, on the other hand, are remarkably free of invasive species and represent high quality examples of the different forest types. Large mammals such as black bear,* bobcat,* and fisher* are known to roam the Taconics, and we observed uncommon or vulnerable birds, such as ruffed grouse,* American woodcock,* Cooper's hawk,* eastern wood pewee,* black-and-white warbler,* and black-throated green warbler* in these forests.
- Over 100 acres (250 ha) of oak-heath barren. The Taconics are the only area in the town where this habitat occurs. The oak-heath barrens are of particular importance as core habitat for the timber rattlesnake,* and are likely to be used by other snakes of conservation concern for basking and breeding. We regularly observed eastern towhee* and three-toothed cinquefoil* in this habitat, and the rare bearberry* and clustered sedge* (NYS Threatened) are known to occur here.
- Two large areas of acidic bog, and an acidic bog lake (Grass Pond). These habitats occur only on the Taconic ridge; rare plants that we found only in these habitats included small cranberry,* spatulate-leaved sundew,* and pitcher-plant.*
- Mixed forest swamps. We found black bear sign in one of these, and also observed rare plant species of northern affinities.
- Numerous rocky ledge, talus, and crest habitats, including calcareous outcrops where we observed a variety of rare and uncommon plants, including walking fern,* rusty woodsia,* blue cohosh,* and Dutchman's breeches.*
- Many springs, seeps, and small streams.
- A cool ravine, and other areas with rare, northern plant species, such as leatherwood,* hobblebush,* and bunchberry.*
- Seven intermittent woodland pools.

Figure 12. Conservation areas in the Town of North East, Dutchess County, New York. These divisions are based on the geophysical and biological attributes of the town, and are intended to aid in townwide conservation planning. For descriptions of each area refer to the report. Hudsonia Ltd., 2008.



The remaining six conservation areas fall largely within another Significant Biodiversity Area—the Harlem Valley Calcareous Wetlands. They contain high quality habitat for many wetland-dependent species and some of the best bog turtle habitat in southeastern New York (Penhollow et al. 2006). The primary threat to all these areas appears to be sprawling residential development. Long driveways and large lawns fragment large forest and meadow areas and separate wetlands that are ecologically connected. We recommend that, with the exception of the Village of Millerton, further residential development within these areas be limited and concentrated along existing roads within "neighborhoods" of other houses. We also recommend that the building of long driveways into unfragmented forest or large upland meadows be strongly discouraged.

Webatuck Valley North/Noster Kill Valley

This area includes the the valley extending north from Millerton. The valley is dissected by north-south running Route 22, Boston Corners Road, and the old railroad grade, but the large wetland complexes nevertheless remain fairly well connected. This conservation area is characterized by:

- Over 1,000 ac (400 ha) of wetland, most of it in large, connected wetland complexes.
- Sixteen fens and over 95 ac (38 ha) of calcareous wet meadow. The large Mount Riga Fen is the only location in North East where we found the NYS Threatened bush aster* and the regionally-rare twig-rush.*
- Large marshes and open water areas, where we observed northern harrier.*
- Extensive upland meadows, including most of the largest contiguous meadow patches in the town.
- Webatuck Creek, a medium-sized, perennial stream, tributary to the Tenmile River.

Millerton

The commercial and residential areas within and surrounding the Village of Millerton are closely entwined with several ecologically valuable wetland areas and streams. We strongly recommend concentrating future development in the Town of North East within the Millerton area as much as possible, practicing "infill" development and the re-use of existing structures wherever feasible, and applying strict conservation measures to safeguard the integrity of the following priority habitats:

- Webatuck Creek and its tributaries flowing through the village and forming a corridor between the northern and southern Webatuck Valley conservation areas.
- The wetland complex behind the cemetery, which includes several fens.
- The wetland complex along the state line north and south of Route 44, which also includes several fens.

Winchell Mountain/Skunk's Misery Road

This area is centered around Winchell Mountain but extends south to include the wooded hill between Route 199 and Skunk's Misery Road, as well as some valuable wetlands west of Skunk's Misery Road, and north to include the wooded slopes west of Route 22, north of Millerton. This area has exceptional scenic value and contains the following priority habitats:

- 11 fens (many of them at higher elevations) and over 20 acres (8 ha) of calcareous wet meadow; one of these fens contained a large population of the NYS Threatened swamp lousewort.*
- Extensive upland meadows, some of which supported breeding bobolink.*
- Large unfragmented forests, forming "stepping stones" of a forested corridor extending north to south through the center of the town and connecting with large forests beyond the town boundaries in Amenia and Ancram.
- Three intermittent woodland pools.
- Sawmill Brook, a fine example of a rocky, perennial woodland stream.

Silver Mountain/Wassaic Valley

This area forms a higher-elevation "plateau" of ridges and valleys separating the Webatuck and Shekomeko valleys. It includes the headwaters of Wassaic Creek, an ecologically important stream in Amenia. The area is noteworthy for the large forests and meadows that remain despite a moderate amount of fragmenting residential development. Priority habitats within this area include:

- Large wooded hills with unfragmented forest which form the southern "stepping stones" of the aforementioned forested corridor through an otherwise largely agricultural part of the town, as well as a large wooded hill connected to another unfragmented forest in the Shekomeko Valley; a landowner reported frequent bobcat sightings in this area.
- Eight intermittent woodland pools, the highest concentration of this priority habitat in the town outside of the Taconic Mountains; the owner of one of these pools observed marbled salamander,* spotted salamander,* and wood frog.*
- Extensive meadows (over 1,800 ac [730 ha]). We saw an immature bald eagle* circling over one of the large meadows in this area.

Shekomeko/Bean River Valley

This area is located in the westernmost part of the town and has a high concentration of calcareous wetland and upland habitats, including fens and marble knolls. Special habitats in this area include:

- 19 fens and almost 30 ac (12 ha) of calcareous wet meadow.
- One of the largest unfragmented forest patches; in forests of this area, we observed Canada warbler,* eastern wood pewee,* black-throated blue warbler,* black-and-white warbler,* wood thrush,* and ovenbird.*
- Marble knolls and cinquefoil shrublands. These areas are likely to support rare plants.
- Three intermittent woodland pools.
- A cool ravine with mountain maple,* and abundant ferns and wildflowers.
- Shekomeko Creek (a medium-sized perennial stream) and associated wetlands.
- Numerous and extensive areas of calcareous crest, ledge, and talus.

Webatuck Valley South

This area covers all of the valley east of Route 22 south of Millerton, as well as a narrow band west of Route 22. Large parts of the valley are open meadow, reflecting a long agricultural history, and part of this area has been designated a historic district for this reason (the Coleman Station Historic District). The valley is characterized by a concentration of high-quality fens and large calcareous wetland areas, and is the only place in North East where we found:

- A circumneutral bog lake (Indian Lake). We observed a pair of pied-billed grebes* in the lake in September and found two NYS Threatened aquatic plant species—knotted spikerush* and Beck's water marigold.*
- A kettle shrub pool, where we observed many birds, including wood duck.*
- A large heath swamp. This swamp seemed to be somewhat calcareous as indicated by the presence of buttonbush, dwarf raspberry, and some other calcium-loving plants. We also found the NYS Threatened swamp lousewort* and the regionally rare lopseed* at the edge of the wetland.
- Two conifer swamps, dominated by eastern hemlock.

The Webatuck Valley area also contains:

- 32 fens, and over 150 ac (60 ha) of calcareous wet meadow (including the largest in North East,"Dutchess Sedge Meadows"). Some of these fens were in good condition and we observed the rare butterfly silver-bordered fritillary* in one of them.
- Over 900 ac (360 ha) of wetland.
- Over 2,600 ac (1,050 ha) of extensive open meadows.
- Mixed forest swamps. One of these was dominated by hemlock and catalpa trees, an unusual composition.
- Marble knolls and red cedar woodlands, which are likely to support rare plants.
- Three intermittent woodland pools.
- Webatuck Creek, a medium-sized, perennial stream, tributary to the Tenmile River.
- Several patches of calcareous crest, ledge, and talus.

CONCLUSION

There are significant opportunities for biodiversity conservation in the rural landscape of the Town of North East. Development pressure is on the rise, however, and strategic land use and conservation planning is needed to ensure that species, communities, and ecosystems are protected for the long term. The habitat map and this report will equip town agencies, landowners, and others with information about local habitats of ecological significance, so they can take steps to protect the resources of greatest importance to them.

The "habitat approach" to conservation is quite different from the traditional parcel-by-parcel approach to land use decision making. It requires examining the landscape beyond the boundaries of any particular land parcel, and considering the size and juxtaposition of habitats in the landscape, the kinds of biological communities and species they support, and the ecological processes that help to maintain those species. After conveying the completed habitat map, database, and report to the Town of North East, Hudsonia hopes to have the opportunity to assist town officials, landowners, and other interested individuals and groups in interpreting the map, understanding the ecological resources of the town, and devising ways to integrate this new information into land use planning and decision making.

The map provides a bird's-eye view of the landscape, illustrating the location and configuration of ecologically significant habitats. At the printed scale of 1:10,000, many interesting ecological and land use patterns emerge, such as the location and extent of remaining unfragmented forest blocks, the areas where fens or other rare habitats are concentrated, and the patterns of habitat fragmentation caused by roads and private residential development. This kind of general information can help the town consider where future development should be concentrated and where future conservation efforts should be targeted. An understanding of the significant ecological resources in the town will enable local decision makers to focus limited conservation resources where they will have the greatest impact.

