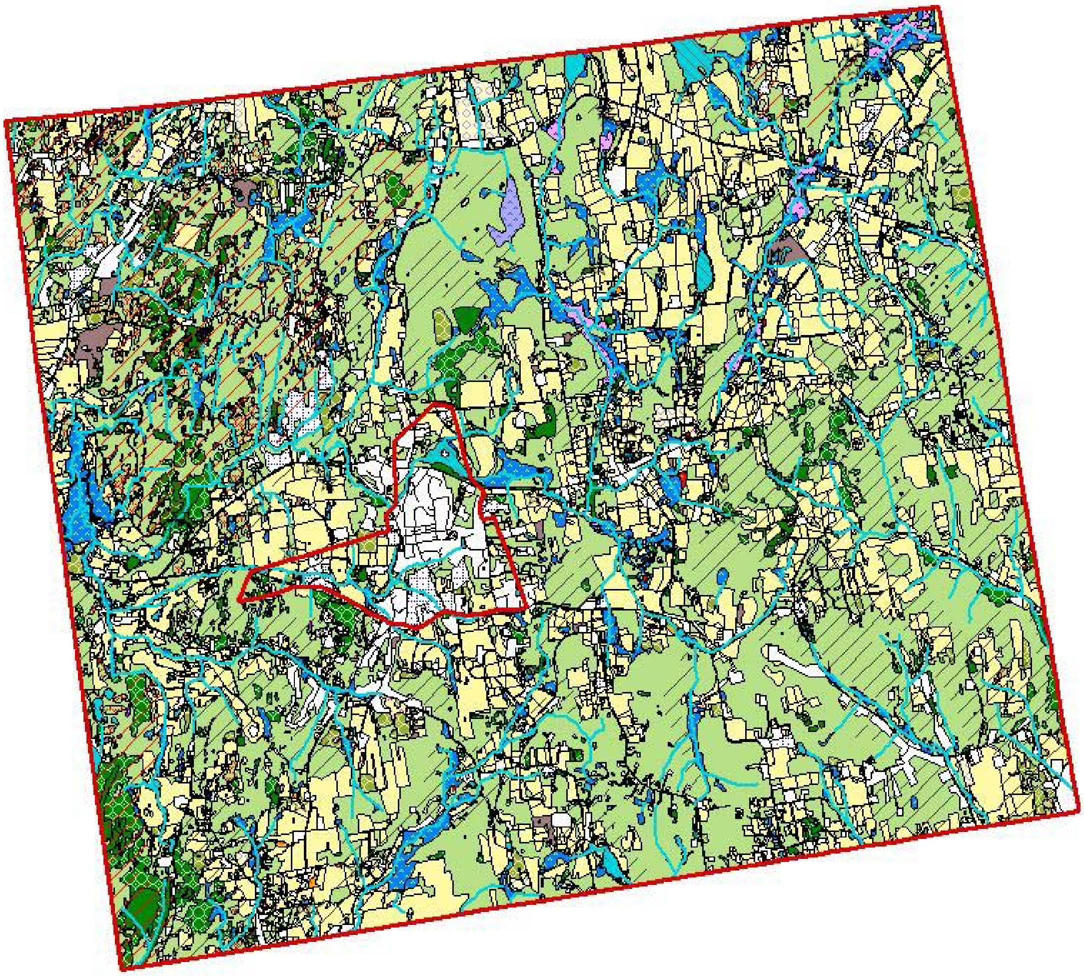
SIGNIFICANT HABITATS IN THE TOWN OF WASHINGTON, DUTCHESS COUNTY, NEW YORK



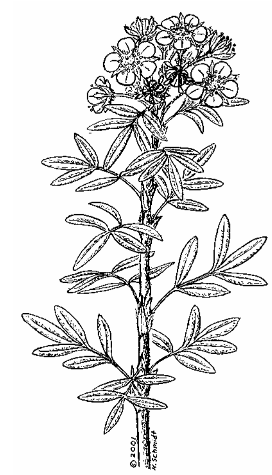
Report to the Millbrook Tribute Garden, the Dyson Foundation, the Town of Washington, and the Dutchess Land Conservancy

By Jenny Tollefson and Gretchen Stevens
Hudsonia Ltd. PO Box 5000, Annandale, NY 12504
April 2004

CONTENTS

(*continued on next page)*

EXECUTIVE SUMMARY



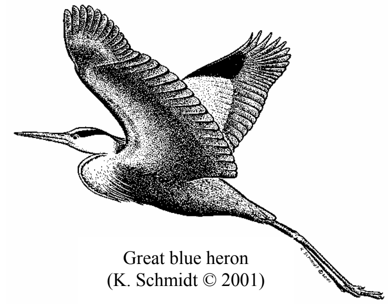
Shrubby cinquefoil
(K. Schmidt © 2001)

Hudsonia Ltd. conducted habitat identification and mapping in the Town of Washington between February 2003 and March 2004. We received funding for this project from the Millbrook Tribute Garden and the Dyson Foundation, and support from the Dutchess Land Conservancy, the Washington Town Board, Planning Board, and Conservation Advisory Council, and Town of Washington landowners.

Through map analysis, aerial photograph interpretation, and field observations, we created a large-scale map showing the location and configuration of ecologically significant habitats throughout the town. Some of these habitats are rare or declining in the region, while others are high quality examples of common habitats and habitat complexes. In total, we identified 24 different kinds of habitats in the Town of Washington that we consider to be of potential ecological importance. These included widespread, common habitats, such as upland forest, upland meadow, marsh, and hardwood swamp, as well as more unusual habitats such as fens, kettle shrub pools, and a circumneutral bog lake. In this report, we describe some of the ecological attributes of each habitat, and discuss some conservation measures that can help to protect the habitats and the species of conservation concern they may support.

This is the second in a series of town-wide habitat mapping projects conducted by Hudsonia in the Hudson Valley, and the first in a series of five habitat mapping projects that Hudsonia will carry out in northeastern Dutchess Country over a five year period. Large-scale habitat maps are intended to serve as tools for land use and conservation planning and decision-making in towns. The habitat maps, which contain ecological information that is unavailable from other sources, can help towns identify 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



Great blue heron
(K. Schmidt © 2001)

Background

Rural landscapes in the Hudson Valley are undergoing rapid change as farms and forest are converted to residential and commercial development. 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. Local land use planning and decision making can be improved if general biodiversity information is available for large areas, such as whole towns, watersheds, or counties.

To address this need, Hudsonia Ltd., a nonprofit scientific research and education institute based in Annandale, New York, initiated a series of large-scale 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 and inform local communities about biodiversity conservation.

Hudsonia completed its first town-wide habitat map for the Town of East Fishkill in May 2002 (Stevens and Broadbent 2002). We then 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. We selected the Town of Washington to be the focus of our mapping efforts for the first year, after receiving enthusiastic support from the Washington Town Board, Planning Board, and Conservation Advisory Council. Throughout the project, we also received support and assistance from many local landowners.

Jenny Tollefson (Biodiversity Mapping Coordinator) and Gretchen Stevens (Director, Biodiversity Resources Center) conducted the work on this project from February 2003 through

March 2004. Through map analysis, aerial photograph interpretation, and field observations, we created a map of ecologically significant habitats in the Town of Washington. Some of these habitats are rare or declining in the region, while others are high quality examples of common habitats. The emphasis of this project was on identifying and mapping general habitat types, and not on conducting species-level inventories or mapping the known locations of rare species.

This is the second in a series of town-wide mapping projects conducted by Hudsonia. We will soon be completing similar projects in several more towns in northern, central, and southwestern Dutchess County, and we hope to extend the program to other parts of the county and region. To facilitate intermunicipal planning, we strive for consistency between towns in the ways that we define and identify habitats and present the information for town use, but we also expect to improve our methods and products as the program evolves. Many passages in this report relating to general conservation concepts and other information applicable to the region as a whole are taken directly from the East Fishkill report (Stevens and Broadbent 2002) without specific attribution. We have adapted the report, however, to encompass our findings in the Town of Washington, and have expanded the discussion of procedures for using the habitat information in planning and decision making. We intend that each of these projects will 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 conservation efforts.

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. Many ecologists agree that protecting native biodiversity is essential to maintaining healthy, functioning ecosystems that sustain the human community and the living world around us. Healthy ecosystems make the earth habitable by moderating the climate, producing oxygen, 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 warn us of environmental deterioration, and may be part of collapses in other parts of the ecosystem. While we do not fully understand the role of most organisms in the ecosystem and cannot fully predict the consequences of the extinction of any particular species, we do know that even some inconspicuous organisms, such as fungi or insect pollinators, can play critical roles in the maintenance of certain biological communities. Maintaining the full complement of native species in a region can allow an ecosystem to respond to 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 described according to its biological and non-biological components. Individual species will be protected for the long term only if their habitats are maintained intact. The local or regional disappearance of a habitat can lead to the local or regional extinction of species that depend on the habitat. For these reasons, and because habitats are a manageable unit for planning and conservation, the focus of this project is on identifying and mapping ecologically significant habitats. 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 alien 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 needs for survival, 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. By illustrating the location and configuration of ecologically significant habitats throughout the town, the Town of Washington 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 Washington is a rural, residential community encompassing approximately 59 mi^2 (153 km^2) in central Dutchess County. The town was created in 1788 and had a population of 4,741 as of the 2000 census. Most of the town is drained by Wappinger Creek, a major tributary of the Hudson River. Sprout Creek, which drains the southwest part of town, flows into Fishkill Creek, another major tributary of the Hudson. The eastern third of town drains east to Wassaic Creek, which flows into the Housatonic River in the Connecticut River drainage.

The terrain in the Town of Washington ranges from steep hills to extensive lowlands. Elevations range from 240 ft (73 m) along Wappinger Creek to 1,350 ft (410 m) on Tower Hill, the highest of the eastern hills. The eastern part of town is characterized by high hills, steep valleys, and deep ravines in the vicinity of Tower Hill, Deep Hollow, Butts Hollow, and Mutton Hollow. In the western part of town, most notably in the Cannoo Hills area, complex faulted terrain creates a system of generally north-south trending ridges and rock outcrops. Extensive wetland complexes occur in low-lying terrain in the Millbrook Marsh watershed (MB-18 and AM-6), the Shaw Brook watershed (MB-34), the Sprout Creek watershed (VB-3), and in the floodplain of the East Branch of Wappinger Creek (SP-60, SP-68, and MB-48).[1]

The bedrock geology is dominated by schist, phyllite, and meta-graywacke, with a large band of quartzite along the western edge of town. Smaller areas of limestone, marble, and shale occur in the central, northeast, and northwest part of town (Figure 1) (Fisher et al. 1970). Most of the bedrock outcrops we observed during the field portion of this project were schist and quartzite; marble and limestone outcrops appear to be rare. Although most of the outcrops were not calcareous, observations of calcicolous plants on schist in several areas suggest that a

[1] Many of the wetlands discussed in this report also appear on the New York State Freshwater Wetlands maps. For these wetlands, the New York State wetland names are given in parentheses in the text.

large area in the northwest quarter of town may be underlain by calcareous schist.[2] The surficial geology is primarily glacial till, with extensive areas of exposed and near-surface bedrock in the hilly terrain along the western and eastern edges of town. Outwash sand and gravel deposits occur along the East Branch of Wappinger Creek, and small kame deposits are scattered throughout the town. Lacustrine silt, clay, and sand deposits that originated in small glacial lake environments occur in the vicinity of Mabbettsville (Cadwell 1989).

Land uses in the Town of Washington include horse farms, sand and gravel mines, Christmas tree farms, agriculture, cattle ranches, dairy farms, residential development, and commercial development in Millbrook Village and the hamlets of Mabbettsville and Washington Hollow. While the Town of Washington has a rich agricultural history, many farms have been converted to residential development (including many second homes). Only a few active dairy farms remain. A small number of private landowners own relatively large parcels of land in the town (the largest ranging from 1,000 acres [400 ha] to over 2,000 acres [800 ha]) that contain extensive areas of forest, upland meadow (mainly agricultural areas) and wetland habitats. Approximately 20% of the developed land in the town is concentrated in the Village of Millbrook. The remaining 80% is dispersed throughout the town and consists primarily of roads and residential development. Overall, the town has a rural character with extensive open space.

[2] We use the term "calcareous" in this report to describe alkaline environments (e.g., soils, water, bedrock) that are rich in calcium carbonate. These environments are limited in extent in the Hudson Valley, and often support distinctive biological communities and rare species. We use the term "calcicolous" to describe plants that inhabit calcium rich environments.

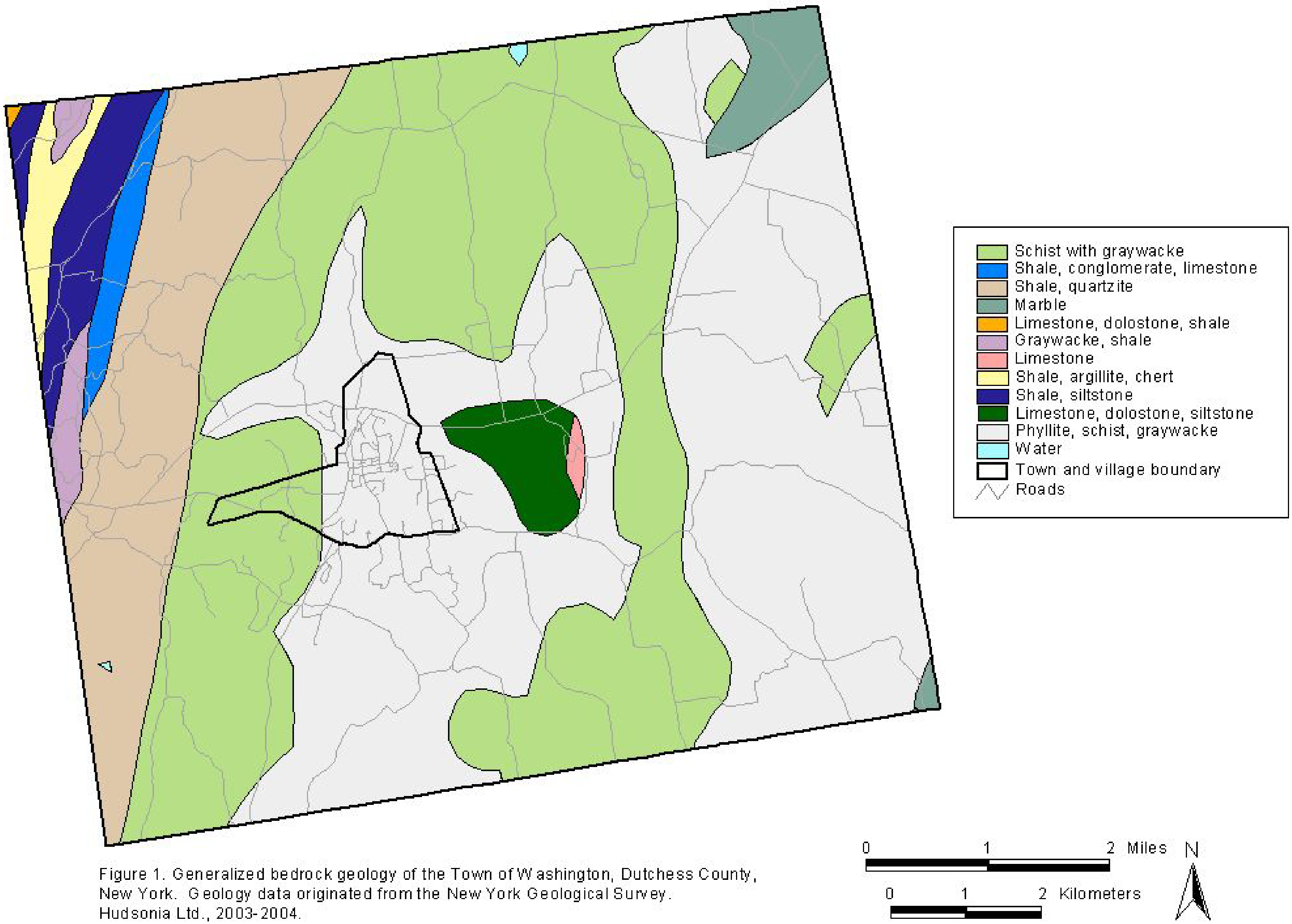
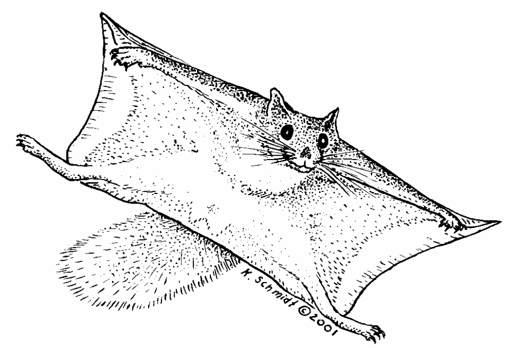


Figure 1. Generalized bedrock geology of the Town of Washington, Dutchess County, New York. Geology data originated from the New York Geological Survey. Hudsonia Ltd., 2003-2004.

METHODS

Hudsonia employs a combination of laboratory and field methods in the habitat identification and mapping process, including predicting habitats, making a preliminary map, verifying habitat predictions in the field, and refining the habitat map. Below, we describe each phase in the Town of Washington habitat mapping project.



Southern flying squirrel
(K. Schmidt © 2001)

Gathering Information and Predicting Habitats

Over 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 physiography and geology. The first step in the habitat mapping process is to assemble all of the necessary and relevant maps, Geographic Information Systems (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., bedrock chemistry, soil depth and drainage, slopes) and features visible on 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 Washington 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 the spring of 1994, obtained from the U.S. Geological Survey.* Viewed in pairs, stereoscopic aerial photograph prints provide a three-dimensional view of the landscape and are extremely useful for identifying vegetation cover types, wetlands, streams, and cultural landscape features. For interpretation of aerial photograph prints, we used an F-71 mirror stereoscope (obtained from Forestry Suppliers, Inc.). For computer mapping, we used high resolution (3.25 ft [1 m] horizontal accuracy) true color digital orthophotos taken in spring 2000 and obtained from the Dutchess County Office of Real Property Tax.

- *U.S. Geological Survey topographic maps (Amenia, Dover Plains, Millbrook, Salt Point, and Verbank 7.5 minute quadrangles).* Topographic maps contain extensive information about landscape features such as elevation, landscape contours, surface water features and some wetlands, significant cultural features, and general land cover. Contour lines on topographic maps can be used to predict the occurrence of such habitats as cliffs, intermittent woodland pools, intermittent streams, and seeps.

- *Bedrock and surficial geology maps (Lower Hudson Sheets) produced by the New York Geological Survey (Fisher et al. 1970, Cadwell 1989).* 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 (USDA Natural Resources Conservation Service 2002).* Specific attributes of soils, such as depth, drainage, texture, and pH, can tell us 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 various 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*. GIS enables us to overlay multiple data layers on the computer screen, greatly enhancing the efficiency and accuracy with which we can predict a variety of 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 the majority of our GIS data layers from the Dutchess County Environmental Management Council (EMC), including roads, streams, soils, bedrock geology, surficial geology, and wetlands (National Wetlands Inventory data prepared by the U.S. Fish and Wildlife Service). We also obtained 10-foot (3 m) contours for the Town of Washington from the Dutchess Land Conservancy, and Town of Washington tax parcels from the Dutchess County Real Property Tax office. We re-projected all GIS layers into New York State Plane NAD 1983.

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 2000 orthophoto images using ArcView 3.2 mapping software on an IBM ThinkPad T30 computer. We then brought these draft habitat maps with us into the field, where we visited as many of the mapped habitat units as possible to verify their presence and extent.

Before going into the field, we contacted individual property owners for permission to enter their land. We identified landowners using tax parcel data obtained from the Dutchess County Real Property Tax office. We prioritized sites for field visits based both on opportunity (e.g., willing landowners) and our need to answer questions regarding habitat identification or extent that could not be answered remotely. There are several habitat distinctions, for example, that can only be made in the field such as wet meadow vs. calcareous wet meadow, wet meadow vs. fen, and calcareous crest vs. acidic crest. In addition to conducting field work on private land, we also viewed habitats visible from public roads.

We estimate that we field checked part or all of 75% of the mapped habitat units. This includes field work conducted on private land as well as habitats viewed from adjacent properties and public roads. Inaccessible areas that could not be field-checked were mapped entirely by remote sensing. Areas of the habitat map that were field checked are generally more accurate than areas we did not visit in the field. Once we have conducted field work in one area, however, we are able to extrapolate our findings to adjacent parcels and similar settings. Because the timeline of this project 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.

Refining the Habitat Map

We corrected and refined the preliminary map on the basis of our field observations to produce the final habitat map. We established certain mapping conventions to simplify our work and to improve the consistency of the final habitat map:

- *Developed areas*. Developed areas (including structures, roads, and other impervious surfaces, as well as immediately surrounding areas) were excluded from the habitat map. Areas that have been developed since 2000 (the aerial photograph date) were only mapped if we observed them in the field. For this reason, it is likely that we underestimated the total acreage of developed land in the town. 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 were connected to other large habitat areas. We did, however, map wetlands (e.g., constructed ponds) within developed areas if they were identifiable on the aerial photographs. These wetland habitats can serve as important drought refuges for rare species and other species of conservation concern.

- *Driveways & paved roads.* We considered driveways and paved roads to be "developed" and excluded them from the habitat map. While gravel and dirt roads crossing private land were not excluded from the map, their presence was noted by a straight line (e.g., where an unpaved road cuts through a field, the field was mapped as two separate polygons).

- *"Cultural" areas.* Intensively managed areas such as golf courses, cemeteries, manicured lawns, and some areas intensively managed for sport shooting and hunting were mapped as "cultural" habitats. See page 36 for a more complete description of cultural habitats.

- *Upland deciduous forests.* Although these forests are extremely variable in terms of their species composition, size and age of trees, vegetation structure, soil drainage and texture, and other factors, we decided to map upland deciduous forests as a single habitat type for practical reasons. Different forest ages and types are not easily distinguished on aerial photographs, and we could not consistently and accurately separate forests according to dominant tree species or size of overstory trees. Our "upland deciduous forest" type therefore includes non-wetland deciduous forests of all ages, at all elevations, and of all species mixtures. Coniferous-deciduous mixed forests and conifer forests were mapped separately. See page 22 for a detailed description of upland forest habitats.

- *Upland meadows and shrubby oldfields.* Pastures, agricultural fields, equestrian fields, abandoned fields, mowed ornamental fields, and extensive lawns were all mapped as "upland meadow." We mapped upland meadows divided by fences, hedgerows, and unpaved roads 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 shrubby oldfield habitats is somewhat arbitrary. In general, we defined shrubby oldfield habitats as those with widely distributed shrubs that accounted for >20% cover. Lands managed for upland game birds on several hunting preserves in the town were mapped as either "upland meadow" or "shrubby oldfield," depending on the amount of shrub cover. See pages 28 and 29 for more detailed descriptions of shrubby oldfield and upland meadow habitats.

- *Crest, ledge, and talus habitats.* Because crest, ledge, and talus habitats are embedded within other habitat types (most commonly upland forest), they are 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 are therefore mapped based on a combination of field observations and locations of potential bedrock exposures inferred from the location of shallow soils (<20 inches [50 cm]) on steep (>15%) slopes. The final overlay of crest, ledge, and talus habitat is therefore an approximation, and it is likely that there are additional bedrock exposures outside the mapped areas. The precise locations and boundaries of actual crest, ledge, and talus habitats should be determined in the field on a site-by-site basis. The distinction between calcareous and non-calcareous crest, ledge, and talus habitats can only be made in the field. The polygons that appear on the map as calcareous crest, ledge and talus, therefore, are extrapolated from the locations of calcareous outcrops observed in the field. All other areas of exposed bedrock (both non-calcareous and unknown bedrock) were mapped as non-calcareous crest, ledge, and talus. See page 32 for a detailed description of crest, ledge, and talus habitats.

- *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 profiles of surface soil layers. Without the benefit of onsite soil data, it was often difficult to distinguish between upland forest and hardwood swamp along some stream corridors and in other low-lying areas with somewhat poorly-drained soils. In the field, these areas were characterized by moist, fine-textured soils with common upland trees in the canopy and dense thickets of vines and shrubs (e.g., Japanese barberry, Eurasian honeysuckle) in the understory. In most cases, we mapped these areas as upland forest. The locations of wetland boundaries (and all other habitat 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. See pages 38-64 for detailed descriptions of wetland habitats.

- *Intermittent woodland pools.* Intermittent woodland pools are best identified in the spring, when the pools are generally 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. We visited ~80 intermittent woodland pools between March and November 2003. We identified those we visited in late summer and fall based on physical features of the habitat. The pools we did not visit in the field were mapped using remote sensing techniques. Many intermittent woodland pools have a distinct aerial photograph signature, and are readily visible within areas of deciduous forest if the photographs are taken while the leaves are off the trees. Intermittent woodland pools located within areas of conifer forest, however, are not easily identified on aerial photographs, and it is likely that we missed some during our mapping. All intermittent woodland pools should be verified in the field on a site-by-site basis. See page 51 for a detailed description of intermittent woodland pool habitat.

- *Springs & seeps.* Springs and seeps are difficult to identify by remote sensing, so we mapped only the very few we happened to see in the field. We expect there are many more springs and seeps in the Town of Washington 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. See page 58 for further description of spring and seep habitats.

- *Streams.* A digital stream layer was created by the Dutchess County EMC based on the New York State Department of Environmental Conservation (NYSDEC) 1:24,000 Biological Survey Series Maps created in 1991. Because these data were incomplete for the Town of Washington, however, we digitized a new stream coverage in ArcView GIS based on these original data, field observations, and interpretation of aerial photographs. We added numerous perennial and intermittent streams to the coverage and connected the sections of stream that had been depicted as discontinuous where they flowed through ponds, impoundments, or large wetlands. We expect there are additional intermittent streams that we missed, 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 professional judgment. See page 61 for a detailed description of perennial and intermittent stream habitats.

The final large-format paper map was printed at a scale of 1:19,000 on a Hewlett Packard DesignJet 800PS plotter. We also printed the map at a scale of 1:10,000 on four 36 x 44 inch sheets. The GIS database that accompanies the map includes additional information about many of the mapped habitats, such as the dates of field visits and plant and animal species observed in the field. The habitat map, the GIS database, and this report have been conveyed to the Town of Washington, the Dutchess County EMC, 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."*

RESULTS

Marbled salamander
(K. Schmidt © 2001)

Overview

The large-format Town of Washington habitat map illustrates the diversity of habitats that occur in the town and the complexity of their configuration on the landscape. A reduction of the completed habitat map is shown in Figure 2. Of the 37,600 acres (15,200 ha) comprising the Town of Washington, approximately 90% are undeveloped (i.e., without structures, paved roads, etc.). Figure 3 shows blocks of contiguous undeveloped habitat within the town that are <500, 500-1,000, and >1,000 acres. Several types of common habitats cover extensive areas within these blocks. For example, approximately 53% of the town is forested, 30% is open meadow (e.g. agricultural areas and other grassland habitats), and 9% are wetlands. Some of the smaller, more unusual habitats we documented include a circumneutral bog lake, fens, and kettle shrub pools. In total, we identified 24 different kinds of habitats in the Town of Washington that we consider to be of potential ecological importance (Table 1).

Table 1. Ecologically significant habitats identified by Hudsonia Ltd. in the Town of Washington, Dutchess County, New York, 2003-2004.

