Significant Habitats
in the Town of Amenia, Dutchess County, New York

Photo: Nava Tabak

Report to the Town of Amenia, 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 Amenia during the period January through November 2006. 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 83 fens, 53 intermittent woodland pools, 2 circumneutral bog lakes, 13 marble knolls, 2 cool ravines, and 5 contiguous forest areas exceeding 1,000 acres (400 ha).

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 discuss the eight places in Amenia that we believe should receive priority in 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 town-wide conservation planning and decision making.

The habitat map, which contains ecological information unavailable from other sources, can help the Town of Amenia 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 town-wide 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. The towns of Washington (Tollefson and Stevens 2004) and Stanford (Bell et al. 2005) were the first of these, and Amenia is the third. We received strong support for the project from the Amenia Town Board, Planning Board, and Conservation Advisory Council, as well as from many local landowners.

Kristen Bell (Biologist), Nava Tabak (Biologist) and Gretchen Stevens (Director of Hudsonia's Biodiversity Resources Center) conducted the work on this project from January through December 2006. Through map analysis, aerial photograph interpretation, and field

observations we created a map of ecologically significant habitats in the Town of Amenia. 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 in several more towns in Dutchess County, and we hope to extend the program to other parts of southeastern New York. To facilitate intermunicipal 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), and Fishkill and Sprout Creek Corridors (Sullivan and Stevens 2005) reports without specific attribution. This report, however, addresses our findings and specific recommendations for the Town of Amenia. 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, town-wide, and region-wide planning and conservation efforts.

We hope that this map and report will help landowners understand how their property fits into the larger ecological landscape, and will inspire them to implement habitat protection measures voluntarily. 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 considerable biological resources that still exist in the Town of Amenia.

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 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 Amenia, the habitat map 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 Amenia is located in eastern Dutchess County in southeastern New York. It is approximately 44 mi^2 (113 km^2) in area and has a population of roughly 4,048 residents (2000 Census). All of the land in Amenia, except for a small portion in the northwest corner, ultimately drains into the Housatonic River in Connecticut. The Tenmile River and its main tributaries–Amenia Stream, Wassaic Creek, and Webatuck Creek–drain most of the town. Bog Hollow Brook drains the southeastern corner of Amenia, and Butts Hollow Brook joins the Tenmile River in the southwestern corner. Elevations in Amenia range from 400 ft (122 m) above mean sea level along the Tenmile River at the southwestern town boundary to 1,390 ft (424 m) just south of the intersection of Flint Hill Road and Cascade Mountain Road near the northern town boundary. Other high elevation areas include Rattlesnake Ridge, East Mountain, and the ridges flanking Turkey Hollow, Deep Hollow, and Tower Hill Road. Large wetland complexes include Bog Hollow, the Smithfield Valley, an area between Route 22 and old Route 22, an area just northeast of the Amenia hamlet, an area between the Rail Trail and Sharon Station Road, Sharon Station Marsh, Swift Pond, and Cleaver Swamp.

Amenia's landscape of roughly north-south trending ridges and valleys reflects the strong influences of bedrock geology and glacier activity. The bedrock geology of the ridges is dominated by phyllite, schist, and meta-graywacke, with schist in the northwest and metasedimentary rock and granitic gneiss in the southeast. The valleys are underlain by Stockbridge marble (Fisher et al. 1970) (Figure 1). The surficial material is primarily glacial

till, and there are extensive areas of exposed or nearly exposed bedrock. Large areas of recent alluvium are mapped on the Wassaic Creek floodplain in the northwest corner of town and in the Tenmile River and Webatuck Creek floodplains running from the northeastern part of town to the southwestern corner. Outwash and kame deposits are scattered in the some of the valleys, with the most sizable kame deposit running north-south between the hamlets of Amenia and Wassaic and southward (Cadwell et al. 1989).

Land uses in the Town of Amenia include farming, forestry, hunting preserves for upland game and waterfowl, horse stables and pastures, and residential and commercial uses in the hamlets of Amenia, Wassaic, Amenia Union, South Amenia, and Smithfield. Although the Harlem Valley was historically a dairy-farming region, many farms have been converted to residential uses, including many second homes. Most privately owned parcels are of 5 acres (2 ha) or less. However, 18 private landowners own parcels totaling over 300 ac (121 ha), with the largest privately owned area exceeding 1,000 ac (400 ha). Residences and their immediate surroundings are the most common type of developed area in Amenia. These are mainly concentrated in the small hamlets and along the roads throughout the town. Amenia has large areas of undeveloped open space (see Figure 3).

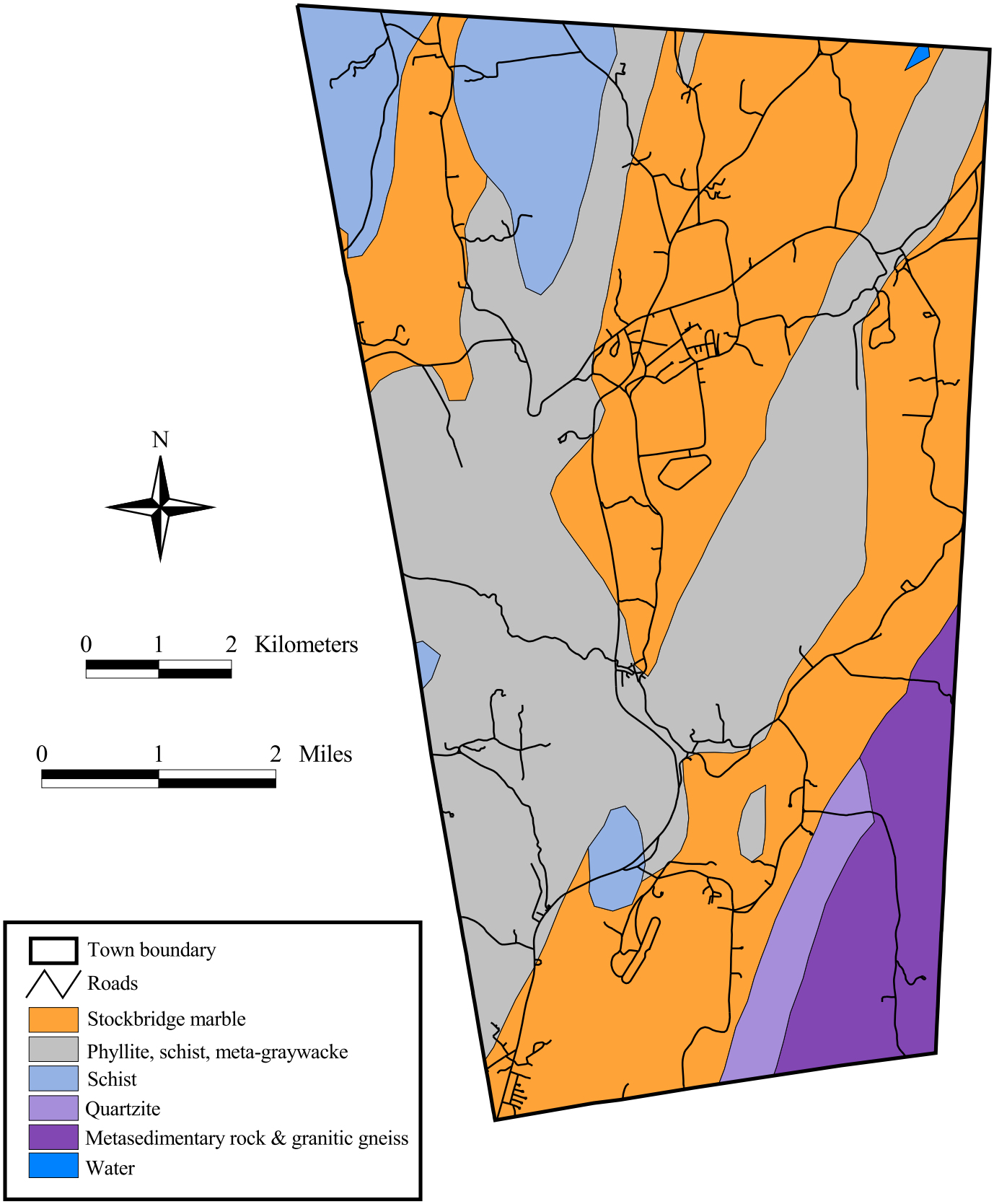


Figure 1. Generalized bedrock geology of the Town of Amenia, Dutchess County, New York. Stockbridge marble is highly calcareous, and other bedrock types are predominantly acidic. Geology data from Fisher et al. 1970. Hudsonia Ltd., 2006.

METHODS

Hudsonia employs a combination of laboratory and field methods in the habitat identification and mapping process, including map analysis, aerial photo interpretation, and field observation. Below we describe each phase in the Town of Amenia 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 Amenia and biological data provided by the New York Natural Heritage Program, we also 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 2006). These digital aerial photos were used for on-screen digitizing of habitat boundaries.

- *U.S. Geological Survey topographic maps* (Amenia 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 Amenia from the Dutchess Land Conservancy, and Town of Amenia 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 3.2 (Environmental Systems Research Institute 1999) 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 part or all of 60% of the total number of habitat units in the town. This figure translates to approximately 39% of the undeveloped land area in Amenia (10,000 acres [4,050 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. But 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 Amenia was only mapped remotely, all of our mapped habitat boundaries should be considered approximations.

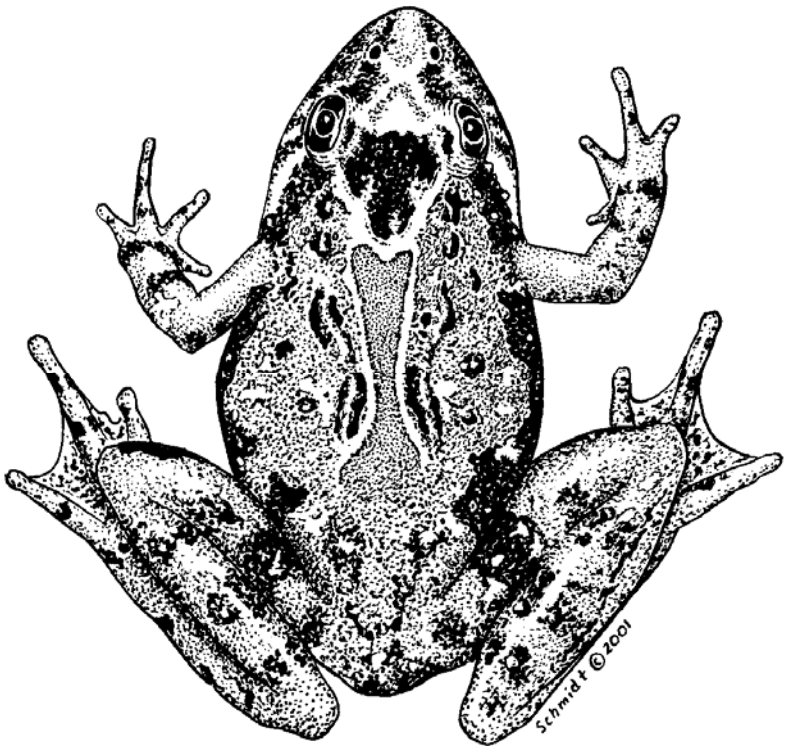
Each habitat profile in the Results section describes the ecological attributes of places that are included in that habitat. Developed areas and other areas that we consider non-significant habitats (e.g., structures, paved roads and driveways, other impervious surfaces, and small lawns and woodlots) 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 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 36 x 44 inch sheets 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 at a scale of 1:19,000. The GIS database that accompanies the map includes additional information about many of the mapped habitats, 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 Amenia 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."*



Northern cricket frog

RESULTS

Overview

The large-format Town of Amenia 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 (113 km^2) area comprising the Town of Amenia, approximately 92% is undeveloped (i.e., without structures, paved roads, 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). Mines are included in the waste ground habitat category, but active (or recently abandoned) mines larger than 2.5 ac (1 ha) are also shown in this figure since they act as fragmenting features. Several types of common habitats cover extensive areas within these blocks. For example, approximately 55% of the town is forested, 27% is open meadow (agricultural areas and other managed and unmanaged grassland habitats), and 11% is wetland. Some of the smaller, more unusual habitats we documented include marble knolls, circumneutral bog lakes, and fens. In total, we identified 26 different kinds of habitats in the Town of Amenia that we consider to be of potential ecological importance (Table 1).

Although the mapped areas represent ecologically significant habitats, all have been altered to variable 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 Amenia, 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 Amenia, Dutchess County, New York, 2006.

Upland Habitats	Wetland Habitats
Upland hardwood forest	Hardwood & shrub swamp
Upland conifer forest	Conifer swamp
Upland mixed forest	Mixed forest swamp
Cool ravine	Marsh
Red cedar woodland	Wet meadow
Upland shrubland	Calcareous wet meadow
Upland meadow	Fen
Crest/ledge/talus	Intermittent woodland pool
Calcareous crest/ledge/talus	Circumneutral bog lake
Marble knoll	Open water
Orchard/plantation	Constructed pond
Cultural	Spring/seep
Waste ground	Stream

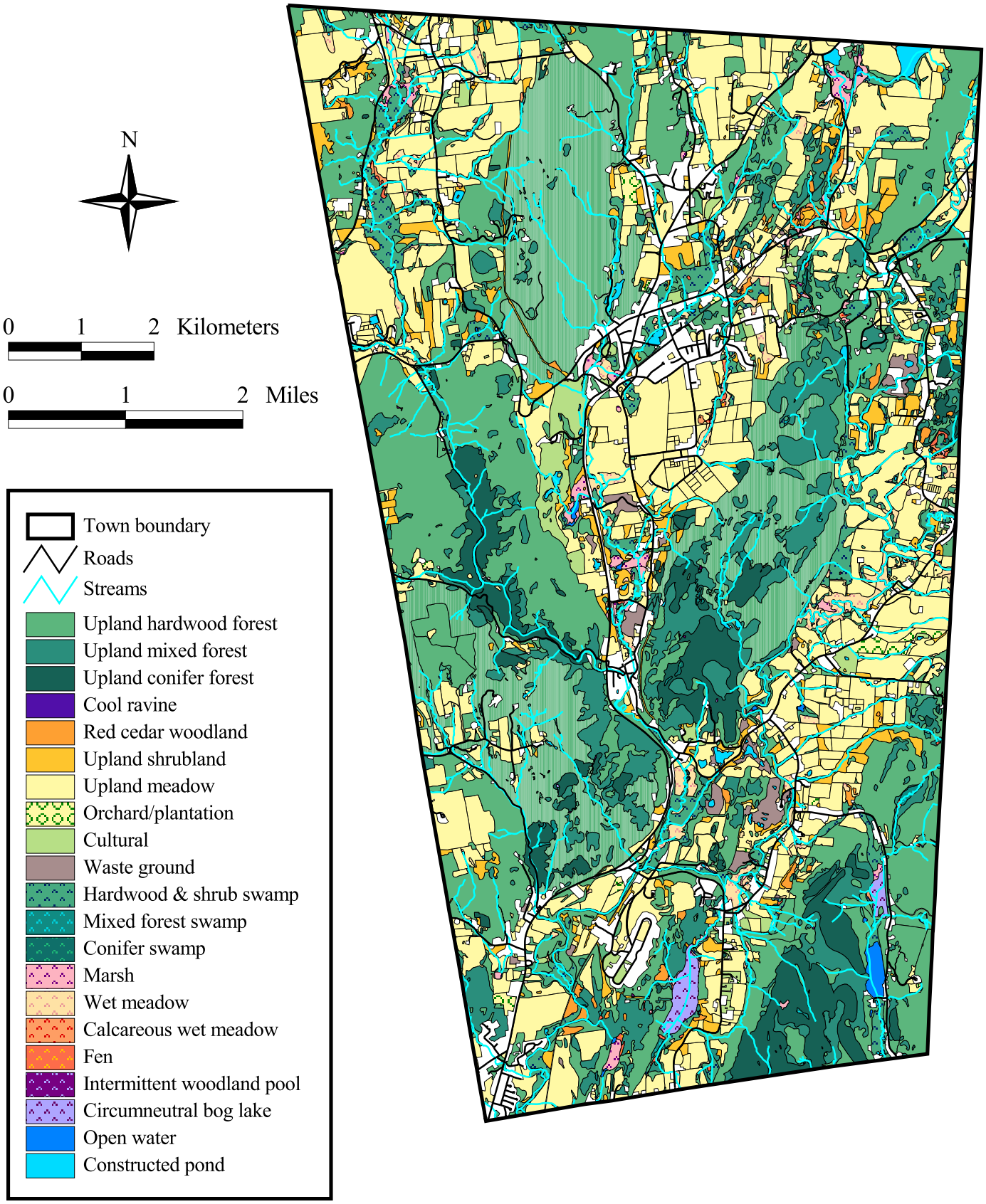


Figure 2. A reduction of the map illustrating the ecologically significant habitats in the Town of Amenia, Dutchess County, New York, identified and mapped by Hudsonia Ltd. in 2006. Developed areas and other non-significant habitats are shown in white. The large-format map is printed in three sections at a scale of 1:10,000.