At the site-specific scale, we hope the map will be used as a resource for routine deliberations over development proposals and other proposed land use changes. The map and report provide an independent body of information for environmental reviews, and will help raise questions about important biological resources that might otherwise be overlooked. We strongly emphasize, however, that the map has not been exhaustively field checked and should therefore be used only as a source of general information. In an area proposed for development, for example, the habitat map can provide basic ecological information about the site and the surrounding lands, but the map should not be considered a substitute for site visits by qualified professionals. During site visits, the presence and boundaries of important habitats should be verified, changes that have occurred since our mapping should be observed, and the site should be assessed for additional ecological values. Based on this information, decisions can be made about the need for rare species surveys. Detailed, up-to-date ecological information is essential to making informed decisions about specific development proposals. Because the natural landscape and patterns of human land use are dynamic, the town should consider refining and/or updating the habitat map over time.

Conservation of habitats is one of the best ways to protect biological resources. We hope that the information contained in the habitat map and in this report will help the Town of North East plan wisely for future development while taking steps to protect biological resources. Incorporating this approach into planning and decision making will help to minimize the adverse effects of human activities on the landscape, integrate the needs of the human community with those of the natural communities, and protect the ecological patterns and processes that support us and the rest of the living world.

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REFERENCES CITED

Aerts, R. and F. Berendse. 1988. The effect of increased nutrient availability on vegetation dynamics in wet heathlands. Vegetatio 76:63-69.

Ambuel, G. and S.A. Temple. 1983. Songbird populations in southern Wisconsin forests: 1954 and 1979. Journal of Field Ornithology 53:149-158.

Askins, R.A. 1993. Population trends in grassland, shrubland, and forest birds in eastern North America. Current Ornithology 11:1-34.

Bailey, J.A. and M.M. Alexander. 1960. Use of closed conifer plantations by wildlife. New York Fish and Game Journal 7(2):130-148.

Bednarz, J.C. and J.J. Dinsmore. 1982. Nest sites and habitat of red-shouldered and red-tailed hawks in Iowa. Wilson Bulletin 94(1):31-45.

Bell, K., C. Dickert, J. Tollefson, and G. Stevens. 2005. Significant habitats in the Town of Stanford, Dutchess County, New York. Report to the Millbrook Tribute Garden, the Dyson Foundation, the Town of Stanford, and the Dutchess Land Conservancy. Hudsonia Ltd., Annandale, NY. 123 p.

Billings, G. 1990. Birds of prey in Connecticut. Rainbow Press, Torrington, CT. 461 p.

Brennan, L.A. and W.P. Kuvlevsky, Jr. 2005. North American grassland birds: An unfolding conservation crisis? Journal of Wildlife Management 69(1):1-13.

Brown, W.S. 1993. Biology, status, and management of the timber rattlesnake (*Crotalus horridus*): A guide for conservation. Society for the Study of Amphibians and Reptiles, Herpetological Circular No. 22.

Buech, R., L.G. Hanson, and M.D. Nelson. 1997. Identification of wood turtle nesting areas for protection and management. In J. Van Abbema, ed., Proceedings: Conservation, Restoration, and Management of Tortoises and Turtles-An International Conference. New York Turtle and Tortoise Society and the WCS Turtle Recovery Program. New York, NY.

Busch, P.S. ed. 1976. The ecology of Thompson Pond in Dutchess County, New York. The Nature Conservancy, Boston.

Cadwell, D.H, G.G. Connally, R.J. Dineen, P.J. Fleisher, M.L. Fuller, L. Sirkin, and G.C. Wiles. 1989. Surficial geologic map of New York (Lower Hudson sheet). Map and Chart Series 40, 1:250,000, 100 ft. contour. New York State Museum, Albany.

Calhoun, A.J.K. and M.W. Klemens. 2002. Best development practices: Conserving pool-breeding amphibians in residential and commercial developments in the North Eastern United States. MCA Technical Paper No. 5, Metropolitan Conservation Alliance, Wildlife Conservation Society, Bronx, NY. 57 p.

Carroll, T.E. and D.H. Ehrenfeld. 1978. Intermediate-range homing in the wood turtle, *Clemmys insculpta*. Copeia 978:117-126.

Crocoll, S.T. 1994. Red-shouldered hawk (*Buteo lineatus*). In A. Poole and F. Gill, eds. The Birds of North America, No. 107. Academy of Natural Sciences, Philadelphia, and American Ornithologists' Union, Washington, DC.

Crum, H. 1988. A focus on peatlands and peat mosses. University of Michigan Press, Ann Arbor. 306 p.

Davies, K.F., C. Gascon, and C. Margules. 2001. Habitat fragmentation: Consequences, management, and future research priorities. P. 81-98 in M.E. Soule and G.H. Orians, eds., Conservation Biology: Research Priorities for the Next Decade. Island Press, Washington, DC.

DeOrsey, S. and B.A. Butler. 2006. The birds of Dutchess County, New York. Grinnell and Lawton Publishing, Millbrook, NY.

Drexler, J.Z. and B.L. Bedford. 2002. Pathways of nutrient loading and impacts on plant diversity in a New York peatland. Wetlands 22:263-281.

Eckler, J.T. and A.R. Breisch. 1990. Radio telemetry techniques applied to the bog turtle (*Clemmys muhlenbergii* Schoepff 1801). P. 70 in R.S. Mitchell, C. J. Sheviak, and D. J. Leopold, eds., Ecosystem Management: Rare Species and Significant Habitats. New York State Museum Bulletin No. 471. Albany.

Edinger, G.J., D.J. Evans, S. Gebauer, T.G. Howard, D.M. Hunt, and A.M. Olivero (eds). 2002. Ecological Communities of New York State. Second Edition. A revised and expanded edition of Reschke (1990) (Draft for review). New York Natural Heritage Program, New York State Department of Environmental Conservation, Albany, NY.

Environmental Laboratory. 1987. Corps of Engineers wetland delineation manual. Waterways Experiment Station, Corps of Engineers, Vicksburg, MS. 100 p. + appendices.

Environmental Law Institute. 2003. Conservation thresholds for land use planners. Environmental Law Institute, Washington, D.C. 55 p.

Environmental Systems Research Institute, Inc. 2006. ArcView 9.2 GIS software. Redlands, CA.

Faber, M. 2002. Soil survey of Dutchess County, New York. USDA, Natural Resources Conservation Service, in cooperation with Cornell University Agricultural Experiment Station. 356 p. + maps.

Fahrig, L., J.H. Pedlar, S.E. Pope, P.D. Taylor, and J.F. Wegner. 1995. Effect of road traffic on amphibian density. Biological Conservation 73: 177-182.

Findlay, C.S. and J. Bourdages. 2000. Response time of wetland biodiversity to road construction on adjacent lands. Conservation Biology 14(1):86-94.

Fisher, D.W., Y.W. Isachsen, and L.V. Rickard. 1970. Geologic map of New York (Lower Hudson Sheet). Map and Chart Series 15. 1:250,000, 100 ft. contour. New York State Museum and Science Service, Albany.

Forman, R.T.T. and R.D. Deblinger. 2000. The ecological road-effect zone of a Massachusetts (U.S.A.) suburban highway. Conservation Biology 14(1):36-46.

Foscarini, D.A. and R.J. Brooks. 1997. A proposal to standardize data collection and implications for management of the wood turtle, *Clemmys insculpta*, and other freshwater turtles in Ontario, Canada. In J. Van Abbema, ed., Proceedings: Conservation, Restoration, and Management of Tortoises and Turtles-An International Conference. New York Turtle and Tortoise Society and the WCS Turtle Recovery Program. New York, NY.

Fowle, S.C. 2001. Priority sites and proposed reserve boundaries for protection of rare herpetofauna in Massachusetts. Report to the Massachusetts Department of Environmental Protection. Westborough, MA. 107 p.

Freemark, K. and B. Collins. 1992. Landscape ecology of birds breeding in temperate forest fragments. P. 443-454 in J.M. Hagan, III, and D.W. Johnston, eds., Ecology and Conservation of Neotropical Migrant Landbirds. Smithsonian Institute Press, Washington, DC. Original not seen; cited in Whitehead and Taylor 2002.

Gibbons, J.W. 2003. Terrestrial habitat: A vital component for herpetofauna of isolated wetlands. Wetlands 23(3):630-635.

Godin, A.J. 1977. Wild mammals of New England. Johns Hopkins University Press, Baltimore, MD. 304 p.

Gremaud, P. 1977. The ecology of the invertebrates of three Hudson Valley brooklets. Senior Project, Bard College, Annandale, NY. 61 p.

Harding, J.H. and T.J. Bloomer. 1979. The wood turtle (*Clemmys insculpta*): A natural history. Bulletin of the New York Herpetological Society 15(1):9-26.

Heady, L.T. and E. Kiviat. 2000. Grass carp and aquatic weeds: Treating the symptom instead of the cause. News from Hudsonia 15(1):1-3.

Hill, N.P. and J.M. Hagan. 1991. Population trends of some North Eastern North American landbirds: A half-century of data. Wilson Bulletin 103(2):165-182.

Holthuijzen, A.M.A. and T.L. Sharik. 1984. Seed longevity and mechanisms of regeneration of eastern red cedar (*Juniperus virginiana* L.). Bulletin of the Torrey Botanical Club 111(2):153-158.

Hubbard, J.P. 1977. Importance of riparian ecosystems: Biotic considerations. In R.R. Johnson and D.A. Jones, eds., Importance, Preservation and Management of Riparian Habitat: A Symposium. USDA Forest Service General Technical Report RM-43.

Joyal, L.A., M. McCollough, and M.L. Hunter, Jr. 2001. Landscape ecology approaches to wetland species conservation: A case study of two turtle species in southern Maine. Conservation Biology 15:1755-1762.

Kaufmann, J.H. 1992. Habitat use by wood turtles in central Pennsylvania. Journal of Herpetology. 26(3):315-321.

Kiviat, E. 1988. Significant habitats of the Town of Dover, Dutchess County, New York. Report to the Town of Dover Planning Board. Hudsonia Ltd., Annandale, NY. 46 p.

Kiviat, E. and G. Stevens. 2001. Biodiversity assessment manual for the Hudson River estuary corridor. New York State Department of Environmental Conservation, Albany. 508 p.