Upland Habitats	Wetland Habitats
Upland Deciduous Forest	Hardwood & Shrub Swamp
Conifer Forest	Marsh
Mixed Forest	Wet Meadow
Red Cedar Woodland	Calcareous Wet Meadow
Shrubby Oldfield	Fen
Upland Meadow	Acidic Bog
Crest/Ledge/Talus	Circumneutral Bog Lake
Orchard/Plantation	Intermittent Woodland Pool
Cultural	Kettle Shrub Pool
Waste Ground	Open Water
	Constructed Pond
	Spring/Seep
	Intermittent & Perennial Stream
	Riparian Corridor

Many areas, while still considered to be ecologically significant habitats, are altered to varying degrees by past and present human activities. Most areas of upland forest, for example, have been logged at least once in the past 250 years, and many forested areas lack the structural complexity of older forests. Many of the wetlands in the town (e.g., Millbrook Marsh, Beaver Dam Marsh) have been extensively altered by human activities (e.g., damming, removal of buffers, nutrient loading). Purple loosestrife, one of the most widespread plants in marshes throughout the town, was introduced to the Hudson Valley 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 Washington, we have provided information on the quality and condition of these habitats in only a few cases.

In the following pages we describe some of the ecological attributes of the habitats identified in the Town of Washington and discuss some conservation measures that can help to protect those habitats and the species of conservation concern they may support. Most habitats described in this report support one or more of the natural communities included in *Ecological Communities of New York State* (Reschke 1990), which describes the rare and common ecological communities recognized by the New York Natural Heritage Program. All of the species we mention in individual habitat descriptions occur in the Hudson Valley, and most have the potential to occur in the Town of Washington. We assigned a code to each habitat type (e.g., conifer forest = cf; marsh = ma) which corresponds with the codes that appear on the large-format (1:10,000 scale) Town of Washington habitat maps. Species of conservation concern mentioned in the text are indicated by an asterisk following the species name. Appendix A 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 A to describe the conservation status of rare species are explained in Appendix B. Appendix C gives the common and scientific names of all plants mentioned in the report.

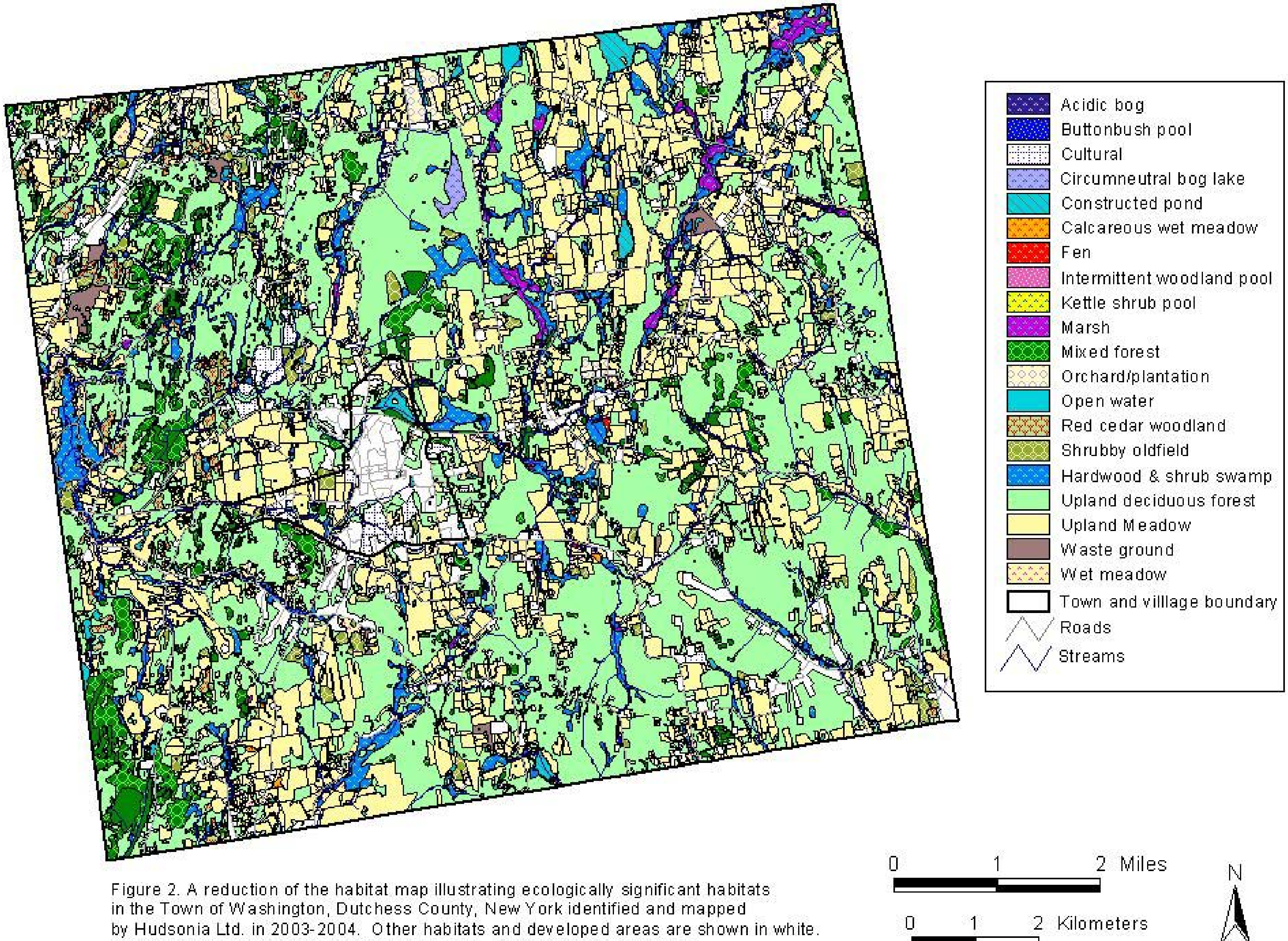


Figure 2. A reduction of the habitat map illustrating ecologically significant habitats in the Town of Washington, Dutchess County, New York identified and mapped by Hudsonia Ltd. in 2003-2004. Other habitats and developed areas are shown in white. The final large-format map is printed at a scale of 1:10,000 on four sheets.

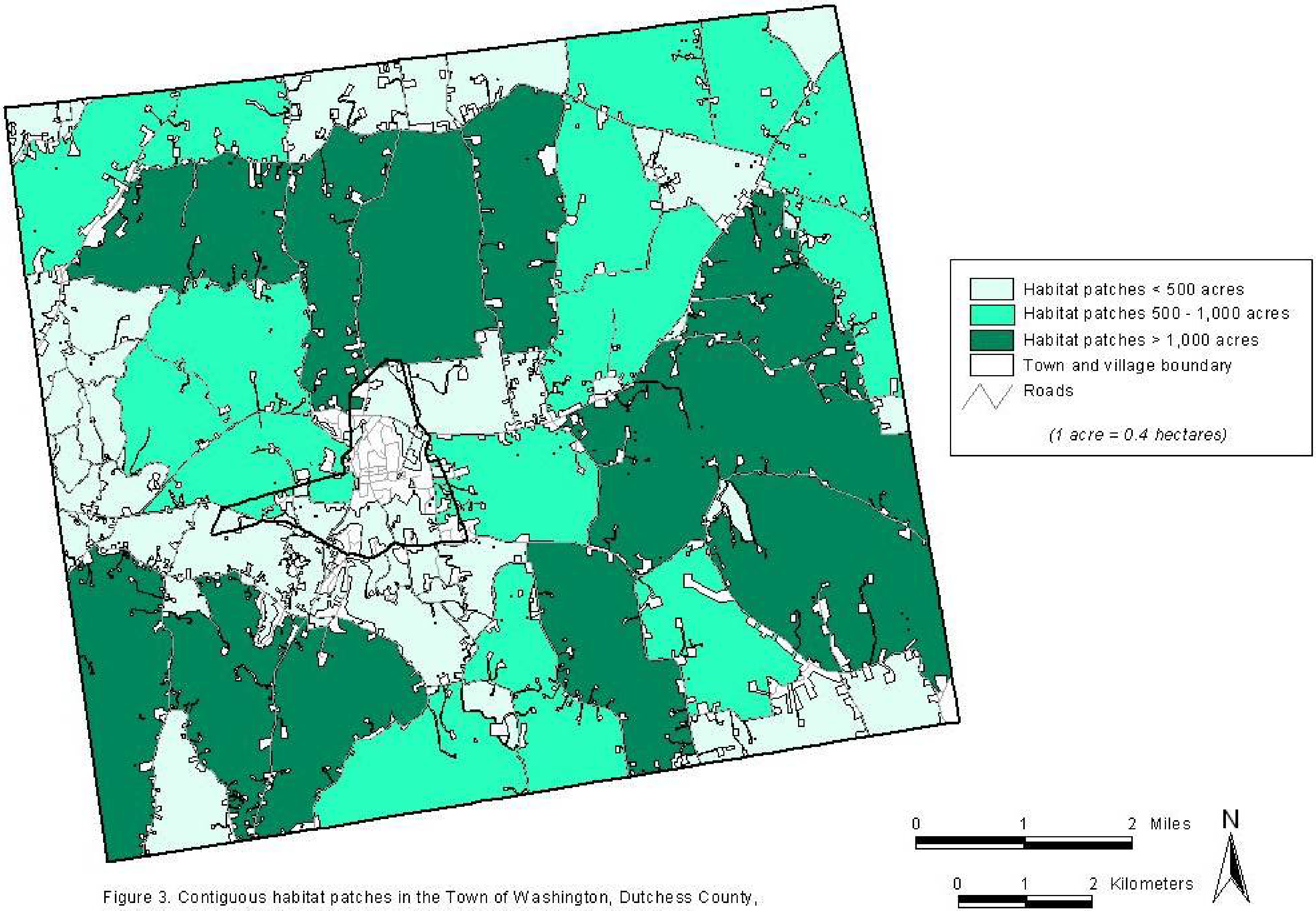


Figure 3. Contiguous habitat patches in the Town of Washington, Dutchess County, New York. Developed areas are shown in white. Hudsonia Ltd., 2003-2004.

HABITAT DESCRIPTIONS: UPLAND HABITATS

UPLAND FORESTS

Ecological Attributes

We identified three general types of upland forest habitat within the Town of Washington: upland deciduous forest, conifer forest, and mixed forest.

Upland Deciduous Forest (uf)

Upland deciduous forest is the most common habitat type in our region, providing habitat for a wide range of common and rare species of plants and animals. Common trees of upland deciduous forests include sugar maple, red maple, oaks (black, red, chestnut, white), shagbark hickory, white ash, and black birch. Common understory species include mapleleaf viburnum, witch-hazel, serviceberries, mountain laurel, and a wide variety of wildflowers, sedges, ferns, lichens, and mosses. Upland deciduous forests provide important breeding and 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, tanagers, thrushes, and flycatchers. Many small mammals are associated with upland deciduous forests, such as eastern chipmunk, southern flying squirrel, and white-footed mouse. Upland deciduous forests are extremely variable in terms of their species composition, size and age of trees, vegetation structure, soil drainage and texture, and other habitat factors. Many smaller habitats are frequently embedded within areas of upland forest, such as intermittent woodland pools and crest, ledge, and talus habitat.

Conifer Forest (cf)

This habitat includes pole-sized to mature conifer plantations and naturally occurring upland forests with >75% cover of conifer trees. Conifer stands provide important habitat for a variety of mammals, including eastern cottontail, red squirrel, eastern chipmunk, deer mouse, and meadow vole (Bailey and Alexander 1960). 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. A roosting long-eared owl was documented in a Scotch pine plantation at the Millbrook

School in 1987 (Kiviat 1994). Pine siskin*, red-breasted nuthatch*, black-throated green warbler*, evening grosbeak*, and blackburnian warbler* will nest in conifer stands. American woodcock* sometimes uses conifer stands for nesting and foraging. Some conifer stands provide winter shelter for white-tailed deer that can be especially important during periods of deep snow cover.

Mixed Forest (mf)

Mixed forest refers to non-wetland forested areas with a combination of hardwood and conifer species, where conifer cover is between 25% and 75%. In most cases, the distinction between conifer and mixed forest was made by aerial photograph interpretation. White pine is the most common conifer found in mixed forest stands. These areas are less densely shaded than pure conifer stands and support a higher diversity and greater abundance of understory species.

Occurrence in the Town of Washington

Upland deciduous forest is by far the most widespread habitat type in the Town of Washington, accounting for nearly 40% of the total land area. We presume that all, or nearly all, forests in the Town of Washington have been cleared or logged at one time and that no "virgin" stands remain. There are at least two sites, however, with distinctly more mature forest. At the Millbrook School "ski hill," a 100-150 year-old forest with trees in the range of 12-25 inches in diameter (30-65 cm) was dominated by oaks and sugar maple with shagbark hickory, pignut hickory, American beech, and yellow birch (Kiviat 1994). On the west side of town, a cove on the Rockefeller University property contained a mature forest with large eastern hemlock, sugar maple, and tulip trees. It is likely that there are other old forest stands in the town that were not observed during field work.

Conifer and mixed forests were widely distributed in the Town of Washington but were generally small, rarely exceeding 30 acres (12 ha). Most of the natural conifer forests were composed of white pine and/or eastern hemlock. In many cases, natural conifer stands were embedded within more extensive areas of mixed forest. White pine stands were widespread and occurred in a variety of ecological settings (generally on well-drained upland soils), while eastern hemlock stands were found most commonly on acidic rock ledges, in ravines, and along perennial streams. Planted conifer stands were composed variably of Scotch pine, red pine, Douglas-fir, European larch, and Norway spruce. In general, plantations were more uniform in size and age of trees, structure, and overall species composition than natural conifer stands. Christmas tree plantations with young trees were mapped as “orchard/plantation.” More extensive areas of mixed forest (up to 200 ac [80 ha]) in the town were located along the East Branch of Wappinger Creek at the Institute of Ecosystem Studies and south of Tyrell Lake.

Many of the large forested blocks in the Town of Washington extend across the town boundaries, encompassing thousands of acres of relatively unfragmented forest. The forested southwest corner of town, for example, is contiguous with a large area of unfragmented forest that extends to the Taconic Parkway, including the Taconic-Hereford Multiple Use Area. On the east side of town, the forested Tower Hill/Deep Hollow area is contiguous with extensive forests in the Turkey Hollow area.

Conservation Considerations

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. Figure 4 illustrates the location and distribution of forested areas in the Town of Washington, showing forest patches that are <100, 100-500, 501-1,000, and >1,000 acres. Although upland forest is by far the most common habitat type in the town, extensive areas of unfragmented forest are increasingly uncommon. Primary sources of forest fragmentation include roads and driveways, agricultural areas, and private houses. New development located along main roads may block important wildlife travel corridors between forested blocks. New houses set back from main roads by long driveways contribute to fragmentation of core forest areas.

The decline of extensive forests has been implicated in the declines of numerous species of migratory songbirds (Robbins 1980, Ambuel and Temple 1983, Wilcove 1985, Hill and Hagan 1991), raptors (Bednarz and Dinsmore 1982, Billings 1990, Crocoll 1994), and large mammals such as black bear (Godin 1977, Merritt 1987). The ecological effects of forest fragmentation are manifold but often invisible to a casual observer. The adverse impacts of a new road through a forest, for example, can extend several hundred meters from the road and can affect soil fauna, birds, amphibians, reptiles, mammals, and plant communities (Forman and Deblinger 2000). We know that fragmentation reduces the potential size of territories, and thus affects the habitat suitability for the bird and mammal species that require large territories in which to breed and to raise their young. The increased amount of forest edge in fragmented forests has multiple habitat effects, but some of the most harmful are increased access for invasive plants, for human-adapted predators such as raccoon and striped skunk, and for brood parasites, such as the brown-headed cowbird. Fragmentation of forests by roads can disrupt seasonal migrations of reptiles and amphibians, and lead to increased road mortality for many wildlife species in their ordinary daily and seasonal movements.

Some general guidelines for forest conservation include:

1. Protect large, contiguous forested areas wherever possible.
2. Protect areas of mature and old-growth forest (e.g., Millbrook School ski hill).
3. Protect natural conifer stands.
4. Avoid development in forest interiors.
5. Maintain the forest canopy and understory vegetation intact.
6. Maintain standing dead wood, downed wood, and organic debris, and prevent disturbance or compaction of the forest floor.
7. Protect smaller forest patches in strategic locations (e.g., those that provide a connection between larger forest patches) or have smaller, unusual habitats embedded in them.
8. Maintain or restore corridors of intact habitat between large forested areas (including connections across roads).

In the Town of Washington, special emphasis should be placed on protecting the integrity of the remaining large forested areas. In the next four years, Hudsonia will be mapping habitats in four additional towns in northeastern Dutchess County, which likely will include some of the towns that border the Town of Washington. 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.

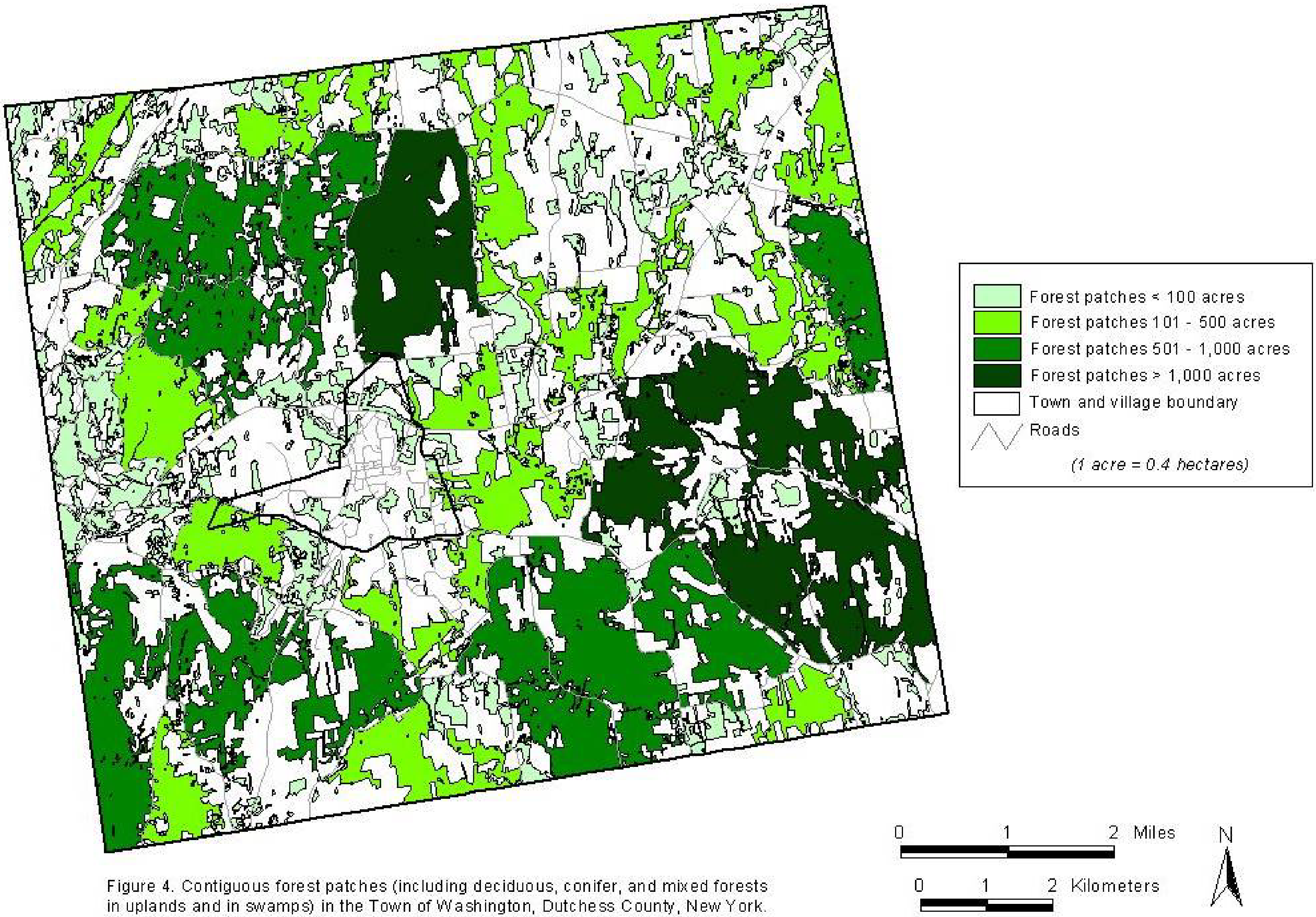


Figure 4. Contiguous forest patches (including deciduous, conifer, and mixed forests in uplands and in swamps) in the Town of Washington, Dutchess County, New York. Hudsonia Ltd., 2003-2004.

RED CEDAR WOODLAND (rcw)

Ecological Attributes

This is a late stage old field habitat with eastern red cedar trees prominent in the overstory. Red cedar is one of the first woody plants to invade abandoned pastures on mildly acidic to alkaline soils in this region. Red cedar woodlands appear to be transitional between shrubby oldfields and young forest. The seeds of red cedar are bird-dispersed, and the seedlings appear to be successful at becoming established in the hot, droughty conditions in old pastures (Charles Canham, personal communication). Eastern red cedar is the dominant tree, which is widely spaced in young stands and denser in more mature stands. 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 shrubby oldfields. Kentucky bluegrass is often dominant in the understory, particularly in more open stands. Red cedar can persist in these stands for many years even after the hardwood forest grows up around them. We mapped areas where abundant red cedar occurs under a canopy of hardwoods as "mixed forest."

Red cedar woodlands may provide habitat for roosting raptors, such as northern harrier*, short-eared owl*, and northern saw-whet owl*, as well as many smaller birds. Short-eared owl* may also breed in red cedar woodlands. Red cedar fruit is a food source for eastern bluebird*, cedar waxwing, and other birds, and many songbirds use red cedar for nesting and roosting. Insectivorous birds such as black-capped chickadee and golden-crowned kinglet forage in red cedar, and the olive hairstreak* (butterfly) uses red cedar as a larval host.

Occurrence in the Town of Washington

Red cedar woodlands in the Town of Washington ranged in size from 1-22 acres (0.5-8 ha), and were concentrated on the west side of town (with many excellent examples in the Cannoo Hills/Woodstock Road area). The distribution of red cedar woodlands appears to be related to the agricultural history in the town and the timing of pasture abandonment. It is reasonable to assume that, as red cedar woodlands continue to develop into young forest, they will become increasingly uncommon in the town (unless they develop in newly abandoned agricultural areas).

Conservation Considerations

Although relatively little is known about the ecology of red cedar woodlands, we do know that they are distinct from other wooded habitats in the region and therefore are likely to provide habitat for a unique suite of species. Extensive occurrences of red cedar woodlands are limited in Dutchess County, and some of the high-quality occurrences in the Town of Washington are worthy of protection.

SHRUBBY OLDFIELD (sof)

Ecological Attributes

We use the term "shrubby oldfield" 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 non-native Japanese barberry, Eurasian honeysuckle, and multiflora rose. Abandoned agricultural fields and pastures support more diverse plant communities, including a variety of meadow grasses and forbs, shrubs such as meadowsweet, gray dogwood, blackberries, and raspberries, and scattered seedlings and saplings of eastern red cedar, hawthorns, white pine, gray birch, red maple, quaking aspen, and oaks. Occasional large, open-grown trees left as shade for livestock may be present.

Many bird species of conservation concern nest in shrubby oldfields and adjacent upland meadow habitats, including northern harrier*, blue-winged warbler*, golden-winged warbler*, yellow-breasted chat*, clay-colored sparrow*, vesper sparrow*, and grasshopper sparrow*. Several species of hawks and falcons use shrubby oldfields and adjacent meadows for hunting. Rare butterflies such as aphrodite fritillary*, dusted skipper*, Leonard's skipper*, and cobweb skipper* may occur where their host plants are present. Shrubby oldfields and other non-forested upland habitats may be used by turtles (e.g., Blanding's turtle*, painted turtle, wood turtle*, spotted turtle*, and box turtle*) for nesting. Although we did not distinguish between calcareous and non-calcareous shrubby oldfields in this project, a few species of rare plants are known from calcareous oldfields in the region, such as stiff-leaf goldenrod*, butterflyweed*, and shrubby St. Johnswort*.

Occurrence in the Town of Washington

Shrubby oldfields were distributed widely throughout the Town of Washington and ranged in size from <1 to 44 acres (0.5-18 ha).

Conservation Considerations

Protecting some of the shrubby oldfields in the Town of Washington from excessive human disturbances would help to protect sensitive species of conservation concern. If these habitats are maintained by brush-hogging or mowing, timing these activities to coincide with the post-fledging season for most birds (e.g., September and later) and only cutting every few years (rather than annually) would reduce the impacts on birds that breed in these habitats.

UPLAND MEADOW (um)

Ecological Attributes

This broad category includes active cropland, hayfields, pastures, equestrian fields, mowed ornamental fields, and abandoned fields. We also mapped extensive lawns in this category if they were adjacent to relatively undisturbed habitats. The ecological values of these habitats can differ widely according to the vegetation and the kinds of disturbance (e.g., crops, tilling, mowing, grazing, pesticide applications) they are subjected to. Extensive hayfields, for example, may support grassland breeding birds (depending on the mowing schedule), while other crop fields may have comparatively little habitat value. We mapped all these types of meadow as a single habitat in part to simplify our work, but also because, after abandonment, these meadows tend to develop similar general habitat 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 was therefore for both for present and potential future ecological values that we considered all of these types of meadow habitat to be ecologically significant.

Grassland breeding birds, such as grasshopper sparrow*, vesper sparrow*, Henslow's sparrow*, eastern meadowlark*, bobolink*, northern harrier*, and upland sandpiper* use extensive meadow habitats for nesting and foraging. Upland meadows can also be used for nesting by Blanding's turtle*, wood turtle*, spotted turtle*, box turtle*, painted turtle, and snapping turtle. 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.