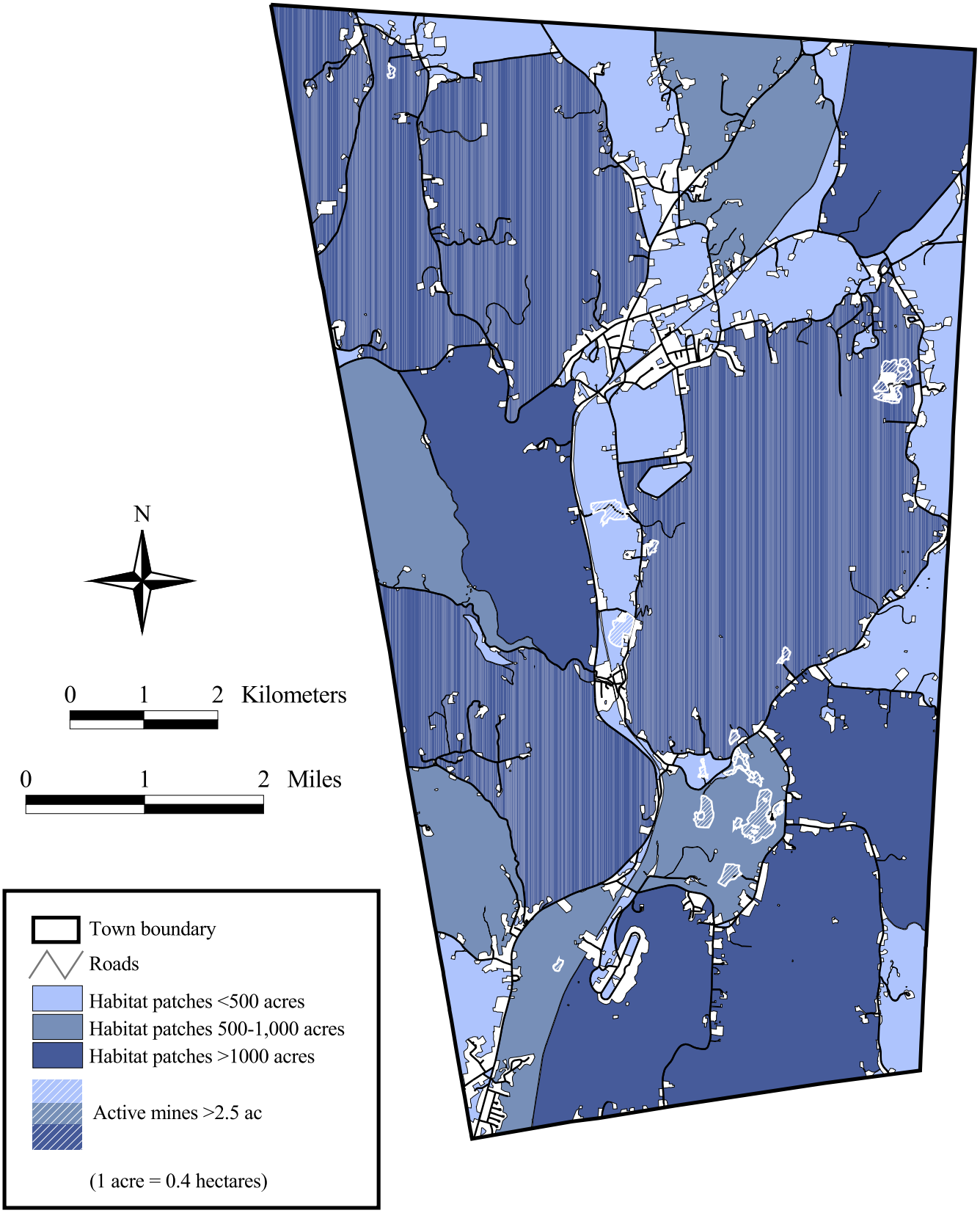


Figure 3. Contiguous habitat patches in the Town of Amenia, Dutchess County, New York. Developed areas and other non-significant habitats are shown in white, and large mines are shown with white hatching. Hudsonia Ltd., 2006.

HABITAT DESCRIPTIONS

In the following pages we describe some of the ecological attributes of the habitats identified in the Town of Amenia, 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 Amenia 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 two-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.

<u>Upland Hardwood Forest (uhf)</u>

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. Scrub oak can be common on rocky, exposed

ridgetops in forests that we term crest oak woodlands (see also crest/ledge/talus section). 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. 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 a number of 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 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 probably 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 growing 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 supported a higher diversity and greater abundance of understory species than pure conifer stands.

Occurrence in the Town of Amenia

Figure 4 illustrates the location of forested areas (including both forested wetlands and uplands) in the Town of Amenia, 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 on East Mountain, Rattlesnake Ridge, Cascade Mountain, the ridge southwest of Deep Hollow Road and Route 22, and the ridge east of Turkey Hollow, each exceeding 1,000 ac (400 ha). Eleven additional forest areas were greater than 200 ac (80 ha).

Upland deciduous forest was the most widespread habitat type in the Town of Amenia, accounting for approximately 35% of the total land area. In some of these forests (e.g., on Rattlesnake Ridge) there were areas of "rich forest", which supported calcium-associated plant species. We identified seven crest oak woodlands (see the crest/ledge/talus section below) on high and somewhat exposed ridges throughout the town. We presume that virtually all forests in the Town of Amenia have been cleared or logged in the past and that no "virgin" stands remain. There may be old forest stands, however, that were not observed during fieldwork.

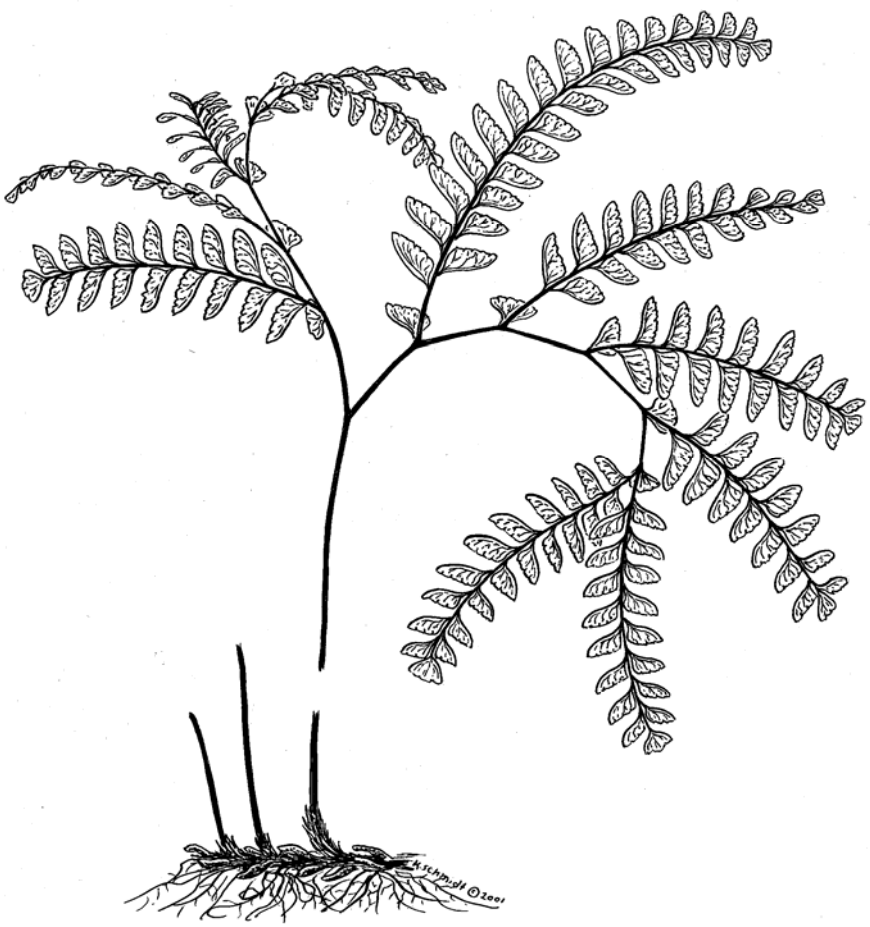
Large areas of upland conifer and mixed forests occurred on East Mountain, Rattlesnake Ridge, and in Turkey Hollow, totaling over 2,000 ac (800 ha) combined. Smaller patches–mostly 25 ac (10 ha) or less–were widely distributed throughout the town within upland hardwood tracts. Most of the natural conifer 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 succession forests growing on abandoned pasture or farm land. Planted conifer stands often consisted of Norway spruce, red pine, white pine, or a non-native larch.

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. Selection 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. 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.



Maidenhair fern

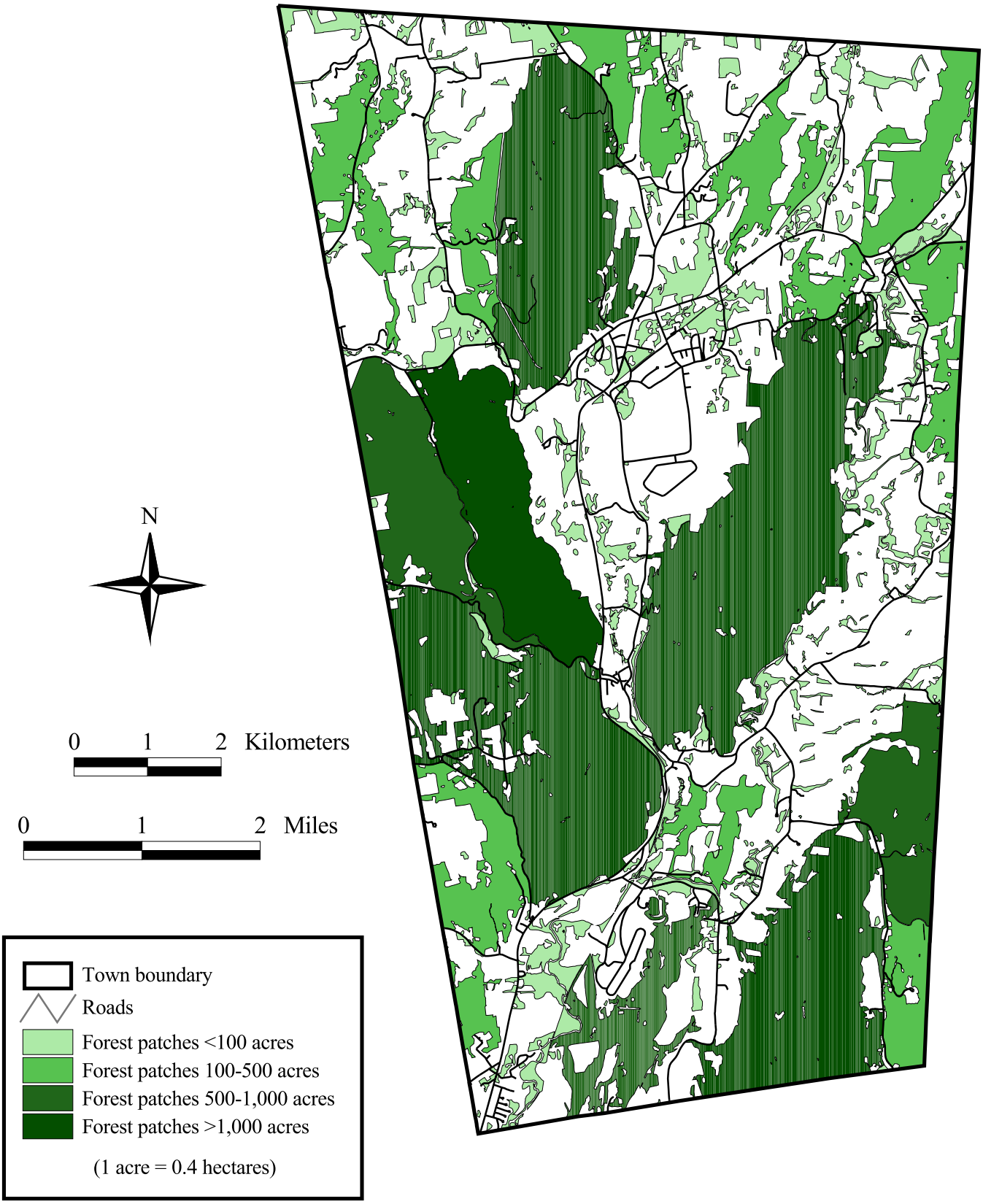


Figure 4. Contiguous forest patches (including hardwood, conifer, and mixed forests in uplands and swamps) in the Town of Amenia, Dutchess County, New York. Hudsonia Ltd., 2006.

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 often supports plants of more northern affinities, such as striped maple, 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.

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. 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 that occurs in cool ravines.

Occurrence in Amenia

Cool ravines were found in Turkey Hollow just north of the dammed reservoir on Wassaic Creek, and in Deep Hollow just west of the dam, along a smaller tributary of the Wassaic (Figure 10).

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 Amenia

Red cedar woodlands in the Town of Amenia ranged in size from 0.25 to 10 ac (0.1-4 ha). The distribution of red cedar woodlands in Amenia 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 Amenia 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 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.

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 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, and maidenhair spleenwort. 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,* worm snake,* and northern copperhead.* Ledge areas with southern to southeastern and southwestern exposure may provide winter den and spring "basking rocks" for timber rattlesnake*. Five-lined skink* uses rocky ledges for shelter and basking. 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.

Occurrence in the Town of Amenia

Crest, ledge, and talus habitats occurred throughout the town in close association with mountain ridges (Figure 5). Extensive rocky areas were found on East Mountain, Rattlesnake Ridge, Cascade Mountain, the ridge southwest of Deep Hollow Road and Route 22, and the ridge east of Turkey Hollow. Some of the high elevations crests of ridges in the town supported oak woodlands, a type of upland hardwood forest that is uncommon in the town. Smaller ridges and hills within the valley areas tended to have calcareous rock outcrops (see marble knoll section below).

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.