Klemens, M.W. 1993. Amphibians and reptiles of Connecticut and adjacent regions. State Geological and Natural History Survey of Connecticut, Bulletin 112, Hartford, CT.

Klemens, M.W. 2001. Bog turtle conservation zones. Appendix A in Bog turtle (*Clemmys muhlenbergii*) Northern Population Recovery Plan. U.S. Fish and Wildlife Service. Hadley, MA. 103 p.

Kulzer, L., S. Luchessa, S. Cooke, R. Errington, F. Weinmann. 2001. Characteristics of low-elevation *Sphagnum*-dominated peatlands of western Washington: a community profile. Part 1. Appendix A. Department of Natural Resources and Parks, Seattle.

Lampila, P., M. Monkkonen, and A. Desrochers. 2005. Demographic responses by birds to forest fragmentation. Conservation Biology 19(5):1537-1546.

Lehtinen, R.M., S.M. Galatowitsch, and J.R. Tester. 1999. Consequences of habitat loss and fragmentation for wetland amphibian assemblages. Wetlands 19:1-12.

Lowe, W.H. and G.E. Likens. 2005. Moving headwater streams to the head of the class. BioScience 55(3):196-197.

Madison, D.M. 1997. The emigration of radio-implanted spotted salamanders, *Ambystoma maculatum*. Journal of Herpetology 31:542-552.

Marchand, M.N. and J.A. Litvaitis. 2004. Effects of habitat features and landscape composition on the population structure of a common aquatic turtle in a region undergoing rapid development. Conservation Biology 18(3):758-767.

McCormick, J.F. 1978. An initiative for preservation and management of wetland habitat. Office of Biological Services, U.S. Fish and Wildlife Service. 25 p.

Merritt, J.F. 1987. Guide to mammals of Pennsylvania. University of Pittsburgh Press, Pittsburgh. 408 p.

Metropolitan Conservation Alliance. 2002. Conservation overlay district: A model local law. Technical Paper Series, No. 3. Wildlife Conservation Society, Bronx, NY. 46 p.

Milam, J.C. and S.M. Melvin. 2001. Density, habitat use, movements, and conservation of spotted turtles (*Clemmys guttata*) in Massachusetts. Journal of Herpetology 35(3):418-427.

Mitchell, R.S. and G.C. Tucker. 1997. Revised checklist of New York State plants. Bulletin No. 490, New York State Museum, Albany. 400 p.

Moore, P.D. 2002. The future of cool temperate bogs. Environmental Conservation 29(1): 3-20.

Murcia, C. 1995. Edge effects in fragmented forests: Implications for conservation. Trends in Ecology and Evolution 10:58-62.

NYS DEC and New York State Department of State. 2004. Local open space planning guide. Albany. 64 p.

NYS DEC. 2005. New York State comprehensive wildlife conservation strategy: A strategy for conserving New York's fish and wildlife resources. New York State Department of Environmental Conservation, Albany. 573 p.

Panno, S.V., V.A. Nuzzo, K. Cartwright, B.R. Hensel, and I.G. Krapac. 1999. Impact of urban development on the chemical composition of ground water in a fen-wetland complex. Wetlands 19:236-245.

Parsons, T. and G. Lovett. 1993. Effects of land use on the chemistry of Hudson River tributaries. In J.R. Waldman and E.A. Blair, eds., Final Reports of the Tibor T. Polgar Fellowship Program, 1991. Hudson River Foundation, New York.

Penhollow, M.E., P.G. Jensen, and L.A. Zucker. 2006. Wildlife and habitat conservation framework: An approach for conserving biodiversity in the Hudson River Estuary Corridor. New York Cooperative Fish and Wildlife Research Unit, Cornell University and New York State Department of Environmental Conservation, Hudson River Estuary Program, Ithaca, NY. 139 p.

Rich, T.D., C.J. Beardmore, H. Berlanga, P.J. Blancher, M.S.W. Bradstreet, G.S. Butcher, D.W. Demarest, E.H. Dunn, W.C. Hunter, E.E. Inigo-Elias, J.A. Kennedy, A.M. Martell, A.O. Panjabi, D.N. Pashley, K.V. Rosenberg, C.M. Rustay, J.S. Wendt, and T.C. Will. 2004. Partners in Flight North American landbird conservation plan. Cornell Lab of Ornithology, Ithaca, NY.

Richburg, J.A., W.A. Patterson III, and F. Lowenstein. 2001. Effects of road salt and *Phragmites australis* invasion on the vegetation of a western Massachusetts calcareous lake-basin fen. Wetlands 21:247-255.

Robbins, C.S. 1979. Effect of forest fragmentation on bird populations. P. 198-212 in R.M. DeGraaf and K.E. Evans, eds., Management of North-Central and North Eastern Forests for Nongame Birds, General Technical Report NC-51, USDA Forest Service, North Central Forest Experimental Station, St. Paul, MN.

Robbins, C.S. 1980. Effect of forest fragmentation on breeding bird populations in the Piedmont of the Mid-Atlantic region. Atlantic Naturalist 33:31-36.

Robbins, C.S, D.K. Dawson, and B.A. Dowell. 1989. Habitat area requirements of breeding forest birds of the middle Atlantic states. Wildlife Monographs 103:1-34.

Robinson, S.K. F.R. Thompson, III, T.M. Donovan, D.R. Whitehead, and J. Faaborg. 1995. Regional forest fragmentation and the nesting success of migratory birds. Science 267:1987-1990.

Rosenberg, K.V., R.W. Rohrbaugh, Jr., S.E. Barker, R.S. Hames, J.D. Lowe, and A.A. Dhondt. 1999. A land manager's guide to improving habitat for scarlet tanagers and other forest-interior birds. The Cornell Lab of Ornithology, Ithaca, NY.

Rosenberg, K.V., R.S. Hames, R.W. Rohrbaugh, Jr., S.B. Swarthout, J.D. Lowe, and A.A. Dhondt. 2003. A land manager's guide to improving habitat for forest thrushes. The Cornell Lab of Ornithology, Ithaca, NY.

Rothermel, B.B. and R.D. Semlitsch. 2002. An experimental investigation of landscape resistance of forest versus old-field habitats to emigrating juvenile amphibians. Conservation Biology 16(5):1324-1332.

Roy, K.M., E.B. Allen, J.W. Barge, J.A. Ross, R.P. Curran, D.J. Bogucki, D.A. Franzi, W.A. Kretser, M.M. Frank, D.M. Spada, J.S. Banta. 1997. Peatlands as critical wetlands. Section III *in* Influences on Wetlands and Lakes in the Adirondack Park of New York State: A Catalog of Existing and New GIS Data Layers for the 400,000 hectare Oswegatchie/Black River Watershed. Report to State Wetlands Protection Program, US Environmental Protection Agency, Grant No. CD 992087-01. New York State Adirondack Park Agency, State University of New York at Plattsburgh, Adirondack Lakes Survey Corporation.

Saunders, D.L., J.J. Meeuwig, and A.C.J. Vincent. 2002. Freshwater protected areas: Strategies for conservation. Conservation Biology 16(1):30-41.

Semlitsch, R.D. 1998. Biological delineation of terrestrial buffer zones for pond-breeding salamanders. Conservation Biology 12:1112-1119.

Semlitsch, R.D. 2000. Size does matter: The value of small isolated wetlands. National Wetlands Newsletter 22(1):5-6,13.

Semlitsch, R.D. and J.R. Bodie. 1998. Are small, isolated wetlands expendable? Conservation Biology 12(5): 1129-1133.

Singler, A. and B. Graber, eds. 2005. Massachusetts stream crossings handbook. Massachusetts Riverways Program, Massachusetts Department of Fish and Game, Boston, MA. 11 p.

Smith, D.G. 1988. Keys to the freshwater macroinvertebrates of Massachusetts (No. 3): Crustacea Malacostraca (crayfish, isopods, amphipods). Report to Massachusetts Division of Water Pollution Control, Executive Office of Environmental Affairs, Department of Environmental Quality Engineering, and Division of Water Pollution Control.

Stevens, G. and E. Broadbent. 2002. Significant habitats of the Town of East Fishkill, Dutchess County, New York. Report to the Marilyn Milton Simpson Charitable Trusts, and the Town of East Fishkill. Hudsonia Ltd., Annandale, NY. 56 p.

Sullivan, J. and G. Stevens. 2005. Significant habitats in the Fishkill and Sprout Creek corridors, towns of Beekman, LaGrange, and Fishkill, Dutchess County, New York. Report to the New York State Department of Environmental Conservation, the Town of Beekman, the Town of LaGrange, the Town of Fishkill, and the City of Beacon. Hudsonia Ltd., Annandale, NY. 164 p.

Tabak, N., K. Bell, and G. Stevens. 2006. Significant habitats in the Town of Amenia, Dutchess County, New York. Report to the Town of Amenia, the Dyson Foundation, and the Dutchess Land Conservancy. Hudsonia Ltd., Annandale, NY. 133 p.

Talmage, E. and E. Kiviat. 2004. Japanese knotweed and water quality on the Batavia Kill in Greene County, New York: Background information and literature review. Report to the Greene County Soil and Water Conservation District and the New York City Department of Environmental Protection. Hudsonia Ltd., Annandale, NY. 27 p.

Tollefson, J. and G. Stevens. 2004. Significant habitats in the Town of Washington, Dutchess County, New York. Report to the Millbrook Tribute Garden, the Dyson Foundation, the Town of Washington, and the Dutchess Land Conservancy. Hudsonia Ltd., Annandale, NY. 89 p.

Trombulak, S.C. and C.A. Frissell. 2000. Review of ecological effects of roads on terrestrial and aquatic communities. Conservation Biology 14(1):18-30.

Vickery, P.D, M.L. Hunter, Jr., and S.M. Melvin. 1994. Effects of habitat area on the distribution of grassland birds in Maine. Conservation Biology 8(4):1087-1097.