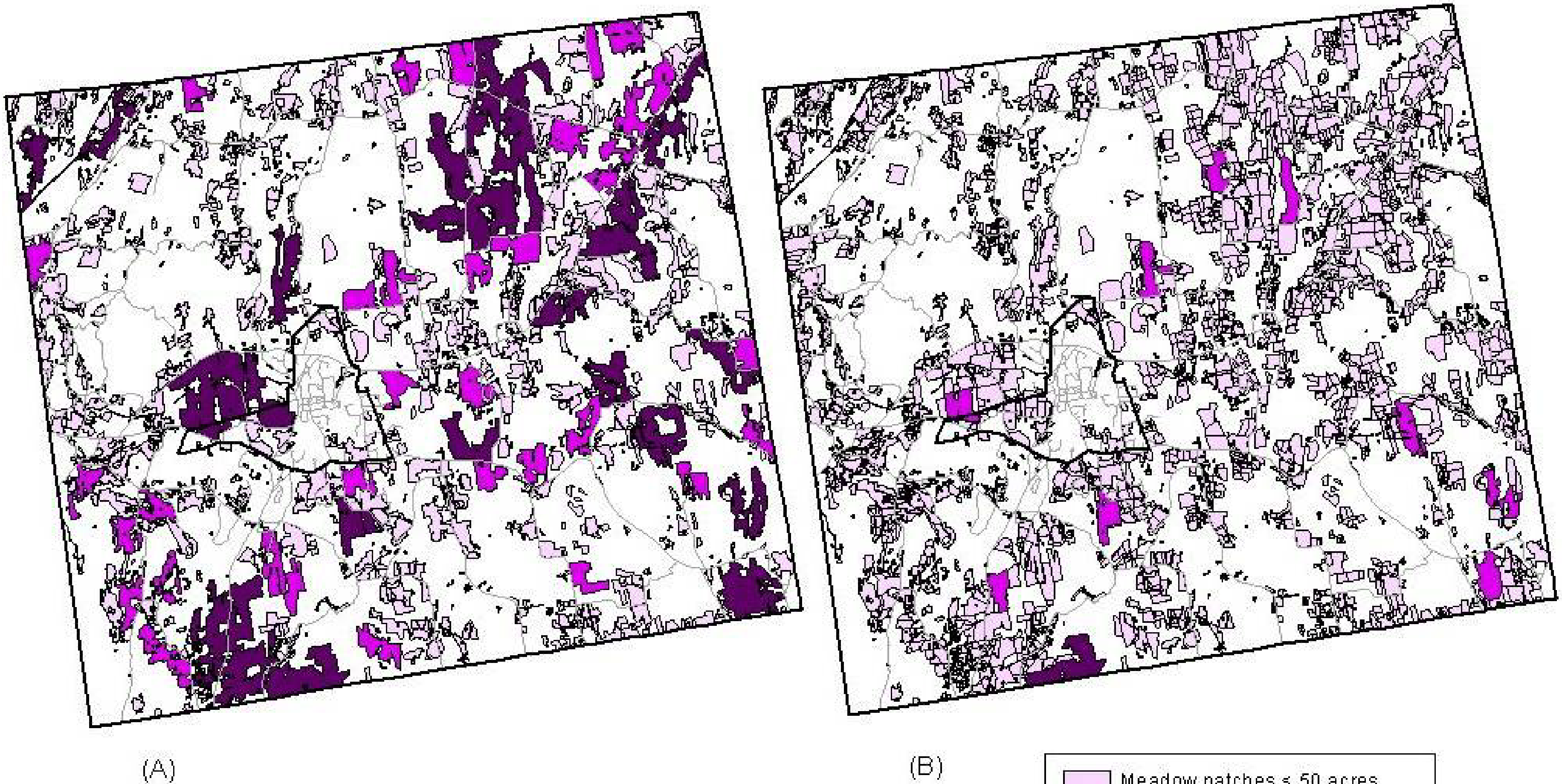
Occurrence in the Town of Washington

Upland meadow was the second most common habitat type in the Town of Washington, accounting for approximately 30% of the total land area. Figure 5 illustrates the location and distribution of meadow habitat in the town, showing those areas that were <50, 50-100, and >100 acres. 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.

Conservation Considerations

The decline of grassland-breeding birds in the Northeast has been attributed to the loss of suitable habitat (Askins 1993, Vickery 1994, Jones and Vickery 1995). Some upland meadows have simply been abandoned and have reverted to forest, and many areas have been converted to residential and commercial development. While there can be significant habitat value in small patches of upland meadow, large patches have especially important habitat value for grassland-breeding birds. Birds nesting in meadows surrounded by development are more vulnerable to a variety of disturbances, including nest predation by human-adapted predators such as raccoon and striped skunk.

Even in large expanses of upland meadow, fences and hedgerows can pose problems for grassland-breeding birds by providing cover and perching sites for raptors and other species that prey upon the birds or their eggs. For example, Henslow's sparrow*, one of our very rare grassland-breeding birds, requires large fields that are undivided by hedgerows or fences (Wiens 1969). The larger the fenceless expanse, the more attractive the field will be to the sparrow. Figure 5 illustrates how meadow patch sizes differ when hedgerows and fences are taken into accoun



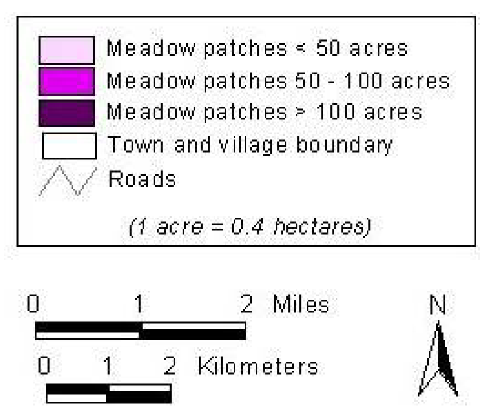


Figure 5. Contiguous meadow habitat, including upland meadows (including agricultural areas), wet meadows, fens, and shrubby oldfields in the Town of Washington, Dutchess County, New York. (A) illustrates contiguous meadow habitat without consideration of hedgerows and fences; (B) includes hedgerows and fences as fragmenting features. Hudsonia Ltd., 2003-2004.

Threats to upland meadow habitats include soil compaction and erosion by ATVs, other vehicles, and equipment, which can reduce the habitat values for invertebrates, small mammals, nesting birds, and nesting turtles. Destruction of vegetation can reduce viable habitat for butterflies and rare plants, and mowing of upland meadows during the bird nesting season can cause extensive mortality of nestlings and fledglings. Timing mowing activities to coincide with the post-fledging season for most birds (e.g., September and later) would reduce these negative impacts. Farmlands where pesticides are used have a reduced capacity to support biodiversity. Protecting upland meadow habitats from these and other human disturbances will help to protect sensitive species of conservation concern.

The Town of Washington has a tremendous opportunity to conserve large expanses of upland meadow habitat. Beyond their 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 contribute to the local economy and to the scenic beauty of the town landscape.

While the ecological values of upland meadows are diverse and significant, it is also important to remember that most upland meadow areas were once areas of upland forest—another very important habitat type in our region. While focusing on conservation of existing upland meadows with high biodiversity value, therefore, 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.

CREST/LEDGE/TALUS

Ecological Attributes

Rocky crest, ledge, and talus habitats often occur together. Crest and ledge habitats occur where bedrock is exposed at the ground surface. They can occur at any elevation, but may be most familiar to local residents on hillsides and hilltops in the region. Talus is the term for the fields of rock fragments, blocks, or boulders that often accumulate at the bases of steep ledges and cliffs. We also included large glacial erratics (glacially-deposited boulders) in this habitat type. Crest, ledge, and talus habitats support well-developed forest as well as sparse, patchy, and stunted vegetation.

Crest, ledge, and talus habitats appear to be harsh and inhospitable, but they can support an extraordinary diversity of plants and animals. Some species, such as wall-rue, 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, and basswood; shrubs such as bladdernut, American prickly-ash, and Japanese barberry; and herbs such as wild-columbine, ebony spleenwort, and maidenhair spleenwort. Calcareous crests can support numerous rare 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 scrub oak, low blueberries, and chokeberries; 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*. Slimy salamander* occurs in non-calcareous wooded talus, and northern hairstreak* (butterfly) occurs with oak species, its larval host plants. Breeding birds of non-calcareous crest habitats include blackburnian warbler* and cerulean warbler*. Eastern hognose snake*, and northern copperhead* are found on both calcareous and non-calcareous crests, and olive hairstreak* (butterfly) occurs on crests with its host plant eastern red cedar. Bobcat* and fisher* use high-elevation crests and ledges for travel, hunting, and cover. Bobcat also uses talus habitats for denning.

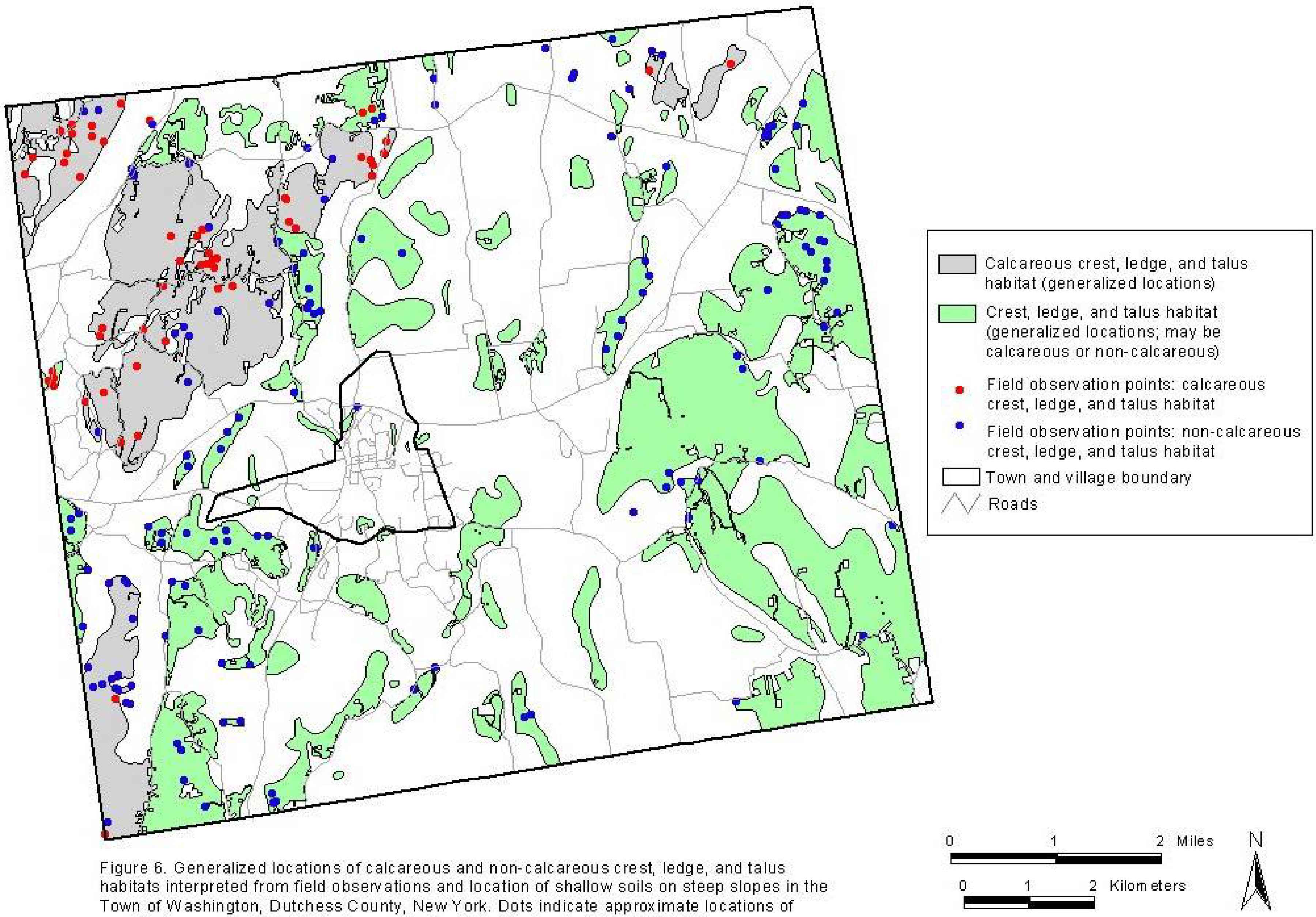


Figure 6. Generalized locations of calcareous and non-calcareous crest, ledge, and talus habitats interpreted from field observations and location of shallow soils on steep slopes in the Town of Washington, Dutchess County, New York. Dots indicate approximate locations of crest, ledge, and talus habitat observed in the field. Hudsonia Ltd., 2003-2004.

Occurrence in the Town of Washington

Crest, ledge, and talus habitats were scattered throughout the Town of Washington, with the largest expanses on knolls and ridges on the east and west edges of town (Figure 6). Extensive areas of calcareous and potentially calcareous crest, ledge, and talus habitat occurred in the faulted terrain in the Cannoo Hills area and in the southwest corner of town. Here, calcareous schist outcrops and non-calcareous quartzite outcrops often occurred adjacent to each other. The non-calcareous bedrock exposures we observed in the field included extensive areas of schist and quartzite outcrops, including several massive quartzite boulders and ledges on the west side of town. Vegetation was very sparse on the quartzite outcrops, and was often limited to rock polypody (fern) and rock tripe (lichen).

Conservation Considerations

Crest, ledge, and talus habitats often occur in locations that are valued by humans for scenic vistas and house sites. Construction of 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 vulnerable to killing or collecting, and rare breeding birds of crests can be easily disturbed by human activities nearby. The shallow soils of these habitats are especially susceptible to erosion from construction and logging activities, and from foot and ATV trails. To protect fragile crest, ledge, and talus habitats and the sensitive species associated with them, activities in the vicinity should be designed to minimize fragmentation, soil erosion, and direct and indirect disturbance to wildlife.

ORCHARD/PLANTATION (or/pl)

This habitat type includes fruit orchards, vineyards, and Christmas tree farms. Conifer plantations with larger or older trees were mapped as "conifer forest." Christmas tree farms are potential northern harrier* breeding habitat, and fruit orchards are potential eastern bluebird* breeding habitat. In the Town of Washington, the primary orchard/plantation areas included the vineyards at the Millbrook Winery and several Christmas tree farms. There were very few fruit orchards. We mapped this as an ecologically significant habitat type more for its future ecological values after abandonment than its current values, which are often compromised by frequent mowing and application of pesticides. These habitats have some of the vegetation structure and ecological values of upland meadows and shrubby oldfields, and will ordinarily develop into young forests if left alone after abandonment.

CULTURAL (c)

Cultural habitats include those that are significantly altered or intensively managed, but are not otherwise developed. They include gardens and parks, golf courses, cemeteries, manicured yards, and areas intensively managed for sport shooting and hunting. Examples of cultural habitats in the Town of Washington included the Millbrook Tribute Garden, parts of Innisfree Garden, parts of the Orvis shooting preserve lands (and other trap clubs and shooting preserves), the Millbrook Golf and Tennis Club, and many private yards and gardens. Like 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, and other types of management. Many cultural areas are valuable for open space, and some provide important ecological services such as buffering areas of natural habitat from developed areas, and linking patches of undeveloped habitat together. Because they are already significantly altered, however, it may be preferable to site new development in these areas instead of in relatively undisturbed habitats.

WASTE GROUND (wg)

Waste ground encompasses a variety of highly altered areas such as active and abandoned soil mines, rock quarries, mine tailings, dumps, and abandoned lots. Many such areas have been stripped of vegetation and topsoil; others have been filled with soil or debris but remain substantially unvegetated. Most waste ground areas are not important for biodiversity, and in fact are particularly susceptible to invasion by non-native, weedy plants once they are abandoned. Some areas, however, have been found to support rare species associated with crests, ledges, sand plains, or other infertile habitats. Rare plants, for example, sometimes occur in abandoned soil and rock mines in the region. Blanding's turtle* and wood turtle* will nest in gravel mines and other disturbed areas where topsoil has been removed. Bank swallow* will nest in relatively stable banks of soil mines. The potential for rare species on waste ground sites, therefore, should not be overlooked. However, on sites where species of conservation concern have are absent or unlikely, it is often preferable to site new development in these areas instead of in relatively unaltered habitats. If these areas are abandoned or reclaimed, many are likely to revert to a natural habitat with biodiversity value over time.

HABITAT DESCRIPTIONS: WETLAND HABITATS

HARDWOOD & SHRUB SWAMP (sw)

Ecological Attributes

A swamp is a wetland dominated by woody vegetation. We combined forested and shrub swamps into a single habitat type because the two often occur together and were often 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 our region, and typical shrubs include silky dogwood, alder, shrubby willows, and northern arrowwood. Two of the most common herbaceous species are tussock sedge and skunk cabbage.

Swamps are important to a wide variety of birds, mammals, amphibians, and reptiles, especially when they are contiguous with other wetland types or embedded within large areas of upland forest. Red-shouldered hawk*, barred owl*, great blue heron*, wood duck*, prothonotary warbler*, Canada warbler*, and white-eyed vireo* are potential nesters in hardwood swamps. Pools within swamps are used by a variety of amphibian species for breeding. Four-toed salamander*, believed to be regionally rare, uses swamps with abundant moss-covered downed wood, rocks, or woody hummocks. Swamp cottonwood* is a very rare tree of hardwood swamps, known only from four locations in the Hudson Valley.

Occurrence in the Town of Washington

Hardwood and shrub swamp is by far the most extensive wetland habitat type in the Town of Washington (Figure 7). These swamps range in size from <1 to 75 acres (0.4-30) and are often contiguous with other wetland habitats such as marsh, wet meadow, and open water (including beaver ponds). Large swamps are located in the Millbrook Marsh watershed (MB-18 and AM-6), the Shaw Brook watershed (MB-34), the Sprout Creek watershed (VB-3), and in the floodplain of the East Branch of Wappinger Creek along the western edge of town (SP-60, SP-68, and MB-48). Small swamps are widely scattered throughout the town.

During field work, we identified at least two calcareous swamps in the northeast corner of town (parts of AM-31 and MB-18). Several of the understory plants we documented at these sites are also found in fens and calcareous wet meadows, including shrubby cinquefoil, bog goldenrod, and lakeside sedge. One example, located on the Millbrook School property, may have been more open and fen-like in the past, prior to hydrologic alteration by beavers and other impacts. Rigid sedge* and phantom cranefly* have been documented from this site (Erik Kiviat, personal communication). These calcareous swamps might be especially valuable for certain rare species that would not occur in a typical red maple swamp. We presume there are more calcareous swamps in the town, particularly in areas that are underlain or influenced by limestone or marble bedrock.

We also documented several shrub-dominated swamps that have some characteristics of kettle shrub pools (see habitat description below), such as dense stands of buttonbush and extensive areas of open water. Although these swamps were not located in or near areas of glacial outwash, they may still provide important habitat for some of the rare species associated with kettle shrub pools such as Blanding's turtle* and spotted turtle*. We did not map either the calcareous or buttonbush-dominated swamps as distinct habitat types, but did make a note of them in the database that accompanies the habitat map.

Conservation Considerations

Many of the smaller swamps in the Town of Washington are embedded in larger areas of upland forest. Many of the larger swamps, however, are located in low-elevation areas where human land uses are also concentrated. These are often surrounded by open agricultural areas or bordered by roads. Maintaining the water quality, quantity, and flow patterns in swamps is important to the plants and animals of swamp habitats. For those swamps surrounded by agricultural land, it is important that runoff contaminated with agricultural chemicals does not enter the swamps. This can degrade the water quality, affecting both the ecological condition of the swamp, associated streams, and the quality of drinking water if the swamp is connected to a public water supply.

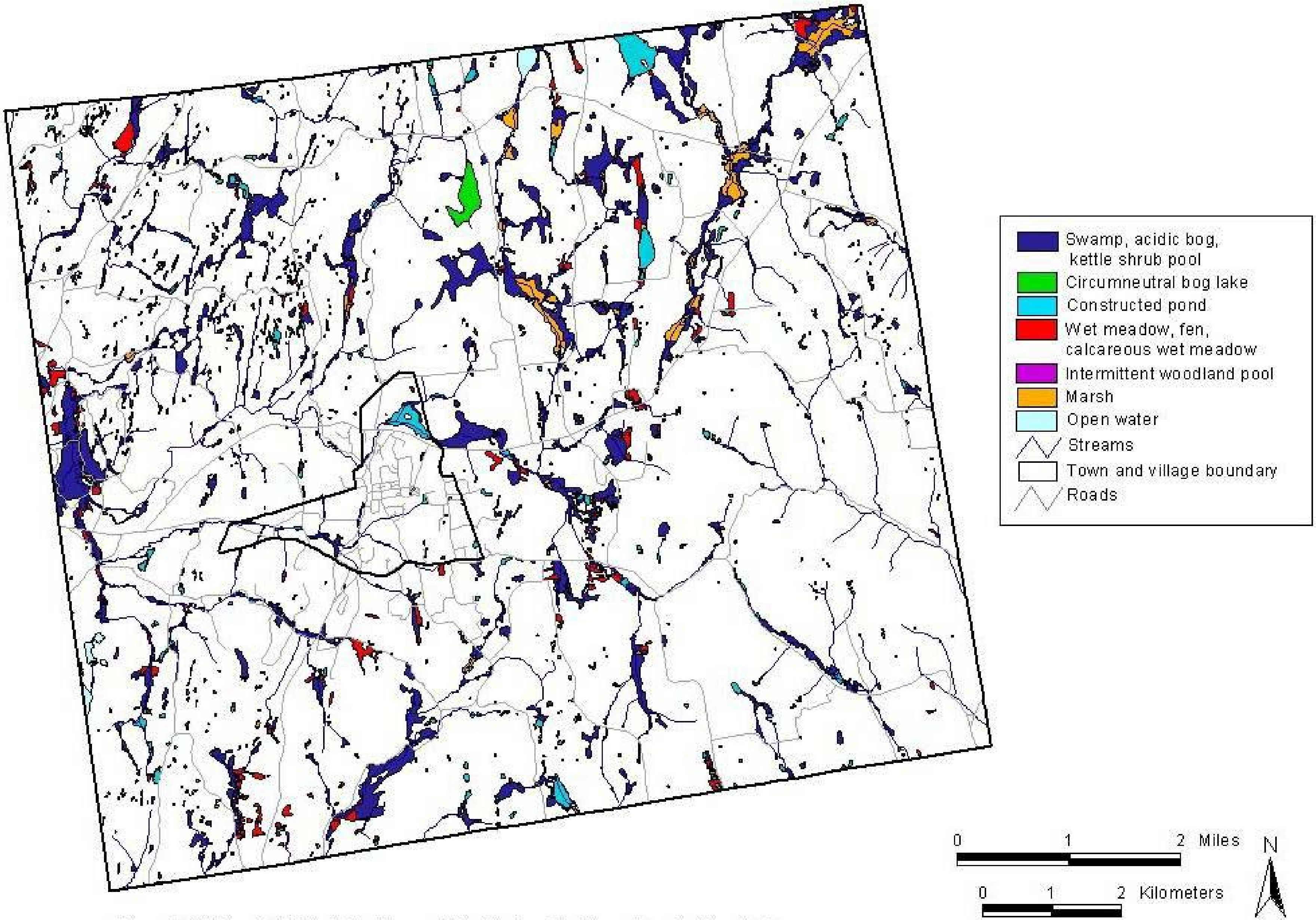


Figure 7. Wetland habitats in the Town of Washington, Dutchess County, New York. Hudsonia Ltd., 2003-2004.

Great blue heron* is a common species that forages in a variety of wetland and stream habitats, but its nesting sites are scarce in the region. It typically nests in rookeries established in stands of dead or partially-dead trees in or at the edge of standing water. Heron colonies are very sensitive to human disturbances during the nesting season. Also, colonies will depart if the wetlands are drained, because the standing water at the base of nest trees provides important protection against nest predators such as raccoons. Any swamps in the Town of Washington with documented great blue heron nesting sites should be priority areas for conservation.

Maintaining connectivity between swamp habitats and adjacent upland and wetland habitats is essential to amphibians that breed in swamps and to 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. Any timber harvest in swamps should be timed to avoid the seasons most critical to sensitive organisms.

MARSH (ma)

Ecological Attributes
An emergent marsh is a wetland that has standing water for most or all of the growing season and is dominated by rooted herbaceous vegetation that emerges above the water surface. Emergent marshes often occur at the fringes of deeper water bodies (e.g., lakes and ponds), or in the midst of or adjacent to other wetland habitats, such as wet meadows or swamps. The edges of emergent marshes, where standing water is less permanent, often grade into wet meadows. Cattail, tussock sedge, arrow arum, arrowheads, water-plantain, and purple loosestrife are some typical marsh plants in this region. Deep pools within or separate from emergent marshes may have floating-leaved plants such as pond-lilies, or submerged aquatic plants such as pondweeds, bladderworts, and watermilfoils. Emergent marshes are the most common marsh habitat in the Town of Washington, but our mapped “marsh” habitat type also includes a few deep pool habitats with only floating-leaved and submerged vegetation.

Emergent marshes are important nesting and nursery habitats for numerous bird species, such as marsh wren*, American bittern*, least bittern*, great blue heron*, Virginia rail*, sora*, American black duck*, and wood duck*. Many raptor, wading bird, and mammal species use marshes for foraging. 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*. Blanding's turtle* uses marshes for summer foraging, for drought refuge, and for rehydration during nesting migrations. Several rare plant species are known from emergent marshes in the region, including spiny coontail* and buttonbush dodder*.

Occurrence in the Town of Washington

Marshes in the Town of Washington were most frequently found along the margins of or embedded in hardwood and shrub swamps. Because it was sometimes difficult to distinguish marsh from shrub swamp 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 and tussock sedge 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 (<3 ac [1.2 ha]). The largest marsh areas were located in the Shaw Brook watershed, north of Daheim Road (MB-34) and in the Millbrook Marsh watershed (AM-6 and MB-18, including portions of Millbrook Marsh, Beaver Dam Marsh, and Hogback Swamp). The marsh habitat within the Millbrook Marsh wetland complex comprised nearly 100 acres (40 ha). At one time, least bittern* and marsh wren* bred in Millbrook Marsh. Their disappearance is thought to be related to the decline in the extent of cattail stands (Kiviat 1994).

Conservation Considerations

In addition to direct disturbance such as filling or draining, marshes are subject to stresses from offsite (upgradient) sources. For example, polluted stormwater runoff from roads, parking lots, lawns, and other surfaces in developed landscapes carry sediments, nutrients, toxins, and other contaminants into the wetland. Alteration of surface water runoff or groundwater flows can lead to dramatic changes in the plant and animal communities of marshes. Nutrient and sediment inputs and human or beaver alteration of water levels can alter the plant community, and facilitate invasion of non-native plants such as purple loosestrife and common reed. Purple loosestrife has displaced many of the native wetland graminoids in recent decades and is now the dominant plant in many of the marshes in the Town of Washington. 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 include protection of surrounding habitats.

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. It is intermediate in wetness between an upland meadow and an emergent marsh. Some wet meadows are dominated by purple loosestrife, common reed, or reed canary-grass, while others have a diverse mixture of wetland grasses, sedges, forbs, and scattered shrubs. Bluejoint, mannagrasses, woolgrass, soft rush, tussock sedge, blue flag, sensitive fern, and marsh fern are some typical plants of wet meadows.

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 that have suffered from loss of habitat throughout the Northeast. 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. Large and small mammals use wet meadows and a variety of other habitats for foraging.

Occurrence in the Town of Washington

Wet meadows were widely distributed throughout the Town of Washington and commonly occurred along the margins of swamps and marshes and in low-lying areas within upland meadows. It is likely that other wet meadows have been drained or excavated for agricultural or ornamental purposes and are no longer functioning as wetlands.

Conservation Considerations

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. Wet meadows are often part of larger complexes of meadows and shrubby oldfield habitats that are prime sites for development and, because many wet meadows are omitted from state, federal, and site-specific wetland maps, they are frequently overlooked in the environmental reviews of development proposals.

CALCAREOUS WET MEADOW (cwm)

Ecological Attributes

Calcareous wet meadows are a subset of the wet meadow habitat and contain a variety of ordinary wet meadow plants, but are distinguished by the presence of plants typical of calcium-rich environments, such as New York ironweed, spreading goldenrod, lakeside sedge, small-flowered agrimony, and sweetflag. Vegetation is often lush and tall. Calcareous wet meadows often occur adjacent to fens and may contain some similar plants, but they are generally supported by water sources other than groundwater seepage. Fens and calcareous wet meadows may be distinguished by a combination of factors, including hydrology (including beaver flooding and abandonment), nutrient inputs, and soil type.

Many common wetland animals occur in calcareous wet meadows, such as red-winged blackbird, green frog, and pickerel frog. High quality calcareous wet meadows with diverse native plant communities are likely to support species-rich invertebrate communities, including rare butterflies such as Dion skipper*, two-spotted skipper*, and Baltimore*. We observed Baltimore larvae on blue flag and tussock sedge leaves in a calcareous wet meadow on the Millbrook School property, and Dion skipper has been reported from the same meadow. The Baltimore is known from several other sites in Dutchess County, but may be declining due to the conversion of wet meadows that are dry at the soil surface much of the year (Kiviat 1994).