MARBLE KNOLL

Ecological Attributes

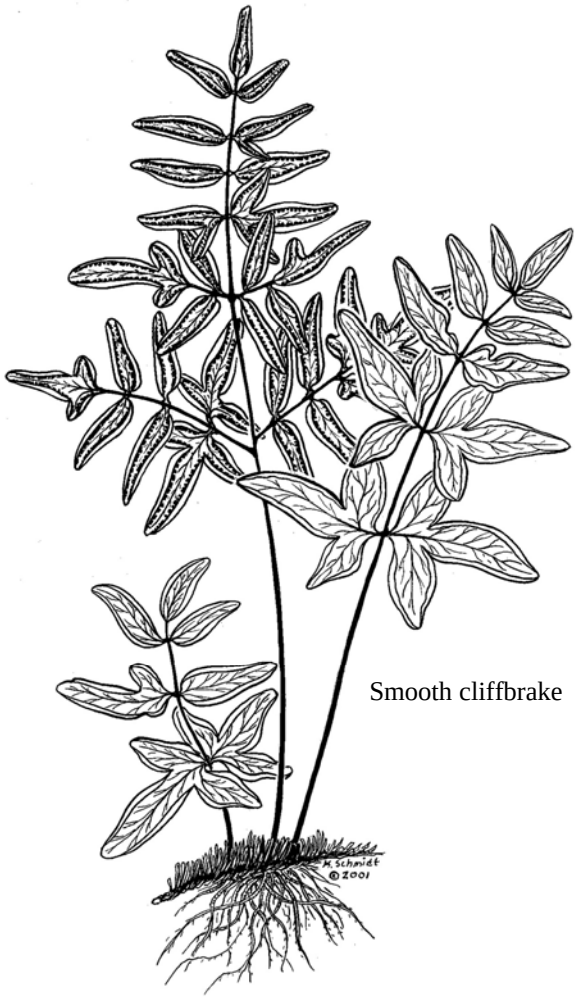
Marble knoll is an uncommon habitat type that is restricted in Dutchess County to the Harlem Valley region. It occurs primarily along the broad valley floor where Stockbridge Marble bedrock forms numerous knoll-like hills, usually with extensive marble outcrops. In addition to marble outcrops these hills usually have sandy or gravelly soils, which help to create a warm and dry microclimate (Kiviat 1988). Marble knolls were commonly used for pasture within the last few decades, and they tend to now support red cedar woodlands with small meadow-like openings, with grasses such as little bluestem and Indian grass.* In some cases these knolls support deciduous forests, but those areas are more difficult to identify by remote mapping methods, and some may have escaped our notice. 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 similar habitat as crest, ledge, and talus to reptiles such as eastern hognose snake* and worm snake,* 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 red cedar woodland above).

Occurrence in Amenia

Marble knolls were often part of larger stretches of calcareous crest/ledge/talus habitats in the valleys of Amenia (Figure 5), although the calcareous bedrock did not always outcrop on these knolls. In many instances the marble knolls appeared as isolated islands of forest habitat surrounded by agricultural land. We found marble knolls east and west of Leedsville Road, between Route 22 and Sharon Station Road, northeast of Sinpatch Road, and west of Swift Pond. We found wall-rue* at this last locality, and purple cliffbrake* on several knolls in the town.

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. Soil disturbance by vehicles, foot traffic, or construction equipment, or removal of vegetation, use of pesticides, or alteration of water runoff patterns 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.



Smooth cliffbrake

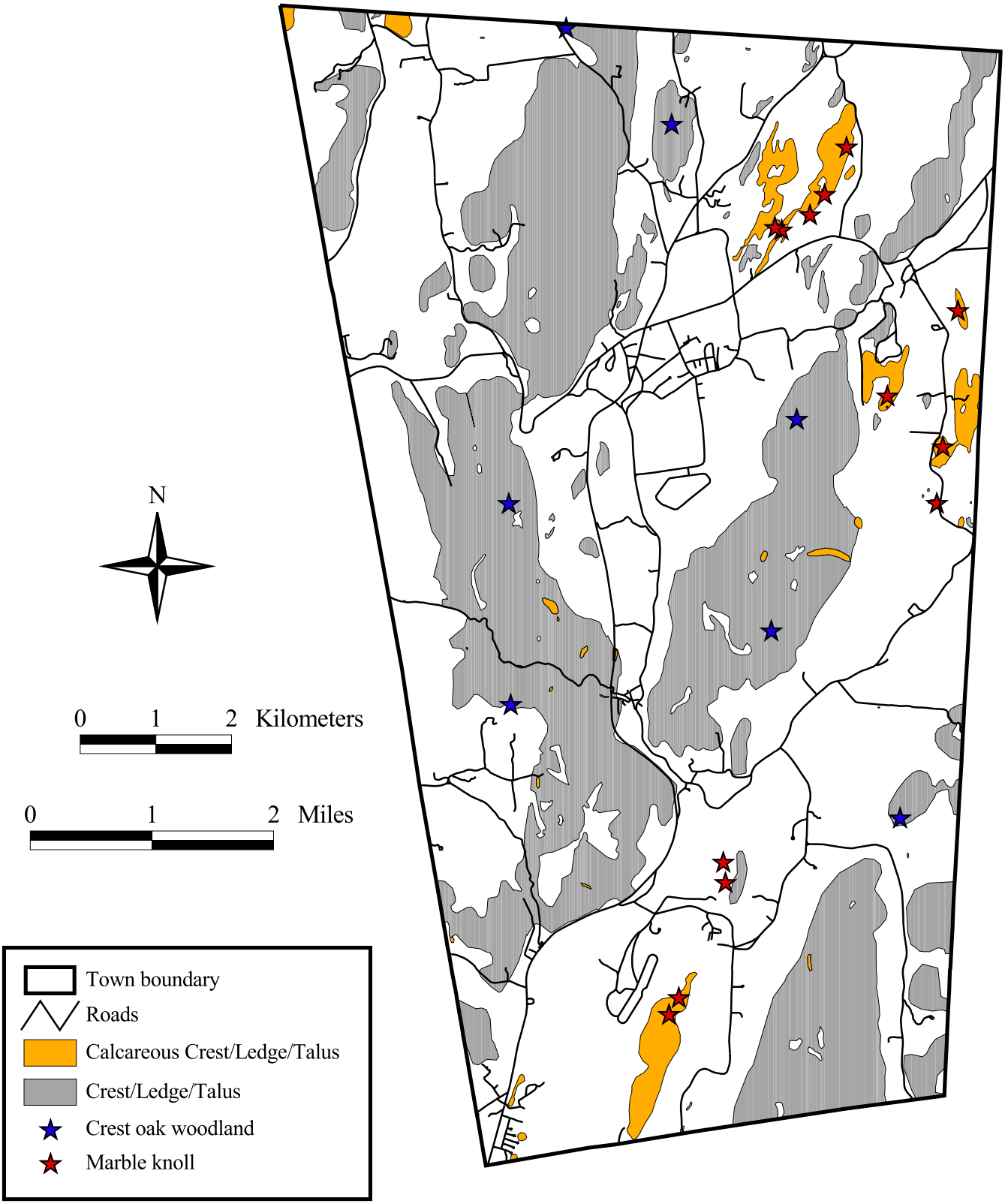


Figure 5. Generalized distribution of calcareous and non-calcareous crest, ledge, and talus habitats, and observed crest oak woodlands and marble knolls in the Town of Amenia, Dutchess County, New York. Locations identified from field observations and inferred from areas of shallow soils on steep slopes. Hudsonia Ltd., 2006.

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, greenbrier, 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 sapling-size 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.

A few species of rare plants are known from calcareous shrublands in the region, such as stiff-leaf goldenrod,* butterflyweed,* and shrubby St. Johnswort.* Rare butterflies such as Aphrodite fritillary,* dusted skipper,* Leonard's skipper,* and cobweb skipper* may occur in shrublands where their host plants are present. 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 a meadow vole, deer mouse, eastern cottontail, and possibly New England cottontail.*

Occurrence in the Town of Amenia

Upland shrublands were widely distributed throughout agricultural parts of the Town of Amenia, and ranged in size from 0.09 to 27 ac (0.04-10.9 ha), for a total of 920 ac (372 ha). The largest shrublands were groups of abandoned pastures.

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. 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. 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.

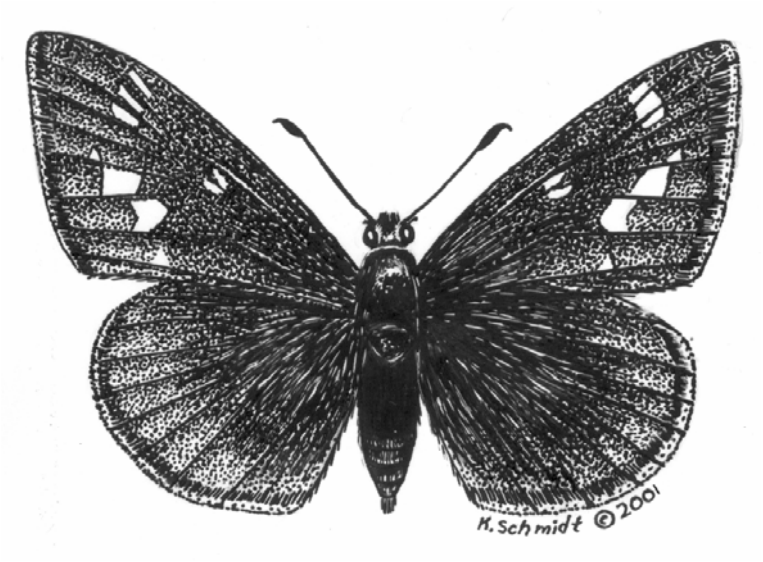
Occurrence in the Town of Amenia

Upland meadow was the second most common habitat type in the Town of Amenia, accounting for more than 26% of the total land area. Figure 6 illustrates the location and distribution of contiguous meadow habitat in the town (including upland meadow, wet meadows, and fens), 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 considerable patches of herbaceous cover. In Amenia the largest areas of open meadow were closely associated with the large valleys (e.g., Smithfield Valley and the Webatuck River plains), 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 158 and 144 ac (64 and 58 ha; Figure 6). 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.

Sensitivities/Impacts

Principle causes of meadow habitat loss 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 Northeast 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.



Dusted skipper

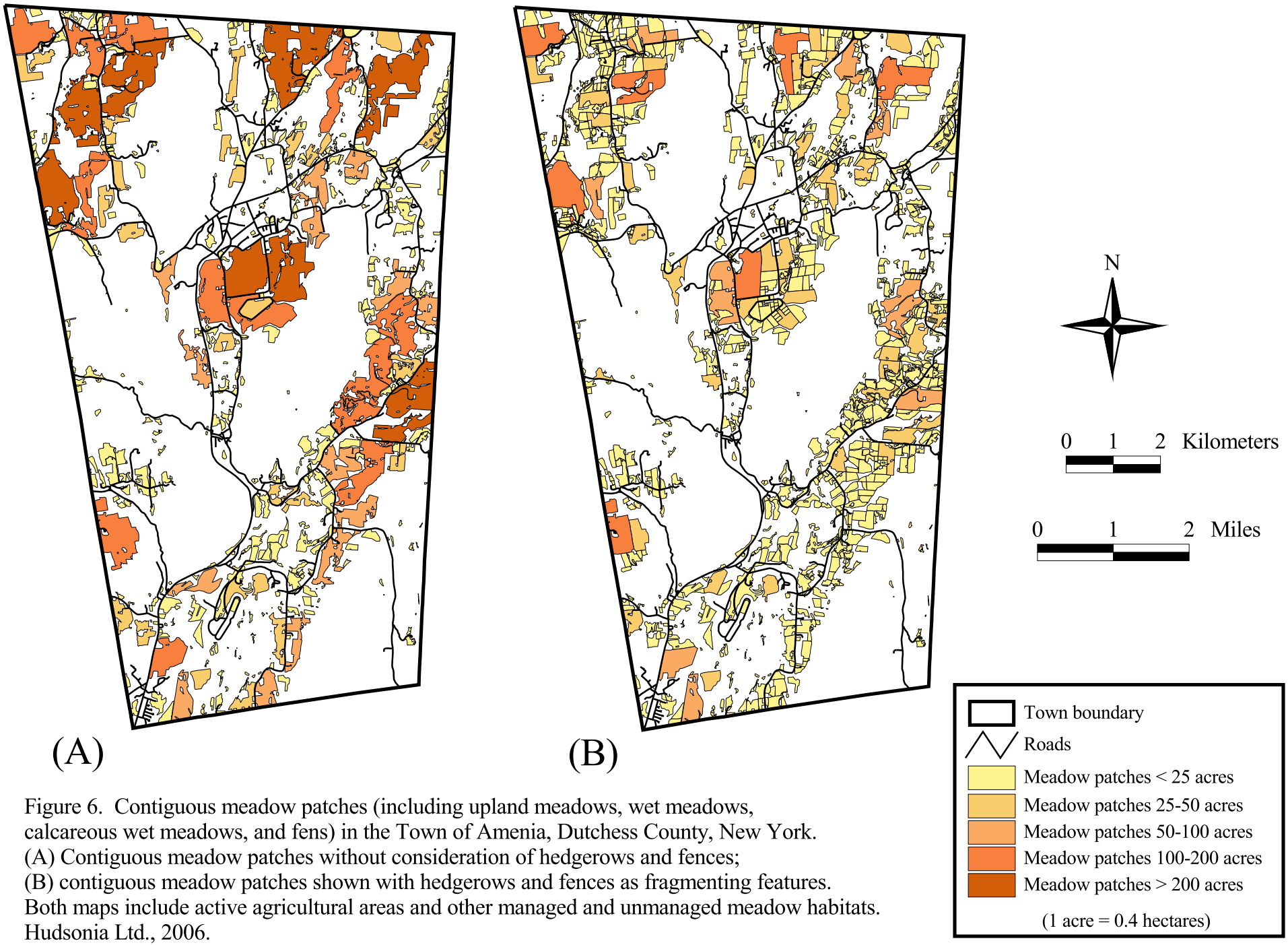


Figure 6. Contiguous meadow patches (including upland meadows, wet meadows, calcareous wet meadows, and fens) in the Town of Amenia, Dutchess County, New York. (A) Contiguous meadow patches without consideration of hedgerows and fences; (B) contiguous meadow patches shown with hedgerows and fences as fragmenting features. Both maps include active agricultural areas and other managed and unmanaged meadow habitats. Hudsonia Ltd., 2006.

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 Amenia, orchard/plantation areas ranged from 0.4 to 24.4 ac (0.16-9.9 ha). Most were Christmas tree plantations or 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. In the Town of Amenia, cultural habitats included large gardens, golf courses, playing fields, riding rings, cemeteries, lawns, and areas that are intensively managed for sport shooting. As for orchards and plantations, 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 botanist's 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. At the time of this report there were several apparently active mining operations in the Town of Amenia, where the value of waste ground habitat appeared negligible (Figure 3).

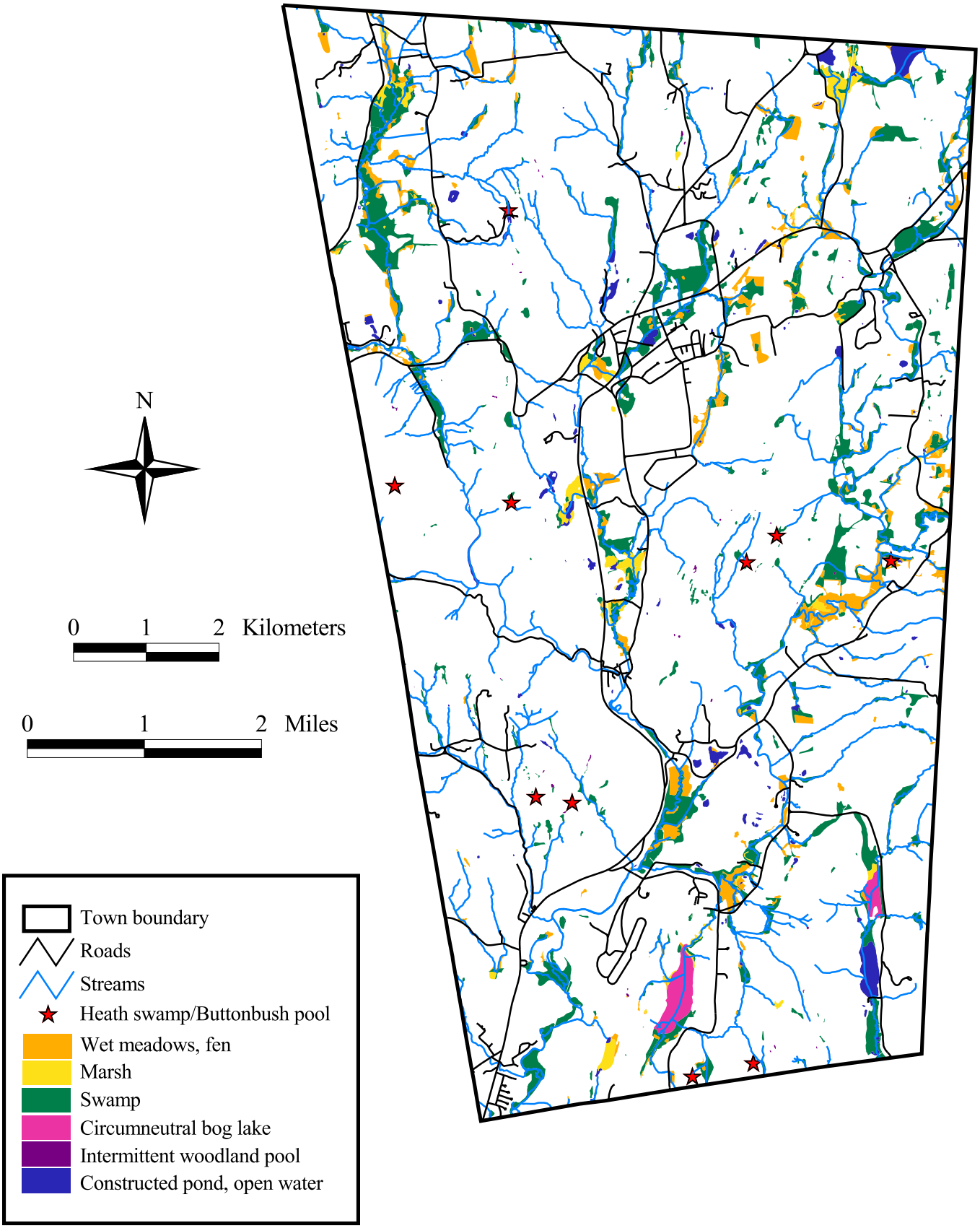


Figure 7. Wetland habitats in the Town of Amenia, Dutchess County, New York. Hudsonia Ltd., 2006.