Whitehead, D.R. and T. Taylor. 2002. Acadian flycatcher (*Empidonax virescens*). The Birds of North America 614.

Wiens, J.A. 1969. An approach to the study of ecological relationships among grassland birds. Ornithological Monographs 8. 93 p.

Wilcove, D.S. 1985. Nest predation in forest tracts and the decline of migratory songbirds. Ecology 66(4):1211-1214.

Zedler, P.H. 2003. Vernal pools and the concept of "isolated wetlands." Wetlands 23(3):597-607.

APPENDICES

Appendix A. Mapping conventions used to draw boundaries between habitat types, and additional information on defining habitat types.

Crest, ledge, and talus. Because crest, ledge, and talus habitats are usually embedded within other habitat types (most commonly upland forest), they were depicted as an overlay on the base habitat map. Except for the most exposed ledges, these habitats do not have distinct signatures on aerial photographs and were therefore mapped based on a combination of field observations and locations of potential bedrock exposures inferred from the mapped locations of shallow soils (<20 inches [50 cm]) on steep (>15%) slopes in Faber (2002). The final overlay of crest, ledge, and talus habitats is therefore an approximation; we expect that there are additional bedrock exposures outside the mapped areas. The precise locations and boundaries of these habitats should be determined in the field as needed. The distinction between calcareous and non-calcareous crest, ledge, and talus habitats can only be made in the field. The areas that appear on the map as calcareous crest, ledge and talus were extrapolated from the locations of calcareous outcrops observed in the field. Marble knolls can be considered a special subset of calcareous crest or ledge, and their locations are marked with stars on the map. All other areas of exposed bedrock (both non-calcareous and unknown bedrock) were mapped simply as crest, ledge, and talus.

Cultural. Very large lawns were typically mapped as "cultural" habitats. It was sometimes difficult to distinguish extensive lawns from upland meadows using aerial photos, so in the absence of field verification some lawns may have been mapped as upland meadow.

Developed areas. Habitats surrounded by or intruding into developed land were mapped only if their dimensions exceeded 50 m (165 ft) in all directions, or if they seemed to provide important connections to other large habitat areas. Exceptions to this protocol were wetlands within developed areas, which we mapped if they were identifiable on the aerial photographs or if we observed them in the field. Even though such wetlands may lack many of the habitat values of wetlands in more natural settings, they still may serve as important drought refuges for rare species and other species of conservation concern. Lawns near buildings and roads were mapped as developed; lawns not adjacent to buildings, and adjacent to significant habitats, were mapped as "cultural" habitats.

Intermittent woodland pools. Intermittent woodland pools are best identified in the spring when the pools are full of water and occupied by invertebrates and breeding amphibians. The presence of fairy shrimp is often a good indicator that the standing water is intermittent. For those intermittent woodland pools we visited in late summer and fall, we relied on general physical features of the site to distinguish them from isolated swamps. We classified those wetlands with an open basin as intermittent woodland pools and those dominated by trees or shrubs as swamps, but they often serve similar ecological functions. Many intermittent woodland pools can also be mapped remotely since they have a distinct signature on aerial photographs, and are readily visible within areas of deciduous forest if the photographs are taken in a leaf-off season. Intermittent woodland pools located within areas of conifer forest, however,

are not easily identified on aerial photographs, and we may have missed some of these in areas we were unable to visit.

Open water and constructed ponds. Most bodies of open water in North East were probably created by damming or excavation, so most were mapped as constructed ponds. Those that we mapped as "open water" habitats included natural ponds, substantially unvegetated pools within marshes and swamps, and ponds that were probably constructed but are now surrounded by unmanaged vegetation.

Orchard/Plantation. Christmas tree plantations with young trees were included in this category (rather than in upland conifer forest).

Springs & seeps. Springs and seeps are difficult to identify by remote sensing. We mapped only the very few we happened to see in the field and those that were either identified on soils maps or have an identifiable signature on topographic maps. We expect there were many more springs and seeps in the Town of North East that we did not map. The precise locations and boundaries of seeps and springs should be determined in the field on a site-by-site basis.

Streams. We created a stream map in our GIS that was based on field observations and interpretation of topographic maps and aerial photographs. We depicted streams as continuous where they flowed through ponds, impoundments, or large wetlands. We expect there were additional intermittent streams that we did not map, and we recommend these be added to the database as information becomes available. Because it was often difficult to distinguish between perennial and intermittent streams based on aerial photograph and map interpretation, these distinctions were made using our best judgment. Streams that were channelized or diverted by humans (i.e., ditches) were mapped when observed in the field or on aerial photos; we used the "stream" habitat for ditches because they function as such from a hydrological perspective. We mapped extensive sand and gravel bars in streams as a separate habitat.

Subcategories. In some places we identified habitats to a more specific category than the mapped habitat type. These included marble knolls as a type of red cedar woodland, upland shrubland, and upland meadows (usually within an area of calcareous crest), cinquefoil shrublands as a type of upland shrubland, and heath swamp and kettle shrub pools as types of hardwood and shrub swamp. These more specific habitats are denoted with stars on the map. These distinctions can generally only be made by visiting sites, so there were likely more of these specific habitats in North East that are not shown on the map.

Upland forests. We mapped just three types of upland forests: hardwood, mixed, and conifer forest. Although these forests are extremely variable in their species composition, size and age of trees, vegetation structure, soil drainage and texture, and other factors, we used these broad categories for practical reasons. Deciduous and coniferous trees are generally distinguishable in aerial photos taken in the spring, although dead conifers can be mistaken for deciduous trees. Different forest communities and ages are not easily distinguished on aerial photographs, however, and we could not consistently and accurately separate forests according to dominant tree species or size of overstory trees. Our "upland forest" type therefore includes non-wetland forests of all ages, at all elevations, and of all species mixtures. Gravel and dirt roads (where

identifiable) were used to delineate boundaries of adjacent forested habitat areas, since they can be significant fragmenting features.

Upland meadows and upland shrubland. We mapped upland meadows divided by fences and hedgerows as separate polygons, to the extent that these features were visible on the aerial photographs. Because upland meadows often have a substantial shrub component, the distinction between upland meadows and upland shrubland habitats is somewhat arbitrary. We defined upland shrubland habitats as those with widely distributed shrubs that accounted for more than 20% of the cover.

Wetlands. We mapped wetlands remotely using topographic maps, soils data, and aerial photographs. In the field, we identified wetlands primarily by the predominance of hydrophytic vegetation and easily visible indicators of surface hydrology (Environmental Laboratory 1987). We did not examine soil profiles. Along stream corridors and in other low-lying areas with somewhat poorly-drained soils, it was often difficult to distinguish between upland forest and hardwood swamp without the benefit of onsite soil data. On the ground, these areas were characterized by moist, fine-textured soils with common upland trees in the canopy, often dense thickets of vines and shrubs (e.g., Japanese barberry, Eurasian honeysuckle) in the understory, and facultative wetland and upland species of shrubs, forbs, and graminoids. In most cases, we mapped these areas as upland forest. Because we did not examine soil profiles in the field, all wetland boundaries on the habitat map should be treated as approximations, and should not be used for jurisdictional determinations. Wherever the actual locations of wetland boundaries are needed to determine jurisdictional limits, the boundaries must be identified in the field by a wetland scientist and mapped by a land surveyor.

Appendix B. Species of conservation concern potentially associated with habitats in the Town of North East. These are not comprehensive lists, but merely a sample of the species of conservation concern known to use these habitats in the region. The letter codes given with each species name denote its conservation status. Codes include **New York State ranks** (E, T, R, SC), **NY Natural Heritage Program ranks** (S1, S2, S3), **NYS DEC Species of Greatest Conservation Need** (SGCN) and **Hudsonia's regional ranks** (RG). For birds, we also indicate those species listed by **Partners in Flight** as **high conservation priorities** at the continental (PIF1) and regional (PIF2) level. These ranks are explained in Appendix C.

UPLAND HARDWOOD FOREST

Plants	***Vertebrates (cont.)***	***Vertebrates (cont.)***
silvery spleenwort (RG)	eastern racer (SGCN)	Kentucky warbler (S2, RG, PIF1, SGCN)
American ginseng (RG)	eastern ratsnake (SGCN)	black-and-white warbler (PIF2)
red baneberry (RG)	northern goshawk (SC, S3N, SGCN)	black-throated blue warbler (RG, SGCN)
blue cohosh (RG)	red-shouldered hawk (SC, SGCN)	black-throated green warbler (RG)
poke milkweed (RG)	Cooper's hawk (SC, SGCN)	worm-eating warbler (RG, SGCN)
lopseed (RG)	sharp-shinned hawk (SC, SGCN)	hooded warbler (RG)
leatherwood (RG)	broad-winged hawk (RG)	ovenbird (RG)
hackberry (RG)	American woodcock (RG, PIF1, SGCN)	ruffed grouse (SGCN)
Vertebrates	barred owl (RG)	whip-poor-will (SC, PIF2, SGCN)
wood frog (RG)	eastern wood-pewee (RG, PIF2)	southern bog lemming (RG)
spotted salamander (RG)	Acadian flycatcher (S3)	Indiana bat (E, S1, SGCN)
Jefferson salamander (SC, SGCN)	wood thrush (RG, PIF1, SGCN)	black bear (RG)
blue-spotted salamander (SC, SGCN)	scarlet tanager (PIF2, SGCN)	bobcat (RG)
marbled salamander (SC, S3, SGCN)	cerulean warbler (SC, PIF1, SGCN)	New England cottontail (SC, S1S2, SGCN)
eastern box turtle (SC, S3, SGCN)	Canada warbler (RG, PIF1, SGCN)	fisher (RG)