Occurrence in the Town of Washington

We documented over 30 calcareous wet meadows in the Town of Washington (Figure 8), most of which were less than 1 acre (0.4 ha). The largest was 5 acres (2 ha). Because a calcareous

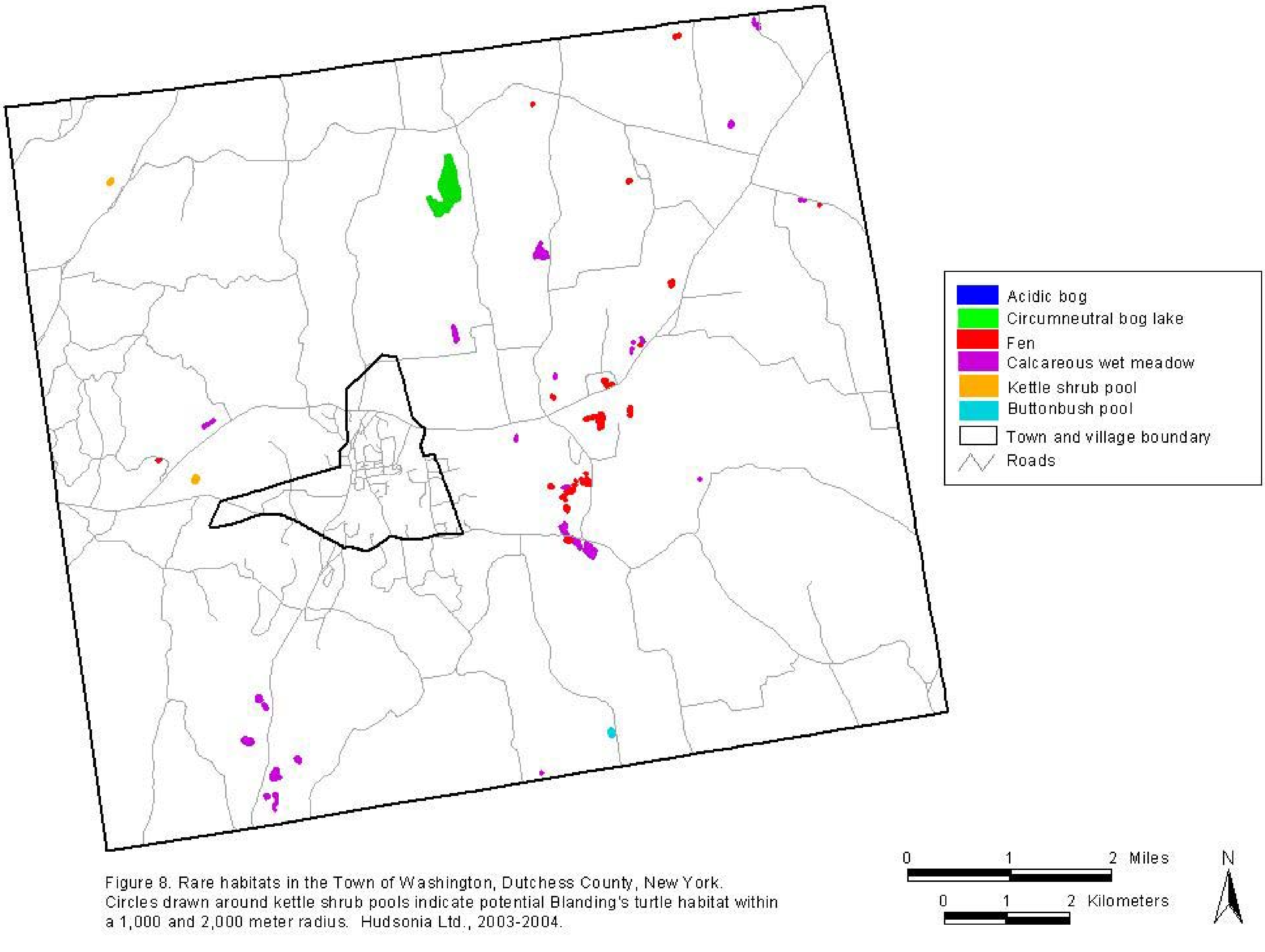


Figure 8. Rare habitats in the Town of Washington, Dutchess County, New York.
Circles drawn around kettle shrub pools indicate potential Blanding's turtle habitat within a 1,000 and 2,000 meter radius. Hudsonia Ltd., 2003-2004.

wet meadow cannot be distinguished from an ordinary wet meadow by remote sensing, indicator plants must be identified in the field. It is possible, therefore, that some of the mapped "wet meadows" we did not visit in the field were actually calcareous wet meadows. The majority of the calcareous wet meadows in the Town of Washington were contiguous with wet meadows, swamps, or upland meadows. In the general vicinity of Mabbettsville, which is underlain by limestone bedrock, several of these were adjacent to fens.

Conservation Considerations

Calcareous wet meadows possess the same sensitivities to disturbance as other wet meadows (see above). Like other small wetland habitats they are often omitted from wetland maps and consequently are 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 to some degree. We recommend that these calcareous wet meadows be treated as potential bog turtle habitat.

FEN (f)

Ecological Attributes

A fen is a wet meadow and low-shrub habitat maintained by calcareous groundwater seepage. Fens tend to occur in areas influenced by calcareous bedrock (e.g., limestone and marble), and are identified by their low, often sparse vegetation and their distinctive plant community. Fens often contain small rivulets of seepage water, 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. Fens are rare in our region because the distribution of calcareous bedrock and soils is very limited. Fens also support many species of conservation concern, including rare plants, invertebrates, reptiles, and breeding birds.

Occurrence in the Town of Washington

We mapped 26 fens in the Town of Washington (Figure 8). Most were less than 1 acre (0.4 ha), and the largest was 4.5 acres (2 ha). The highest concentration of fens occurred in the vicinity of Mabbettsville, an area which is underlain or influenced by limestone bedrock. Most of the fens were located within or along the margin of larger wetlands which included swamp, marsh, wet meadow, and calcareous wet meadow habitats. Because fens are difficult to identify using aerial photographs, there may be other fens in the town that we did not map. Kiviat (1994), for example, notes the occurrence of calcareous seepage forming small fen-like areas along the western foot of Tower Hill. Unmapped fens could occur at the edges or interiors of calcareous wet meadows, swamps, marshes, or wet meadows in low-elevation areas with calcareous bedrock or soils. The perimeter of Round Pond could contain areas of fen.

The mapped fens were of variable quality. The highest quality fens we observed in the field were characterized by rivulets of seepage water flowing into shallow depressions with low-growing vegetation and patches of exposed gravel and deep organic muck. Shrubby cinquefoil was the dominant shrub, along with alder-leaf buckthorn*. Herbaceous species included bog goldenrod, marsh fern, yellow sedge, woolly-fruit sedge, swamp thistle, grass-of-Parnassus*, roundleaf sundew*, fringed gentian*, showy ladyslipper*, and Kalm's lobelia*. Twig-rush and shining flatsedge were dominant in the wettest areas of exposed organic muck. Small hummocks supported several species of sphagnum mosses, cinnamon fern, round-lobed hepatica, Canada mayflower, and poison sumac. Although some of the lower-quality fens lack some of the structure and species characteristic of fens, they were more similar to fens than any other habitat.

Conservation Considerations

Fens are the core habitat of the bog turtle* in southeastern New York, and the marsh and swamp matrix in which some fens occur is a critical part of the bog turtle habitat complex. The bog turtle is listed as federally Threatened, and as Endangered in New York State. Few remaining fens still support bog turtle populations in southeastern New York, apparently due to habitat loss and degradation. The bog turtle has been rediscovered recently in Orange County, but is now extinct, or nearly so, in Westchester and Rockland counties. Any of the high-quality fens in the Town of Washington could be potential bog turtle habitat. Fens seem to be vulnerable to degradation from influences originating offsite, such as runoff from roads, lawns, and agricultural fields. Nutrient pollution, disruption of groundwater flow, or direct physical disturbance can lead to changes in the character of the habitat, including invasion by non-native species and by native tall shrubs and forbs, that can render the habitat unsuitable for bog turtle and other fen animals and plants. It is likely that the fen habitats in the Town of Washington have deteriorated due to many of these factors. Conservation of fens therefore requires attention not only to the fen footprint, but also to land uses outside the fen. Because many of the highest quality fen complexes in the Town of Washington cross multiple privately owned parcels, fen conservation also requires coordinating across property boundaries.

ACIDIC BOG (ab)

Ecological Attributes

An acidic bog is a distinctive type of shrub swamp that is cool, acidic, low in available nutrients, fed by precipitation, and dominated by low shrubs. Leatherleaf, sheep laurel, swamp azalea, cranberries, highbush blueberry, chokeberries, and sphagnum mosses are typical bog plants in this region. Bogs are often characterized by floating or quaking mats of vegetation. The highly acidic, perennially wet, mineral-poor environment slows decomposition of organic matter, often leading to deep accumulations of peat (partially decomposed organic matter). Rare and uncommon species of plants and animals that may occur in acidic bogs in this region include pod grass*, pitcher-plant*, roundleaf sundew*, snakemouth orchid*, tussock cottongrass*, Virginia chainfern*, four-toed salamander*, golden-winged warbler*, and southern bog lemming*.

Occurrence in the Town of Washington

The only known occurrence in the Town of Washington is a constructed bog at the Fern Glen on the Institute of Ecosystem Studies property. Described in the Fern Glen trail brochure as a “poor fen,” this habitat harbors many plants that are common in bogs, such as sphagnum mosses, leatherleaf, bog rosemary*, pitcher-plant*, and roundleaf sundew*. Small patches of acidic bog habitat also occur on the floating mats in Round Pond, the only circumneutral bog lake documented in the Town of Washington (see habitat description below).

Conservation Considerations

Acidic bogs are very rare in Dutchess County. Although the Fern Glen bog is a constructed and managed site, it is significant as a unique pocket of biodiversity within the town. The biological communities of acidic bog habitats seem to be closely tied to the water chemistry, water temperature, and hydroperiods of these environments. Grazing, human trampling, and alterations to the watershed (e.g., tree removal, soil disturbance, applications of fertilizers or pesticides, alterations to groundwater or surface water drainage) could adversely affect this habitat.

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. This is a rare habitat type in the Hudson Valley, and is known to support many species of rare and uncommon 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 northern cricket frog*, Blanding's turtle*, blue-spotted salamander*, and marsh wren*. These habitats have also been found to have diverse communities of mollusks, dragonflies, and damselflies.

Occurrence in the Town of Washington

We found only one circumneutral bog lake in the Town of Washington: Round Pond (MB-31) (Figure 8). We did not field check all water bodies in the town, however, so other such lakes may be present. Round Pond is approximately 53 acres (20 ha), although the footprint of the lake was once closer to 30 acres (12 ha) and was limited to the round central basin area. An active beaver dam at the north end of the lake has caused the water level to rise by approximately 6 feet (2 m) and the surface area of the lake to expand to the north and south. According to the Soil Survey of Dutchess County, New York (Natural Resources Conservation Service 2002), the lake is underlain by Carlisle muck, a deep, calcareous, organic soil. The surrounding area is underlain by Georgia, Stockbridge, and Sun silt loams (also calcareous).

At the time of our field visit in early October, approximately 75% of the lake was covered with floating-leaved vegetation, including white and yellow pond lilies and watershield. Several species of floating and submerged pondweeds and bladderworts were also abundant. A narrow fringe of herbaceous and shrubby vegetation along the shoreline included meadowsweet, cattail, purple loosestrife, lakeside sedge, tussock sedge, sensitive fern, cinnamon fern, skunk cabbage, marsh fern, and marsh St. Johnswort. We observed numerous (15+) great blue herons* on the lake, and at least 16 wood ducks*. On an earlier field visit in the spring, we heard green frogs and wood frogs* calling.

Three large, relatively stable, floating mats (0.1-0.5 acres [0.04-0.2 ha]) were located in the central portion of the lake, and numerous smaller mats, many of which appeared to be sinking at the time of our field visit, were distributed around the pond. The larger mats supported a high diversity of plants, including several rare species. Some of the species we observed include sphagnum mosses, leatherleaf, buttonbush, meadowsweet, steeplebush, purple loosestrife, water-willow*, sweet-gale, poison sumac, false nettle, marsh fern, marsh St. Johnswort, roundleaf sundew*, horned bladderwort*, olivaceous spikerush*, and spiny coontail*. In the Hudson Valley, we have observed olivaceous spikerush and horned bladderwort only on floating mats in circumneutral bog lakes. We observed abundant Canada goose droppings on the mats (particularly the smaller mats), which may have long-term implications for the nutrient balance in the lake. We also observed at least four beaver lodges on the larger mats.

Conservation Considerations

We believe that circumneutral bog lakes are very 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, or altered drainage. Mechanical disturbance or changes in surface water levels or chemistry could disrupt the floating vegetation mats. The plant and animal communities in general are likely to be adversely affected by dredging, by use of motorized watercraft, or other significant intrusions to the pond.

Round Pond is located in an undeveloped portion of an approximately 2,000 acre (800 ha) parcel of privately owned land. It is surrounded by upland deciduous forest, with several small swamps and one large (~70 acre [28 ha]) swamp located nearby. The closest developed areas are along Bangall Road, 650 feet (200 m) to the east. Valley Farm Road is located 3,000 feet (900 m) to the west, and the Shunpike is located 1300 feet (400 m) to the north. This excellent landscape context presents a tremendous conservation opportunity. We strongly recommend that forests be maintained intact within 1,000 feet (300 m) of the lake. Special attention should be paid to potential sources of contamination of groundwater or surface water entering the pond, such as septic systems or runoff from roads. 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.

INTERMITTENT WOODLAND POOL (iwp)

Ecological Attributes

An intermittent woodland pool is a shallow wetland partially or entirely surrounded by forest, typically with no inlet or outlet, 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 "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 Brodie 1998, Semlitsch 2000). The seasonal drying of these pools ensures that the habitat supports no fish (fish are major predators on amphibian eggs and larvae), and the surrounding forest provides habitat for adult amphibians during the non-breeding seasons.

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

Occurrence in the Town of Washington

We mapped nearly 200 intermittent woodland pools in the Town of Washington. Nearly all of these were smaller than 1 acre (0.4 ha) and the largest was 1.6 acres (0.6 ha). Intermittent woodland pools were distributed widely, with a distinct concentration on the west side of the town. Here, faulted terrain creates a system of generally north-south trending ridges with abundant woodland pools in the pockets between ridges. Excellent examples of intermittent woodland pools were located on several properties in the Cannoo Hills area.

We also documented several pools that share some characteristics of kettle shrub pools (see habitat description below), such as dense stands of buttonbush and extensive areas of open water. Although these pools were not located in or near mapped areas of glacial outwash, they may still provide important habitat for some of the rare species associated with kettle shrub pools such as Blanding's turtle* and spotted turtle*. We did not map buttonbush-dominated woodland pools as a distinct habitat type, but we did make a note of them in the database that accompanies the habitat map.

Conservation Considerations

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 acre [0.04 ha]) and their ecological importance is often undervalued. They are frequently drained or filled by landowners and developers and overlooked in environmental reviews of proposed developments. Many intermittent woodland pools in Dutchess County have already been filled, drained, or converted to open ornamental ponds. 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 temporary 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 successfully in larger wetland systems.

The populations of many amphibian species depend not just on a single woodland pool, but on a forested landscape dotted with such wetlands between which individuals can disperse for breeding, foraging, and replenishing locally diminished or extinct populations (Semlitsch 2000, Calhoun and Klemens 2002). The mole salamanders (genus *Ambystoma,* including Jefferson, marbled, and spotted salamander), for example, breed in intermittent woodland pools but spend most of their juvenile and adult lives in the soils and organic litter of upland forests. The best upland habitats for adult salamanders are deciduous forests with plenty of downed wood, rocks, leaf litter and other organic debris, and soft organic duff at the soil surface to provide cover and invertebrate food sources. The mole salamanders are known to migrate seasonally up to 650 feet (200 m) from their breeding pools into surrounding forests (Downs 1989, Semlitsch 1998). A wood frog juvenile may travel as far as 1,550 feet (470 m) from a breeding pool (Calhoun and Klemens 2002). The forested area within a 750 foot (230 m) radius of the intermittent woodland pool is considered necessary to support upland populations of amphibians that breed in intermittent woodland pools (Calhoun and Klemens 2002). The loss of individual pools or the forested connections between them can cause local extinctions of species.

Other threats to the viability of intermittent woodland pools and the survival of the species that depend on them include roads and other forms of human development. Roads, especially denser networks of roads or more heavily-traveled roads, have been associated with reduced amphibian populations (Lehtinen et al. 1999, Findlay and Bourdages 2000, Egan 2001). Both salamanders and frogs are vulnerable to vehicle mortality where roads or driveways cross their travel routes between intermittent woodland pool and upland forest habitats. Amphibians associated with forest habitats, such as the mole salamanders, have been found to be especially sensitive to urbanization (Richter and Azous 1995, Lehtinen et al. 1999). Development results in habitat fragmentation and habitat loss, thereby limiting the amount of upland forest habitat available to amphibian populations (Calhoun and Klemens 2002).

Important overall conservation measures for intermittent woodland pools include protecting pools from filling, draining, dumping, dredging, or compaction, and preserving overland connections between pools by protecting the forest habitats in which networks of intermittent woodland pools are embedded. The following specific recommendations for conserving intermittent woodland pool habitats are from Calhoun and Klemens (2002):

1. Protect the intermittent woodland pool depression up to the spring high water mark.
2. Protect the intermittent woodland pool "envelope" (the area within 100 feet (30 m) of the pool edge), measured from the spring high water mark. Throughout the breeding season, high numbers of adult and juvenile amphibians occupy this zone.
3. Protect the critical terrestrial habitat (the area between 100 and 750 feet [30-230 m] of the pool edge) which serves as critical upland habitat for amphibians during the non-breeding season, allows for movement between pools, and keeps stormwater runoff out of pools.

KETTLE SHRUB POOL (ksp)

Ecological Attributes

A kettle shrub pool is a seasonally or permanently flooded, shrub-dominated pool located in a glacial kettle—a depression formed by the melting of a stranded block of glacial ice. Glacial outwash soils (e.g., Hoosic gravelly loam) are located adjacent to or near the pools. Buttonbush, an aquatic shrub, is often the dominant shrub, but other shrubs such as highbush blueberry, swamp azalea, and willows may also be abundant and buttonbush may be absent. Often, a shrub thicket in the middle of the pool is entirely or partly surrounded by an open water moat. The kettle shrub pool is usually ringed with mature hardwoods, and may have some small trees such as red maple or green ash in the pool interior, but typically lacks a forested canopy.

Kettle shrub pools typically have no stream inlet or outlet, although some may have a small or intermittent inlet or outlet. Standing water is normally present in winter and spring but often disappears by late summer, or remains only in isolated puddles. The pools thus have many of the habitat attributes of intermittent woodland pools, and are used by many of the same wildlife species. Hudsonia has found two state-listed rare plants (spiny coontail* and buttonbush dodder*) and three regionally-rare plants (*Helodium paludosum**, short-awn foxtail*, and pale alkali-grass*) in kettle shrub pools in nearby towns. Kettle shrub pools are used by spotted turtle*, wood duck*, mallard, and American black duck*, and are part of the critical habitat of the Blanding's turtle*, a Threatened species in New York.

Occurrence in the Town of Washington

We documented eleven buttonbush-dominated pools and swamps in the Town of Washington. Of these, eight were located between 180 and 4,500 feet (50-1,400 m) from the nearest mapped glacial outwash deposits. We chose to map these as either swamps or intermittent woodland pools. Of the remaining three pools, one had many of the characteristics of a kettle shrub pool, including a well-developed buttonbush stand surrounded by an open water moat, but was located over 4,500' (1,300 m) from the nearest mapped glacial outwash deposits. We mapped this pool as a "buttonbush pool" to indicate its close resemblance to a kettle shrub pool and to highlight its potential habitat value for Blanding's turtle* and other rare species associated with kettle shrub pools. We mapped only two pools as true kettle shrub pools (Figure 8). These pools were 0.5 acres (0.2 ha) and 1.6 acres (0.6 ha), and were located in or near mapped areas of Hoosic gravelly loam soil. They were situated in semi-round basins with dense buttonbush stands, and were partly surrounded by an open water moat. One of these pools was surrounded by upland forest and shrub swamp, with open agricultural areas nearby. The other was located in an active (although small scale) gravel mine and had little to no vegetated buffer on one side.

Conservation Considerations

Kettle shrub pools are part of the critical habitat of the state Threatened Blanding's turtle. The Blanding's turtle typically spends at least winter and spring in a kettle shrub pool. In late spring and early summer, adult females move overland to their upland nesting sites, which are usually on coarse, gravelly, friable soils in locations lacking a tree canopy. During the summer, it uses kettle shrub pools and a variety of other wetlands for foraging and resting, including emergent marshes, swamps, intermittent woodland pools, and circumneutral bog lakes. During drought periods and during the nesting season, it may move into constructed ponds or other water bodies that retain standing water.

Most Blanding's turtle seasonal movements occur within 3,300 feet (1,000 m) of their winter and spring wetland habitat. In the Northeast and elsewhere in their range, however, movements of 6,500 feet (2,000 m) or more have been documented on numerous occasions (Joyal et al. 2000, Fowle 2001, Joyal et al. 2001). To delineate the potential extent of the habitat complex used by a Blanding's turtle population, we draw a 1,000 m and 2,000 m radius around their winter and spring wetland habitat (Figure 8). We consider 1,000 m to be the zone of primary concern, and 2,000 m to be the zone of secondary concern (Kiviat 1997). Within those zones, potential Blanding's turtle habitats include both wetlands and upland nesting habitats, as well as the travel corridors between them. Nesting habitats are typically non-forested, unshaded habitats with coarse-textured, well drained soil (often gardens, agricultural fields, utility rights-of-way, soil mines, etc.). Other suitable nesting habitats include areas where the soil has been disturbed during the past ten years, and small pockets of soil on rock outcrops. Blanding's turtle hatchlings and larger juveniles use shallower and more densely-vegetated habitats in kettle shrub pools or other types of wetlands (including very small wetlands).

The Blanding's turtle has been observed in the Town of Washington, but turtle surveys have not been conducted in the potential habitats and the number of sites occupied by the turtles is unknown. There are records of Blanding's turtle in the neighboring towns of Union Vale, Stanford, Pleasant Valley, and La Grange, several of which are within 2-3 miles (3.2-4.8 km) of the Town of Washington border. By identifying kettle shrub pools in the town, we have identified some of winter and spring habitats that may be used by Blanding's in normal years. If Blanding's turtles are found in the Town of Washington, the potential habitat complex should be evaluated and delineated more precisely so that any development can be designed to accommodate the needs of the turtles as they move between habitats. Wherever land use changes are anticipated in the vicinity of one of these pools, we recommend that the pool be surveyed for Blanding's turtle by qualified biologists early in the planning process.

OPEN WATER (ow)

Ecological Attributes

Open water habitats include natural ponds and lakes, open water areas within marshes, and ponds that may have originally been constructed but have since reverted to a more natural state (e.g., surrounded by unmanaged vegetation; no longer maintained as ornamental or livestock ponds, etc.). Open water areas are important habitat for many common species, including invertebrates, fishes, frogs, turtles, waterfowl, muskrat, beaver, and bats. American bittern*, osprey*, bald eagle*, and great blue heron* may use open water areas as foraging habitat. Blanding's turtle* and spotted turtle* use ponds and lakes during non-drought periods and as refuges during drought periods, and Blanding's turtle may use open water areas for nesting. Wood turtle* may overwinter and mate in open water areas. Northern cricket frog* may occur in circumneutral ponds, and spiny coontail* is known from several open water ponds. Open water areas sometimes support submerged aquatic vegetation which can provide important habitat for aquatic invertebrates and fish.

Occurrence in the Town of Washington

Natural open water areas are far less common than constructed ponds (see below) in the Town of Washington. Of the approximately 30 open water habitats we mapped, the majority were smaller than 2 acres (0.8 ha). The largest open water areas were Tyrrell Lake (47 ac [19 ha] with portions in Washington and Pleasant Valley) and Shaw Pond (MB-17, 30 ac [12 ha] with portions in Washington and Stanford). With the exception of limited development and landscaping at Innisfree Garden (on the shore of Tyrell Lake), both of these water bodies had undeveloped shorelines. Areas of open water within beaver wetlands appear to be dynamic habitats that increase or decrease in size depending on the degree of beaver activity. These areas are often transitional to emergent marshes or wet meadows. Some of the open water habitats we mapped included open water areas within abandoned sand/gravel mines. These would have originally been classified as "constructed ponds," but have since reverted to more natural conditions. Most of the open water habitats in the town were mapped from aerial photographs. During field work, we found that some areas that appeared to be open water on the aerial photographs supported abundant floating-leaved vegetation (e.g., pond lilies, duckweed) by late summer. We mapped these areas as "marsh."

Conservation Considerations

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 located within a mosaic of undeveloped habitat. These 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 use of herbicides, grass carp, harvesting, and biocontrol, is an especially important concern in open water habitats, and the potential negative impacts should be assessed carefully before any such activities are undertaken. Because they are often located within larger wetland and stream complexes, any disturbance to the open water habitat may also have more far-reaching impacts in the watershed. To protect water quality and habitat values, broad zones of undisturbed vegetation and soils around undeveloped ponds and lakes should be maintained. If part of a pond or lake must be kept open for ornamental or other reasons, it is desirable to avoid dredging and to allow other parts of the pond to develop abundant vegetation.

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, and aesthetics. They also include the water bodies created during mining operations. If constructed ponds are not intensively disturbed by human activities, they can be important habitats for many of the common and rare species that are associated with natural open water habitats (see above).

Occurrence in the Town of Washington

The majority of the open water bodies we mapped in the Town of Washington were constructed ponds. Most of these were apparently created for aesthetic purposes and were located within landscaped areas in close proximity to residences. Many others were used for livestock, and several were located in active gravel mines. Overall, we mapped close to 500 constructed ponds within the town. Because of the potential value of constructed ponds as drought refuge for turtles and other wildlife, we mapped constructed ponds within developed areas as well.

All but six of the constructed ponds we mapped were smaller than 5 acres (2 ha). The largest was Bontecou Lake (MB-18, also known as Tamarack Lake) which covers 118 acres (47 ha) in the towns of Washington and Stanford. Prior to flooding in 1956, this was a large tamarack swamp with a central bog lake. Today it is a shallow lake used by a variety of wildlife (e.g., ducks, Canada goose, great blue heron, eastern bluebird*, tree swallow) and as a water source for cattle. Other large constructed ponds included Dietrich Pond (MB-39, 34 ac [14 ha]), and a large pond north of Andrew Haight Road (MB-35, 26 ac [10 ha]). All of these larger ponds had undeveloped shorelines. Constructed ponds with substantial cover of floating-leaved or emergent vegetation (e.g., pondweeds, duckweed, cattail, purple loosestrife, common reed) were mapped as "marsh."

Conservation Considerations

The habitat value of constructed ponds varies depending on the landscape context and the extent of human disturbance. In general, the habitat value increases when the ponds have undeveloped shorelines, are relatively undisturbed by human activities, and are embedded within a mosaic of intact habitat. Because many constructed ponds are not buffered by natural vegetation, they are vulnerable to the adverse impacts of agricultural runoff, septic leachate, and pesticide/fertilizer runoff from private yards. We expect that many of those maintained as ornamental ponds are treated with herbicides and perhaps other toxins. 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 those ponds. In most cases, the loss of ecological functions of natural habitats far outweighs any habitat gains in the new artificial environments.

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, and 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.