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 Amenia: 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, 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, eastern 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 windthrow. The resulting tip-up mounds, root pits, and coarse woody debris all contribute to the habitat's complex structure and microtopography.

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 shrub swamps that we visited, we noted two particular types with exceptional habitat value: heath swamps and buttonbush pools. 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 few such swamps that we mapped should be considered examples of the habitats rather than a complete inventory; there may be many more shrub swamps in the town that fall into these categories that we did not visit.

- *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. Often, heath swamps are calcareous, supporting plants such as buttonbush, poison sumac, and *Riccia fluitans* (an aquatic liverwort). In other cases they seem quite acidic, supporting mountain laurel and large areas of peat moss. Heath swamps are often found in depressions isolated from other wetlands, and they appear to be excellent habitat for uncommon plants, pool-breeding amphibians, and other rare species.
- *Buttonbush 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. The buttonbush pool may have some small trees such as red maple or green ash in the pool interior, but usually lacks a forest canopy. Some buttonbush pools 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 buttonbush pools in nearby towns. The organic muck is good overwintering habitat for several turtle species.

Occurrence in the Town of Amenia

Hardwood and shrub swamp is by far the most extensive wetland habitat type in the Town of Amenia (Figure 7), with a total of 1,621 ac (656 ha). Swamps ranged in size from <0.5 to 131 ac (<0.2-53 ha), with an average extent of 3.3 ac (1.3 ha). They were often contiguous with other wetland habitats such as marsh, wet meadow, and open water (including beaver ponds). Large swamps were located in Smithfield Valley, north of Route 343 in the hamlet of Amenia, in Bog Hollow, and along the Tenmile River in the southwest portion of the town, among other areas. Smaller swamps were widely scattered throughout the town. Conifer swamps often

featured a red cedar canopy, and mixed forest swamps were often associated with the mixed forests of uplands such as those on Rattlesnake Ridge and East Mountain.

Swamps occurred in a variety of settings, such as on seepy slopes, along streams, and in depressions. 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 Amenia 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 subjected to runoff contaminated with agricultural chemicals, and those near roads and other developed areas 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 that is submergent, floating, or most often emergent above the water surface. 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. Deeper water may have floating-leaved plants such as pond-lilies, or submergent aquatic plants such as pondweeds, bladderworts, and watermilfoils.

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 Amenia

We mapped 99 marshes in the Town of Amenia, covering a total of 215 ac (87 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 of the marshes we observed in the field were dominated by purple loosestrife, common reed, cattail, or reed canary-grass, 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. Most of the mapped marshes within the town were small (<2 ac [0.8 ha]). Some of these were constructed ponds that had filled with sediment and vegetation over time. The largest marsh areas were Sharon Station Marsh, Cleaver Swamp, areas in the Smithfield Valley, near the center of the town west of Route 22, and between Route 22 and Old Route 22.

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 Amenia. 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 Amenia

Wet meadows were widely distributed primarily in the valleys in Amenia, and commonly occurred along the margins of swamps and marshes, and in low-lying areas within upland meadows. We mapped over 300 wet meadows, for a total of 558 ac (226 ha) in the town. Most wet meadows were smaller than 2 ac (0.8 ha). The largest wet meadows occurred near the Webatuck Creek at the intersection of Sinpatch Road and Poplar Hill Road, northwest of Amenia Union Road, and near the center of the town east of Route 22 and the Harlem Valley rail trail.

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 page 80 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 (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 and soils. These conditions favor the establishment of a calcicolous plant community, including such species as sweetflag, lakeside sedge, New York ironweed, rough-leaf goldenrod, 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.* Ribbon snake* 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 Amenia

We documented over 40 calcareous wet meadows in the Town of Amenia (Figure 8), totaling 43 ac (17.4 ha). Most of these meadows were smaller than 1 ac (0.4 ha), with the largest being 4.8 ac (1.9 ha). 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 Amenia 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,* autumn willow, spike-muhly, sterile sedge, porcupine sedge, yellow sedge, woolly-fruit sedge, 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 rare 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 ribbon snake.* 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 Amenia

We mapped 83 fens in the Town of Amenia (Figure 8), which is an exceptionally large number for the size of the town. Most were less than 1 ac (0.4 ha), and the largest was 3.7 ac (1.5 ha). The quality of fens varied greatly: some were exemplary while others were being overgrown by tall forbs and shrubs. The fens were generally found in the calcareous valleys in the town, with concentrations in areas such as the Smithfield Valley, east of the hamlet of Amenia, and the Swift Pond area. 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 Amenia 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 Amenia 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.

Fringed gentian (*Gentianopsis crinita*)

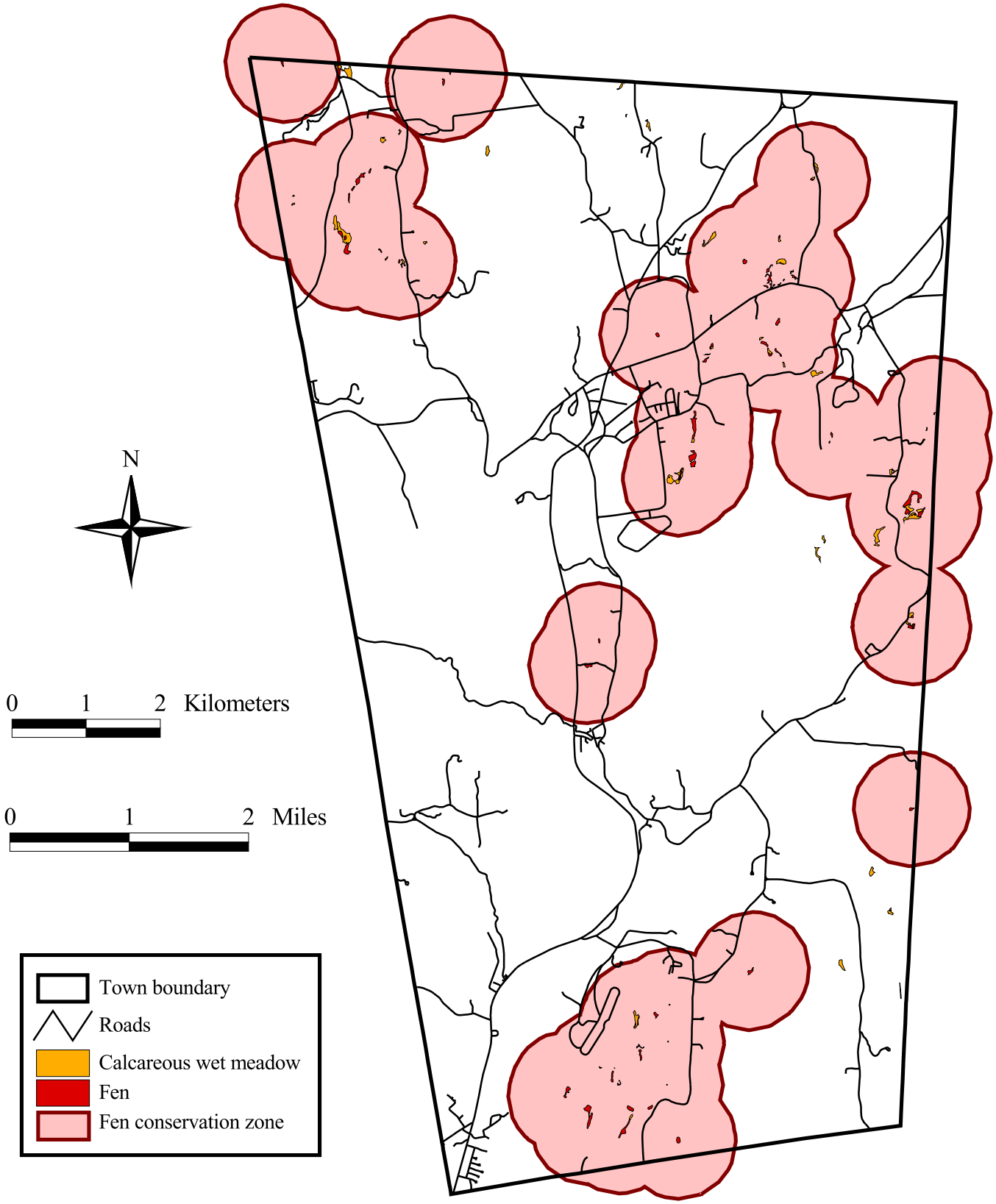


Figure 8. Fens, calcareous wet meadows, and fen conservation zones in the Town of Amenia, Dutchess County, New York. Fen conservation zones measure 2500 ft (750 m) from the fen edge. Hudsonia Ltd., 2006.

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 Amenia

We mapped 53 intermittent woodland pools in the Town of Amenia (Figure 9). Pools were distributed on the forested ridges, and all were smaller than 0.75 acre (0.3 ha), with an average size of 0.14 ac (0.06 ha). Because these pools are small and often difficult to identify from

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.

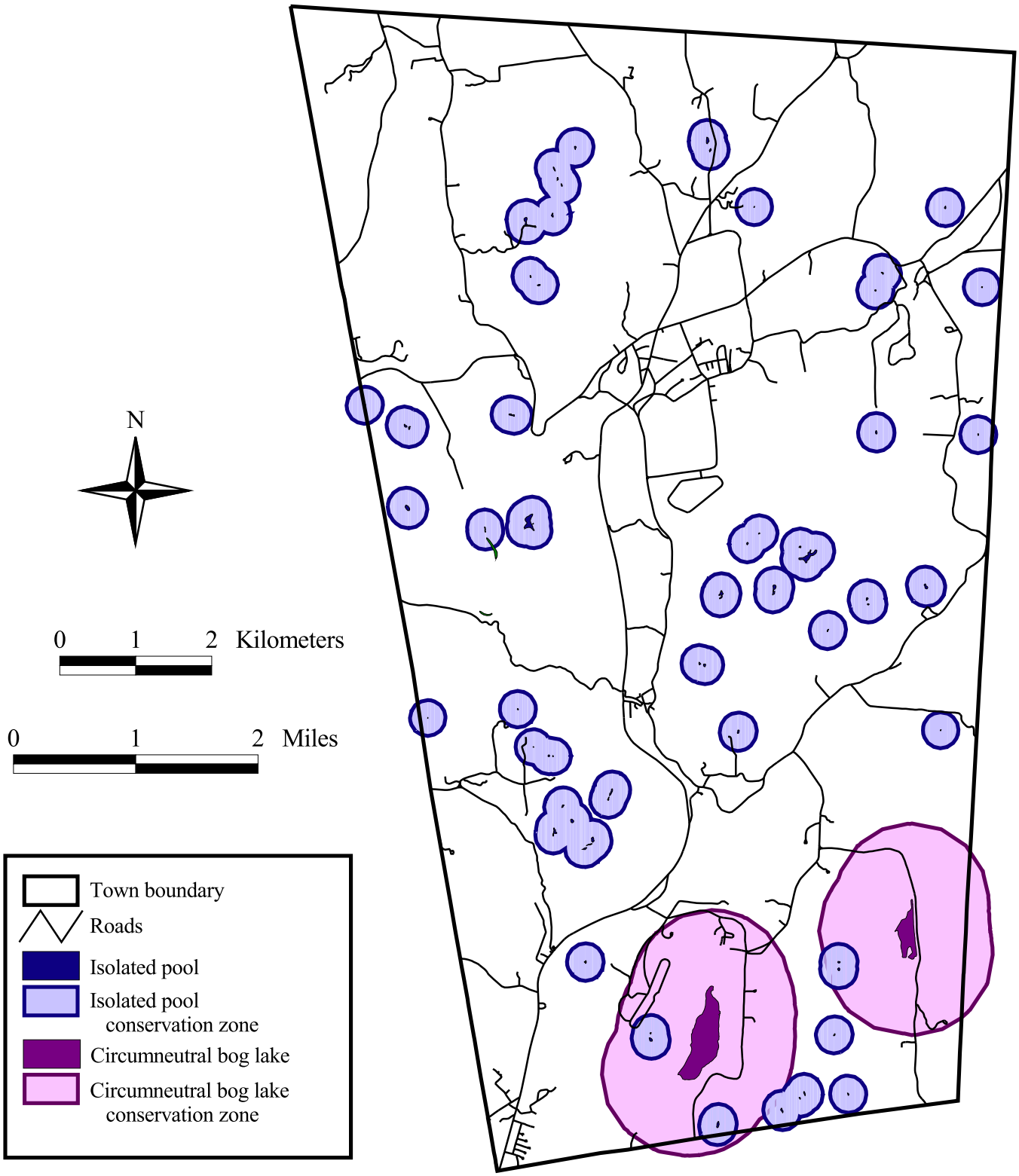


Figure 9. Isolated pools (intermittent woodland pools, heath swamps, buttonbush pools), circumneutral bog lakes, and associated conservation zones in the Town of Amenia, Dutchess County, New York. Woodland pool conservation zones extend 750 ft (230 m) and circumneutral bog lake conservation zones extend 3300 ft (1000 m) from wetland boundaries. Hudsonia Ltd., 2006.

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 Amenia

The majority of the water bodies we mapped in the Town of Amenia were constructed ponds. These ponds were most commonly maintained for ornamental purposes (and located within landscaped areas in close proximity to residences), constructed at active and abandoned mines, or used for agricultural purposes. Overall, we mapped nearly 170 constructed ponds within the town. 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.

All but seven of the constructed ponds we mapped were smaller than 5 ac (2 ha). The largest constructed pond was Round Pond, which is in the northeastern part of Amenia straddling the boundary between the towns of Amenia and Northeast. Constructed ponds with substantial cover of floating-leaved or emergent vegetation (e.g., pondweeds, common duckweed, 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 private yards. 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,* a state-listed plant, 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 Amenia

Natural open water areas are far less common than constructed ponds (see above) in the Town of Amenia. Of the 37 open water habitats we mapped, the great majority were smaller than 1 ac (0.4 ha). Two of the three largest open water areas were categorized as circumneutral bog lakes (see below). The remaining largest open water area was the southern Bog Hollow Pond, which measured over 40 ac (16 ha). At least four 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. Open water areas that supported abundant floating-leaved vegetation (e.g., pond-lilies, common duckweed) during the growing season were mapped as marshes.