UPLAND CONIFER FOREST

Plants	***Vertebrates (cont.)***	***Vertebrates (cont.)***
pinesap (RG)	American woodcock (RG, PIF1, SGCN)	Blackburnian warbler (RG, PIF2)
Vertebrates	long-eared owl (S3, SGCN)	pine siskin (RG)
blue-spotted salamander (SC, SGCN)	short-eared owl (E, S2, PIF1, SGCN)	red-breasted nuthatch (RG)
Cooper's hawk (SC, SGCN)	barred owl (RG)	evening grosbeak (RG)
sharp-shinned hawk (SC, SGCN)	black-throated green warbler (RG)	purple finch (PIF2)

COOL RAVINE

Plants	***Plants (cont.)***	***Vertebrates (cont.)***
purple cliffbrake (RG)	hobblebush (RG)	winter wren (RG)
walking fern (RG)	mountain maple (RG)	black-throated green warbler (RG)
plantain sedge (RG)	leatherwood (RG)	Blackburnian warbler (RG, PIF2)
spikenard (RG)	American yew (RG)	Louisiana waterthrush (PIF2, SGCN)
American ginseng (RG)	***Vertebrates***	dark-eyed junco (RG)
bunchberry (RG)	Acadian flycatcher (S3)	woodland jumping mouse (RG)
fly honeysuckle (RG)	blue-headed vireo (RG)	

RED CEDAR WOODLAND

Plants	***Vertebrates***	***Vertebrates (cont.)***
Carolina whitlow-grass (T, S2)	spotted turtle (SC, S3, SGCN)	eastern bluebird (RG)
yellow wild flax (T, S2)	wood turtle (SC, S3, SGCN)	eastern towhee (PIF2)
Bicknell's sedge (T, S3)	eastern box turtle (SC, S3, SGCN)	brown thrasher (PIF2, SGCN)
Indian grass (RG)	eastern hognose snake (SC, S3, SGCN)	golden-winged warbler (SC, PIF1, SGCN)
Invertebrates	northern harrier (T, S3B, S3N, SGCN)	blue-winged warbler (PIF1, SGCN)
olive hairstreak (butterfly) (RG)	northern saw-whet owl (S3)	black-billed cuckoo (SGCN)
	long-eared owl (S3, SGCN)	whip-poor-will (SC, PIF2, SGCN)
	short-eared owl (E, S2, PIF1, SGCN)	ruffed grouse (SGCN)

NON-CALCAREOUS CREST/LEDGE/TALUS

Plants
mountain spleenwort (T, S2S3)
Bicknell's sedge (T, S3)
bronze sedge (RG)
clustered sedge (T, S2S3)
reflexed sedge (E, S2S3)
whorled milkweed (RG)
blunt-leaf milkweed (RG)
whorled milkwort (RG)
rock sandwort (RG)
goat's-rue (RG)
slender knotweed (R, S3)
dittany (RG)
Torrey's mountain-mint (E, S1)
Allegheny-vine (RG)
bearberry (RG)
three-toothed cinquefoil (RG)
stiff-leaf aster (RG)

Invertebrates
Edward's hairstreak (butterfly) (S3S4)
striped hairstreak (butterfly) (RG)
brown elfin (butterfly) (RG)
olive hairstreak (butterfly) (RG)
northern hairstreak (butterfly) (S1S3, SGCN)
gray hairstreak (butterfly) (RG)
Horace's duskywing (butterfly) (RG)
swarthy skipper (butterfly) (RG)
Leonard's skipper (butterfly) (RG)
cobweb skipper (butterfly) (RG)
dusted skipper (butterfly) (S3)

Vertebrates
Fowler's toad (RG, SGCN)
northern slimy salamander (RG)
marbled salamander (SC, S3, SGCN)
eastern box turtle (SC, S3, SGCN)
eastern ratsnake (SGCN)
eastern racer (SGCN)

Vertebrates (cont.)
eastern hognose snake (SC, S3, SGCN)
eastern wormsnake (SC, S2, SGCN)
copperhead (S3, SGCN)
timber rattlesnake (T, S3, SGCN)
turkey vulture (RG)
golden eagle (E, SHB, S1N, SGCN)
whip-poor-will (SC, PIF2, SGCN)
common raven (RG)
winter wren (RG)
eastern bluebird (RG)
hermit thrush (RG)
Blackburnian warbler (RG, PIF2)
cerulean warbler (SC, PIF1, SGCN)
worm-eating warbler (RG, PIF1, SGCN)
small-footed bat (SC, S2, SGCN)
boreal redback vole (RG)
porcupine (RG)
fisher (RG)
bobcat (RG)

CALCAREOUS CREST/LEDGE/TALUS

Plants
purple cliffbrake (RG)
walking fern (RG)
smooth cliffbrake (T, S2)
wall-rue (RG)
side-oats grama (E, S1)
Emmons' sedge (S3)
Bicknell's sedge (T, S3)
yellow wild flax (T, S2)

Plants (cont.)
Carolina whitlow-grass (T, S2)
hairy rock-cress (RG)
yellow harlequin (S3)
Dutchman's breeches (RG)
pellitory (RG)
northern blazing-star (T, S2)
small-flowered crowfoot (T, S3)
roundleaf dogwood (RG)

Invertebrates
anise millipede (RG)
olive hairstreak (butterfly) (RG)

Vertebrates
eastern hognose snake (SC, S3, SGCN)
eastern racer (SGCN)
eastern ratsnake (SGCN)
copperhead (S3, SGCN)

OAK-HEATH BARREN

Plants
bronze sedge (RG)
clustered sedge (T, S2S3)
bearberry (RG)
three-toothed cinquefoil (RG)
dwarf shadbush (RG)
rusty woodsia (RG)

Invertebrates
brown elfin (butterfly) (RG)

Invertebrates (cont.)
cobweb skipper (butterfly) (RG)
Leonard's skipper (butterfly) (RG)
Edward's hairstreak (butterfly) (S3S4)

Vertebrates
copperhead (S3, SGCN)
timber rattlesnake (T, S3, SGCN)
turkey vulture (RG)
golden eagle (E, SHB, S1N, SGCN)

Vertebrates (cont.)
whip-poor-will (SC, PIF2, SGCN)
common raven (RG)
hermit thrush (RG)
Nashville warbler (RG)
prairie warbler (PIF1, SGCN)
eastern towhee (PIF2)
field sparrow (PIF2)
vesper sparrow (SC, SGCN)

MARBLE KNOLL

Plants
purple cliffbrake (RG)
walking fern (RG)
side-oats grama (E, S1)
Indian grass (RG)
Bicknell's sedge (T, S3)
Virginia false gromwell (E, S1)

Plants (cont.)
Carolina whitlow-grass (T, S2)
yellow wild flax (T, S2)
green milkweed (T, S2)
northern blazing star (T, S2)
large twayblade (E, S1)
Torrey's mountain mint (E, S1)

Vertebrates
Fowler's toad (RG, SGCN)
eastern box turtle (SC, S3, SGCN)
eastern hognose snake (SC, S3, SGCN)
eastern wormsnake (SC, S2, SGCN)
northern saw-whet owl (S3)

UPLAND SHRUBLAND

Plants
stiff-leaf goldenrod (RG)
shrubby St. Johnswort (T, S2)
butterflyweed (RG)

Invertebrates
Aphrodite fritillary (butterfly) (RG)
dusted skipper (butterfly) (S3)

Invertebrates (cont.)
cobweb skipper (butterfly) (RG)

Vertebrates
wood frog (RG)
spotted turtle (SC, S3, SGCN)
eastern box turtle (SC, S3, SGCN)
wood turtle (SC, S3, SGCN)

Vertebrates (cont.)
short-eared owl (E, S2, PIF1, SGCN)
northern saw-whet owl (S3)
loggerhead shrike (E, S1B, SGCN)
whip-poor-will (SC, PIF2, SGCN)
black-billed cuckoo (SGCN)
ruffed grouse (SGCN)

UPLAND SHRUBLAND (cont.)

Invertebrates (cont.)	*Vertebrates (cont.)*	*Vertebrates (cont.)*
Leonard's skipper (butterfly) (RG)	blue-winged warbler (PIF1, SGCN)	white-eyed vireo (RG)
eastern towhee (PIF2)	golden-winged warbler (SC, PIF1, SGCN)	willow flycatcher (SGCN)
brown thrasher (PIF2, SGCN)	grasshopper sparrow (SC, PIF2, SGCN)	clay-colored sparrow (S2)
prairie warbler (PIF1, SGCN)	Henslow's sparrow (T, S3B, PIF1, SGCN)	vesper sparrow (SC, SGCN)
yellow-breasted chat (SC, S3, SGCN)	northern harrier (T, S3B, S3N, SGCN)	field sparrow (PIF2)
		New England cottontail (SC, S1S2, SGCN)

UPLAND MEADOW

Plants	*Vertebrates*	*Vertebrates (cont.)*
small-flowered agrimony (S3)	spotted turtle (SC, S3, SGCN)	eastern bluebird (RG)
Bush's sedge (S3)	eastern box turtle (SC, S3, SGCN)	savannah sparrow (RG)
Invertebrates	wood turtle (SC, S3, SGCN)	vesper sparrow (SC, SGCN)
Aphrodite fritillary (butterfly) (RG)	northern harrier (T, S3B, S3N, SGCN)	grasshopper sparrow (SC, PIF2, SGCN)
dusted skipper (butterfly) (S3)	upland sandpiper (T, S3B, PIF1, SGCN)	Henslow's sparrow (T, S3B, PIF1, SGCN)
Leonard's skipper (butterfly) (RG)	sedge wren (T, S3B, PIF2, SGCN)	bobolink (RG, SGCN)
swarthy skipper (butterfly) (RG)		eastern meadowlark (RG, SGCN)