Very little is known, or at least published, on the ecology of seeps in the Northeast. A few rare invertebrates are restricted to springs in the region. Springs emanating from calcareous bedrock or calcium-rich surficial deposits sometimes support an abundant and diverse snail fauna. Northern dusky salamander* uses springs and cold streams, and gray petaltail* and tiger spiketail* are two rare dragonflies of seeps in the region. Spring salamander* may use lowland springs and seeps, although they are more often associated with higher elevation streams.

Occurrence in the Town of Washington

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. We expect there are many more springs and seeps in the Town of Washington that we did not map. More detailed inventories of seeps and springs should be conducted as needed on a site-by-site basis.

Conservation Considerations

Springs and seeps provide important water sources for many organisms during droughts, and during winter when these habitats may remain free of ice. Because groundwater discharges at a fairly constant temperature, spring and seep habitats tend to be warmer than surrounding habitats in winter and cooler than surrounding habitats in summer. This enables them to support certain organisms that occur rarely or not at all in other habitats in the region. Springs are easily disrupted by disturbance to upgradient land or groundwater, altered patterns of surface water infiltration, or pollution of infiltering waters.

PERENNIAL & INTERMITTENT STREAMS

Ecological Attributes

Perennial streams flow continuously throughout years with normal precipitation, but some may dry up during droughts. Perennial streams provide essential water sources for wildlife throughout the year, and are critical habitat for many vertebrate and invertebrate species. Perennial streams and their banks and floodplains provide nesting and foraging habitat for many species of birds, such as spotted sandpiper, belted kingfisher, tree swallow, bank swallow, Louisiana waterthrush, great blue heron* and green heron. Bats use perennial stream corridors for foraging. Wood turtle* uses perennial streams with pools and recumbent logs, undercut banks, and muskrat or beaver burrows. Parts of the East Branch of Wapppinger Creek appear to have excellent habitat for wood turtle. 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 DEC and by private groups.

Intermittent streams flow only during certain times of year or after rains. They are the headwaters of many 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 disappearance in a portion of the landscape can affect the presence and behavior of wildlife populations over a large area. Although intermittent streams have been little studied by biologists, they have nonetheless been found to support rich aquatic invertebrate communities, including regionally rare and state-listed rare mollusks (Gremaud 1977) and dragonflies. Both perennial and intermittent streams provide breeding, larval, and adult habitat for northern dusky salamander*, spring salamander*, and northern two-lined salamander. Spring salamander is more often associated with higher elevation streams. The forests and sometimes the meadows adjacent to streams provide nonbreeding (e.g., foraging) habitats for adults and juveniles of these species.

Occurrence in the Town of Washington

Perennial streams are distributed widely throughout the Town of Washington. Intermittent streams are most common in the more hilly terrain on the eastern and western edges of the town.

Conservation Considerations

In a study examining relationships between land use and water quality in 15 Hudson River tributaries, Parsons and Lovett (1993) found a marked correlation between urbanization (including roads and residential and commercial development) and water quality deterioration. In a 1988-1989 study (Stevens et al. 1994) of Hudson River tributaries, Hudsonia found that water quality in many streams had significantly deteriorated since previous studies in 1966 (Ayer and Pauszek 1968) and 1985 (Schmidt and Kiviat 1986). The report states:

> *"It is not premature to warn planners, regulators, and other decision makers that there is a lot of stream pollution and habitat degradation occurring in Hudson River tributaries, and...the overall picture is one of streams under considerable stress from both point and non-point pollution sources. Environmental planners and managers should worry less about what is happening at particular point sources and more about the cumulative impacts of pollutants from sources such as sewage discharges, septic leachate, and runoff from construction sites, agricultural lands, and highways. Planners and regulators should not wait to act; it is more difficult to restore streams than to protect them....Although a pristine ideal may not be achievable given the intensity of land development in this region of the Hudson Valley, restoration and maintenance of viable functioning communities of native stream organisms is a realistic objective."*

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. Activities in the watershed that cause soil erosion, increased 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.

Along the stream, removal of trees or other shade-producing vegetation can lead to elevated stream temperatures that can 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, and can diminish the floodplain's capacity for floodwater attenuation, leading to increased flooding downstream, scouring and bank erosion, and sedimentation of downstream reaches. 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. Effective protection of stream habitats, therefore, requires attention not only to the stream channel, but to land uses in the riparian corridor and throughout the watershed.

RIPARIAN CORRIDOR

Ecological Attributes

We loosely define "riparian corridor" as the zone along a perennial stream that includes the stream banks, the floodplain, and adjacent steep slopes. Although we did not delineate riparian zones on the Town of Washington habitat map, it is such an important part of the ecological landscape that we are including it in this report in hopes that town officials and residents will consider it as a critical factor when undertaking land-use planning or reviewing development proposals.

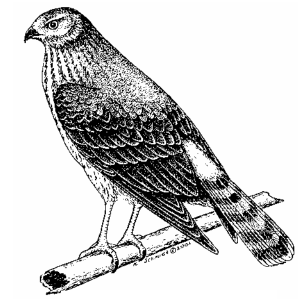
Riparian zones may contain many different habitat types, including rocky crest or ledge, bottomland forest, hardwood swamp, emergent marsh, fen, wet meadow, and upland meadow. Riparian zones tend to have high species diversity and biological productivity, and most fish and wildlife depend upon riparian habitats in some way for their survival (Hubbard 1977, McCormick 1978). We know of many rare plants of riparian zones, such as cattail sedge*, Davis' sedge*, and diarrhena* (a grass). Wood turtle* uses certain kinds of riparian zones, and red-shouldered hawk* and cerulean warbler* nest in areas with extensive riparian forests, especially those with mature trees. Muskrat, beaver, mink, river otter*, and scores of other mammals, reptiles, amphibians, and birds use riparian corridors regularly or intermittently.

Conservation Considerations

The riparian zone is a good example of a landscape component that provides ecological services disproportionate to its size at any location. Floodplains act to store floodwaters, decrease stream velocities at flood stages, and decrease the potential for catastrophic flooding downstream. They capture sediments and nutrients, help to stabilize riverbanks, and provide critical habitats for wildlife and aquatic species. Portions of the riparian zone are subject to irregular disturbances from flooding, which can scour stream channels and cut new channels, erode streambanks and floodplain soils, uproot and carry away plants and organic debris, and deposit sediments and debris. These disturbances are important to the instream habitats and stream water quality, and help to create some of the specialized habitats of floodplains. Any alteration of flooding regimes, stream water volumes, timing of runoff, and water quality can profoundly affect the habitats and species of streams and riparian zones.

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, paving, logging, soil mining, clearing of vistas, creating lawns, and other disruptive activities in and near riparian zones can eliminate riparian functions and adversely affect the species that depend on streams, riparian zones, and nearby upland habitats. Because one of the most important means of protecting stream quality is to protect the riparian zones from disturbance, we recommend maintaining (or restoring, if necessary) natural riparian habitats wherever possible.

DISCUSSION


Northern harrier
(K. Schmidt © 2001)

Using Biodiversity Information in Land Use and Conservation Planning

Most local land use decisions in the Hudson Valley are made on a site-by-site basis without the benefit of good ecological information about the site or the surrounding lands. The incremental loss of biological resources from any single development site may seem trivial. The cumulative impacts of site-by-site decision making, 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.

The size of habitats, the degree of connectivity between habitats, and the juxtaposition of habitats in the landscape all have important implications for regional biodiversity. While some species and habitats may be adequately protected at a relatively small scale, many wide-ranging species with large spatial requirements, such as black bear, barred owl, and red-shouldered hawk require large, interconnected blocks of unbroken habitat. Many species, such as Blanding's turtle, bog 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 the movements of, and interactions between, animals and can disrupt patterns of dispersal, reproduction, competition, and predation. According to Wilcove et al. (1986), habitat fragmentation may be "the principal threat to most species in the temperate zone." 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.

Because habitats, biological communities, and ecosystems do not respect property boundaries, the best approach to biodiversity conservation is from the perspective of whole landscapes. The Town of Washington habitat map facilitates this approach by illustrating the location and configuration of ecologically significant habitats throughout the town. This spatial ecological information, together with the information included in this report, can be applied directly to land use and conservation planning and decision-making at multiple scales:

1. *Large-Scale Conservation and Land Use Planning*

   The town-wide habitat map and report are practical tools that can help the town establish conservation goals, priorities, and strategies. Rather than making land use decisions on a parcel-by-parcel basis, the map provides a landscape perspective that can help users prioritize areas for protection and identify sites for new development where the ecological impact will be minimized. The landscape approach is much more likely to yield sound conservation decisions than the typical parcel-by-parcel approach. Once habitat mapping is complete in contiguous towns, the maps can also be used for conservation planning across town boundaries.

2. *Reviewing development proposals and other land use proposals*

   At a site-specific scale, the habitat map and report can provide more detailed ecological information about a proposed development site, as well as the surrounding area that might be impacted. The information contained in the habitat map can help developers, residents, and town officials understand the ecological connections between habitats when considering development proposals, and plan new development in a way that minimizes impact to ecologically significant habitats.

In the following pages, we outline recommendations for: 1) establishing town-wide conservation goals and priorities; 2) using the map as a resource for reviewing site-specific land use proposals; and 3) developing conservation strategies in the Town of Washington.

Establishing Conservation Goals and Priorities in the Town of Washington

Rural landscapes in Dutchess County have faced increasing development pressure in recent years. In the Town of Washington, habitat fragmentation caused by roads and private residential development poses a significant threat to local biodiversity. There are, however, still relatively large areas of undeveloped land in the Town of Washington that contain a variety of ecologically significant habitats. By employing a proactive approach to land use and conservation planning, the town has the opportunity to protect the integrity of its biological resources for the long term.

With limited financial resources to devote to conservation purposes, the Town of Washington must decide how best to direct those resources to achieve the greatest conservation results. While it may be impossible to protect all significant habitats, there are reasonable ways to prioritize conservation efforts. Below we suggest seven general conservation goals, and highlight some areas of particular conservation significance within the Town of Washington. While we hope this information will help the Town of Washington think strategically about future land-use planning, it should be understood that this is not an exhaustive list of important conservation areas in the town. In addition to the information contained in the habitat map and this report, the town should incorporate local knowledge and priorities into a set of conservation goals, priorities, and strategies that are compatible with other planning goals and with the character of existing, anticipated, and desired land uses in the town. These conservation goals and priorities should be reviewed and revised periodically to accommodate new ecological information and landscape changes in the town.

Goal #1: Protect large areas of contiguous, undeveloped habitat.

Large habitat patches generally support greater biological diversity and a wider range of ecological and natural disturbance processes (e.g., nutrient cycling, groundwater flow, fires, floods) than small patches.[3] Effective biodiversity conservation, therefore, requires

[3] The importance of small habitat patches, however, should not be overlooked. Small patches of intact habitat can have important ecological values, particularly when they are well connected to other critical habitats. Isolated habitat patches may play a crucial role in connecting distant habitats ecologically (Semlitsch 2000). They may, for example, serve as essential stopover sites for migratory birds, or as important habitat for certain amphibians,

protecting large, functional landscapes that sustain a broad diversity of native species and habitats and the ecosystem processes that support them. The largest block of unfragmented habitat in the Town of Washington is over 2,000 acres (800 ha), located between Valley Farm and Bangall Roads. In addition, there are several habitat blocks larger than 1,000 acres (400 ha) and many larger than 500 acres (200 ha) (Figure 3). We recommend that maintaining the integrity of these large habitat areas be a primary conservation goal. The ecological impact of new roads and houses is greater when they are constructed in the core of previously undeveloped habitat blocks. The impact can be lessened if new construction is concentrated along pre-existing roads or clustered in villages and hamlets.

Goal #2: Protect large and high quality areas of contiguous forest.

Forest occurs naturally at a large geographic scale, providing habitat for wide-ranging species with large spatial requirements and "forest interior" species sensitive to disturbance from forest edges. Large areas of unfragmented forest are increasingly uncommon in Dutchess County, making it particularly important to maintain the integrity of those that remain. There are several areas of large, relatively unfragmented forest within the Town of Washington (Figure 4), some of which are contiguous with forest habitat that extends across the town boundaries. Forest patches that have a lower edge-to-interior habitat ratio (e.g., those that are more round and less linear) are particularly important for interior forest-dwelling species. Some priority conservation areas include:

- Several large, forested blocks in the northwest part of town, including the areas between the Shunpike and Woodstock Road; south of Woodstock Road between Cannoo Hill and Stanford Roads; and west of Cannoo Hill Road and north of Route 44.
- The >1,000 acre (400 ha) forest block south of the Shunpike, between Valley Farm and Bangall Roads.
- The ~700 acre (280 ha) forest block west of Milewood Road, which is contiguous with a forested area of Pleasant Valley extending to the Taconic Parkway.

invertebrates, and plants. In some cases, isolated habitat patches may protect a species from predators or competitors. In order to maintain native biodiversity, small, high quality habitat patches should not necessarily be considered more expendable than large habitat patches.

- Several large, forested blocks in the southeast part of town, including the areas on Tower Hill, which are contiguous with the forested Turkey Hollow area in Amenia; north and south of Butts Hollow Road; between Chestnut Ridge Road and Route 343; and east and west of Killearn Road.
- The mature forest at the Millbrook School "ski hill," and other areas of mature or old-growth forest as they are identified in the town.

Goal #3: Protect large areas of contiguous meadow.

Meadows are among the habitats most vulnerable to future development. In agricultural areas, for example, development can be an attractive alternative to the economic challenges faced by small farmers. Meadows account for approximately 30% of the total land area in the Town of Washington. Not only are meadows an important scenic resource in the town, they are also an important ecological resource.[4] In particular, larger areas of upland meadows (especially those unfragmented by hedgerows and fences) are potential habitat for several species of rare or declining grassland-breeding birds. Meadow patches that have a lower edge-to-interior habitat ratio (e.g., those that are more round and less linear) and those that are not intensively managed are especially valuable for these grassland-breeding birds. Hay fields, fallow fields, herb-dominated old fields, and some shrub-dominated fields have greater potential to support many rare and uncommon grassland and shrubland species than cultivated fields. Figure 5 illustrates the location and distribution of meadow habitat in the town. Some of the largest expanses of upland meadow include:

- Just west of Millbrook Village, 500 acres between Routes 44 and 44A.
- Large areas in the southwest corner of town, east and west of Oak Summit Road and east and west of Route 82.
- Large areas in the northwest part of town on both sides of North Mabbettsville Road, extending north of the Shunpike.
- Extensive areas along Route 44, northeast of Mabbettsville.
- Several large patches in the southeast corner of town, including south of Butts Hollow Road and south of Route 343.

[4] While focusing on conservation of existing upland meadows with high biodiversity value, however, the town should also consider avoiding further conversion of forest to upland meadow and perhaps even allowing some meadows (particularly smaller ones, or those that are contiguous with areas of upland forest) to revert back to forest cover.

Goal #4: Protect rare habitats.

We documented several rare and unusual habitat types in the Town of Washington, all of which have the potential to support a variety of rare species (Figure 8). Unlike the common, widespread habitats (e.g., upland deciduous forest) that occur naturally on a scale of thousands of acres or more, these smaller habitats occur at a smaller geographic scale as a result of local physical factors and ecological processes. The biodiversity value of these small habitats is often disproportionate to their size, making them particularly important targets for conservation. Effective conservation of small-patch habitats requires protecting not only the habitat footprint, but also the habitats around them and often the connections between them. Some conservation priorities in the Town of Washington include:

- The circumneutral bog lake between Valley Farm and Bangall Roads (MB-31). This is a high quality example of this unusual habitat type, and it is the only occurrence in the Town of Washington.
- Fens and calcareous wet meadows, including those in the Mill Brook Watershed west of Little Rest Road; in the vicinity of Mabbettsville, north and south of Route 44; in the Hogback Swamp-Beaver Dam Marsh-Millbrook Marsh wetland complex; east and west of Route 82 in the southwest part of town; and other isolated locations in the town (see Figure 8).
- Kettle shrub pools, including the surrounding uplands and wetlands that serve as potential Blanding's turtle habitat (see Figure 8). We identified two kettle shrub pools in the Town of Washington, and one buttonbush pool (a closely related habitat type that may also provide Blanding's turtle habitat).
- Calcareous and non-calcareous crest, ledge, and talus habitat throughout the town. To protect these fragile habitats and the sensitive species associated with them, human disturbance in the vicinity should be minimized. Where possible, areas of crest, ledge, and talus habitat should be protected within a matrix of upland forest.

Goal #5: Protect high quality habitat complexes.

Protecting complexes of intact, connected habitats (which may include both common and rare habitats) is preferable to protecting individual habitats in isolation. In habitat complexes, important ecological processes and connections that sustain individual habitats and the species that travel among them are more likely to be maintained. In the more developed parts of Dutchess County, these complexes of connected habitats have disappeared or are rapidly disappearing. The Town of Washington, however, still has the opportunity to protect many high quality habitat complexes. We have chosen just a few examples to list here:

- The wetlands of the Millbrook Marsh Watershed (MB-18 and AM-6, including Millbrook Marsh, Beaver Dam Marsh, and Hogback Swamp) comprise one of the most extensive areas of calcareous wetlands in Dutchess County (Kiviat 1994). Although the wetlands have been altered by the invasion of purple loosestrife and other non-native plants, and by a variety of human activities (e.g., channelization, impoundment, nutrient enrichment from surrounding agricultural lands), they still constitute one of the most important ecological resources in the town. Agriculture is one of the dominant land uses in the area. With careful management, agriculture can continue to be a compatible land use, as long as a substantial portion of the watershed remains forested.
- Areas with high concentrations of intermittent woodland pools embedded within large areas of unfragmented forest should be high priorities for conservation. To serve as viable amphibian habitat, these pools must exist within a matrix of intact upland forest. In the Town of Washington, high quality intermittent woodland pool habitat occurred in the faulted terrain west of Valley Farm Road, between the Shunpike and Route 44A; in the southwest corner of town, west of Route 82; and in the Tower Hill area. Many of these forested areas also contain extensive areas of calcareous and non-calcareous crest, ledge, and talus habitat, making them particularly important habitat complexes.
- West of Fowler Road, the low-gradient, meandering East Branch of Wappinger Creek supports extensive floodplain wetlands (SP-60, SP-68, and MB-48) including wet meadow, hardwood & shrub swamp, and marsh habitats. This habitat complex is a unique ecological feature in the town.
- Some of the highest quality fens and calcareous wet meadows we documented in the Town of Washington are concentrated in the Mill Brook Watershed, west and south of Little Rest Road. Most of these are embedded within a larger wetland complex, including hardwood and shrub swamp, marsh, and wet meadow habitats. This largely intact habitat complex, which includes both rare and common habitats, stands out as a high conservation priority in the town.

Goal #6: Protect representative examples of all habitat types that occur in the town.

The previous goals have addressed the importance of protecting large, high quality, and rare habitats and habitat complexes. When striving to conserve local biodiversity, it is important to be sure that examples of common habitats not captured in any of those categories are also included within conservation areas. Each distinct habitat, including both common and rare types, supports a unique suite of species that are important components of local biodiversity.

Goal #7: Protect or restore corridors of undeveloped land between habitat patches.

Connectivity among diverse habitats is essential to maintaining ecologically functional landscapes that support viable populations of native species. The ability to move among habitat patches is essential for maintaining genetic diversity within populations and for ensuring that species can disperse to new habitat if a particular habitat is degraded or becomes otherwise unsuitable (Mech and Hallett 2001). It is therefore critical to maintain or restore corridors of undeveloped land between habitat patches. In the Town of Washington, this means:

- Maintaining or restoring connections across roads. Roads are a primary fragmenting feature in the town, exposing mobile species to a higher risk of mortality as they attempt to move from one habitat patch to another. Currently, much development in the town is concentrated along roads. To maintain travel corridors for wildlife moving between habitats on two sides of the road, it is essential that some undeveloped areas remain along all roads. Where development is particularly dense along roads, even narrow strips of habitat may serve as important wildlife travel corridors.
- Preserving links, and creating new links, between natural habitats on adjacent properties.
- Maintaining forested corridors between large areas of unfragmented forest. Some forest-dwelling species do not cross agricultural or developed lands, and therefore remain isolated if forest patches are not linked together by forested corridors.

Goal #8: Protect habitats associated with resources of special economic, public health, or aesthetic importance to the town.

In addition to the important ecological values associated with the habitats we describe in this report, the town may also wish to consider habitats that provide other direct or indirect benefits to local residents when establishing conservation goals and priorities. The quality and quantity of drinking water in the town, for example, is dependent upon the condition of stream, lake, pond, and other wetland habitats, as well as the groundwater aquifers. Protection of farmland (e.g., upland meadows) may help to ensure the long-term contribution of active farms to the local economy and the scenic beauty of the landscape.

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 also be used for reviewing site-specific development and other land use proposals. The habitat map can provide ecological information about a proposed development site, as well as the surrounding areas that might be impacted. The map can also help planning and regulatory agencies consider the ecological relationships among habitats when making land use decisions. We recommend that reviewers considering a new land use on a particular site take the following steps to consider 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 habitat descriptions in this report, and note the conservation recommendations for each.
3. 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. Design modifications may include (but are not limited to):
   - Minimizing intrusions into large forested or meadow habitats.
   - Minimizing intrusions into forested areas that are within 200 m of an intermittent woodland pool.
   - Avoiding disturbances that would disrupt the groundwater quantity or quality available to onsite or offsite fens.
   - Channeling stormwater runoff from paved areas or fertilized turf into detention basins instead of directly into streams, ponds, or wetlands.
   - Locating human activity areas as far as possible from the most sensitive habitats.
   - Locating developed features such that corridors of undeveloped land are maintained between habitats.

Because the habitat map has not been 100% ground-truthed, we emphasize that, at the site-specific scale, it 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.

Strategies for Achieving Conservation Goals

We hope that the Town of Washington habitat map and report will help landowners understand how their land 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 tremendous biological resources that still exist within the Town of Washington.

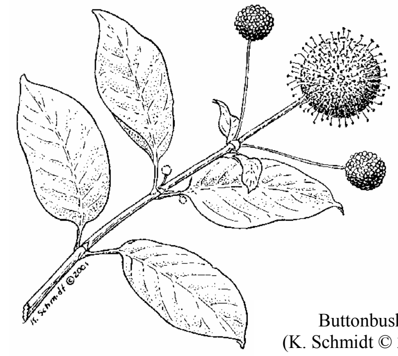
A variety of regulatory and non-regulatory means can be employed by a municipality to achieve its conservation goals, including volunteer conservation efforts, master planning, zoning ordinances, tax incentives, land stewardship incentives, permit conditions, land acquisition, and conservation easements. Section 4 in the *Biodiversity Assessment Manual* (Kiviat and Stevens 2001) provides additional information about these and other conservation strategies. 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. *Conservation Thresholds for Land-Use Planners* (Environmental Law Institute 2003), for example, 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 Master Plan and adapted to the local zoning ordinance.

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, unaltered tracts wherever possible.
- Preserve links, and create new links, between natural habitats on adjacent properties.

- 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, along shores of other 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.
- Encourage and provide incentives for developers to consider environmental concerns early in the planning process, and 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.
- Preserve farmland potential wherever possible.
- Plan landscapes with interconnected networks of open space. When considering protection for a particular species or group of species, design the open space networks according to the particular needs of the species of concern.
- Restore degraded habitats wherever possible, but do not use restoration projects as a license to destroy existing habitats.

CONCLUSION



Buttonbush
(K. Schmidt © 2001)

In the rural landscapes of northern Dutchess County, including the Town of Washington, there are still significant opportunities for biodiversity conservation. 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, local residents, 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, however, 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 Washington, Hudsonia hopes to have the opportunity to assist town officials, local landowners, and other interested individuals and groups in interpreting the map, understanding what ecological resources exist within the town, and devising ways to integrate this new information into land-use planning and decision making.

We believe that the town-wide habitat map is an invaluable tool for land use and conservation planning. 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. 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 think about where future development should be concentrated and where future conservation efforts should be targeted.

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 bring an independent body of information to environmental reviews, and will help users 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. The map, however, should never be considered a substitute for site visits by qualified professionals. During site visits, the presence and boundaries of important habitats can be verified, and the site can be assessed for additional ecological values, such as rare species occurrences. This detailed, up-to-date 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 town decision-makers plan wisely for future development while taking steps to protect biological resources of greatest importance. Incorporating this approach into planning and decision making will help to minimize the adverse effects of human activities, to integrate the needs of the human community with those of the natural landscape, and to protect the ecological patterns and processes that support the human community and the rest of the living world.

ACKNOWLEDGEMENTS

We are extremely grateful to the Millbrook Tribute Garden and the Dyson Foundation who provided funding for this project, and to the Dutchess Land Conservancy for their partnership and support. The Washington Town Board, Planning Board, and Conservation Advisory Council welcomed the project and assisted us in many ways. We thank Sal Licausi of the Dutchess County Environmental Management Council and Art Collings of the Dutchess Land Conservancy for providing GIS data and technical assistance. The New York State GIS Clearinghouse was a valuable resource for digital data unavailable from local sources, and the Dutchess County Real Property Tax office provided the high resolution orthophoto images that greatly improved the accuracy of our mapping. Nick Conrad of the New York Natural Heritage Program and Ray Winchcombe, Brad Roeller, Judy Sullivan, and Joe Warner of the Institute of Ecosystem Studies provided valuable baseline ecological information and shared their expertise generously. Kathleen A. Schmidt, our scientific illustrator, created the drawings that appear throughout this report. Finally, we would like to thank the many landowners in the Town of Washington who graciously allowed us access to their land for field-verification of the habitat map:

Munir & Susan Abu-Haidar
Jane Auchincloss
William & Elizabeth Baldwin
Marco & Elizabeth Bellin
Paul Beneway and the 110 Rod & Gun Club
Jesse & Gayle Bontecou
Ted Briggs
Donald & Mary Briggs
Lee Buchheit
Mark & Lauri Burk
Brian & Gloria Carlson
E.C. & Susie Clarke
Ken Cohen
John E. Cole
Farnham Collins
Petronella Collins and the Innisfree Foundation
Peter & Lillian Corbin
Daytop Village Foundation
John & Priscilla De Veer
Harrison & Audrey Dickson
John Dyson
Rob Dyson
Eberhard Deer Farm
Shepard & Jane Ellenberg
Alexander & Sheila Ewing
Tony & Aura Gebauer
Neil Grossman
Julia Hall
Penelope & Mortimer Hall
Bill & Christina Hammond
David Hammond DVM
David & Nancy Hathaway
Higher Ground Farm
Tommy Hitchcock
John & Patricia Ike
Institute of Ecosystem Studies
Stephen & Belinda Kaye
Hamilton & Edith Kean
Scott Keeley
Fernanda Kellogg & Kirk Henckel
David P. & Barbara McNulty
Jane & Jono Meigs and the Millbrook School
Barbara Meyer
Marta & Fernando Nottebohm
Orvis Sandanona
Alec & Leslie Pandaleon
Lawrence & June Parish
Raoul & Helen Pelletier
Mr. & Mrs. George W. Perkins Jr.
Robert & Carol Perkins
Eve Propp
Claire Reid
Bradley C. & Nancy Reifler
Rockefeller University Center for Field Research
Brad Roeller and the Millbrook Rod & Gun Club
Nancy Rudolph
Lawrence & Julie Salander
Deborah & Justin Scheer
Andy & Maxine Schor
David Sloane
Andre & Liso Starrett
Alfred & Erica Stepan
Robbe Stimson
Sylvia Sutton
Felicitas Thorne
Oakleigh B. Thorne
Top of the Hill Farm
Antoine Treuille & Beverly Benz
Robert & Blaine Trump
Stephen & Jill Van Tassell
Village of Millbrook
Joan Weberman
Mr. & Mrs. Lawrence Wechsler
Richard Whalen
Mr. & Mrs. Alfred White
Julia & Nigel Widdowson
Ray Winchcombe
Winley Farm

REFERENCES CITED

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

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

Ayer, G.R. and F.H. Pauszek. 1968. Streams in Dutchess County, New York: Their flow characteristics and water quality in relation to water problems. State of New York Conservation Department, Water Resources Commission, Albany. 103 p.