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.

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 mats of vegetation that form on floating peat rafts are commonly present. Open water is often covered with pond-lilies; peat rafts and shoreline areas may support cattails, purple loosestrife, water-willow, alder, or leatherleaf. 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 ribbon snake,* 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.

Occurrence in the Town of Amenia

We identified two circumneutral bog lakes in the Town of Amenia: Swift Pond and the northern Bog Hollow Pond (Figure 9); other waterbodies that we did not visit may also be circumneutral bog lakes. Swift Pond was the largest body of water in Amenia, measuring approximately 79 ac (32 ha), and the Bog Hollow Pond measured 26 ac (10.5 ha). Swift Pond was surrounded by a mosaic of fen, marsh, shrub swamp, and upland habitats. Peat rafts have been documented there in the past (Kiviat, pers. comm.) and pond-lilies were abundant. The upper Bog Hollow pond was bordered mostly by hardwood and shrub swamp and marsh. Pond-lilies were abundant, and we found plants of both calcium-rich and acidic habitats on its shores.

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, groundwater extraction, or altered drainage. Mechanical disturbance or changes in surface water levels or chemistry could disrupt the floating vegetation mats. 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 avoided or minimized. Information about a circumneutral bog lake in the Town of Pine Plains can be found in Busch (1976). See the conservation priorities section for recommendations on preserving the habitat values of circumneutral bog lakes.

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 Northeast. 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 Amenia

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.

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 as an independent habitat type, but instead defined them according to buffer zones of a set width on either side of streams (Figure 11). 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 10). 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.

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,* and goldenseal.* 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 New York State Department of Environmental Conservation 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 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 Amenia

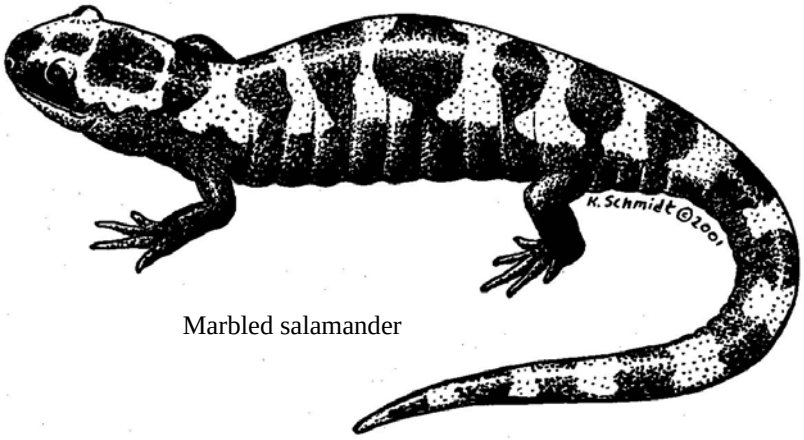
Perennial streams and their riparian corridors occupied the major valleys in the Town of Amenia. The largest stream in Amenia was the Tenmile River, and its largest tributaries were Webatuck Creek and Wassaic Creek. Amenia Stream was also a relatively large tributary which joined Wassaic Creek before its confluence with Webatuck Creek. There were many intermittent streams in the town as well (Figure 10).

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 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.



Marbled salamander

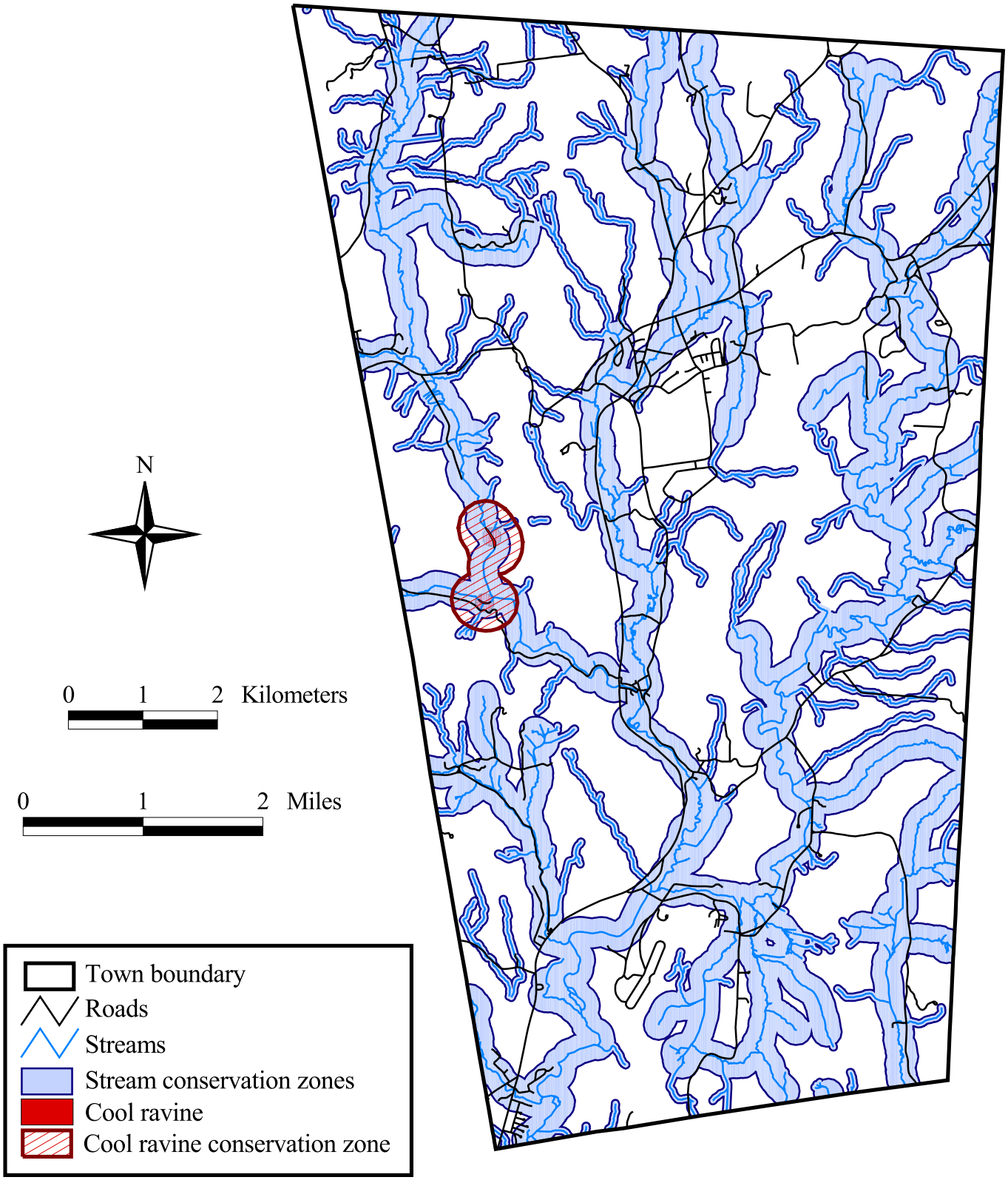


Figure 10. Streams, cool ravines, and associated conservation zones in the Town of Amenia, Dutchess County, New York. Streams have conservation zones extending at least 160 ft (50 m) on each side; large, perennial streams have conservation zones of 660 ft (200 m). Cool ravines have conservation zones of 1200 ft (360 m). Hudsonia Ltd., 2006.

CONSERVATION PRIORITIES IN AMENIA

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. The cumulative impacts of making decisions on a site-by-site basis alone, however, 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 in the region.

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 Amenia 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 town-wide 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 Town-wide Conservation Planning

The Town of Amenia 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 Amenia 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 Amenia may support some of the few remaining populations of bog turtle* in the region. The two circumneutral bog lakes may be the only places in Amenia that could support northern cricket frog.* Figures 7 through 10 illustrate some of the areas we have identified as having priority habitats and the conservation zones associated with them. These habitats are especially valuable if they are located within larger areas of intact and connected habitat.

Finally, this report identifies several Priority Conservation Areas (Figure 11). Each of these contains several priority habitat units in a relatively unfragmented landscape, and represents an area where biodiversity conservation efforts might be particularly effective.

The town-wide habitat map and this report provide a landscape perspective that can help the town establish conservation goals, priorities, and strategies. Taking a landscape approach to land use planning is much more likely to yield sound conservation decisions than the typical parcel-by-parcel approach. 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 town-wide 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 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 650 ft (200 m) of an intermittent woodland pool.
    - Avoiding disturbances that would disrupt the quantity or quality of groundwater available to onsite or offsite fens.
    - Channeling stormwater runoff from paved areas or fertilized turf into detention basins or "rain gardens" instead of directly into streams, ponds, or wetlands. Oil-water separators can also be installed where runoff leaves paved areas.

- 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 Amenia 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.

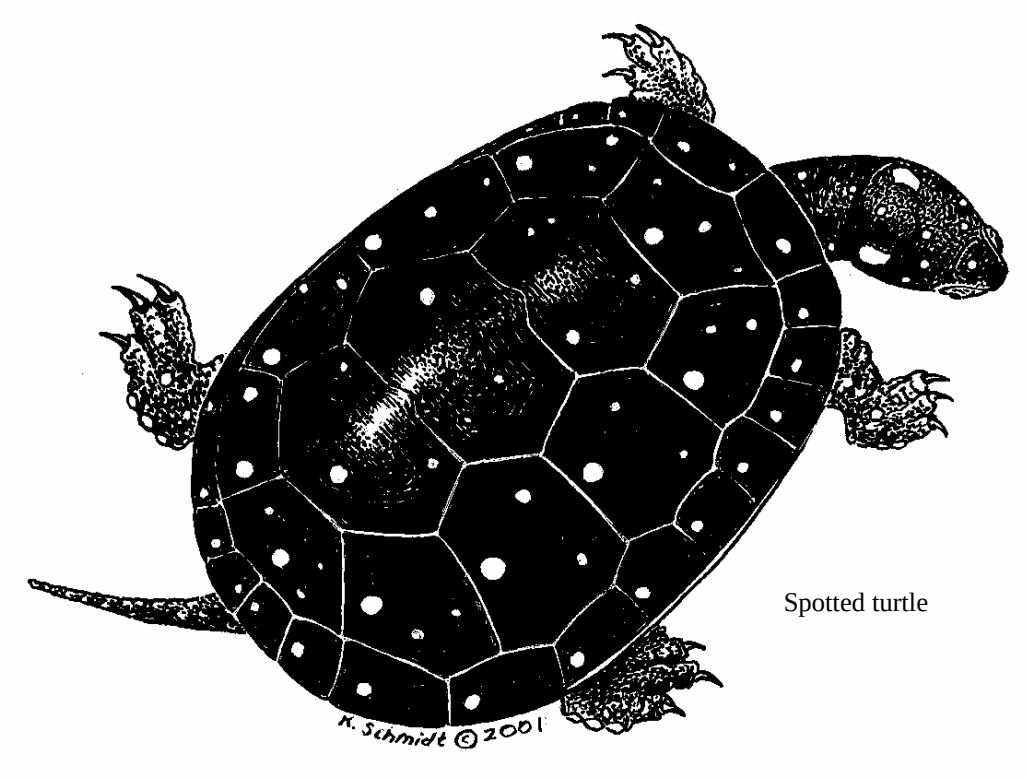
A variety of regulatory and non-regulatory means can be employed by a municipality to achieve its conservation goals, including volunteer conservation efforts, master planning, zoning ordinances, tax incentives, land stewardship incentives, permit conditions, land acquisition, conservation easements, and public education. Section four 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 recent 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 Department of Environmental Conservation 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 town-wide 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. Habitat restoration should be based on scientific research so that it ultimately has the intended positive impacts on biodiversity.



Spotted turtle

PRIORITY HABITATS IN AMENIA

Although much land in Amenia has been developed for residential uses, large areas of high-quality habitat still remain. By employing a proactive approach to land use and conservation planning, the Town of Amenia 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. Below we highlight some habitat types that we consider "priority habitats" for conservation in the Town of Amenia. While we hope this information will help the town think strategically about future land use planning, 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 of these species 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 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.

Table 2. Priority habitats, species of concern, and associated priority conservation zones identified by Hudsonia in the Town of Amenia, 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 - 200 ac (40 - 80 ha).	Required for moderate to high probability of supporting breeding scarlet tanagers and forest thrushes in a 50-60% 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
Crest/ledge/talus	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	Northern cricket frog*	3300 ft (1000 m) from shore.	Represents the reported overland distance traveled between wetlands.	Gray 1983
Wetland complexes	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 streams & riparian zones	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.

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. There were 22 patches greater than 100 ac (40 ha). The largest contiguous patches (over 1,000 ac [400 ha] each) occurred on Rattlesnake Ridge, East Mountain, Cascade Mountain, Turkey Hollow and the ridges on either side, and the ridge including the DEC Multiple Use Area west of Route 22. Extensive areas of forested crest, ledge, and talus occurred on these same ridges, while smaller areas of calcareous rock generally occurred in valley localities. The Amenia habitat map does not take into account the actual size of forest patches that extend beyond Amenia's boundary, but this is an important consideration in understanding the habitat value of these patches. Hudsonia mapped habitats in the Towns of Washington and Stanford in 2004 and 2005, and in the next two years will be mapping habitats in at least two other towns in northeastern Dutchess County. Once complete, this 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 decreased 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 50-60% forest cover, such as the Town of Amenia, scarlet tanager requires patches of at least 100 ac (40 ha) for high quality breeding habitat (Rosenberg et al. 1999); forest thrushes need a minimum of about 200 ac (80 ha) (Rosenberg et al. 2003). Forested rocky crests provide habitat for several rare reptiles (see crest, ledge, and talus section 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 Amenia, but the threat is imminent. Such an infestation could eliminate Amenia's hemlock forests within a few years, with devastating consequences to the biological communities of hemlock-associated habitats.

Recommendations

We recommend that the remaining blocks of large forest within the Town of Amenia 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 deep, mesic soils (as opposed to those on rocky areas), forests with an unusual tree species composition, or forests that have smaller, unusual habitats (such as calcareous crests) embedded in them.*
3. ***Maintain or restore broad corridors of intact habitat between large forested areas*** *(including connections across roads). This can sometimes be accomplished by protecting smaller forest patches that provide a connection between larger forest patches.*
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***.

COOL RAVINES

Target Areas

Amenia has many steep slopes and ravines with dense hemlock forest. We categorized two of these, found in Turkey Hollow and Deep Hollow, as "cool ravines" based on their physical structure, vegetation, and cool microclimate.

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 the 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. 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 1989, 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.*

LARGE MEADOWS

Target Areas

Large and contiguous patches of meadow, particularly pasture, hayfields, and old fields, can be valuable wildlife habitats. In Amenia, some of these meadow complexes exceeded 350 ac (142 ha), and the largest single meadow was 158 ac (64 ha). 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 little shrub cover (i.e., some herbaceous cover). The largest wet meadows occurred along Webatuck Creek northwest of Amenia Union 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 Northeast have declined dramatically in recent decades due to habitat loss, as meadows are lost and fragmented by the intensification of agriculture, regrowth of forest, 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 cause decreased 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 6 illustrates how meadow patch sizes differ when hedgerows and fences are taken into account. Although Amenia has over 7,500 ac (3,035 ha) of upland meadow, only 55 of those are greater than 25 ac (10 ha), the minimum preferred area for savannah sparrow to nest, and just 18 are large enough to support vesper sparrow (50 ac [20 ha]). The largest single meadow is 158 ac (64 ha); this is only marginal habitat 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 Northeast 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 small 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 raccoon. Meadows and the rare species they support are also highly susceptible to other human activities such as mowing, conversion to crop agriculture, application of pesticides, and ATV traffic.

Recommendations

In cases where landowners 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 Northeast:

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 Amenia 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.