WASTE GROUND

Plants	*Plants (cont.)*	*Vertebrates (cont.)*
hair-rush (RG)	slender knotweed (R, S3)	American black duck (RG, PIF1, SGCN)
toad rush (RG)	*Vertebrates*	common raven (RG)
orangeweed (RG)	Fowler's toad (RG, SGCN)	grasshopper sparrow (SC, PIF2, SGCN)
field-dodder (S3)	spotted turtle (SC, S3, SGCN)	Henslow's sparrow (T, S3B, PIF1, SGCN)
slender pinweed (T, S2)	wood turtle (SC, S3, SGCN)	bank swallow (RG)
rattlebox (E, S1)	eastern hognose snake (SC, S3, SGCN)	common nighthawk (SC, SGCN)
blunt mountain-mint (T, S2S3)	copperhead (S3, SGCN)	

SWAMP

Plants	*Vertebrates*	*Vertebrates (cont.)*
swamp cottonwood (T, S2)	blue-spotted salamander (SC, SGCN)	red-shouldered hawk (SC, SGCN)
swamp lousewort (T, S2)	four-toed salamander (RG, SGCN)	American woodcock (RG, PIF1, SGCN)
winged monkey-flower (R, S3)	spotted turtle (SC, S3, SGCN)	barred owl (RG)
ostrich fern (RG)	wood turtle (SC, S3, SGCN)	white-eyed vireo (RG)
wood horsetail (RG)	eastern box turtle (SC, S3, SGCN)	willow flycatcher (SGCN)
false hop sedge (R, S2)	great blue heron (RG)	eastern bluebird (RG)
Invertebrates	wood duck (RG, PIF2)	prothonotary warbler (S2, PIF1, SGCN)
phantom cranefly (RG)	Virginia rail (RG)	Canada warbler (RG, PIF1, SGCN)
	American bittern (SC, SGCN)	northern waterthrush (RG)

MARSH

Plants	*Vertebrates (cont.)*	*Vertebrates (cont.)*
winged monkey-flower (R, S3)	American bittern (SC, SGCN)	Virginia rail (RG)
buttonbush dodder (E, S1)	least bittern (T, S3B, S1N, SGCN)	sora (RG)
spiny coontail (T, S3)	great blue heron (RG)	common moorhen (RG)
Vertebrates	wood duck (RG, PIF2)	marsh wren (RG)
northern cricket frog (E, S1, SGCN)	American black duck (RG, PIF1, SGCN)	northern harrier (T, S3B, S3N, SGCN)
northern leopard frog (RG)	king rail (T, S1B, PIF1, SGCN)	pied-billed grebe (T, S3B, S1N, SGCN)
spotted turtle (SC, S3, SGCN)		

WET MEADOW

Invertebrates	*Invertebrates (cont.)*	*Vertebrates (cont.)*
mulberry wing (butterfly) (RG)	Milbert's tortoiseshell (butterfly) (RG)	American bittern (SC, SGCN)
black dash (butterfly) (RG)	phantom cranefly (RG)	Virginia rail (RG)
two-spotted skipper (butterfly) (RG)	*Vertebrates*	American woodcock (RG, PIF1, SGCN)
meadow fritillary (butterfly) (RG)	eastern ribbonsnake (RG, SGCN)	sedge wren (T, S3B, PIF2, SGCN)
bronze copper (butterfly) (RG)	spotted turtle (SC, S3, SGCN)	Henslow's sparrow (T, S3B, PIF1, SGCN)
eyed brown (butterfly) (RG)	northern harrier (T, S3B, S3N, SGCN)	southern bog lemming (RG)

FEN/CALCAREOUS WET MEADOW

Plants
wood horsetail (RG)
twig-rush (RG)
Schweinitz's sedge (T, S2S3)
handsome sedge (T, S1)
Bush's sedge (S3)
ovate spikerush (E, S1S2)
slender lady's tresses (RG)
rose pogonia (RG)
showy ladyslipper (RG)
spreading globeflower (R, S3)
scarlet Indian paintbrush (E, S1)
grass-of-Parnassus (RG)
Kalm's lobelia (RG)
bush aster (T, S2)

Plants (cont.)
fringed gentian (RG)
swamp lousewort (T, S2)
roundleaf sundew (RG)
small-flowered agrimony (S3)
bog valerian (E, S1S2)
buckbean (RG)
swamp birch (T, S2)
alder-leaf buckthorn (RG)

Invertebrates
Gammarus pseudolimnaeus (amphipod) (RG)
Pomatiopsis lapidaria (snail) (RG)
forcipate emerald (dragonfly) (S1, SGCN)
Kennedy's emerald (dragonfly) (SNA)
phantom cranefly (RG)

Invertebrates (cont.)
eyed brown (butterfly) (RG)
silver-bordered fritillary (butterfly) (RG)
two-spotted skipper (butterfly) (RG)
Dion skipper (butterfly) (S3)
Baltimore (butterfly) (RG)
mulberry wing (butterfly) (RG)
black dash (butterfly) (RG)

Vertebrates
bog turtle (E, S2, SGCN)
spotted turtle (SC, S3, SGCN)
eastern ribbonsnake (RG, SGCN)
northern harrier (T, S3B, S3N, SGCN)
sedge wren (T, S3B, PIF2, SGCN)

INTERMITTENT WOODLAND POOL

Plants
Virginia chain fern (RG)
false hop sedge (R, S2)
featherfoil (T, S2)

Invertebrates
black dash (butterfly) (RG)
mulberry wing (butterfly) (RG)

Invertebrates (cont.)
springtime physa (snail) (RG)

Vertebrates
wood frog (RG)
four-toed salamander (RG, SGCN)
Jefferson salamander (SC, SGCN)
marbled salamander (SC, S3, SGCN)

Vertebrates (cont.)
spotted salamander (RG)
spotted turtle (SC, S3, SGCN)
wood turtle (SC, S3, SGCN)
wood duck (RG, PIF2)
American black duck (RG, PIF1, SGCN)
northern waterthrush (RG)

CIRCUMNEUTRAL BOG LAKE

Plants
ovate spikerush (E, S1S2)
knotted spikerush (T, S2)
olivaceous spikerush (RG)
prairie sedge (RG)
twig-rush (RG)
floating bladderwort (T, S2)
hidden-fruit bladderwort (S3)
swollen bladderwort (E, S2)
horned bladderwort (RG)
spotted pondweed (T, S2)
water-thread pondweed (E, S1)
Hill's pondweed (T, S2)
spiny coontail (T, S3)

Plants (cont.)
Beck's water-marigold (T, S3)
rose pogonia (RG)
pipewort (RG)
roundleaf sundew (RG)
pitcher-plant (RG)
globe-fruited ludwigia (S2, T)
southern dodder (E, S1)

Vertebrates
wood frog (RG)
blue-spotted salamander (SC, SGCN)
four-toed salamander (RG, SGCN)
northern cricket frog (E, S1, SGCN)
bog turtle (E, S2, SGCN)

Vertebrates (cont.)
spotted turtle (SC, S3, SGCN)
eastern ribbonsnake (RG, SGCN)
pied-billed grebe (T, S3B, S1N, SGCN)
American bittern (SC, SGCN)
least bittern (T, S3B, S1N, SGCN)
great blue heron (RG)
wood duck (RG, PIF2)
American black duck (RG, PIF1, SGCN)
red-shouldered hawk (SC, SGCN)
sharp-shinned hawk (SC, SGCN)
king rail (T, S1B, PIF1, SGCN)
marsh wren (RG)
river otter (RG, SGCN)

ACIDIC BOG

Plants
Virginia chain fern (RG)
tussock cottongrass (RG)
pod-grass (R, S3)
dragon's mouth orchid (T, S2)
rose pogonia (RG)
grass pink orchid (RG)
white-fringed orchid (RG)
pitcher-plant (RG)
round-leaf sundew (RG)

Plants (cont.)
narrow-leaf sundew (RG)
small cranberry (RG)
large cranberry (RG)

Invertebrates
bog copper (butterfly) (RG)
pitcher plant borer (moth) (RG)
Exyra moth (RG)
subarctic darner (dragonfly) (S1, SGCN)
ebony bog haunter (dragonfly) (S1, SGCN)

Invertebrates (cont.)
ringed bog haunter (dragonfly) (SH, SGCN)

Vertebrates
wood frog (RG)
four-toed salamander (RG, SGCN)
eastern bluebird (RG)
golden-winged warbler (P, SC, PIF1, SGCN)
Nashville warbler (RG)
Canada warbler (RG, PIF1, SGCN)
northern waterthrush (RG)
southern bog lemming (RG)

OPEN WATER/CONSTRUCTED POND

Plants	***Vertebrates (cont.)***	***Vertebrates (cont.)***
spiny coontail (T, S3)	American bittern (SC, SGCN)	osprey (SC, SGCN)
Vertebrates	wood duck (RG, PIF2)	bald eagle (T, S2S3B, SGCN)
spotted turtle (SC, S3, SGCN)	American black duck (RG, PIF1, SGCN)	great blue heron (RG)
wood turtle (SC, S3, SGCN)	pied-billed grebe (T, S3B, S1N, SGCN)	river otter (RG, SGCN)
northern cricket frog (E, S1, SGCN)		

SPRING/SEEP

Plants	***Invertebrates***	***Vertebrates***
Bush's sedge (S3)	Piedmont groundwater amphipod (RG, SGCN)	northern dusky salamander (RG)
devil's-bit (T, S1S2)	gray petaltail (dragonfly) (SC, S2, SGCN)	spring salamander (RG)
	tiger spiketail (dragonfly) (S1, SGCN)	

STREAM & RIPARIAN CORRIDOR

Plants	***Invertebrates (cont.)***	***Vertebrates (cont.)***
winged monkey-flower (R, S3)	brook floater (mussel) (T, S1, SGCN)	spring salamander (RG)
riverweed (T, S2)	*Pisidium adamsi* (fingernail clam) (RG)	wood turtle (SC, S3, SGCN)
spiny coontail (T, S3)	*Sphaerium fabale* (fingernail clam) (RG)	American black duck (RG, PIF1, SGCN)
goldenseal (T, S2)	arrowhead spiketail (dragonfly) (S2S3, SGCN)	wood duck (RG, PIF2)
cattail sedge (T, S1)	mocha emerald (dragonfly) (S2S3, SGCN)	bank swallow (RG)
Davis' sedge (T, S2)	sable clubtail (dragonfly) (S1, SGCN)	great blue heron (RG)
small-flowered agrimony (S3)	ostrich fern borer (moth) (SGCN)	red-shouldered hawk (SC, SGCN)
false-mermaid (RG)	***Vertebrates***	American woodcock (RG, PIF1, SGCN)
swamp rose-mallow (RG)	creek chubsucker (fish) (RG)	cerulean warbler (SC, PIF1, SGCN)
ostrich fern (RG)	bridle shiner (fish) (RG)	winter wren (RG)
may-apple (RG)	brook trout (fish) RG, SGCN)	Louisiana waterthrush (RG, SGCN)
Invertebrates	slimy sculpin (fish) (RG)	river otter (RG, SGCN)
Marstonia decepta (snail) (RG)	northern dusky salamander (RG)	Indiana bat (E, S1, SGCN)

Appendix C. Explanation of ranks of species of conservation concern listed in Appendix B. Explanations of New York State Ranks and New York Natural Heritage Program Ranks are from the New York Natural Heritage Program website, accessed in 2007 (http://www.dec.state.ny.us/website/dfwmr/heritage/index.htm).