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

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

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

Cadwell, D.H. 1986. Surficial geologic map of New York (Lower Hudson sheet). Map and Chart Series 40, 1:250,000, 100 ft. contour. New York State Museum, Albany.

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

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

Downs, F.L. 1989. Family Ambystomatidae. P. 87-172 in R.A. Pfingsten and F.L. Downs, eds., Salamanders of Ohio. Ohio Biological Survey Bulletin. New Series 7(2).

Egan, R.S. 2001. Within-pond and landscape-level factors influencing the breeding effort of *Rana sylvatica* and *Ambystoma maculatum*. M.S. thesis, University of Rhode Island, Kingston, RI.

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

Environmental Law Institute. 2003. Conservation Thresholds for Land Use Planners. Environmental Law Institute, Washington, D.C.

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

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

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

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

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

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

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

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

Jones, A.L. and P.D. Vickery. 1995. Distribution and population status of grassland birds in Massachusetts. Bird Observer 23(2):89-96.

Joyal, L.A., M. McCollough, and M.L. Hunter, Jr. 2000. Population structure and reproductive ecology of Blanding's turtle (*Emydoidea blandingii)* in Maine, near the northeastern edge of its range. Chelonian Conservation and Biology 3: 580-588.

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

Kiviat, E., 1994. Millbrook marsh watershed: Conservation of biological resources. Final Report. Hudsonia Ltd., Annandale, NY. 75 p.

Kiviat, E. 1997. Blanding's turtle habitat requirements and implications for conservation in Dutchess County, New York. P. 377-382 in J. van Abbema, ed., Proceedings: Conservation, Restoration, and Management of Tortoises and Turtles--An International Conference. New York Turtle and Tortoise Society.

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

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

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

Mech, Stephen G. and James G. Hallett. 2001. Evaluating the effectiveness of corridors: a genetic approach. Conservation Biology15(2):467-474.

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

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

Mitchell, R.S. and G. C. Tucker. 1997. Revised Checklist of New York State Plants. Bulletin No. 490, New York State Museum, Albany, NY.

Natural Resources Conservation Service. 2002. Soil Survey of Dutchess County, New York. National Cooperative Soil Survey, US Department of Agriculture.

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

Reschke, C. 1990. Ecological communities of New York State. New York Natural Heritage Program, New York State Department of Environmental Conservation, Latham, NY.

Richter, K.O. and A.L. Azous. 1995. Amphibian occurrence and wetland characteristics in the Puget Sound Basin. Wetlands 15(3):305-312.

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

Schmidt, R.E. and E. Kiviat. 1986. Environmental quality of the Fishkill Creek drainage, a Hudson River tributary. Report to the Hudson River Fisherman's Association and the Open Space Institute. Hudsonia Ltd., Annandale, NY. 60 p.

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

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

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

Stevens, G., R.E. Schmidt, D.R. Roeder, J.S. Tashiro, and E. Kiviat. 1994. Baseline assessment of tributaries to the Hudson (BATH): Water quality, fishes, macroinvertebrates, and diatoms in Fishkill Creek, Quassaic Creek, and Moodna Creek. Volume I. Report to the Hudson River Improvement Fund of the Hudson River Foundation. Grant HI/88A. et al. Hudsonia Ltd., Annandale, NY. 97 p.

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

Vickery, P.D. 1994. Birds of the grasslands. Sanctuary 33(5):26-27.

Wiens, J.A., 1969. An approach to the study of ecological relationships among grassland birds. Ornithological Monographs No. 8. 93 p.

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

Wilcove, D.S., C.H. McLellan, and A.P. Dobson. 1986. Habitat fragmentation in the temperate zone. P. 309-329 in M.E. Soule, ed., Conservation Biology. Sinacur Associates, Sunderland, MA. [Original not seen; cited in Wiens, J.A. 1990. Habitat fragmentation and wildlife populations: the importance of autecology, time, and landscape structure. Transactions of the 19th IUGB Congress, Trondheim, 1989.]

Appendix A. Species of conservation concern potentially associated with habitats in the Town of Washington. These are not comprehensive lists, but are 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 conservation status. Codes include **statewide ranks** (E, T, R, SC), **NY Natural Heritage Program ranks** (S1, S2, S3), and **regional ranks** (RG). For birds, we also indicate those species listed by the American Bird Conservancy as high conservation priorities in the continental U.S. and Canada (ABC). This ranking system is explained in Appendix B.

UPLAND DECIDUOUS FOREST		
Plants	***Vertebrates (cont.)***	***Vertebrates (cont.)***
silvery spleenwort (RG)	Jefferson salamander (SC)	eastern wood-pewee (RG)
American ginseng (RG)	blue-spotted salamander (SC)	Acadian flycatcher (S3)
red baneberry (RG)	marbled salamander (SC)	wood thrush (ABC, RG)
blue cohosh (RG)	northern goshawk (SC, S3N)	cerulean warbler (SC, ABC)
leatherwood (RG)	red-shouldered hawk (SC)	black-throated blue warbler (RG)
hackberry (RG)	Cooper's hawk (SC)	black-throated green warbler (RG)
sweet-gum (RG)	sharp-shinned hawk (SC)	ovenbird (RG)
Vertebrates	broad-winged hawk (RG)	southern bog lemming (RG)
wood frog (RG)	American woodcock (ABC, RG)	
spotted salamander (RG)	barred owl (RG)	

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

RED CEDAR WOODLAND		
Invertebrates	***Vertebrates (cont.)***	***Vertebrates (cont).***
olive hairstreak (butterfly) (RG)	northern saw-whet owl (S3)	short-eared owl (E, S2, ABC)
Vertebrates	long-eared owl (S3)	eastern bluebird (RG)
northern harrier (T, S3B, S3N)		

SHRUBBY OLDFIELD		
Plants	***Vertebrates***	***Vertebrates (cont.)***
stiff-leaf goldenrod (T, S2)	wood frog (RG)	golden-winged warbler (SC, ABC)
small-flowered agrimony (S3)	Blanding's turtle (T, S2S3)	prairie warbler (ABC)
shrubby St. Johnswort (T, S2)	spotted turtle (SC)	yellow-breasted chat (SC, S3)
devil's-bit (T, S1S2)	eastern box turtle (SC)	clay-colored sparrow (S2)
butterfly weed (RG)	wood turtle (RG)	vesper sparrow (SC)
Invertebrates	northern harrier (T, S3B, S3N)	grasshopper sparrow (SC)
aphrodite fritillary (butterfly) (RG)	short-eared owl (E, S2, ABC)	Henslow's sparrow (T, S3B, ABC)
dusted skipper (butterfly) (S3)	northern saw-whet owl (S3)	
Leonard's skipper (butterfly) (RG)	loggerhead shrike (E, S1B)	
cobweb skipper (butterfly) (RG)	blue-winged warbler (ABC)	

UPLAND MEADOW		
Plants	***Vertebrates***	***Vertebrates (cont.)***
Bush's sedge (S3)	Blanding's turtle (T, S2S3)	eastern bluebird (RG)
Invertebrates	spotted turtle (SC)	vesper sparrow (SC)
aphrodite fritillary (butterfly) (RG)	eastern box turtle (SC)	grasshopper sparrow (SC)
dusted skipper (butterfly) (S3)	wood turtle (RG)	Henslow's sparrow (T, S3B, ABC)
Leonard's skipper (butterfly) (RG)	northern harrier (T, S3B, S3N)	bobolink (RG)
swarthy skipper (butterfly) (RG)	upland sandpiper (T, S3B, ABC)	eastern meadowlark (RG)
	sedge wren (T, S3B)	

NON-CALCAREOUS CREST/LEDGE/TALUS		
Plants	***Invertebrates***	***Vertebrates (cont.)***
mountain spleenwort (T, S2S3)	Edward's hairstreak (butterfly) (S3S4)	slimy salamander (RG)
Bicknell's sedge (T, S3)	striped hairstreak (butterfly) (RG)	marbled salamander (SC)
bronze sedge (RG)	brown elfin (butterfly) (RG)	Fowler's toad (RG)
clustered sedge (T, S2S3)	olive hairstreak (butterfly) (RG)	turkey vulture (RG)
reflexed sedge (E, S1S2)	northern hairstreak (butterfly) (S1S3)	golden eagle (E, S1N)
whorled milkweed (RG)	gray hairstreak (butterfly) (RG)	whip-poor-will (SC)
blunt-leaf milkweed (RG)	Horace's duskywing (butterfly) (RG)	common raven (RG)
eastern prickly-pear (RG)	swarthy skipper (butterfly) (RG)	winter wren (RG)
whorled milkwort (RG)	Leonard's skipper (butterfly) (RG)	eastern bluebird (RG)
rock sandwort (RG)	cobweb skipper (butterfly) (RG)	hermit thrush (RG)
downy arrowwood (RG)	dusted skipper (butterfly) (S3)	blackburnian warbler (RG)
goat's-rue (RG)	***Vertebrates***	cerulean warbler (SC, ABC)
slender knotweed (R, S3)	eastern box turtle (SC)	worm-eating warbler (ABC, RG)
dittany (RG)	five-lined skink (S3?)	small-footed bat (SC, S2)
Torrey's mountain-mint (E, S1)	black rat snake (RG)	boreal redback vole (RG)
allegheny-vine (RG)	northern copperhead (S3)	porcupine (RG)
bearberry (RG)	eastern hognose snake (SC)	fisher (RG)
three-toothed cinquefoil (RG)	worm snake (SC)	bobcat (RG)
stiff-leaf aster (RG)	timber rattlesnake (T, S3)	

CALCAREOUS CREST/LEDGE/TALUS		
Plants	***Plants (cont.)***	***Invertebrates (cont.)***
walking fern (RG)	yellow harlequin (S3)	olive hairstreak (butterfly) (RG)
purple cliffbrake (RG)	Dutchman's breeches (RG)	***Vertebrates***
side-oats grama (E, S1)	pellitory (RG)	five-lined skink (S3?)
Emmons' sedge (S3)	blazing-star (T, S2)	eastern hognose snake (SC)
yellow wild flax (T, S2)	small-flowered crowfoot (T, S2S3)	northern black racer (RG)
Carolina whitlow-grass (T, S2)	roundleaf dogwood (RG)	black rat snake (RG)
devil's-bit (T, S1S2)	***Invertebrates***	northern copperhead (S3)
hairy rock-cress (RG)	anise millipede (RG)	

WASTE GROUND		
Plants	***Plants (cont.)***	***Vertebrates (cont.)***
hair-rush (RG)	slender knotweed (R, S3)	northern copperhead (S3)
toad rush (RG)	river birch (S3)	American black duck (ABC, RG)
orangeweed (RG)	***Vertebrates***	common raven (RG)
field dodder (S3)	Blanding's turtle (T, S2S3)	grasshopper sparrow (SC)
slender pinweed (T, S2)	wood turtle (SC)	Henslow's sparrow (T, S3B, ABC)
rattlebox (E, S1)	Fowler's toad (RG)	bank swallow (RG)
blunt mountain-mint (T, S2S3)	eastern hognose snake (SC, S3S4)	

HARDWOOD & SHRUB SWAMP		
Plants	***Vertebrates (cont.)***	***Vertebrates (cont.)***
swamp cottonwood (T, S2)	northern leopard frog (RG)	American woodcock (ABC, RG)
ostrich fern (RG)	spotted turtle (SC)	barred owl (RG)
wood horsetail (RG)	wood turtle (SC)	white-eyed vireo (RG)
Vertebrates	great blue heron (RG)	eastern bluebird (RG)
blue-spotted salamander (SC)	wood duck (RG)	prothonotary warbler (S2, ABC)
four-toed salamander (RG)	red-shouldered hawk (SC)	Canada warbler (ABC, RG)

MARSH		
Plants	***Vertebrates (cont.)***	***Vertebrates (cont.)***
winged monkey-flower (R, S3)	spotted turtle (SC)	Virginia rail (RG)
buttonbush dodder (E, S1)	American bittern (SC)	sora (RG)
spiny coontail (T, S3)	least bittern (T, S3B, S1N)	common moorhen (RG)
Vertebrates	wood duck (RG)	marsh wren (RG)
northern cricket frog (E, S1)	American black duck (ABC, RG)	northern harrier (T, S3B, S3N)
northern leopard frog (RG)	king rail (T, S1B, ABC)	pied-billed grebe (T, S3B, S1N)
Blanding's turtle (T, S2S3)		

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

FEN/CALCAREOUS WET MEADOW		
Plants	***Plants (cont.)***	***Invertebrates (cont.)***
slender lady's tresses (RG)	Kalm's lobelia (RG)	Dion skipper (butterfly) (S3)
small-flowered agrimony (S3)	rose pogonia (RG)	Baltimore (butterfly) (RG)
bog valerian (E, S1S2)	roundleaf sundew (RG)	mulberry wing (butterfly) (RG)
Schweinitz's sedge (T, S2S3)	wood horsetail (RG)	black dash (butterfly) (RG)
handsome sedge (T, S2S3)	alder-leaf buckthorn (RG)	***Vertebrates***
ovate spikerush (E, S1S2)	***Invertebrates***	northern leopard frog (RG)
showy ladyslipper (RG)	*Gammarus pseudolimnaeus* (amphipod) (RG)	bog turtle (E, S2)
spreading globeflower (R, S3)	*Pomatiopsis lapidaria* (snail) (RG)	spotted turtle (SC)
swamp birch (T, S2)	eyed brown (butterfly) (RG)	ribbon snake (RG)
Indian paintbrush (E, S1)	two-spotted skipper (butterfly) (RG)	sedge wren (T, S3B)
grass-of-Parnassus (RG)	phantom cranefly (RG)	

ACIDIC BOG		
Plants	***Plants (cont.)***	***Vertebrates***
pod-grass (R, S3)	Virginia chain fern (RG)	four-toed salamander (RG)
cottongrass (RG)	small cranberry (RG)	eastern bluebird (RG)
pitcher-plant (RG)	large cranberry (RG)	golden-winged warbler (SC, ABC)
roundleaf sundew (RG)	bog rosemary (RG)	Nashville warbler (RG)
dragonmouth orchid (RG)		northern waterthrush (RG)
		southern bog lemming (RG)

CIRCUMNEUTRAL BOG LAKE		
Plants	***Plants (cont.)***	***Vertebrates (cont.)***
ovate spikerush (E, S1S2)	olivaceous spikerush (RG)	spotted turtle (SC)
floating bladderwort (T, S2)	spiny coontail (T, S3)	ribbon snake (RG)
hidden-fruit bladderwort (S3)	water-marigold (T, S3)	American bittern (SC)
inflated bladderwort (E, S1)	southern dodder (E, S1)	least bittern (T, S3B, S1N)
spotted pondweed (T, S2)	***Vertebrates***	king rail (T, S1B, ABC)
water-thread pondweed (E, S1)	wood frog (RG)	wood duck (RG)
prairie sedge (RG)	blue-spotted salamander (SC)	American black duck (ABC, RG)
twig-rush (RG)	four-toed salamander (RG)	great blue heron (RG)
pipewort (RG)	northern cricket frog (E, S1)	marsh wren (RG)
horned bladderwort (RG)	Blanding's turtle (T, S2S3)	river otter (RG)
roundleaf sundew (RG)	bog turtle (E, S2)	

INTERMITTENT WOODLAND POOL		
Plants	***Vertebrates***	***Vertebrates (cont.)***
featherfoil (T, S2)	four-toed salamander (RG)	spotted turtle (SC)
false hop sedge (R, S2)	Jefferson salamander (SC)	wood turtle (RG)
Invertebrates	marbled salamander (SC)	wood duck (RG)
black dash (butterfly) (RG)	blue-spotted salamander (RG)	American black duck (ABC, RG)
mulberry wing (butterfly) (RG)	wood frog (RG)	northern waterthrush (RG)
springtime physa (snail) (RG)	Blanding's turtle (T, S2S3)	

KETTLE SHRUB POOL		
Plants	***Vertebrates***	***Vertebrates (cont.)***
pale alkali-grass (RG)	blue-spotted salamander (SC)	wood duck (RG)
short-awn foxtail (RG)	Blanding's turtle (T, S2S3)	American black duck (ABC, RG)
spiny coontail (T, S3)	spotted turtle (SC)	
buttonbush dodder (E, S1)	ribbon snake (RG)	

OPEN WATER/CONSTRUCTED POND		
Plants	***Vertebrates (cont.)***	***Vertebrates (cont.)***
spiny coontail (T, S3)	wood turtle (RG)	bald eagle (T, S2S3B)
Vertebrates	northern cricket frog (E, S1)	great blue heron (RG)
spotted turtle (SC)	American bittern (SC)	
Blanding's turtle (T, S2S3)	osprey (SC)	

SPRING/SEEP		
Invertebrates	***Vertebrates***	
Piedmont groundwater amphipod (RG)	northern dusky salamander (RG)	
gray petaltail (dragonfly) (SC, S2)	spring salamander (RG)	
tiger spiketail (dragonfly) (S1)		

PERENNIAL & INTERMITTENT STREAM		
Plants	***Invertebrates (cont.)***	***Vertebrates (cont.)***
winged monkey-flower (R, S3)	*Marstonia decepta* (snail) (RG)	slimy sculpin (fish) (RG)
riverweed (T, S2)	*Pisidium adamsi* (fingernail clam) (RG)	northern dusky salamander (RG)
spiny coontail (T, S3)	*Vertebrates*	spring salamander (RG
goldenseal (T, S2)	tadpole madtom (fish) (S3?)	wood turtle (RG)
Invertebrates	creek chubsucker (fish) (RG)	wood duck (RG)
sable clubtail (dragonfly) (S1)	longnose sucker (fish) (S3?)	American black duck (ABC, RG)
brook floater (mussel) (T, S1)	bridle shiner (fish) (RG)	bank swallow (RG)
arrowhead spiketail (dragonfly) (S2S3)	brook trout (fish) (RG)	great blue heron (RG)
mocha emerald (dragonfly) (S2S3)	mud sunfish (fish)	

RIPARIAN CORRIDOR		
Plants	***Plants (cont.)***	***Vertebrates***
cattail sedge (T, S2)	goldenseal (T, S2)	wood turtle (SC)
Davis' sedge (T, S2)	false-mermaid (RG)	red-shouldered hawk (SC)
winged monkey-flower (R, S3)	swamp rose-mallow (RG)	American woodcock (RG)
river birch (S3)	ostrich fern (RG)	cerulean warbler (SC, ABC)
small-flowered agrimony (S3)		wood duck (RG)
		river otter (RG)

Appendix B. Explanation of ranks of species of conservation concern listed in Appendix A. Explanations of New York State Ranks and New York Natural Heritage Program Ranks are from the New York Natural Heritage Program website, updated May 2003.

New York State Ranks

The following categories are defined in regulation 6NYCRR part 193.3 and apply to New York State Environmental Conservation Law section 9-1503.

E **Endangered Species**. Any species which meets one of the following criteria: species with 5 or fewer extant sites or fewer than 1,000 individuals; species restricted to fewer than 4 USGS 7 ½ minute topographical maps; or species listed as endangered by the U.S. Department of the Interior, as enumerated in the Code of Federal Regulations 50 CFR 17.11.

T **Threatened Species**. Any species which meets one of the following criteria: species with 6 to 20 extant sites or 1,000-3,000 individuals; species restricted to not less than 4 or more than 7 USGS 7 ½ minute topographical maps; or species listed as Threatened by the United States Department of the Interior, as enumerated in the Code of 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 9-1503.

New York Natural Heritage Program Ranks (Statewide)

S1 Critically imperiled in NY State because of extreme rarity (5 or fewer sites or very few remaining individuals) or extremely vulnerable to extirpation from NY State due to biological factors.

S2 Imperiled in NY State because of rarity (6-20 sites or few remaining individuals) or highly vulnerable to extirpation in NY State due to biological factors.

S3 Rare in NY State (usually 21-100 extant sites).

SH Historical. No extant sites known in New York State but it may be rediscovered.

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)

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 be regionally rare also, but are not assigned an 'RG' rank.

National Status (birds only)

ABC We use this code to indicate those bird species listed on the American Bird Conservancy's Green List. Building on the species assessments conducted by Partners in Flight (PIF), the Green List uses a single, consistent set of criteria for all birds to produce a comprehensive set of priority species for conservation in the continental U.S. and Canada.

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

Common Name	Scientific Name
agrimony, small flowered	*Agrimonia parviflora*
allegheny-vine	*Adlumia fungosa*
arrow-arum	*Peltandra virginica*
arrowhead	*Sagittaria*
arrowwood, downy	*Viburnum rafinesquianum*
arrowwood, northern	*Viburnum dentatum* v. *lucidum*
ash, green	*Fraxinus pensylvanica*
ash, white	*Fraxinus americana*
aspen, quaking	*Populus tremuloides*
aster, stiff-leaf	*Aster linariifolius*
azalea, swamp	*Rhododendron viscosum*
baneberry, red	*Actaea spicata* ssp. *rubra*
barberry, Japanese	*Berberis vulgaris*
basswood	*Tilia americana*
bearberry	*Arctostaphylos uva-ursi*
beech, American	*Fagus grandifolia*
birch, black	*Betula lenta*
birch, gray	*Betula populifolia*
birch, river	*Betula nigra*
birch, swamp	*Betula pumila*
birch, yellow	*Betula alleghaniensis*
blackberry, northern	*Rubus allegheniensis*
bladdernut	*Staphylea trifolia*
bladderwort	*Utricularia*
bladderwort, floating	*Utricularia radiata*
bladderwort, hidden-fruit	*Utricularia geminiscapa*
bladderwort, horned	*Utricularia cornuta*
bladderwort, inflated	*Utricularia inflata*
blazing-star	*Liatris scariosa* v. *novae-angliae*
blueberry	*Vaccinium*
blueberry, highbush	*Vaccinium corymbosum*
bluegrass, Kentucky	*Poa pratensis*
bluejoint	*Calamagrostis canadensis*
bluestem, little	*Schizachyrium scoparium*
breeches, Dutchman's	*Dicentra cucullaria*
buckthorn, alder-leaf	*Rhamnus alnifolia*
butterflyweed	*Asclepias tuberosa*
buttonbush	*Cephalanthus occidentalis*
cabbage, skunk	*Symplocarpus foetidus*
canary-grass, reed	*Phalaris arundinacea*
cattail	*Typha*
chokeberry	*Aronia*
cinquefoil, shrubby	*Potentilla fruticosa*
cinquefoil, three-toothed	*Potentilla tridentata*
cliffbrake, purple	*Pellaea atropurpurea*
cohosh, blue	*Caulophyllum thalictroides*
coontail, spiny	*Ceratophyllum echinatum*
cottongrass	*Eriophorum viridi-carinatum*
cottonwood, swamp	*Populus heterophylla*
cranberry	*Vaccinium*
cranberry, large	*Vaccinium macrocarpon*
(CONTINUED)	
cranberry, small	*Vaccinium oxycoccos*
crowfoot, small-flowered	*Ranunculus micranthus*
devil's-bit	*Chamaelirium luteum*
diarrhena	*Diarrhena obovata*
dittany	*Cunila origanoides*
dodder, buttonbush	*Cuscuta cephalanthi*
dodder, field	*Cuscuta pentagona*
dodder, southern	*Cuscuta obtusiflora* v. *glandulosa*
dogwood, gray	*Cornus foemina* ssp. *racemosa*
dogwood, roundleaf	*Cornus rugosa*
dogwood, silky	*Cornus amomum*
Douglas-fir	*Pseudotsuga menziesii*
duckweed	*Spirodela*
elm, American	*Ulmus americana*
elm, slippery	*Ulmus rubra*
false-mermaid	*Floerkea prosperpinacoides*
featherfoil	*Hottonia inflata*
fern, cinnamon	*Osmunda cinnamomea*
fern, marsh	*Thelypteris palustris*
fern, ostrich	*Matteuccia struthiopteris*
fern, sensitive	*Onoclea sensibilis*
fern, Virginia chain	*Woodwardia virginica*
fern, walking	*Asplenium rhizophyllum*
flag, blue	*Iris versicolor*
flatsedge, shining	*Cyperus bipartitus*
flax, yellow wild	*Linum sulcatum*
foxtail, short-awn	*Alopecurus aequalis*
gentian, fringed	*Gentianopsis crinita*
ginseng, American	*Panax quinquefolius*
globeflower, spreading	*Trollius laxus*
goat's-rue	*Tephrosia virginiana*
goldenrod, bog	*Solidago uliginosa*
goldenrod, spreading	*Solidago patula*
goldenrod, stiff-leaf	*Solidago rigida*
goldenseal	*Hydrastis canadensis*
grama, side-oats	*Bouteloua curtipendula*
grass-of-Parnassus	*Parnassia glauca*
grass, pale alkali-	*Torreyochloa pallida* v. *pallida*
hackberry	*Celtis occidentalis*
hairgrass	*Deschampsia flexuosa*
hair-rush	*Bulbostylis capillaris*
harlequin, yellow	*Corydalis flavula*
hawthorn	*Crataegus*
hemlock, eastern	*Tsuga canadensis*
hepatica, round-lobed	*Hepatica americana*
hickory	*Carya*
hickory, pignut	*Carya glabra*
hickory, shagbark	*Carya ovata*
honeysuckle, Eurasian	*Lonicera morrowi*
horsetail, wood	*Equisetum sylvaticum*
ironweed, New York	*Vernonia noveboracensis*