CREST, LEDGE, AND TALUS

Target Areas

Extensive areas of crest, ledge, and talus occurred on East Mountain, Rattlesnake Ridge, Cascade Mountain, the ridge southwest of Deep Hollow Road and Route 22, and the ridge east of Turkey Hollow. We noted the locations of seven crest oak woodlands on some of these larger ridges, as well as on Peaked Mountain (north of Bog Hollow Road) and the small ridge east of Cascade Mountain. We found calcareous rock outcrops and talus areas at the lower edges of these ridges and on smaller ridges and hills within the valley areas. Many of these small calcareous hills were described as marble knolls (see below).

Conservation Issues

Crest oak woodland is a plant community type found on especially rocky, high elevation ridges and mountains in Amenia. In the past, crest oak woodlands 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. The more open, dry woodlands occurring along hill summits and ridge tops are often viewed as prime sites for communication towers. These woodlands and crests are also frequented by people seeking scenic views, and thus are often

subjected to ATV and foot traffic. All such disturbances can severely degrade these habitats and expose rare reptiles (see below) to fatal encounters with humans.

By virtue of their more lowland location and marble rock, calcareous crest, ledge, and talus areas have generally been subjected to more regular disturbances and development pressures than the high ridges. The marble bedrock weathers to form sandy soils, which make these calcareous rocky areas highly susceptible to erosion. These areas provide habitat for rare plants and animals, and in Amenia are typified by marble knolls (see below).

Crests, ledges, and talus in forested areas provide core habitat for several rare reptiles that require rocky outcrops and unshaded conditions at crucial stages in their life cycle. Five-lined skink* typically uses crest, ledge, and talus habitats throughout the year for basking, foraging, and shelter. Snakes such as northern copperhead* may only use open rocky habitats at key times of the year, including for spring basking and breeding.

Timber rattlesnake,* a Threatened species in New York State, has been reported from all of the mountainous areas in Amenia (S. Ringler, unpublished data). However, populations of timber rattlesnake have been declining in the northeastern United States due to loss or disturbance of habitat, collections for live trade, and malicious killing (Brown 1993, Klemens 1993). The protection of this species in the Taconic mountains region is important for the species' viability in the northeast (Klemens 1993). Timber rattlesnakes den in ledge and talus areas in somewhat open deciduous forests, such as 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 miles (6.4 km) from the den, but the average travel distance is closer to 2 miles (3.2 km). To protect most of the snakes in a given population, undisturbed habitat with a radius of 1.5 miles (2.4 km) from the den is a minimum (Brown 1993).

Perhaps one of the greatest threats to the long-term viability of the rare animals associated with crest, ledge, and talus is the isolation of these habitats from one another. The low-lying valley areas between ridge-top complexes are often seen as prime development sites. The construction of houses, roads, and other structures in these areas isolates habitats 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 other environmental conditions and make them more prone to local extinction.

Recommendations

The following guidelines will help protect fragile crest, ledge, and talus habitats and the sensitive species associated with them. (Additional recommendations more specific to calcareous rocky areas are found in the marble knoll section below).

1. ***Minimize the building of new roads, houses, and other developments on rocky, high elevation ridgetops***.
2. ***Protect crest, ledge, and talus areas from disturbances associated with high intensity human recreation****, including soil erosion, trampling of sensitive plants, and direct injury to or disturbance of animals.*
3. ***Maintain intact habitats in the areas between crest oak woodlands*** *to allow for dispersal of plant and animal populations.*
4. ***Avoid direct disturbance to timber rattlesnake dens****, and minimize logging to the winter months when the snakes are hibernating (Brown 1993).*
5. ***Consult with the Endangered Species Unit of the New York State Department of Environmental Conservation*** *about any activity proposed in the vicinity of a timber rattlesnake habitat.*

MARBLE KNOLLS

Target Areas

We mapped 13 marble knolls in the valleys of Amenia, and we expect there are several more in places we could not field check.

Conservation Issues

Marble knolls are unusual habitats known to support many rare species of plants and animals (Kiviat 1988). Many of Amenia'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 83 fens and over 40 calcareous wet meadows in the Town of Amenia. This number is probably an underestimate, since these habitats can only be positively identified in the field. The exceptionally high number of these uncommon habitats in Amenia is reflective of the calcareous bedrock underlying the town's valleys.

Conservation Issues

Fens and calcareous wet meadows are uncommon in the Northeast 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 Amenia 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 Amenia has an unusual number of fen habitats, 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 Amenia 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 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 roads, residences, driveways, parking lots, sewer lines, utility lines, stormwater or sedimentation basins, or other structures.
- 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 New York State Department of Environmental Conservation. 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).
    - Delineation of lot lines for development, even if the proposed building or structure will not be in the wetland.
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 New York State Department of Environmental Conservation using the most up-to-date scientific information on this species and its sensitive habitats.

INTERMITTENT WOODLAND POOLS

Target Areas

We identified and mapped more than 50 intermittent woodland pools in the Town of Amenia, and we believe this to be an underestimate. 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.

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 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 sediment 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.*
- *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 (in consultation with the New York State Department of Environmental Conservation) to keep amphibians out of the active construction areas.*
6. ***Consult with the Endangered Species Unit of the New York State Department of Environmental Conservation*** *regarding any activity proposed within this intermittent woodland pool conservation zone.*

CIRCUMNEUTRAL BOG LAKES

Target Areas

The two circumneutral bog lakes we mapped in Amenia were Swift Pond, west of Poplar Hill Road, and the northern Bog Hollow pond, west of Bog Hollow Road. Swift Pond was surrounded by continuous habitats, while the northern Bog Hollow pond had some adjacent developed area and only a small strip of swamp separating it from Bog Hollow Road. Both lakes lacked public access.

Conservation Issues

The unusual water chemistry, hydrology, and sediments of circumneutral bog lakes may combine to provide critical habitat for a number of organisms. Northern cricket frog,* for example, is rapidly declining in the northern part of its range, and is listed as Endangered in New York, where it occurs in only three counties. In most of this region, its breeding habitat is restricted to circumneutral bog lakes (Dickinson 1993). Males prefer gently-sloping banks and floating peat and aquatic vegetation to use as calling sites. The species seems to have greater reproductive success at sites with buffered (circumneutral) pH conditions (Sparling et al. 1995) and with abundant submerged vegetation which provides shelter for tadpoles (Beasley et al. 2005). This vegetation can be affected by herbicide application or herbicide-contaminated runoff into the lake, and water quality is reduced by fertilizers and other nutrient additions, as well as sedimentation. Northern cricket frog* also uses specific overwintering sites, e.g., deep cracks in moist soil that may occur at the perimeters of these lakes. Such microsites can be destroyed by pond dredging or clearing of surrounding vegetation (Irwin 2005). Individual cricket frogs have been known to disperse between ponds up to 0.8 miles (1.3 km) apart (Gray 1983), and based on the distribution of suitable habitats in this region they can probably disperse much farther (Dickinson 1993). It is not known whether they disperse overland or use riparian corridors.

Recommendations

1. ***Maintain water quality***. *Reduce or eliminate use of fertilizers and pesticides on nearby agricultural fields and lawns; minimize soil disturbance around the circumneutral bog lake and upstream; upgrade nearby septic systems to prevent nutrient enrichment; minimize runoff from roads and other impervious surfaces; avoid the use of herbicides for aquatic weed control.*
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 northern cricket frog overwintering sites. The contiguous habitats around Swift Pond currently meet this buffer recommendation and should be preserved. The buffer zone around the northern Bog Hollow Pond is compromised by residential areas and Bog Hollow Road. Additional development in this buffer area should be discouraged, and road treatments (such as salting or sanding) should be kept to a minimum.*
4. ***Protect habitats and assess potential impacts within 3,300 ft (1,000 m) of the lake edge***. *Development within this area may sever important travel corridors between northern cricket frog breeding habitats.*
5. ***If any significant land use changes are proposed in the vicinity, we recommend that rare species surveys be conducted in the pond 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 future 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 fish that may disrupt the lake's food web***, *including grass carp (which is used as a biological weed control) or game fish.*

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, a large and variable wetland complex in Smithfield Valley included hardwood swamp, marsh, wet meadow, calcareous wet meadow, and fen. Bog Hollow in the southeast of the town is a wetland complex that included open water (and a circumneutral bog lake), hardwood swamp, marsh, and calcareous wet meadow. The Swift Pond area included swamp, marsh, fen, and wet meadows adjacent to the circumneutral bog lake. There were additional examples of wetland complexes elsewhere in Amenia.

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, shrub pools, and fens and their conservation zones*** *as described elsewhere in this report (pages 85-92). 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.*

Wetland complexes vary enormously, and can be difficult to define on a map. In general, look for areas with a moderate to high density of wetland habitats that are not intersected by roads or development.

STREAMS AND RIPARIAN CORRIDORS

Target Areas

Tenmile River, Wassaic Creek, Webatuck Creek, Amenia Stream, and Bog Hollow Brook were the major perennial waterways in Amenia. 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.

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 affects 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 protective buffer 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 protective buffer 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. Buffer 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 specifications, 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):

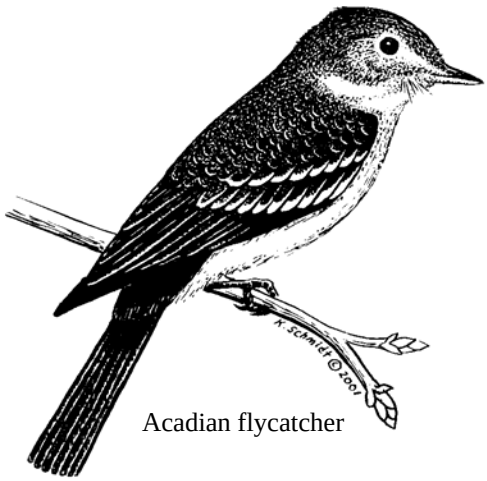
- Use bridges and open-bottomed arches instead of culverts.
- Use structures that span at least 1.2 times the full width of the stream so that one or both banks remain in a semi-natural state beneath the structure. This may promote the overland passage of turtles and other wildlife.
- Design the structure 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 priority 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 new and 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) corridor (e.g., upland meadows, upland shrublands, waste ground with exposed gravelly soils) be protected from development and other disturbance.*



Acadian flycatcher

PRIORITY CONSERVATION AREAS IN AMENIA

We have identified eight locations in Amenia that encompass several of the priority habitats described above, and we recommend these places as priorities for conservation (Figure 11). Below we discuss the features that make these especially valuable to biodiversity conservation. The Town of Amenia has a wealth of habitats worthy of protection, however, and we stress that the list below does not include all of the areas in Amenia deserving conservation attention. Rather, these are areas where habitat loss would be especially detrimental. We recognize that these are large areas belonging to multiple property owners, and that it may prove difficult to apply effective conservation measures to an entire Priority Conservation Area. However, any conservation action within these is likely to have disproportionately large returns for biodiversity as compared with other areas. It is also important to note that effective protection of some of the habitats included in these Priority Conservation Areas will require conservation of lands extending beyond these areas. For conservation issues and recommendations for each habitat type, refer to the preceding sections.

Amenia Fen Complex

This area encompasses much of the valley that contains the hamlet of Amenia, extending north to Sharon Station Marsh, south just past Depot Hill Road, and west to Route 22. The whole valley is underlain by Stockbridge marble, so the low hills and intervening small valleys are highly calcareous and contain many uncommon habitats. The habitat units are fragmented by development in and around the hamlet of Amenia, including by Route 343, the Harlem Valley Rail Trail, and Prospect Avenue. Despite these barriers, we consider this to be a single Priority Conservation Area because it was hydrologically interconnected and encompassed many clusters of similar habitats. The most important of these were:

- Marble knolls. We observed five marble knoll areas in the hills just east of the Harlem Valley Rail Trail. These marble knolls supported red cedar, shrubby cinquefoil, and other calcicolous plants, and appeared to be suitable habitat for rare plant species. On the large format map we also marked areas (with question marks) that we were unable to visit in the field and may also be marble knolls.

- Numerous fens. These were clustered into five main areas, which unfortunately were separated by development and major highways (especially Route 343 and Prospect Avenue). Many of these fens appeared to be high quality habitat for rare plants and animals. There could be other fens in areas we did not field check, especially in the large wetland between the Price Chopper shopping center and Route 343.
- Large wetland complexes. The fens all occurred as part of larger wetland complexes that included hardwood and shrub swamp, wet meadow, calcareous wet meadow, and marsh. We documented an uncommon, native species of burning-bush (wahoo) in one swamp. Sharon Station Marsh was a large marsh with areas of open water, providing habitat for spotted turtle,* waterfowl, and other wildlife.

Bog Hollow/East Mountain

This area includes the wetlands in Bog Hollow and the forested ridges to the west (East Mountain) and the east (including Peaked Mountain). The ridges, in addition to providing a large extent of unbroken forest habitat, comprise much of the watershed for Bog Hollow, so will directly influence the Bog Hollow wetland quality. Priority habitats included:

- A circumneutral bog lake. The northernmost body of water in Bog Hollow supported both calcicolous flora such as swamp thistle, watershield, and rough-leaf goldenrod, and acidic bog flora such as leatherleaf and sundew* (D. Reagon, pers. comm.). This area has the potential to support northern cricket frog.*
- Extensive upland conifer, mixed, and hardwood forest. We encountered the regionally rare plant pinesap* under a conifer canopy on East Mountain. Uncommon or vulnerable songbirds such as hermit thrush,* wood thrush,* and eastern wood-pewee* have been reported from this forest.
- Many isolated wetlands including intermittent woodland pools, mixed forest swamps, and a heath swamp.
- Rocky crest, ledge, and talus habitat. A large population of timber rattlesnake* occurred historically on East Mountain, and this species may still inhabit the area.

Leedsville Road Ridge

This area includes most of the low ridge just east of Leedsville Road. The bedrock of this ridge is predominantly Stockbridge marble, which supports high-quality calcareous habitats such as fens, marble knolls, and conifer swamps.

- Over five acres (2 ha) of fen. A wetland complex including several fens was located at the base of the south end of the ridge. This large patch of fen appeared to be excellent habitat, and supported a large population of fringed gentian.*
- Marble knolls. We observed several patches of open red cedar woodland on marble hillsides that may be good habitat for rare plants. Purple cliffbrake,* an uncommon fern, was locally abundant on the ridge. We also encountered a fairly large, dense patch of shrubby St. Johnswort,* a state-listed rare shrub.
- Conifer swamps. This ridge supported many calcareous, seepy swamps dominated by red cedar, as well as steep hillsides with springs and seeps with similar vegetation. Ground cover under the red cedars was mossy or sedge-dominated, and grass-of-Parnassus* was common, along with other plants ordinarily associated with fens.

Rattlesnake Ridge

This area includes the entire forested upland area of Rattlesnake Ridge, as well as an adjacent small hill to the northeast. Important habitats included:

- Extensive upland hardwood, mixed, and conifer forest. Large conifer forests are uncommon in Dutchess County, which makes ridges like Rattlesnake of particular importance in regional conservation. The forests on the ridge were for the most part fairly young (perhaps 50-80 yrs), and appeared to have been selectively logged, as evidenced by the networks of old logging roads, shrubby gaps, and patchy regrowth of saplings. However, the age of the forest is not as important as its extent (almost 1,900 ac [770 ha]). Large, unbroken areas of forest are critical for the survival of many species, including forest birds. We observed barred owl,* Cooper's hawk,* American woodcock,* and brown creeper. The frequent occurrence of maidenhair fern (and a single sighting of four-leaf milkweed*) indicated that soils may be calcareous.

- Many rocky outcrops and ledges. Most of the rocky areas we visited were acidic but there were a few calcareous ledges. Timber rattlesnake,* which uses rocky areas for basking, breeding, and den sites, has been found historically on the ridge.
- Abundant small, isolated wetlands. These hardwood and shrub swamps, mixed forest swamps, intermittent woodland pools, and a buttonbush pool were scattered in depressions along the ridgetop. Two of the swamps, described as heath swamps, had deeper water and many heath shrubs. We observed wood frog,* marbled salamander,* spotted salamander,* and spotted turtle* in pools on the ridge.
- A marble knoll and patches of fen. These occurred adjacent to the northeast side of the ridge, in the calcareous valley.