NEW YORK STATE RANKS

Categories of Endangered and Threatened species are defined in New York State Environmental Conservation Law section 11-0535. Endangered, Threatened, and Special Concern species are listed in regulation 6NYCRR 182.5.

ANIMALS

E **Endangered Species**. Any species which meet one of the following criteria: 1) Any native species in imminent danger of extirpation; 2) Any species listed as endangered by the US Department of the Interior, as enumerated in the Code of Federal Regulations 50 CFR 17.11.

T **Threatened Species**. Any species which meet one of the following criteria: 1) Any native species likely to become an endangered species within the foreseeable future in New York; 2) Any species listed as threatened by the US Department of the Interior, as enumerated in the Code of the Federal Regulations 50 CFR 17.11.

SC **Special Concern Species**. Those species which are not yet recognized as endangered or threatened, but for which documented concern exists for their continued welfare in New York. Unlike the first two categories, species of special concern receive no additional legal protection under Environmental Conservation Law section 11-0535 (Endangered and Threatened Species).

PLANTS

E **Endangered Species**. Listed species are those 1) with five or fewer extant sites, or 2) with fewer than 1,000 individuals, or 3) restricted to fewer than 4 USGS 7.5 minute map quadrangles, or 4) listed as endangered by the US Department of the Interior, as enumerated in the Code of the Federal Regulations 50 CFR 17.11.

T **Threatened Species**. Listed species are those 1) with 6 to fewer than 20 extant sites, or 2) with 1,000 or fewer than 3000 individuals, or 3) restricted to not less than 4 or more than 7 USGS 7.5 minute map quadrangles, or 4) listed as threatened by the US Department of the Interior, as enumerated in the Code of the Federal Regulations 50 CFR 17.11.

R **Rare Specie**s. Listed species are those with 1) 20-35 extant sites, or 2) 3,000 to 5,000 individuals statewide.

NEW YORK NATURAL HERITAGE PROGRAM RANKS – ANIMALS AND PLANTS

S1 Typically 5 or fewer occurrences, very few remaining individuals, acres, or miles of stream, or some factor of its biology making it especially vulnerable in New York State.

S2 Typically 6-20 occurrences, few remaining individuals, acres, or miles of stream, or factors demonstrably making it very vulnerable in New York State.

S3 Typically 21-100 occurrences, limited acreage, or miles of stream in New York State.

SH Historically known from New York State, but not seen in the past 15-20 years.

SNA Visitor to New York State, but not regular occupant (such as migrating birds or insects) or predicted to occur in New York State, but has not been found yet.

B,N These modifiers indicate when the breeding status of a migratory species is considered separately from individuals passing through or not breeding within New York State. B indicates the breeding status; N indicates the non-breeding status.

SPECIES OF GREATEST CONSERVATION NEED (SGCN) IN NEW YORK - ANIMALS

Species that meet one or more of the following criteria (NYSDEC 2005):

- Species on the current federal list of endangered or threatened species that occur in New York.
- Species that are currently State-listed as endangered, threatened or special concern.
- Species with 20 or fewer elemental occurrences in the New York Natural Heritage Program database.
- Estuarine and marine species of greatest conservation need as determined by New York Department of Environmental Conservation, Bureau of Marine Resources staff.
- Other species determined to be in great conservation need due to status, distribution, vulnerability, or disease.

REGIONAL STATUS (HUDSON VALLEY) – ANIMALS AND PLANTS

RG Hudsonia has compiled lists of native plants and animals that are rare in the Hudson Valley but do not appear on statewide or federal lists of rarities (Kiviat and Stevens 2001). We use ranking criteria similar to those used by the NYNHP, but we apply those criteria to the Hudson Valley below the Troy Dam. Our regional lists are based on the extensive field experience of biologists associated with Hudsonia and communications with other biologists working in the Hudson Valley. These lists are subject to change as we gather more information about species occurrences in the region. In this report, we denote all regional ranks (rare, scarce, declining, vulnerable) with a single code (RG). Species with New York State or New York

Natural Heritage Program ranks are presumed to also be regionally rare, but are not assigned an 'RG' rank. For birds, the RG code sometimes refers specifically to their breeding status in the region.

BIRDS - PARTNERS IN FLIGHT PRIORITY SPECIES LISTS

The Partners in Flight (PIF) WatchList is a list of landbirds considered to be of highest conservation concern, excluding those already designated as endangered under the federal Endangered Species Act. The WatchList is compiled jointly by several federal and private associations, including the Colorado Bird Observatory, the American Bird Conservancy, Partners in Flight, and the U.S. Fish and Wildlife Service. The current PIF WatchList is based on a series of scores assigned to each species for 7 different aspects of vulnerability: population size, breeding distribution, non-breeding distribution, threats to breeding, threats to non-breeding, population trend, and "area importance" (relative abundance of the species within a physiographic area compared to other areas in the species' range). Scores for each of these factors range from 1 (low priority) to 5 (high priority), and reflect the degree of the species' vulnerability associated with that factor. Species are assigned "**High Regional Priority**" if their scores indicate high vulnerability in a physiographic area (delineated similarly to the physiographic areas used by the Breeding Bird Survey), and "**High Continental Priority**" if they have small and declining populations, limited distributions, and deteriorating habitats throughout their entire range. The most recent WatchList was updated in August 2003. We include birds from the lists for physiographic areas # 17 (Northern Ridge and Valley) and # 9 (Southern New England).

PIF1* High continental priority (Tier IA and IB species)
PIF2 High regional priority (Tier IIA, IIB, and IIC species)

* Prothonotary warbler was not included in the watch lists for this region, but we have included this species with the PIF1 species because it is listed as "High Continental Priority" in PIF's national North American Landbird Conservation Plan (Rich et al. 2004).

Appendix D. Common and scientific names of plants mentioned in this report. Scientific names follow the nomenclature of Mitchell and Tucker (1997).

Common Name	Scientific Name
agrimony, small-flowered	*Agrimonia parviflora*
alder	*Alnus*
Allegheny-vine	*Adlumia fungosa*
arrow arum	*Peltandra virginica*
arrowhead, broad-leaved	*Sagittaria latifolia*
arrowwood, downy	*Viburnum rafinesquianum*
arrowwood, northern	*Viburnum dentatum* v. *lucidum*
ash, black	*Fraxinus nigra*
ash, green	*Fraxinus pensylvanica*
ash, white	*Fraxinus americana*
aspen, quaking	*Populus tremuloides*
aster, bush	*Aster borealis*
aster, stiff-leaf	*Aster linariifolius*
azalea, swamp	*Rhododendron viscosum*
baneberry, red	*Actaea spicata* ssp. *rubra*
barberry, Japanese	*Berberis thunbergii*
basswood	*Tilia americana*
bearberry	*Arctostaphylos uva-ursi*
bergamot, wild	*Monarda fistulosa*
birch, black	*Betula lenta*
birch, gray	*Betula populifolia*
birch, river	*Betula nigra*
birch, swamp	*Betula pumila*
birch, yellow	*Betula alleghaniensis*
blackberry, northern	*Rubus allegheniensis*
bladdernut	*Staphylea trifolia*
bladderwort, floating	*Utricularia radiata*
bladderwort, hidden-fruit	*Utricularia geminiscapa*
bladderwort, horned	*Utricularia cornuta*
bladderwort, swollen	*Utricularia inflata*
blazing-star, northern	*Liatris scariosa* v. *novae-angliae*
blueberry, highbush	*Vaccinium corymbosum*
blueberry, lowbush	*Vaccinium angustifolium*
blueberry, lowbush	*Vaccinium pallidum*
bluegrass, Kentucky	*Poa pratensis*
bluejoint	*Calamagrostis canadensis*
bluestem, little	*Schizachyrium scoparium*
breeches, Dutchman's	*Dicentra cucullaria*
buckbean	*Menyanthes trifoliata*
buckthorn, alder-leaf	*Rhamnus alnifolia*
bunchberry	*Cornus canadensis*
butterflyweed	*Asclepias tuberosa*
butternut	*Juglans cinerea*
buttonbush	*Cephalanthus occidentalis*
cabbage, skunk	*Symplocarpus foetidus*
canary-grass, reed	*Phalaris arundinacea*
catalpa	*Catalpa speciosa*
cattail	*Typha*
cedar, eastern red	*Juniperus virginiana*
chokeberry	*Aronia*
cinquefoil, shrubby	*Potentilla fruticosa*
cinquefoil, three-toothed	*Potentilla tridentata*
cliffbrake, purple	*Pellaea atropurpurea*
cliffbrake, smooth	*Pellaea glabella*
cohosh, blue	*Caulophyllum thalictroides*
columbine, wild	*Aquilegia canadensis*
coontail, spiny	*Ceratophyllum echinatum*
cottongrass, tussock	*Eriophorum vaginatum* ssp. *spissum*
cottonwood, swamp	*Populus heterophylla*
cranberry, large	*Vaccinium macrocarpon*
cranberry, small	*Vaccinium oxycoccos*
crowfoot, small-flowered	*Ranunculus micranthus*
deerberry	*Vaccinium stamineum*
devil's-bit	*Chamaelirium luteum*
dittany	*Cunila origanoides*
dodder, buttonbush	*Cuscuta cephalanthi*
dodder, field	*Cuscuta pentagona*
dodder, southern	*Cuscuta obtusiflora* v. *glandulosa*
dogwood, gray	*Cornus foemina* ssp. *racemosa*
dogwood, red osier	*Cornus sericea*
dogwood, roundleaf	*Cornus rugosa*
dogwood, silky	*Cornus amomum*
elder, red-berried	*Sambucus racemosa*
elm, American	*Ulmus americana*
elm, slippery	*Ulmus rubra*
false-mermaid	*Floerkea proserpinacoides*
featherfoil	*Hottonia inflata*
fern, bracken	*Pteridium aquilinum*
fern, fragile	*Cystopteris fragilis*
fern, maidenhair	*Adiantum pedatum*
fern, marsh	*Thelypteris palustris*
fern, ostrich	*Matteuccia struthiopteris*
fern, sensitive	*Onoclea sensibilis*
fern, Virginia chain	*Woodwardia virginica*
fern, walking	*Asplenium rhizophyllum*
flag, blue	*Iris versicolor*
flax, yellow wild	*Linum sulcatum*
foxtail, short-awn	*Alopecurus aequalis*
gentian, fringed	*Gentianopsis crinita*
ginseng, American	*Panax quinquefolius*
globeflower, spreading	*Trollius laxus*
goat's-rue	*Tephrosia virginiana*
goldenrod, bog	*Solidago uliginosa*
goldenrod, rough-leaf	*Solidago patula*
goldenrod, stiff-leaf	*Solidago rigida*
goldenseal	*Hydrastis canadensis*
grama, side-oats	*Bouteloua curtipendula*
grass-of-Parnassus	*Parnassia glauca*
grass, Indian	*Sorghastrum nutans*
grass, pale alkali	*Torreyochloa pallida* v. *pallida*
gromwell, Virginia false	*Onosmodium virginianum*
hackberry	*Celtis occidentalis*
hairgrass	*Deschampsia flexuosa*
hair-rush	*Bulbostylis capillaris*
harlequin, yellow	*Corydalis flavula*
hawthorn	*Crataegus*
hemlock, eastern	*Tsuga canadensis*
hickory, pignut	*Carya glabra*
hickory, shagbark	*Carya ovata*
hobblebush	*Viburnum alnifolium*