Common Name	Scientific Name	Common Name	Scientific Name
knotweed, slender	*Polygonum tenue*	sarsaparilla, bristly	*Aralia hispida*
ladyslipper, showy	*Cypripedium reginae*	sedge	*Carex*
lady's tresses, slender	*Spiranthes lacera*	sedge, Bicknell's	*Carex bicknellii*
larch, European	*Larix decidua*	sedge, bronze	*Carex aenea*
laurel, mountain	*Kalmia latifolia*	sedge, Bush's	*Carex bushii*
leatherleaf	*Chamaedaphne calyculata*	sedge, cattail	*Carex typhina*
leatherwood	*Dirca palustris*	sedge, clustered	*Carex cumulata*
lobelia, Kalm's	*Lobelia kalmii*	sedge, Davis'	*Carex davisii*
loosestrife, purple	*Lythrum salicaria*	sedge, Emmons'	*Carex albicans* v. *emmonsii*
mannagrass	*Glyceria*	sedge, false hop	*Carex lupuliformis*
maple, red	*Acer rubrum*	sedge, handsome	*Carex formosa*
maple, sugar	*Acer saccharum*	sedge, lakeside	*Carex lacustris*
mayflower, Canada	*Maianthemum canadense*	sedge, Pennsylvania	*Carex pensylvanica*
meadowsweet	*Spiraea latifolia*	sedge, porcupine	*Carex hystericina*
milkweed, blunt-leaf	*Asclepias amplexicaulis*	sedge, prairie	*Carex prairea*
milkweed, whorled	*Asclepias verticillata*	sedge, reflexed	*Carex retroflexa*
milkwort, whorled	*Polygala verticillata*	sedge, Schweinitz's	*Carex schweinitzii*
monkey-flower, winged	*Mimulus alatus*	sedge, sterile	*Carex sterilis*
(moss)	*Helodium paludosum*	sedge, tussock	*Carex stricta*
moss, peat	*Sphagnum*	sedge, woolly-fruit	*Carex lasiocarpa*
mountain-mint, blunt	*Pycnanthemum muticum*	sedge, yellow	*Carex flava*
mountain-mint, Torrey's	*Pycnanthemum torrei*	serviceberry	*Amelanchier*
nettle, false	*Boehmeria cylindrica*	sheep-laurel	*Kalmia angustifolia*
oak, black	*Quercus velutina*	soft-rush	*Juncus effusus*
oak, chestnut	*Quercus montana*	spike-muhly	*Muhlenbergia glomerata*
oak, red	*Quercus rubra*	spikemoss, rock	*Selaginella rupestris*
oak, scrub	*Quercus ilicifolia*	spikerush, olivaceous	*Eleocharis flavescens*
oak, swamp white	*Quercus bicolor*	spikerush, ovate	*Eleocharis obtusa* v. *ovata*
oak, white	*Quercus alba*	spleenwort, ebony	*Asplenium platyneuron*
orangeweed	*Hypericum gentianoides*	spleenwort, maidenhair	*Asplenium trichomanes*
orchid, snakemouth	*Pogonia ophioglossoides*	spleenwort, mountain	*Asplenium montanum*
paintbrush, Indian	*Castilleja coccinea*	spleenwort, silvery	*Deparia acrostichoides*
pellitory	*Parietaria pensylvanica*	spruce, Norway	*Picea abies*
pickerelweed	*Pontederia cordata*	steeplebush	*Spiraea tomentosa*
pine, pitch	*Pinus rigida*	St. Johnswort, marsh	*Triadenum fraseri*
pine, red	*Pinus resinosa*	St. Johnswort, shrubby	*Hypericum prolificum*
pine, Scotch	*Pinus sylvestris*	sumac, poison	*Toxicodendron vernix*
pine, white	*Pinus strobus*	sundew, roundleaf	*Drosera rotundifolia*
pinweed, slender	*Lechea tenuifolia*	sweetflag	*Acorus americanus*
pipewort	*Eriocaulon septangulare*	sweet-gale	*Myrica gale*
pitcher-plant	*Sarracenia purpurea*	sweet-gum	*Liquidambar styraciflua*
pod-grass	*Scheuchzeria palustris*	tamarack, eastern	*Larix larcina*
polypody, rock	*Polypodium vulgare*	thistle, swamp	*Cirsium muticum*
pond lily, yellow	*Nuphar advena*	tree, tulip	*Liriodendron tulipifera*
pond lily, white	*Nymphaea odorata*	tripe, rock (lichen)	*Umbilicaria*
pondweed	*Potamogeton*	twig-rush	*Cladium mariscoides*
pondweed, spotted	*Potamogeton pulcher*	valerian, bog	*Valeriana uliginosa*
pondweed, water-thread	*Potamogeton diversifolius*	viburnum, maple-leaf	*Viburnum acerifolium*
prickly-ash, American	*Zanthoxylum americana*	wall-rue	*Asplenium ruta-muraria*
prickly-pear, eastern	*Opuntia humifusa*	water-marigold	*Megalodonta beckii*
raspberry	*Rubus*	watermilfoil	*Myriophyllum spicatum*
rattlebox	*Crotalaria sagittalis*	water-plantain	*Alisma triviale*
red cedar, eastern	*Juniperus virginiana*	watershield	*Brasenia schreberi*
reed, common	*Phragmites australis*	water-willow	*Decodon verticillata*
riverweed	*Podostemum ceratophyllum*	whitlow-grass, Carolina	*Draba reptans*
rock-cress, hairy	*Arabis hirsuta* v. *pycnocarpa*	wild-columbine	*Aquilegia canadensis*
rose-mallow, swamp	*Hibiscus moscheutos*	willow	*Salix*
rose, multiflora	*Rosa multiflora*	willow, autumn	*Salix serissima*
rush, toad	*Juncus bufonius*	witch-hazel	*Hamamelis virginiana*
sandwort, rock	*Minuartia michauxii*	woolgrass	*Scirpus cyperinus*

Priority Habitats and Conservation Recommendations for the Town of Washington

An addendum to the report

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

by Jenny Tollefson and Gretchen Stevens, 2004

Kristen Bell and Gretchen Stevens

September 2006

Hudsonia

PO Box 5000, Annandale, NY 12504

PRIORITY HABITATS IN WASHINGTON

Although much land in the Town of Washington 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 Washington 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, the town must decide how best to direct those resources to achieve the best 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. Below we highlight some areas that we consider “priority habitats” for conservation in the Town of Washington. 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 wildlife 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 home-range size and average travel distance data reported in the scientific literature to estimate the priority conservation zone for each species or group of concern (Table 1). 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.

This document is an addendum to the report titled *Significant Habitats in the Town of Washington, Dutchess County, New York* (Tollefson and Stevens 2004). Consult that report and the large-format habitat map provided to the town for more detailed information about the habitats identified by Hudsonia in the Town of Washington.

Table 1. Some special habitats, species of concern, and associated priority conservation zones identified by Hudsonia in the Town of Washington, Dutchess County, New York.

Priority Habitat	Associated Species or Group of Concern	Priority Conservation Zone	Rationale	References
Large forests	Forest interior-breeding birds	Unfragmented patches of 175 - 400 ac (70-160 ha).	Required for moderate to high probablility of supporting breeding scarlet tanagers and forest thrushes in a 30-40% forested landscape.	Rosenberg et al. 1999, Rosenberg et al. 2003
Large meadow and shrubland complexes	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
Fen & calcareous wet meadow	Bog turtle*	2500 ft (750 m)	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 et al. 1990, Klemens 2001
Intermittent woodland pool	Pool-breeding amphibians	750 ft (230 m)	Encompasses non-breeding season foraging and refuge habitats and most dispersal routes between pools.	Madison 1997, Semlitsch 1998, Calhoun and Klemens 2002
Kettle shrub pool, Buttonbush pool	Blanding's turtle*	3300 ft (1000 m)	Encompasses most of the critical habitat including nesting areas, summer foraging wetlands, drought refuge pools and overland travel corridors.	Kiviat 1997, Hartwig et al. in prep.
Circumneutral bog lake	Northern cricket frog*	3300 ft (1000 m)	Represents the reported overland distance traveled between wetlands.	Gray 1983
Large perennial streams & riparian zones	Wood turtle*	650 ft (200 meters)	Encompasses most of the critical habitat including winter hibernacula, spring basking sites, nesting areas, 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 A of Tollefson and Stevens (2004).

LARGE FORESTS

Target Areas

In general, forested areas with the highest conservation value include large forests, 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 the landscape context. The largest forest areas are illustrated in Figure 1. There are 35 patches greater than 100 ac (40 ha). Our map does not take into account the actual size of forest patches that extend beyond Washington's boundary, but this is an important consideration in understanding the habitat value of these patches.

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, those 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, and these edges favor a set of disturbance-adapted species, including many predators and a nest parasite (brown-headed cowbird) of forest-breeding birds (Murcia 1995). Nesting success of many species of forest birds is reduced by forest fragmentation (Lampila et al. 2005). Large forests, particularly those that are more round and less linear, support forest species that are highly sensitive to disturbance and predation along forest edges. For example, in landscapes with 50-60% forest cover, such as the Town of Washington, scarlet tanager requires patches of at least 60 ac for suitable breeding habitat (Rosenberg et al. 1999); forest thrushes need a minimum of about 200 ac (Rosenberg et al. 2003).

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

Recommendations

We recommend that the remaining blocks of large forest within the Town of Washington 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. 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 areas of mature and old-growth forest, as well as natural conifer stands.*
3. *Maintain the forest canopy and understory vegetation intact*.
4. *Maintain standing dead wood, downed wood, and organic debris, and prevent disturbance or compaction of the forest floor.*
5. *Maintain or restore broad corridors of intact habitat between large forested areas* (including connections across roads).
6. *Protect smaller forest patches in strategic locations* (e.g., those that provide a connection between larger forest patches) *or those that have smaller, unusual habitats embedded in them.*

In the Town of Washington, special emphasis should be placed on protecting the integrity of the remaining large forested areas. Hudsonia has mapped habitats in the Town of Stanford, is working on mapping the Town of Amenia, and will be mapping two other nearby towns in the next two years. Once complete, this regional map will enable town officials and private

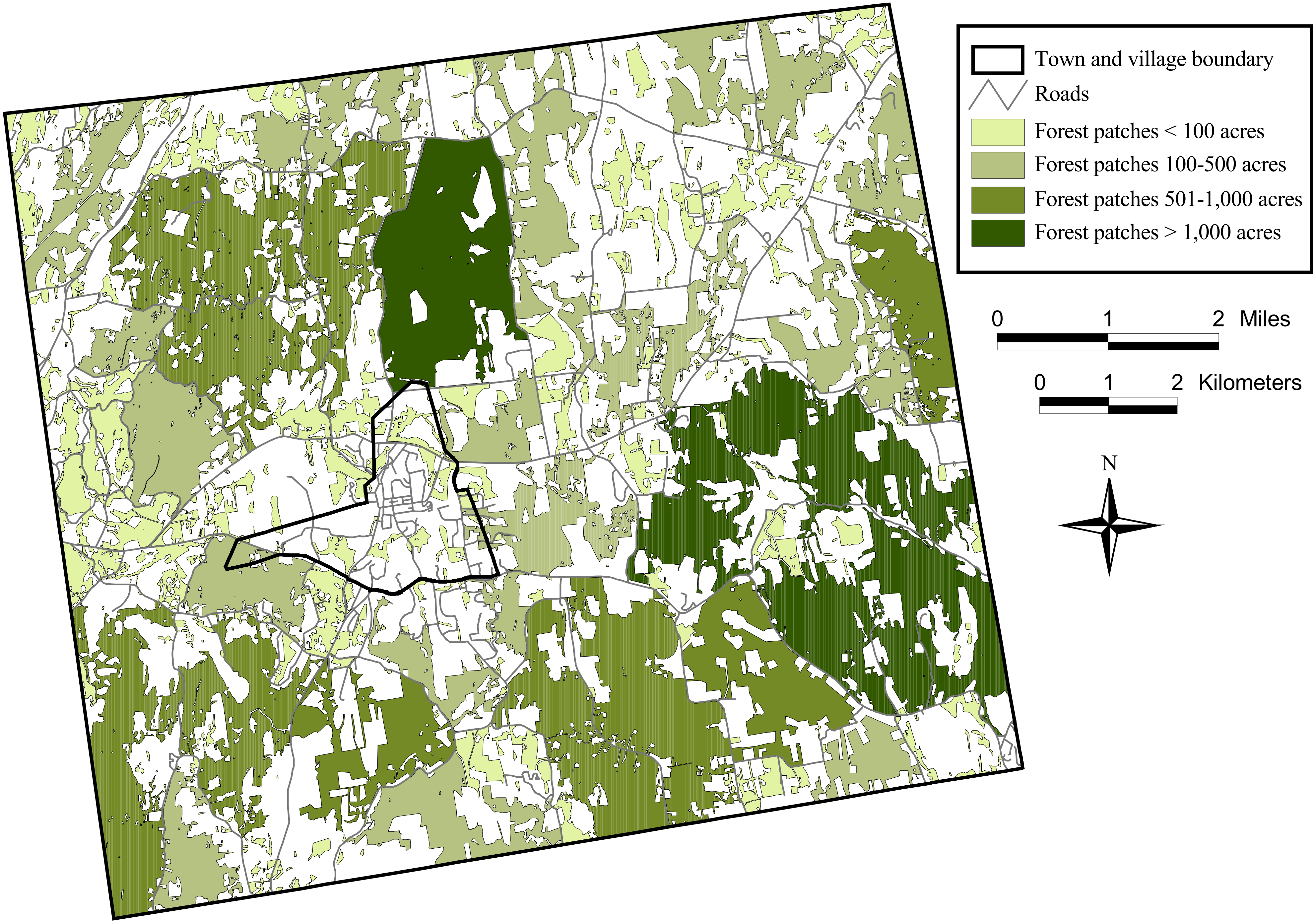


Figure 1. Contiguous forest patches (including deciduous, conifer, and mixed forests in uplands and in swamps) in the Town of Washington, Dutchess County, New York. Hudsonia Ltd., 2003-2004.

landowners to plan strategically across town boundaries to ensure that large forested areas are conserved.

LARGE MEADOWS AND SHRUBLANDS

Target Areas

Open areas with the highest habitat value include large, contiguous patches of upland meadow, upland shrubland, and wet meadow. In Washington, some of these meadow complexes exceeded 250 ac (100 ha). The largest single meadow is 150 ac (60 ha); this is located in an area with many smaller meadows in the southwest corner of town. Other large meadow areas occur in the northeast quadrant of Washington. 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. Figure 2 shows areas of meadow patches in the Town of Washington.

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 fragmented by the intensification of agriculture, regrowth of forest, and residential and commercial development (Askins 1993, Brennan and Kuvlesky 2003). These birds require large, undivided meadows (25 to 500 ac [10-202 ha]) to reproduce successfully (Vickery et al. 1994). Fences and hedgerows can reduce nesting success for grassland-breeding birds by providing cover and perching sites for raptors and other species that prey upon the birds or their eggs (Wiens 1969). Figure 5 illustrates how meadow patch sizes differ when hedgerows and fences are taken into account. Although Washington has over 10,000 ac (> 4,000 ha) of upland meadow, only 71 meadows are greater than 25 ac (10 ha), the preferred area for savannah sparrow to nest, and just 10 are large enough to support vesper sparrow (50 ac [20 ha]). The largest single meadow is 150 ac (60 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 of 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 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 ideal 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.

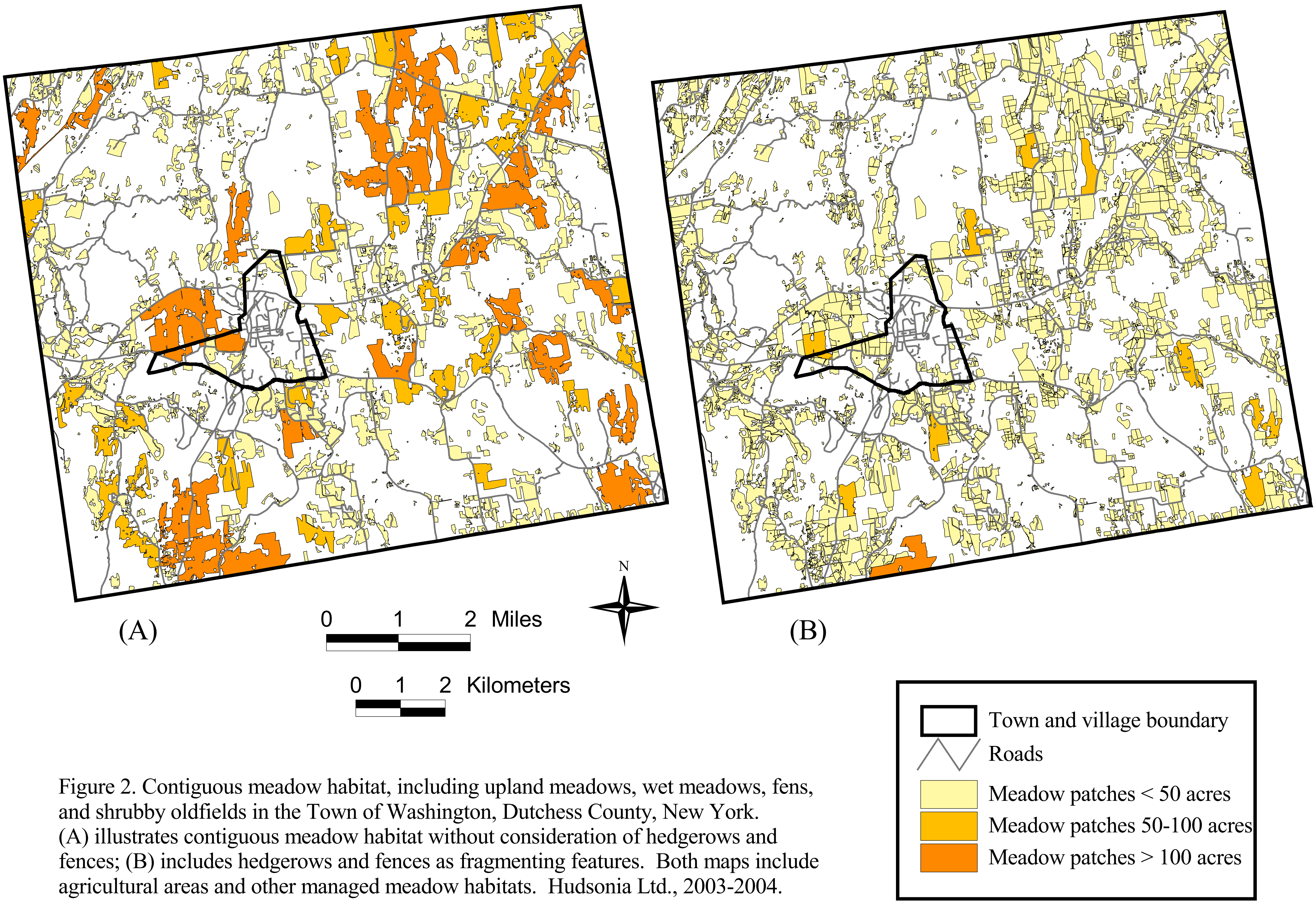


Figure 2. Contiguous meadow habitat, including upland meadows, wet meadows, fens, and shrubby oldfields in the Town of Washington, Dutchess County, New York. (A) illustrates contiguous meadow habitat without consideration of hedgerows and fences; (B) includes hedgerows and fences as fragmenting features. Both maps include agricultural areas and other managed meadow habitats. Hudsonia Ltd., 2003-2004.

The Town of Washington 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 scenic beauty of the town landscape.

FENS AND CALCAREOUS WET MEADOWS

Target Areas

Twenty-seven fens and 33 calcareous wet meadows were mapped in the Town of Washington (Fig.3). This is probably an underestimate, since these habitats can only be positively identified in the field. Calcareous wet meadows were scattered throughout the town, with one concentration along Route 82 in the southern part of town. Fens were concentrated in the east-central part of Washington.

Conservation Issues

Fens and calcareous wet meadows are uncommon in the Hudson Valley and many provide important habitat for plant and animal species of conservation concern (see Appendix A of Tollefson and Stevens [2004]). 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 the bog turtle in southeastern New York, and the marsh and swamp matrix in which some fens occur is a critical part of the bog turtle habitat complex. Few of the remaining fens in this region still support bog turtle populations, apparently 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 Washington 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 habitats.

Fens are maintained by calcareous groundwater seepage. Alterations to the quality or quantity of groundwater or surface water feeding the fen can alter the vegetation structure or plant community composition, and can render the habitats unsuitable for the bog turtle and other species of conservation concern. Thus, even if the fen is not disturbed directly, 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 migrations. 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 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 and populations to relocate as habitat quality changes.

Recommendations

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 (91-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 habitat complexes 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, buildings, 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 (91 m) wide should be established around known or potential bog turtle wetlands to help prevent or minimize the effects of land-use 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, buildings, 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 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.

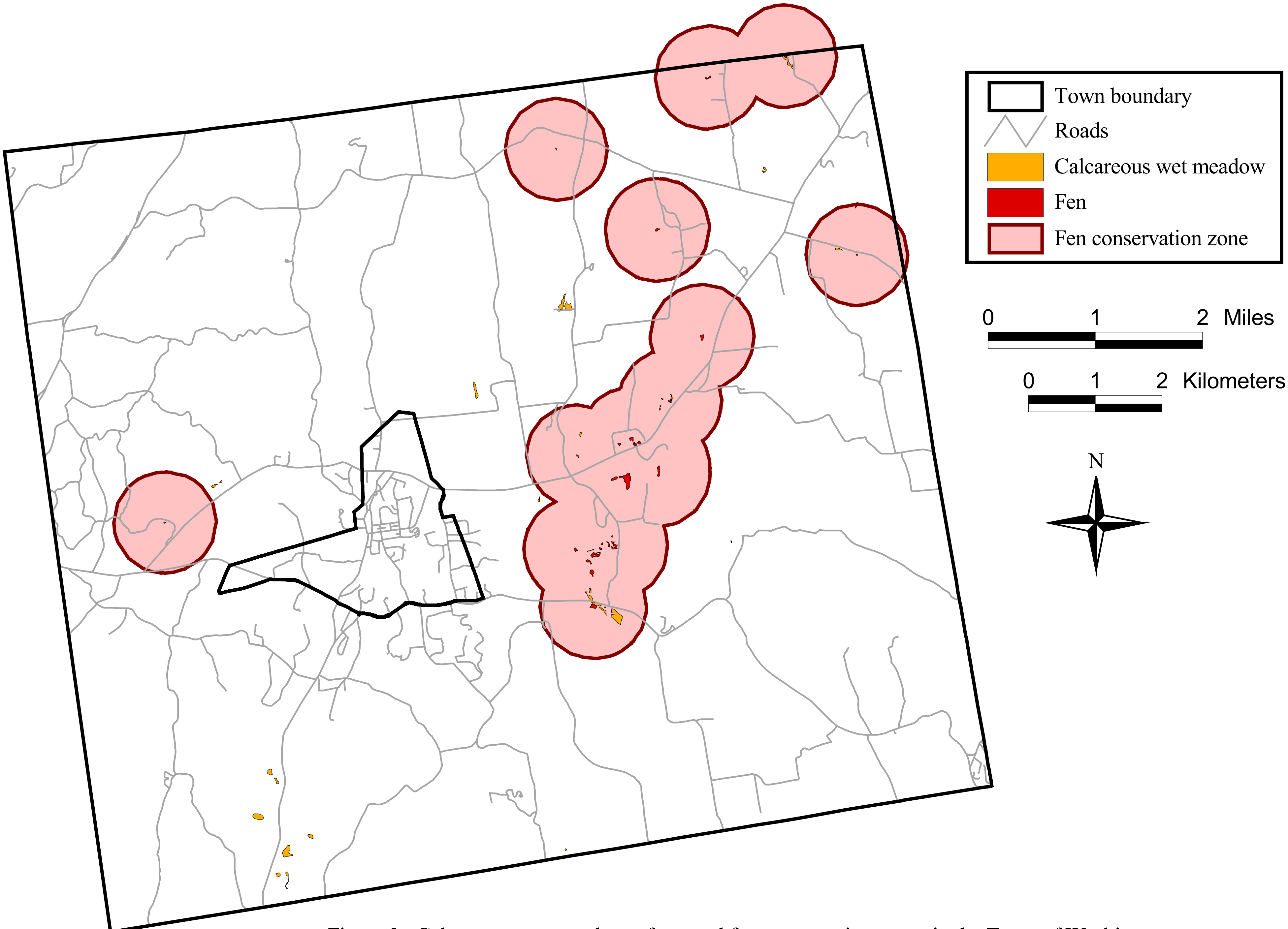


Figure 3. Calcareous wet meadows, fens, and fen conservation zones in the Town of Washington, Dutchess County, New York. Fen conservation zones measure 2500 ft (750 m) from the fen edge. Hudsonia Ltd., 2006.

- 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 habitat.

INTERMITTENT WOODLAND POOLS

Target Areas

More than 200 intermittent woodland pools were identified and mapped in the Town of Washington (Fig. 4), and we believe this to be an underestimate. Each intermittent pool is important to preserve, but groups or networks of pools are particularly important. Groups of pools can support metapopulations—groups of small populations that are able to exchange individuals and recolonize sites in which the species has recently disappeared.

Conservation Issues

Intermittent woodland pools, because they lack fish and certain other predators, provide crucial breeding and nursery habitat for several amphibian species that cannot successfully reproduce in other wetlands: 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, thick leaf litter, uncompacted soil and coarse woody debris of the surrounding upland forest for foraging and shelter. The forested area within a 750-foot (230-m) radius of the intermittent woodland pool is considered necessary to support upland 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 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 denser networks of roads or more 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 crossing open fields have a high risk of desiccation and predation in that exposed environment (Rothermel and Semlitsch 2002).

Populations of these amphibian species depend not just on a single woodland pool, but on a forested landscape dotted with such wetlands between which individuals can disperse for breeding, foraging, and replenishing locally diminished or extinct populations (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 variation in precipitation. 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" each other; 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., the 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 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 percent of this zone should remain in contiguous (unfragmented) forest with an undisturbed forest floor. 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 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) 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 effects 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:

   - 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 to the greatest extent possible.
   - 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.

Figure 4. Intermittent woodland pools and associated conservation zones in the Town of Washington, Dutchess County, New York. Conservation zones extend 750 ft (230 m) from pool boundaries. Hudsonia Ltd., 2006.

- 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 these water features rarely survive due to the high sediment and pollutant loads and short hydroperiod.
4. Design or modify potential pitfall hazards such as swimming pools or excavations to prevent the entrapment and death of migrating amphibians.
5. Schedule construction activities to occur outside peak amphibian movement periods in 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. We strongly recommend that all activity proposed within this zone 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 woodland pool-breeding amphibians and their habitat requirements.

KETTLE SHRUB AND BUTTONBUSH POOLS

Target Areas

We identified two kettle shrub pools and one buttonbush pool in the Town of Washington (Fig. 5). A buttonbush pool is a seasonally or permanently flooded, shrub-dominated pool, with buttonbush normally the dominant plant. 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 significant forest canopy. Buttonbush pools typically have no stream inlet or outlet, although some may have an intermittent inlet or outlet. The kettle shrub pool, a specific type of buttonbush pool, has all the previous characteristics but is also located in a glacial kettle—a depression formed by the melting of a stranded block of glacial ice. Glacial outwash soils (e.g., Hoosic gravelly loam) are located adjacent to the pools.

Conservation Issues

Buttonbush pools, particularly kettle shrub pools, are the typical core wetlands used by the Blanding's turtle* (NYS Threatened). The Blanding's turtle typically spends winter, spring, early summer, and fall in its core wetland, which is used for hibernation, thermoregulation, and foraging. During the active season, Blanding's turtles also use other nearby wetlands, including emergent marshes, swamps, intermittent woodland pools, and circumneutral bog lakes, for foraging, rehydrating, and resting. Females nest in open habitats with (usually) coarse-textured, well-drained soil (often gardens, agricultural fields, utility rights-of-way, soil mines, etc.) in late spring to early summer. During drought periods and during the nesting season, individuals may move into constructed ponds or other water bodies that retain standing water. Maintaining a Blanding's turtle population requires protecting not only the core wetland habitat (e.g., kettle shrub pool or buttonbush pool), but also the associated foraging and drought refuge wetlands, the upland nesting areas, and the upland areas providing travelways between these habitats.

Blanding's turtles travel overland on a day-to-day and seasonal basis to reach important foraging areas, nesting sites, overwintering areas, and refuge habitats. These regular movements can encompass an area up to 3,300 ft (1,000 m) from a core wetland habitat. In the Northeast and elsewhere in their range, movements of 6,500 feet (2,000 m) or more have been documented on numerous occasions (Joyal et al. 2000, 2001; Fowle 2001). These long distance movements enable turtles to select alternative habitats as habitat quality or social dynamics change, and to breed with individuals from neighboring habitat complexes. Therefore, to define the potential extent of the habitat complex used by a Blanding's turtle population, we delineated 3,300-ft (1,000-m) and 6,500-ft (2,000-m) zones around each buttonbush pool (Figure 8). The 1000-m "Conservation Zone" encompasses the wetlands that the turtles use regularly on a seasonal basis, most of the nesting areas, and most of the travelways between those habitats. One can expect turtles regularly in this zone throughout the active season (April through October). The 2000-m "Area of Concern" includes the landscape within which the Blanding's turtle makes long-distance movements to explore new wetlands or to nest. One can expect a few turtles from a particular core wetland in this zone each year.