Smithfield Valley

A large, calcareous wetland complex runs the length of Smithfield Valley. Primary land uses in the valley were pasture for cattle and horses, hayfields, and row crops. Due to past and present agricultural activity in the valley, the wetlands have probably been altered in various ways by nutrient additions, grazing, and soil compaction. Noteworthy habitats included:

- Fens. Smithfield Valley fens ranged from highly diverse, high quality habitat to areas overgrown with non-fen vegetation. Many areas of calcareous wet meadow, marsh, and shrub swamp may have been fen in the past, and have the potential to be restored.
- Large wetland complex. Extending from north of the Presbyterian Church south to Route 44, this complex of swamp, marsh, wet meadow, and fen covered over 285 ac (115 ha). Bur oak,* a regionally rare tree, grows at the edges of some fens in this complex.
- Wassaic Creek. Land uses in the area influence water quality downstream in this major tributary of the Tenmile River.

Swift Pond/Cleaver Swamp

Located between the railroad and Poplar Hill Road, this area of calcareous hills and valleys underlain by marble included:

- Swift Pond, a circumneutral bog lake. We observed wood duck,* and tundra swan and river otter* were historically reported here (E. Kiviat, pers. comm.).

- Cleaver Swamp, a marshy wetland complex. Deep peat and rare species such as wood duck* and breeding pied-billed grebe* have been observed here (E. Kiviat, pers. comm.).
- Several high-quality fens. Some were associated with larger wetland complexes around Swift Pond and Cleaver Swamp. Others were hydrologically isolated in upland areas, which is rare in Amenia. We found several rare or uncommon plants in fens in this area, including big bluestem,* pitcher-plant,* roundleaf sundew,* and buckbean.*
- Marble knolls. We visited two adjacent and exceptionally high-quality marble knolls in this area, which supported regionally rare or uncommon plants such as purple cliffbrake,* wall-rue,* fringed gentian,* and grass-of-Parnassus.*
- Isolated pools. Two intermittent woodland pools and a buttonbush pool were also found within this area.

Deep Hollow/Turkey Hollow

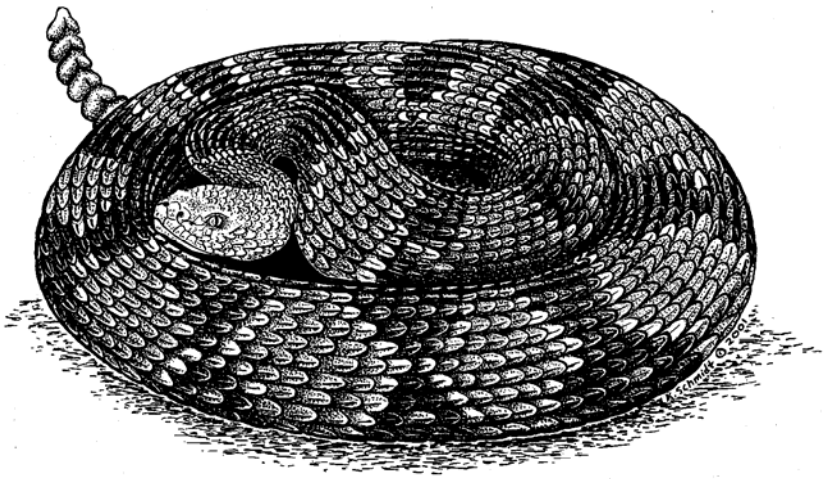
This area includes the steep forested valley of Wassaic Creek and the forested ridges on either side of it, between Route 44, and Tower Hill Road. Important habitats included:

- Wassaic Creek. We observed juvenile snapping turtle in a pool near the creek, and brook trout* have been reported from this creek in the past (E. Kiviat, pers. comm.).
- Two cool ravines, one along Wassaic Creek north of the dam, and one on a smaller tributary of the Wassaic just west of the dam. Cool ravines are rare in the region, and the two we observed in this area were the only ones we found in Amenia. Acadian flycatcher* nests in cool ravines and is known to occur in Deep Hollow (Bowman and Bunch 1976). This is also one of few known breeding localities for dark-eyed junco* in the county (DeOrsey and Butler 2006).
- Extensive upland hardwood, mixed, and conifer forest. We observed barred owl* and black bear* sign in this area. Uncommon plants such as silvery spleenwort,* Dutchman's breeches,* red baneberry,* and blue cohosh,* and nesting birds such as scarlet tanager,* black-and-white warbler,* and hermit thrush* have also been reported from this forest (E. Kiviat, pers. comm.).

- Isolated wetlands on ridges, including 12 intermittent woodland pools, many isolated hardwood swamps, and nine mixed forest swamps. We classified three of the swamps we observed as buttonbush pools, and one as a heath swamp. We observed spotted salamander,* marbled salamander,* and wood frog* in some of these pools.

Webatuck-Tenmile Riparian Corridor

The Tenmile River was the largest stream in the Town of Amenia, and an important tributary of the Housatonic River. Its two main tributaries were Webatuck and Wassaic creeks. These areas provide habitat for many plants and animals, including great blue heron* and wood duck*. The riparian corridors of these creeks also serve as important links between habitats throughout the town. They are essential for maintaining stream water quality in the Town of Amenia and all other downstream reaches.



Timber rattlesnake

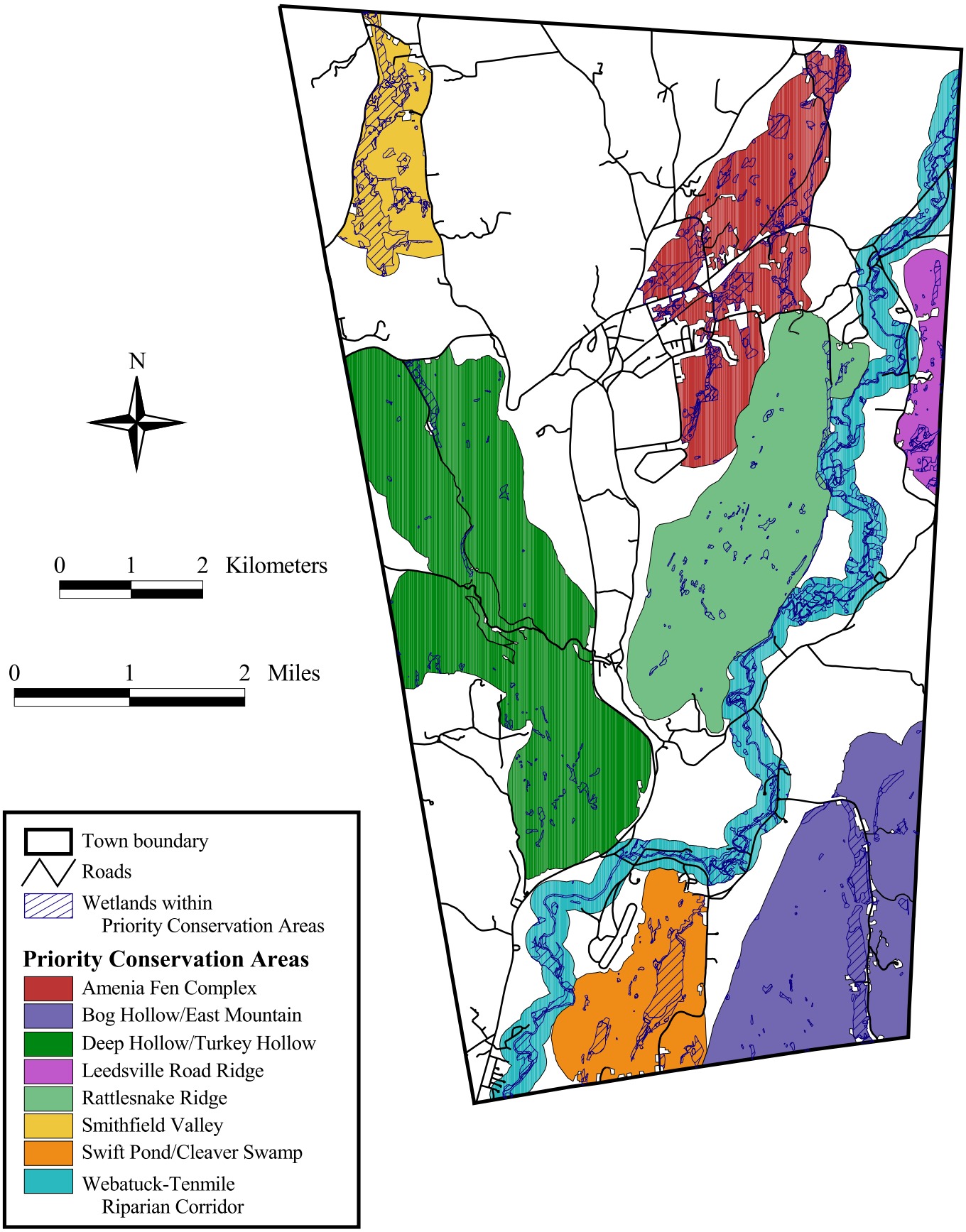


Figure 11. Priority Conservation Areas in the Town of Amenia, Dutchess County, New York. The map shows areas with especially high biodiversity value, but does not depict all areas of conservation concern. Hudsonia Ltd., 2006.

CONCLUSION

There are significant opportunities for biodiversity conservation in the rural landscape of the Town of Amenia. 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. Through our habitat mapping work, Hudsonia hopes to 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 Amenia, 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, it is important for the town to 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 Amenia 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, to integrate the needs of the human community with those of the natural communities, and to protect the ecological patterns and processes that support the us and the rest of the living world.

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John & Karen Klopp
Sharon Kroeger
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Richard & Ellen Levine
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James Preston
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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.

Hardwood and shrub swamp. We used the term "isolated pools" to describe two special kinds of swamps: heath swamps and buttonbush pools (see subcategories section below). When these isolated pools are embedded in a large, upland forest habitat they may function very similarly to intermittent woodland pools for amphibian breeding and other wildlife uses.

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 Amenia were probably created by damning 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 Amenia 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.

Subcategories. In some places we identified habitats to a more specific category than the mapped habitat type. These included crest oak woodlands as a type of crest/ledge/talus (and upland hardwood forest) habitat, marble knolls as a type of calcareous crest, and heath shrub swamp and buttonbush pools as a 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 Amenia 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. Lands managed for upland game birds on hunting preserves were mapped as either upland meadow or upland shrubland depending on the amount of shrub 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 Amenia. These are not comprehensive lists, but merely a sample of the species of conservation concern known to use these habitats in the region. The two-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), 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 ranking systems are explained in Appendix C.

UPLAND HARDWOOD FOREST		
Plants	***Vertebrates (cont.)***	***Vertebrates (cont.)***
silvery spleenwort (RG)	marbled salamander (SC, S3)	scarlet tanager (PIF2)
American ginseng (RG)	eastern box turtle (SC)	cerulean warbler (SC, PIF1)
red baneberry (RG)	northern goshawk (SC, S3N)	Kentucky warbler (S2, RG, PIF1)
blue cohosh (RG)	red-shouldered hawk (SC)	black-and-white warbler (PIF2)
leatherwood (RG)	Cooper's hawk (SC)	black-throated blue warbler (RG)
hackberry (RG)	sharp-shinned hawk (SC)	black-throated green warbler (RG)
sweet-gum (RG)	broad-winged hawk (RG)	ovenbird (RG)
Vertebrates	American woodcock (RG, PIF1)	southern bog lemming (RG)
wood frog (RG)	barred owl (RG)	Indiana bat (E, S1)
spotted salamander (RG)	eastern wood-pewee (RG, PIF2)	black bear (RG)
Jefferson salamander (SC, S3)	Acadian flycatcher (S3)	bobcat (RG)
blue-spotted salamander (SC, S3)	wood thrush (RG, PIF1)	New England cottontail (SC, SH)

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

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

RED CEDAR WOODLAND		
Plants	***Vertebrates***	***Vertebrates (cont.)***
Carolina whitlow-grass (T, S2)	Blanding's turtle (T, S2S3)	long-eared owl (RG)
yellow wild flax (T, S2)	wood turtle (SC)	short-eared owl (E, S2, PIF1)
Bicknell's sedge (T, S3)	eastern box turtle (SC, S3)	eastern bluebird (RG)
Indian grass (RG)	eastern hognose snake (SC)	eastern towhee (PIF2)
Invertebrates	northern harrier (T, S3B, S3N)	brown thrasher (PIF2)
olive hairstreak (butterfly) (RG)	northern saw-whet owl (S3)	field sparrow (PIF2)

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)
eastern prickly-pear (RG)
whorled milkwort (RG)
rock sandwort (RG)
downy arrowwood (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)
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
eastern box turtle (SC)
five-lined skink (RG)
black rat snake (RG)
northern copperhead (RG)
eastern hognose snake (SC)
worm snake (SC)
timber rattlesnake (T, S3)

Vertebrates (cont.)
slimy salamander (RG)
marbled salamander (SC)
Fowler's toad (RG)
turkey vulture (RG)
golden eagle (E, SHB, S1N)
whip-poor-will (SC, PIF2)
common raven (RG)
winter wren (RG)
eastern bluebird (RG)
hermit thrush (RG)
Blackburnian warbler (RG, PIF2)
cerulean warbler (SC, PIF1)
worm-eating warbler (RG, PIF1)
small-footed bat (SC, S2)
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)
side-oats grama (E, S1)
Emmons' sedge (S3)
yellow wild flax (T, S2)
Carolina whitlow-grass (T, S2)
hairy rock-cress (RG)

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

Invertebrates
anise millipedes (RG)

Invertebrates (cont.)
olive hairstreak (butterfly) (RG)

Vertebrates
five-lined skink (RG)
eastern hognose snake (SC)
northern black racer (RG)
black rat snake (RG)
northern copperhead (RG)

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 (RG)
northern blazing star (S2)
large twayblade (E, S1)
Torrey's mountain mint (E, S1)

Vertebrates
eastern hognose snake (SC)
worm snake (SC)
Fowler's toad (RG)
northern saw-whet owl (RG)

UPLAND SHRUBLAND

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

Invertebrates
Aphrodite fritillary (butterfly) (RG)
dusted skipper (butterfly) (S3)
Leonard's skipper (butterfly) (RG)
cobweb skipper (butterfly) (RG)

Vertebrates
wood frog (RG)

Vertebrates (cont.)
Blanding's turtle (T, S2S3)
spotted turtle (SC)
eastern box turtle (SC)
wood turtle (SC)
northern harrier (T, S3B, S3N)
short-eared owl (E, S2, PIF1)
northern saw-whet owl (RG)
loggerhead shrike (E, S1B)
blue-winged warbler (PIF1)
golden-winged warbler (SC, PIF1)

Vertebrates (cont.)
prairie warbler (PIF1)
yellow-breasted chat (SC)
clay-colored sparrow (S2)
vesper sparrow (SC)
grasshopper sparrow (SC, PIF2)
Henslow's sparrow (T, S3B, PIF1)
eastern towhee (PIF2)
brown thrasher (PIF2)
field sparrow (PIF2)

UPLAND MEADOW

Invertebrates
Aphrodite fritillary (butterfly) (RG)
dusted skipper (butterfly) (S3)
Leonard's skipper (butterfly) (RG)
swarthy skipper (butterfly) (RG)
Vertebrates
Blanding's turtle (T, S2S3)
spotted turtle (SC)

Vertebrates (cont.)
eastern box turtle (SC)
wood turtle (SC)
northern harrier (T, S3B, S3N)
upland sandpiper (T, S3B, PIF1)
sedge wren (T, S3B, PIF2)
eastern bluebird (RG)

Vertebrates (cont.)
savannah sparrow (RG)
vesper sparrow (SC)
grasshopper sparrow (SC, PIF2)
Henslow's sparrow (T, S3B, PIF1)
bobolink (RG)
eastern meadowlark (RG)

WASTE GROUND

Plants
hair-rush (RG)
toad rush (RG)
orangeweed (RG)
field-dodder (S3)
slender pinweed (T, S2)
rattlebox (E, S1)
blunt mountain-mint (T, S2S3)