(CONTINUED)

Common Name	Scientific Name
holly, winterberry	*Ilex verticillata*
honeysuckle, Eurasian	*Lonicera* x *bella*
honeysuckle, fly	*Lonicera canadensis*
horsetail, wood	*Equisetum sylvaticum*
huckleberry, black	*Gaylussacia baccata*
ironweed, New York	*Vernonia noveboracensis*
knotweed, Japanese	*Fallopia japonica*
knotweed, slender	*Polygonum tenue*
ladyslipper, showy	*Cypripedium reginae*
laurel, mountain	*Kalmia latifolia*
laurel, sheep	*Kalmia angustifolia*
leatherleaf	*Chamaedaphne calyculata*
leatherwood	*Dirca palustris*
liverwort	Hepaticae
liverwort	*Riccia fluitans*
lobelia, Kalm's	*Lobelia kalmii*
locust, black	*Robinia pseudoacacia*
lopseed	*Phyrma leptostachya*
loosestrife, purple	*Lythrum salicaria*
lousewort, swamp	*Pedicularis lanceolata*
ludwigia, globe-fruited	*Ludwigia sphaerocarpa*
mannagrass	*Glyceria*
mallow, swamp-rose	*Hibiscus moscheutos*
maple, mountain	*Acer spicatum*
maple, red	*Acer rubrum*
maple, striped	*Acer pensylvanicum*
maple, sugar	*Acer saccharum*
marjoram	*Origanum vulgare*
may-apple	*Podophyllum peltatum*
meadowsweet	*Spiraea latifolia*
milkweed, blunt-leaf	*Asclepias amplexicaulis*
milkweed, green	*Asclepias viridiflora*
milkweed, poke	*Asclepias exaltata*
milkweed, whorled	*Asclepias verticillata*
milkwort, whorled	*Polygala verticillata*
monkey-flower, winged	*Mimulus alatus*
moss	*Helodium paludosum*
moss, haircap	*Polytrichum*
moss, peat	*Sphagnum*
mountain-mint, blunt	*Pycnanthemum muticum*
mountain-mint, Torrey's	*Pycnanthemum torrei*
oak, black	*Quercus velutina*
oak, chestnut	*Quercus montana*
oak, red	*Quercus rubra*
oak, scarlet	*Quercus coccinea*
oak, scrub	*Quercus ilicifolia*
oak, swamp white	*Quercus bicolor*
oak, white	*Quercus alba*
orangeweed	*Hypericum gentianoides*
orchid, grass pink	*Calopogon tuberosus*
orchid, white-fringed	*Platanthera blephariglottis* v. *blephariglottis*
orchid, dragon's mouth	*Arethusa bulbosa*
paintbrush, scarlet Indian	*Castilleja coccinea*
pellitory	*Parietaria pensylvanica*
pine, pitch	*Pinus rigida*
pine, white	*Pinus strobus*
pinesap	*Monotropa hypopithys*
pinweed, slender	*Lechea tenuifolia*
pipewort	*Eriocaulon septangulare*
pitcher-plant	*Sarracenia purpurea*
pod-grass	*Scheuchzeria palustris*
pogonia, rose	*Pogonia ophioglossoides*
polypody, rock	*Polypodium vulgare*
pond-lily, yellow	*Nuphar advena*
pond-lily, white	*Nymphaea odorata*
pondweed, Hill's	*Potamogeton hillii*
pondweed, spotted	*Potamogeton pulcher*
pondweed, water-thread	*Potamogeton diversifolius*
poverty-grass	*Danthonia spicata*
prickly-ash, American	*Zanthoxylum americana*
raspberry	*Rubus*
raspberry, dwarf	*Rubus pubescens*
rattlebox	*Crotalaria sagittalis*
reed, common	*Phragmites australis*
riverweed	*Podostemum ceratophyllum*
rock-cress, hairy	*Arabis hirsuta* v. *pycnocarpa*
rose, multiflora	*Rosa multiflora*
rose-mallow, swamp	*Hibiscus moscheutos*
rush, toad	*Juncus bufonius*
rush, soft	*Juncus effusus*
sandwort, rock	*Minuartia michauxii*
sarsaparilla, bristly	*Aralia hispida*
saxifrage, golden	*Chrysosplenium americanum*
sedge	*Carex*
sedge, Bicknell's	*Carex bicknellii*
sedge, bronze	*Carex aenea*
sedge, Bush's	*Carex bushii*
sedge, cattail	*Carex typhina*
sedge, clustered	*Carex cumulata*
sedge, Davis'	*Carex davisii*
sedge, Emmons'	*Carex albicans* v. *emmonsii*
sedge, false hop	*Carex lupuliformis*
sedge, handsome	*Carex formosa*
sedge, lakeside	*Carex lacustris*
sedge, Pennsylvania	*Carex pensylvanica*
sedge, plantain	*Carex plantiginea*
sedge, porcupine	*Carex hystericina*
sedge, prairie	*Carex prairea*
sedge, reflexed	*Carex retroflexa*
sedge, Schweinitz's	*Carex schweinitzii*
sedge, sterile	*Carex sterilis*
sedge, three-way	*Dulichium arundinaceum*
sedge, tussock	*Carex stricta*
sedge, woolly-fruit	*Carex lasiocarpa*
sedge, yellow	*Carex flava*
serviceberry	*Amelanchier*
shadbush, dwarf	*Amelanchier spicata*
spike-muhly	*Muhlenbergia glomerata*
spikerush, knotted	*Eleocharis equisetoides*
spikerush, olivaceous	*Eleocharis flavescens*
spikerush, ovate	*Eleocharis obtusa* v. *ovata*
spleenwort, ebony	*Asplenium platyneuron*
spleenwort, maidenhair	*Asplenium trichomanes*
spleenwort, mountain	*Asplenium montanum*
spleenwort, silvery	*Deparia acrostichoides*

(CONTINUED)

Common Name	Scientific Name	Common Name	Scientific Name
spruce, Norway	*Picea abies*	vervain, blue	*Verbena hastata*
St. Johnswort, shrubby	*Hypericum prolificum*	viburnum, maple-leaf	*Viburnum acerifolium*
steeplebush	*Spiraea tomentosa*	violet	*Viola*
sundew, round-leaf	*Drosera rotundifolia*	water-marigold, Beck's	*Bidens beckii*
sundew, narrow-leaf	*Drosera intermedia*	water-plantain	*Alisma triviale*
sweetfern	*Comptonia peregrina*	water-willow	*Decodon verticillatus*
sweetflag	*Acorus*	whitlow-grass, Carolina	*Draba reptans*
sweet-gale	*Myrica gale*	willow	*Salix*
sycamore	*Platanus occidentalis*	willow, autumn	*Salix serissima*
tamarack, eastern	*Larix laricina*	willow, sage-leaved	*Salix candida*
thyme, wild	*Thymus pulegioides*	witch-hazel	*Hamamelis virginiana*
twayblade, large	*Liparis lilifolia*	woodsia, rusty	*Woodsia ilvensis*
twig-rush	*Cladium mariscoides*	woolgrass	*Scirpus cyperinus*
valerian, bog	*Valeriana uliginosa*	yew, American	*Taxus canadensis*