Within these zones, potential Blanding's turtle habitats include wetlands, upland nesting habitats, and travel corridors between them.

Development activity within this habitat complex can have significant adverse effects on the turtles and their habitats, including the direct loss of wetland habitat (especially small, unregulated wetlands); degraded water quality from pesticides, fertilizers, and toxic substances; altered wetland hydroperiod and water depth from groundwater extraction or surface water diversion; habitat fragmentation from roads and other developed land uses; and increased nest predation by human-subsidized predators. Road mortality of nesting females and individuals migrating between wetlands or dispersing to new habitats is one of the greatest threats to Blanding's turtle populations.

Recommendations

Several Blanding's turtles have been found in the Town of Washington, and the town almost certainly contains one or more viable populations of this Threatened species. To help protect Blanding's turtles and the habitat complexes they require, we recommend the following measures (adapted from Hartwig et al., in prep.):

Within the <u>2000-m Area of Concern</u>, we recommend the following:

1. *Protect wetland habitats*. All wetland habitats should be protected from filling, dumping, drainage, incursion of construction equipment, siltation, polluted runoff, and hydrological alterations (including both surface flow and groundwater).
2. *Minimize impacts from new and existing roads*. Prohibit the building of new roads crossing or adjoining Blanding's 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. Medium and heavy volume roads within the priority zone should be considered as candidates for installing turtle underpasses.
3. *Maintain broad corridors between habitats*, and broad buffers (at least 100 ft [30 m] in width) of natural soil and vegetation around all wetlands. Broad, naturally vegetated travel corridors should be maintained between individual habitats within a complex (e.g., between kettle shrub pools, foraging wetlands, drought refuge ponds, and nesting areas) and between neighboring habitat complexes.

4. *Minimize or eliminate pesticide use* on lawns, gardens, and agricultural fields, and prevent movement of soil and nutrients into wetlands.
5. *Educate landowners* about the Blanding's turtle and its conservation.

Additional recommendations for the 1000-m Conservation Zone include:

1. *Protect nesting areas*. Blanding's turtles traditionally nest in upland meadow or open shrublands, habitats that also tend to be prime targets for development. We recommend that large areas of potential nesting habitat within the Conservation Zone (e.g., upland meadows, upland shrublands, waste grounds with exposed gravelly soils) be permanently protected from development and other disturbance. These areas, however, may need to be managed as part of an approved management plan to maintain suitable nesting conditions.
2. *Consider the impacts on water quality, hydrology, and habitat disturbance* to turtle habitat complexes when reviewing all applications for Freshwater Wetlands permits, Stormwater Management permits, and Mined Lands permits, and siting of water supply wells, septic systems, and other sewage treatment systems.
3. *Identify high-priority areas for special protection*, e.g., for acquisition of conservation land by public or private entities, or for establishment of conservation easements on privately-owned land. Keep in mind that the turtles need broad corridors in the Area of Concern to move between Conservation Zones.

Finally, within 660 ft (200 m) of buttonbush pools, we recommend that no buildings, pavement, roads, or other structures be constructed. Blanding's turtle activity (basking, aestivation, short-distance travel) is most concentrated within 660 ft (200 m) of a buttonbush pool. A 200-m buffer of natural vegetation and soil will minimize direct impacts to the turtles, help maintain wetland hydrology and water temperature, and filter runoff containing silt and other pollutants.

In addition to the recommendations discussed above, local and state agencies should require the following of any proposed development project within the 1000-m Conservation Zone:

1. Potential pitfall hazards such as window wells, storm drains, catch basins, swimming pools, and silt fencing should be designed or modified to prevent the entrapment of turtles.
2. Potential barriers to turtle movement either on land or in the water, such as stone walls or chain-link fences (excluding those designed to protect pitfalls), should be designed with openings to allow safe turtle passage. Openings must be no less than 4 in (10 cm) high and no more than 82 ft (25 m) apart to allow turtles to move freely across the landscape.

3. Construction crews and eventual residents should be educated on how to look for and safely move turtles under cars, construction equipment, or mowing machines before operating or driving.
4. Under certain circumstances (to be determined on a case-by-case basis by the New York State Department of Environmental Conservation or a Blanding's turtle specialist), temporary exclusion fencing should be erected around a construction site to keep Blanding's turtles out of the work area.
5. We strongly recommend that all activity proposed within the Area of Concern 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 habitat requirements.

CIRCUMNEUTRAL BOG LAKES

Target Areas

The two circumneutral bog lakes we mapped in Washington are Round Pond, near the intersection of Bangall Road and Shunpike, and Shaw Pond, on the town's northern border (Fig. 5). Round Pond is entirely surrounded by forest. Shaw Pond is bordered by forest and agricultural fields.

Conservation Issues

The unusual water chemistry, hydrology, and sediments of circumneutral bog lakes may together provide critical habitat for many plants and animals of conservation concern (see Appendix A in Tollefson and Stevens [2004]). 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), which seem to have the right combination of characteristics essential to reproductive success. 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). Aquatic plants and algae can be affected by herbicide application or runoff, 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 mi (1.3 km) apart (Gray 1983), and, based on the distribution of suitable habitats in this region, can probably disperse much farther (Dickinson 1993). It is unknown whether these frogs 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.
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, and groundwater extraction (e.g., wells).
3. *Ban use of motorized boats.* Motorized boats pollute water, physically damage plant and animal life, and may introduce non-native species of plants and animals.
4. *Maintain or restore a vegetated buffer of 300 ft (91 m) from the lake edge.* Most circumneutral bog lakes are naturally surrounded by a border of swamp or marsh, and are located within upland forest. Leaving a broad buffer of undisturbed soils and vegetation may be crucial to safeguarding wetland habitat quality, hydrology, and northern cricket frog overwintering sites.
5. *Protect habitats and assess potential impacts within 3,300 ft (1,000) of the lake edge.* Development within this area may alter surface water and groundwater hydrology and water quality affecting the lake, and may sever important travel corridors between northern cricket frog breeding habitats.
6. *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*

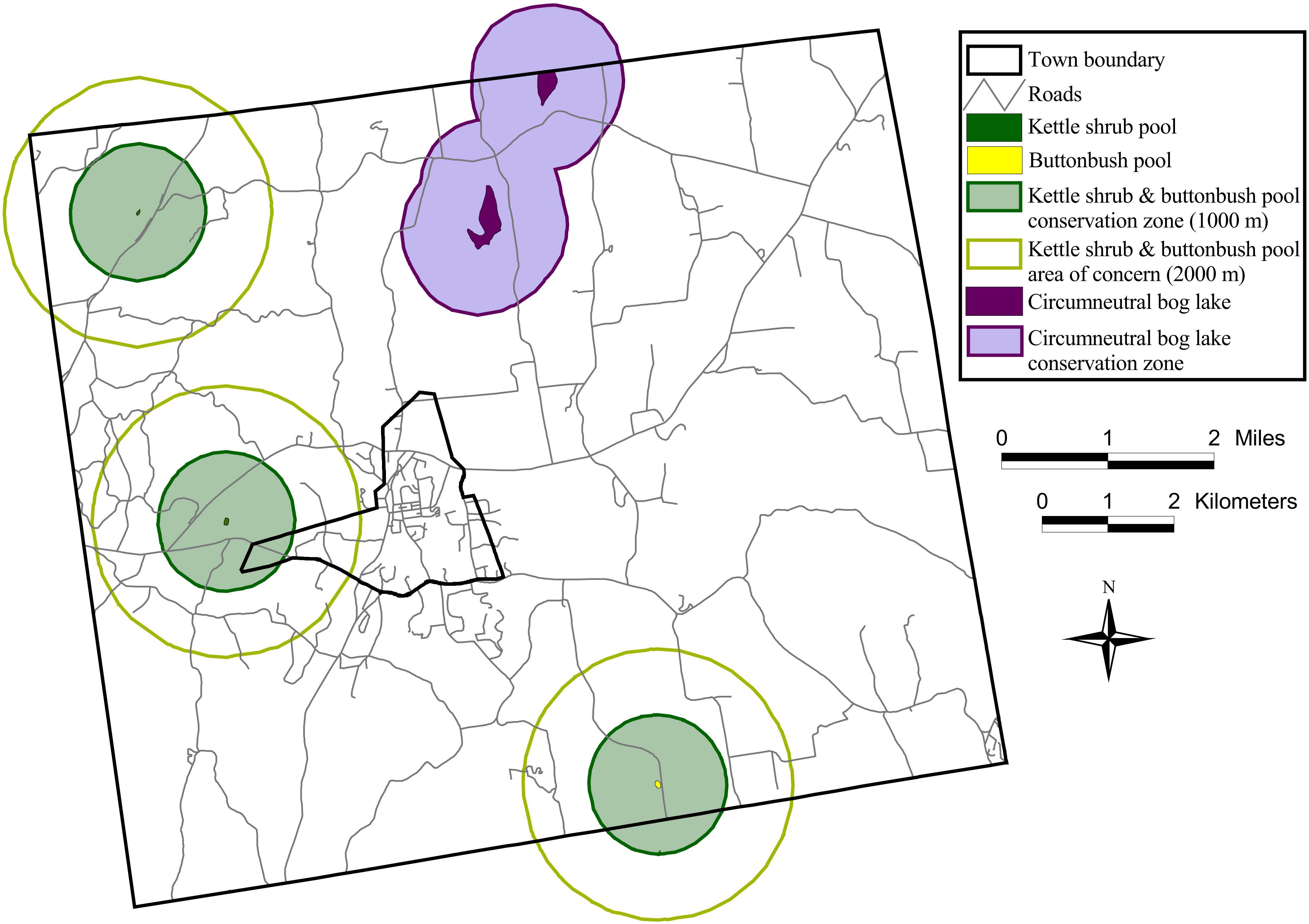


Figure 5. Kettle shrub pools, buttonbush pool, circumneutral bog lakes, and their associated conservation zones in the Town of Washington, Dutchess County, New York. Conservation zones extend 3300 ft (1000 m) from wetland boundaries; the area of concern for kettle shrub and buttonbush pools extends 6500 ft (2000 m). Hudsonia Ltd., 2006.

planning process, so that development designs can accommodate the needs of sensitive species. Surveys should include rare plants, amphibians, reptiles, and breeding birds.

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 various wetlands. For example, the Millbrook Marsh area is a high quality wetland complex containing hardwood swamp, marsh, wet meadow, calcareous wet meadow, and fen. In the vicinity of Redwing and Flagler Drive is an extensive area of swamp (> 140 acres), with many bordering areas of wet meadow. Between Bangall Road and Mabbettsville Road are large areas of marsh, swamp, and wet meadow. An extremely valuable complex of fen, swamp, and marsh occurs to the west of Little Rest Road. These are just a few examples of the many important wetland complexes in the Town of Washington.

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, buttonbush pool, intermittent woodland pool, and constructed pond 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 upland habitats. This species follows an annual pattern of activity: it usually overwinters in 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 (Joyal et al. 2001).

Recommendations

1. *Protect intermittent woodland pools, buttonbush pools, and fens and their conservation zones* as described elsewhere in this addendum and in Tollefson and Stevens (2004). These are habitats used by spotted turtle especially in the summer.
2. *When these wetland 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 potential spotted turtle travelways, and nesting, aestivation, and basking sites.
3. *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 can 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

Wappinger Creek and its East Branch are two of the major perennial streams in Washington. 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 entire watersheds (Fig. 6).

Conservation Issues

Low gradient, perennial streams can provide essential core habitat for the wood turtle, a Species of Special Concern in New York State. Wood turtles require streams with overhanging banks, muskrat burrows, or other underwater shelter for overwintering. In early spring, they use overhanging tree limbs and roots 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 habitats.

Conserving wood turtles requires protecting not only their core habitat (e.g., suitable 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 660 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, including 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, and toxic compounds; increased nest predation by human-subsidized predators; disturbance from human recreational activities; and higher road mortality of nesting females and other individuals migrating between habitats.

Water quality in large streams depends on the water quality and quantity of the small, intermittent streams that feed them (Lowe and Likens 2005). To help protect water quality and habitat in intermittent streams (as well as downstream), the adjoining lands extending 160 ft (50 m) on each side of the stream should be protected. This protective buffer can help by filtering sediment, nutrients, and contaminants from runoff, stabilizing stream banks, preventing channel erosion, regulating microclimate, and protecting ecosystem processes (Saunders et al. 2002).

Recommendations

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

1. *Protect integrity of stream habitats*. Engineering practices that alter the physical structure of the stream channel (e.g., stream channelization, bank stabilization)

can destroy key hibernation and basking habitat. To help protect the core stream habitats within this priority zone, we advise the following:

- Prohibit activities such as stream channelization, artificial stream bank stabilization (e.g., rock rip-rap, concrete), construction of dams or artificial weirs, vehicle crossing (e.g., from construction or logging equipment, ATVs), and the clearing of natural stream bank vegetation.
- Avoid or minimize direct discharge of stormwater runoff, chlorine-treated wastewater, agricultural by-products, and other potential pollutants to the greatest extent possible.
- Establish a protective buffer zone at least 160 ft (50 m) wide on all streams in the watershed, including perennial and intermittent tributary streams, whether or not they are known to be 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. Such a buffer zone will help stabilize stream banks, prevent channel erosion, filter sediments, nutrients, and other contaminants from runoff before it enters the stream, regulate stream temperature and microclimate, and provide important organic materials (e.g., woody debris and leaf litter) to the stream ecosystem.

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, incursion of construction equipment, siltation, polluted runoff, and hydrological alterations. In addition, large, contiguous blocks of upland habitats (e.g., forests, meadows, shrublands) within 660 ft (200 m) of a core wood turtle stream should be preserved to the greatest extent possible to provide important basking, foraging, and nesting habitat for this species. Special efforts may need to be taken to protect particularly vulnerable components of the habitat complex such as wet meadows. 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 suggest 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 animals including wood turtles.
    - 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 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, driveways, 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 200-m corridor (e.g., upland meadows, upland shrublands, waste ground with exposed gravelly soils) be protected from development and other disturbance.

For any proposed development project within the riparian corridor, local and state agencies should follow the guidelines listed above.

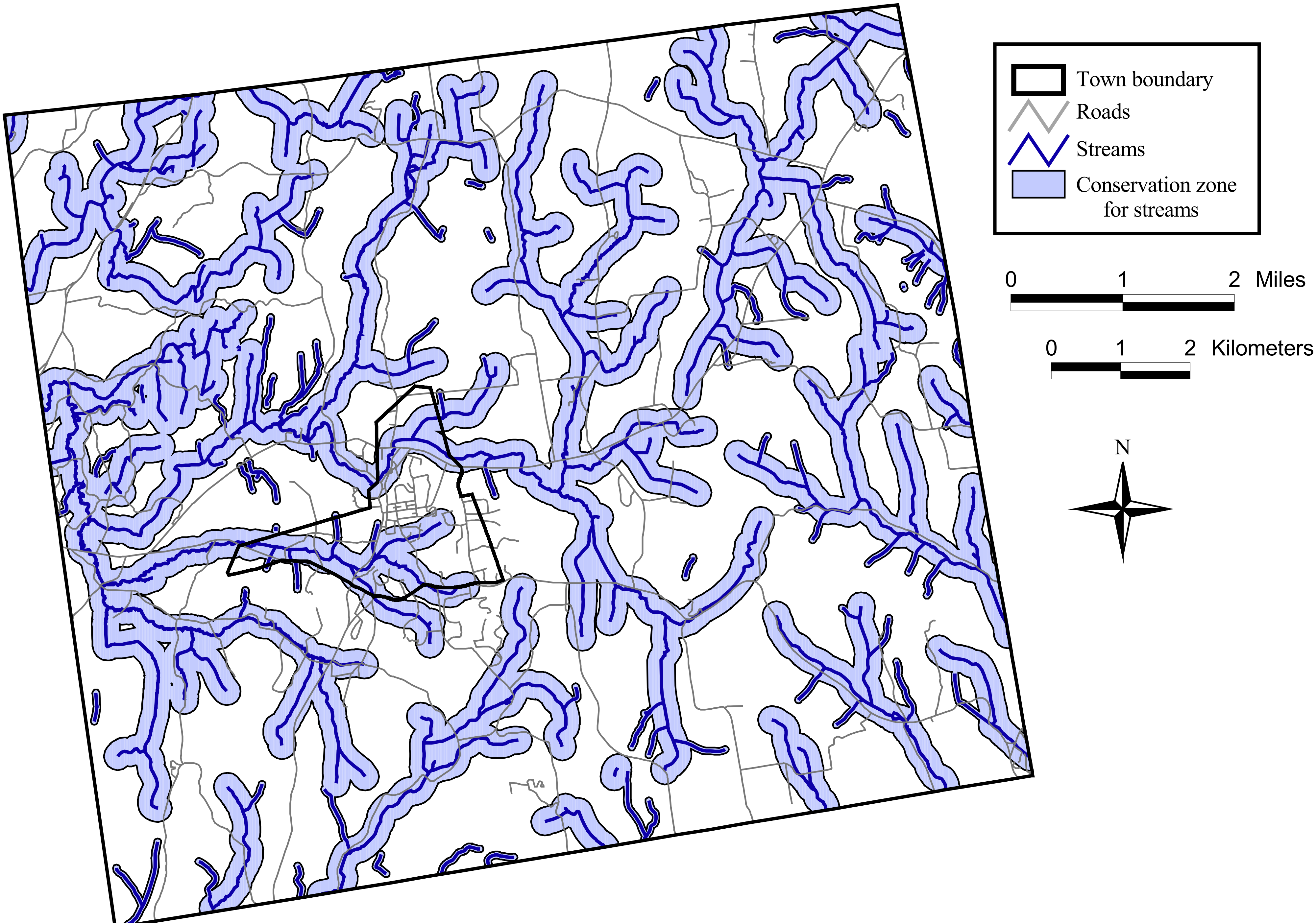


Figure 6. Streams and associated conservation zones in the Town of Washington, Dutchess County, New York. All streams have a minimum conservation zone of 160 ft (50 m) on each side; large, perennial streams have a conservation zone of 660 ft (200 m). Extent of large, perennial streams is approximate. Hudsonia Ltd., 2006.

PRIORITY CONSERVATION AREAS IN WASHINGTON

In addition to the priority habitats discussed above, there are locations in Washington that deserve special attention because they each contain several priority habitats (Fig. 7). We discuss the features of each area that make it especially valuable to biodiversity. This is not meant to be a comprehensive list of such areas in the Town of Washington. For conservation issues and recommendations for each habitat type, refer to the preceding sections.

Fen Hotspot

This area encompasses land on both sides of Route 44, north to Andrew Haight Road and south beyond Route 343. Noteworthy features include:

- Numerous fens (at least 20), including several clusters of fens. In most cases the fens are part of larger wetland complexes that include calcareous wet meadows, marshes, and large swamps.
- Several intermittent woodland pools.
- Large, contiguous meadows.

Killearn Road

This area includes land on both sides of Killearn Road. Important features include:

- A large area of continuous upland hardwood forest.
- One buttonbush pool.
- Several intermittent woodland pools and isolated swamps.

Millbrook Marsh

Millbrook Marsh is a large wetland complex that continues into the towns of Stanford and Amenia. This area contains:

- Extensive marsh, calcareous wet meadow, and swamp habitats, containing several rare plants.
- At least one fen.
- Sightings of many rare and uncommon species. Breeding birds: pied-billed grebe, great blue heron, American bittern, king rail, Cooper's hawk, barn owl, sedge wren, and eastern bluebird. Wintering birds: bald eagle, osprey, and long-eared owl. Reptiles and amphibians: bog turtle, wood turtle, spotted turtle, Jefferson salamander, spotted salamander, and marbled salamander. Butterflies: Baltimore, bronze copper, and sedge skipper (Kiviat 1994).

Shaw Pond

This area extends south from Shaw Pond to Andrew Haight Road, and continues north into the Town of Stanford. It is noteworthy for the following features:

- The largest concentration of extensive meadowland in the town.
- Shaw Pond, a circumneutral bog lake. Red-shouldered hawk, sharp-shinned hawk, and wood duck were sighted here.
- Two fens.

Round Pond

This area comprises most of the Hitchcock property south to Hitchcock Lane. The priority habitats include:

- Round Pond, a circumneutral bog lake.
- A large area of unfragmented upland forest.
- Several intermittent woodland pools.

Woodstock Road

Located on both sides of Woodstock Road and both sides of Route 82, this is a large wooded area that contains:

- Extensive forest, including conifer and mixed forest.
- Numerous intermittent woodland pools (at least 60).
- A kettle shrub pool.
- Wappinger Creek, an important tributary of the Hudson River. Its riparian corridor is an important link between habitats across town boundaries. Also, maintaining water quality in the Town of Washington is important for all downstream reaches.

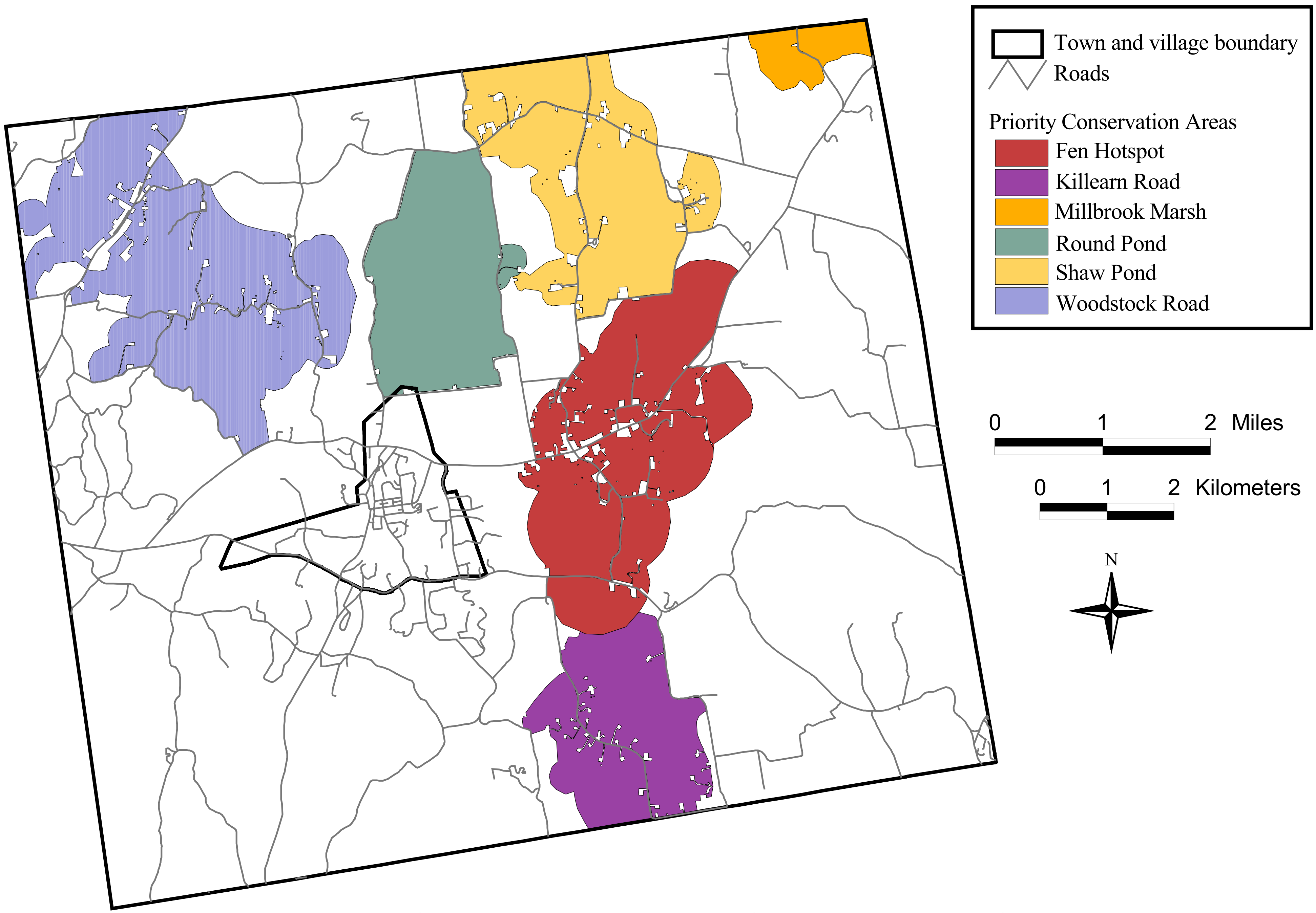


Figure 7. Priority Conservation Areas in the Town of Washington, Dutchess County, New York. These are examples of areas with especially high biodiversity value, but not a complete list. Hudsonia Ltd., 2006.

REFERENCES CITED

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

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

Beasley, V.R., S.A. Faeh, B. Wikoff, C. Staehle, J. Eisold, D. Nichols, R. Cole, A.M. Schotthoefer, M. Greenwell, and L.E. Brown. 2005. Risk factors and declines in northern cricket frogs (*Acris crepitans*). P. 75-86 in M. Lannoo, ed., Amphibian declines: The conservation status of United States species. University of California Press, Berkeley, CA.

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

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

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

Buech, R., L.G. Hanson, and M.D. Nelson. 1997. Identification of wood turtle nesting areas for protection and management. In J. Van Abbema, ed. Proceedings: conservation, restoration, and management of tortoises and turtles- an international conference. New York Turtle and Tortoise Society and the WCS Turtle Recovery Program. New York, NY.

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

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

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

Dickinson, R.A. 1993. Northern cricket frog (*Acris crepitans*) survey in Ulster County, New York, 1992. M.S. thesis, Bard College, Annandale, NY.

Eckler, J.T. and A.R. Breisch. 1990. Radio telemetry techniques applied to the Bog Turtle (*Clemmys muhlenbergii* Schoepff 1801). P. 70 in R.S. Mitchell, C. J. Sheviak, and D. J. Leopold, eds. Ecosystem management: rare species and significant habitats. New York State Museum Bulletin No. 471. Albany.

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

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

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

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

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

Gray, R.H. 1983. Seasonal, annual, and geographic variation in color morph frequencies of the cricket frog, *Acris crepitans*, in Illinois. Copeia 1983(2):300-311.

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

Hartwig, T., G. Stevens, J. Sullivan, and E. Kiviat. in prep. Blanding's turtle habitats in southern Dutchess County. Report to the Marilyn Milton Simpson Charitable Trusts. Hudsonia Ltd., Annandale, NY.

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

Irwin, J.T. 2005. Overwintering in northern cricket frogs (*Acris crepitans*). P. 55-58 in M. Lannoo, ed., Amphibian declines: The conservation status of United States species. University of California Press, Berkeley, CA.

Joyal, L.A., M. McCollough, and M.L. Hunter, Jr. 2000. Population structure and reproductive ecology of Blanding's turtle (*Emydoidea blandingii)* in Maine, near the northeastern edge of its range. Chelonian Conservation and Biology 3:580-588.

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

Kiviat, E. 1997. Blanding's turtle habitat requirements and implications for conservation in Dutchess County, New York. P. 377-382 in J. van Abbema, ed., Proceedings: Conservation, restoration, and management of tortoises and turtles--an international conference. New York Turtle and Tortoise Society.

Klemens, M.W. 2001. Bog turtle conservation zones. Appendix A in Bog turtle (*Clemmys muhlenbergii*) northern population recovery plan. U.S. Fish and Wildlife Service. Hadley, MA. 103 p.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Sparling, D.W., T.P. Lowe, D. Day, and K. Dolan. 1995. Responses of amphibian populations to water and soil factors in experimentally treated aquatic macrocosms. Archives Environmental Contamination and Toxicology 29:455-461.

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

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

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

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

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