Plants (cont.)
slender knotweed (R, S3)
Vertebrates
Blanding's turtle (T, S2S3)
wood turtle (SC)
Fowler's toad (RG)
eastern hognose snake (SC)
northern copperhead (RG)

Vertebrates (cont.)
American black duck (RG, PIF1)
common raven (RG)
grasshopper sparrow (SC, PIF2)
Henslow's sparrow (T, S3B, PIF1)
bank swallow (RG)

SWAMP

Plants
swamp cottonwood (T, S2)
ostrich fern (RG)
wood horsetail (RG)
Invertebrates
phantom cranefly (RG)
Vertebrates
blue-spotted salamander (SC)

Vertebrates (cont.)
four-toed salamander (RG)
spotted turtle (SC)
wood turtle (SC)
Blanding's turtle (T, S2S3)
eastern box turtle (SC)
great blue heron (RG)
wood duck (RG, PIF2)

Vertebrates (cont.)
red-shouldered hawk (SC)
American woodcock (RG, PIF1)
barred owl (RG)
white-eyed vireo (RG)
eastern bluebird (RG)
prothonotary warbler (S2, PIF1)
Canada warbler (RG, PIF1)

MARSH

Plants
winged monkey-flower (R, S3)
buttonbush dodder (E, S1)
spiny coontail (T, S3)
Vertebrates
northern cricket frog (E, S1)
northern leopard frog (RG)
Blanding's turtle (T, S2S3)

Vertebrates (cont.)
spotted turtle (SC)
American bittern (SC)
least bittern (T, S3B, S1N)
great blue heron (RG)
wood duck (RG, PIF2)
American black duck (RG, PIF1)
king rail (T, S1B, PIF1)

Vertebrates (cont.)
Virginia rail (RG)
sora (RG)
common moorhen (RG)
marsh wren (RG)
northern harrier (T, S3B, S3N)
pied-billed grebe (T, S3B, S1N)

WET MEADOW

Invertebrates
mulberry wing (butterfly) (RG)
black dash (butterfly) (RG)
two-spotted skipper (butterfly) (RG)
meadow fritillary (butterfly) (RG)
Baltimore (butterfly) (RG)
bronze copper (butterfly) (RG)
eyed brown (butterfly) (RG)

Invertebrates (cont.)
Milbert's tortoiseshell (butterfly) (RG)
phantom cranefly (RG)
Vertebrates
ribbon snake (RG)
spotted turtle (SC)
northern harrier (T, S3B, S3N)
American bittern (SC)

Vertebrates (cont.)
Virginia rail (RG)
American woodcock (RG, PIF1)
sedge wren (T, S3B, PIF2)
Henslow's sparrow (T, S3B, PIF1)
southern bog lemming (RG)

FEN/CALCAREOUS WET MEADOW

Plants
slender lady's tresses (RG)
small-flowered agrimony (S3)
bog valerian (E, S1S2)
Schweinitz's sedge (T, S2S3)
handsome sedge (T)
ovate spikerush (E, S1S2)
showy ladyslipper (RG)
spreading globeflower (R, S3)
swamp birch (T, S2)
scarlet Indian paintbrush (E, S1)
grass-of-Parnassus (RG)
Kalm's lobelia (RG)

Plants (cont.)
rose pogonia (RG)
roundleaf sundew (RG)
wood horsetail (RG)
alder-leaf buckthorn (RG)
buckbean (RG)

Invertebrates
Gammarus pseudolimnaeus (amphipod) (RG)
Pomatiopsis lapidaria (snail) (RG)
forcipate emerald (S1)
Kennedy's emerald (SR)
phantom cranefly (RG)
eyed brown (butterfly) (RG)

Invertebrates (cont.)
two-spotted skipper (butterfly) (RG)
Dion skipper (butterfly) (RG)
Baltimore (butterfly) (RG)
mulberry wing (butterfly) (RG)
black dash (butterfly) (RG)

Vertebrates
bog turtle (E, S2)
spotted turtle (SC)
ribbon snake (RG)
northern harrier (T, S3B, S3N)
sedge wren (T, S3B, PIF2)

INTERMITTENT WOODLAND POOL

Plants
featherfoil (T, S2)
false hop sedge (R, S2)

Invertebrates
black dash (butterfly) (RG)
mulberry wing (butterfly) (RG)
springtime physa (snail) (RG)

Vertebrates
four-toed salamander (RG)
Jefferson salamander (SC)
marbled salamander (SC)
spotted salamander (RG)
wood frog (RG)
Blanding's turtle (T, S2S3)

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

CIRCUMNEUTRAL BOG LAKE

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

Plants (cont.)
olivaceous spikerush (RG)
spiny coontail (T, S3)
water-marigold (T, S3)
southern dodder (E, S1)

Vertebrates
wood frog (RG)
blue-spotted salamander (SC)
four-toed salamander (RG)
northern cricket frog (E, S1)
Blanding's turtle (T, S2S3)
bog turtle (E, S2)
spotted turtle (SC)

Vertebrates (cont.)
ribbon snake (RG)
American bittern (SC)
least bittern (T, S3B, S1N)
great blue heron (RG)
wood duck (RG, PIF2)
American black duck (RG, PIF1)
red-shouldered hawk (SC)
sharp-shinned hawk (SC)
king rail (T, S1B, PIF1)
marsh wren (RG)
river otter (RG)

OPEN WATER/CONSTRUCTED POND

Plants
spiny coontail (T, S3)

Vertebrates
spotted turtle (SC)
Blanding's turtle (T, S2S3)

Vertebrates (cont.)
wood turtle (SC)
northern cricket frog (E, S1)
American bittern (SC)
osprey (SC)

Vertebrates (cont.)
bald eagle (T, S2S3B)
great blue heron (RG)

SPRING/SEEP

Plants
Bush's sedge (S3)
devil's-bit (T, S1S2)

Invertebrates
Piedmont groundwater amphipod (RG)
gray petaltail (dragonfly) (SC, S2)
tiger spiketail (dragonfly) (S1)

Vertebrates
northern dusky salamander (RG)
spring salamander (RG)

STREAM & RIPARIAN CORRIDOR

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

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 December 2006 (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.

SR Reported in New York but without persuasive documentation.

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.

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

Based on August 2003 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)

* Two species were not included in the watch lists for this region, but we have included them with the PIF1 species because they are 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	Common Name	Scientific Name
agrimony, small-flowered	*Agrimonia parviflora*	coontail, spiny	*Ceratophyllum echinatum*
alder	*Alnus*	cottonwood, swamp	*Populus heterophylla*
Allegheny-vine	*Adlumia fungosa*	crowfoot, small-flowered	*Ranunculus micranthus*
arrow arum	*Peltandra virginica*	devil's-bit	*Chamaelirium luteum*
arrowhead, broad-leaved	*Sagittaria latifolia*	dittany	*Cunila origanoides*
arrowwood, downy	*Viburnum rafinesquianum*	dodder, buttonbush	*Cuscuta cephalanthi*
arrowwood, northern	*Viburnum dentatum* v. *lucidum*	dodder, field	*Cuscuta pentagona*
ash, green	*Fraxinus pensylvanica*	dodder, southern	*Cuscuta obtusiflora* v. *glandulosa*
ash, white	*Fraxinus americana*	dogwood, gray	*Cornus foemina* ssp. *racemosa*
aspen, quaking	*Populus tremuloides*	dogwood, roundleaf	*Cornus rugosa*
aster, stiff-leaf	*Aster linariifolius*	dogwood, silky	*Cornus amomum*
azalea, swamp	*Rhododendron viscosum*	duckweed, common	*Lemna minor*
baneberry, red	*Actaea spicata* ssp. *rubra*	elder, red-berried	*Sambucus racemosa*
barberry, Japanese	*Berberis vulgaris*	elm, American	*Ulmus americana*
basswood	*Tilia americana*	elm, slippery	*Ulmus rubra*
bearberry	*Arctostaphylos uva-ursi*	false-mermaid	*Floerkea proserpinacoides*
beech, American	*Fagus grandifolia*	featherfoil	*Hottonia inflata*
birch, black	*Betula lenta*	fern, maidenhair	*Adiantum pedatum*
birch, gray	*Betula populifolia*	fern, marsh	*Thelypteris palustris*
birch, river	*Betula nigra*	fern, ostrich	*Matteuccia struthiopteris*
birch, swamp	*Betula pumila*	fern, sensitive	*Onoclea sensibilis*
birch, yellow	*Betula alleghaniensis*	fern, walking	*Asplenium rhizophyllum*
blackberry, northern	*Rubus allegheniensis*	flag, blue	*Iris versicolor*
bladdernut	*Staphylea trifolia*	flax, yellow wild	*Linum sulcatum*
bladderwort	*Utricularia*	foxtail, short-awn	*Alopecurus aequalis*
bladderwort, floating	*Utricularia radiata*	gentian, fringed	*Gentianopsis crinita*
bladderwort, hidden-fruit	*Utricularia geminiscapa*	ginseng, American	*Panax quinquefolius*
bladderwort, horned	*Utricularia cornuta*	globeflower, spreading	*Trollius laxus*
bladderwort, swollen	*Utricularia inflata*	goat's-rue	*Tephrosia virginiana*
blazing-star, northern	*Liatris scariosa* v. *novae-angliae*	goldenrod, bog	*Solidago uliginosa*
blueberry, highbush	*Vaccinium corymbosum*	goldenrod, rough-leaf	*Solidago patula*
blueberry, lowbush	*Vaccinium angustifolium*	goldenrod, stiff-leaf	*Solidago rigida*
blueberry, lowbush	*Vaccinium pallidum*	goldenseal	*Hydrastis canadensis*
bluegrass, Kentucky	*Poa pratensis*	grama, side-oats	*Bouteloua curtipendula*
bluejoint	*Calamagrostis canadensis*	grass-of-Parnassus	*Parnassia glauca*
bluestem, big	*Andropogon gerardii*	grass, Indian	*Sorghastrum nutans*
bluestem, little	*Schizachyrium scoparium*	grass, pale alkali	*Torreyochloa pallida* v. *pallida*
breeches, Dutchman's	*Dicentra cucullaria*	greenbrier	*Smilax*
buckbean	*Menyanthes trifoliata*	gromwell, Virginia false	*Onosmodium virginianum*
buckthorn, alder-leaf	*Rhamnus alnifolia*	hackberry	*Celtis occidentalis*
burning-bush	*Euonymus atropurpureus*	hairgrass	*Deschampsia flexuosa*
butterflyweed	*Asclepias tuberosa*	hair-rush	*Bulbostylis capillaris*
butternut	*Juglans cinerea*	harlequin, yellow	*Corydalis flavula*
buttonbush	*Cephalanthus occidentalis*	hawthorn	*Crataegus*
cabbage, skunk	*Symplocarpus foetidus*	hemlock, eastern	*Tsuga canadensis*
canary-grass, reed	*Phalaris arundinacea*	hickory, pignut	*Carya glabra*
cattail	*Typha*	hickory, shagbark	*Carya ovata*
cedar, eastern red	*Juniperus virginiana*	hobblebush	*Viburnum alnifolium*
chokeberry	*Aronia*	holly, winterberry	*Ilex verticillata*
cinquefoil, shrubby	*Potentilla fruticosa*	honeysuckle, Eurasian	*Lonicera* x *bella*
cinquefoil, three-toothed	*Potentilla tridentata*	honeysuckle, fly	*Lonicera canadensis*
cliffbrake, purple	*Pellaea atropurpurea*	horsetail, wood	*Equisetum sylvaticum*
cliffbrake, smooth	*Pellaea glabella*	ironweed, New York	*Vernonia noveboracensis*
cohosh, blue	*Caulophyllum thalictroides*	knotweed, japanese	*Fallopia japonica*
columbine, wild	*Aquilegia canadensis*	knotweed, slender	*Polygonum tenue*

(CONTINUED)

Common Name	Scientific Name
ladyslipper, showy	*Cypripedium reginae*
larch	*Larix*
laurel, mountain	*Kalmia latifolia*
leatherleaf	*Chamaedaphne calyculata*
leatherwood	*Dirca palustris*
liverwort	Hepaticae
liverwort	*Riccia fluitans*
lobelia, Kalm's	*Lobelia kalmii*
locust, black	*Robinia pseudoacacia*
loosestrife, purple	*Lythrum salicaria*
mannagrass	*Glyceria*
mallow, swamp-rose	*Hibiscus moscheutos*
maple, mountain	*Acer spicatum*
maple, red	*Acer rubrum*
maple, striped	*Acer pensylvanicum*
maple, sugar	*Acer saccharum*
may-apple	*Podophyllum peltatum*
meadowsweet	*Spiraea latifolia*
milkweed, blunt-leaf	*Asclepias amplexicaulis*
milkweed, four-leaf	*Asclepias quadrifolia*
milkweed, green	*Asclepias viridiflora*
milkweed, whorled	*Asclepias verticillata*
milkwort, whorled	*Polygala verticillata*
monkey-flower, winged	*Mimulus alatus*
moss	*Helodium paludosum*
moss, peat	*Sphagnum*
mountain-mint, blunt	*Pycnanthemum muticum*
mountain-mint, Torrey's	*Pycnanthemum torrei*
oak, black	*Quercus velutina*
oak, bur	*Quercus macrocarpa*
oak, chestnut	*Quercus montana*
oak, red	*Quercus rubra*
oak, scrub	*Quercus ilicifolia*
oak, swamp white	*Quercus bicolor*
oak, white	*Quercus alba*
orangeweed	*Hypericum gentianoides*
paintbrush, scarlet Indian	*Castilleja coccinea*
pellitory	*Parietaria pensylvanica*
pine, pitch	*Pinus rigida*
pine, red	*Pinus resinosa*
pine, white	*Pinus strobus*
pinesap	*Monotropa hypopithys*
pinweed, slender	*Lechea tenuifolia*
pipewort	*Eriocaulon septangulare*
pitcher-plant	*Sarracenia purpurea*
pogonia, rose	*Pogonia ophioglossoides*
polypody, rock	*Polypodium vulgare*
Pond-lily, yellow	*Nuphar advena*
Pond-lily, white	*Nymphaea odorata*
pondweed	*Potamogeton*
pondweed, Hill's	*Potamogeton hillii*
pondweed, spotted	*Potamogeton pulcher*
pondweed, water-thread	*Potamogeton diversifolius*
prickly-ash, American	*Zanthoxylum americana*
prickly-pear, eastern	*Opuntia humifusa*
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, tussock	*Carex stricta*
sedge, woolly-fruit	*Carex lasiocarpa*
sedge, yellow	*Carex flava*
serviceberry	*Amelanchier*
spike-muhly	*Muhlenbergia glomerata*
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*
spruce, Norway	*Picea abies*
St. Johnswort, shrubby	*Hypericum prolificum*
sumac, poison	*Toxicodendron vernix*
sundew	*Drosera*
sundew, roundleaf	*Drosera rotundifolia*
sweetflag	*Acorus*
sweet-gum	*Liquidambar styraciflua*
sycamore	*Platanus occidentalis*
tamarack, eastern	*Larix laricina*
thistle, swamp	*Cirsium muticum*
twayblade, large	*Liparis lilifolia*
twig-rush	*Cladium mariscoides*
valerian, bog	*Valeriana uliginosa*
viburnum, maple-leaf	*Viburnum acerifolium*
wall-rue	*Asplenium ruta-muraria*
water-marigold	*Bidens beckii*
watermilfoil	*Myriophyllum*
water-plantain	*Alisma triviale*

(CONTINUED)

Common Name	Scientific Name	Common Name	Scientific Name
watershield	*Brasenia schreberi*	willow, autumn	*Salix serissima*
water-willow	*Decodon verticillatus*	witch-hazel	*Hamamelis virginiana*
whitlow-grass, Carolina	*Draba reptans*	woolgrass	*Scirpus cyperinus*
willow	*Salix*	yew, American	*Taxus canadensis*