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

Catherine Dickert

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

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EXECUTIVE SUMMARY

Hudsonia Ltd. conducted habitat identification and mapping in the Town of Stanford between April 2004 and November 2005. We received funding for this project from the Millbrook Tribute Garden (through the Dutchess Land Conservancy) and the Dyson Foundation, and support from the Dutchess Land Conservancy, the Stanford Town Board, Planning Board, and Conservation Advisory Council, and Town of Stanford landowners.

Through map analysis, aerial photograph interpretation, and field observations, we created a large-format 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 or habitat complexes. In total, we identified 25 different kinds of habitats in the Town of Stanford 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 fen, buttonbush pool, and 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 third in a series of town-wide habitat mapping projects conducted by Hudsonia in the Hudson Valley, and the second in a series of five such projects that Hudsonia will carry out in northeastern Dutchess County over a five year period. Town-wide habitat maps are intended to serve as tools for conservation planning and decision-making. The habitat maps, which contain ecological information 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

Background

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

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

After Hudsonia completed its first town-wide habitat map for the Town of East Fishkill (Stevens and Broadbent 2002), we received funding from the Millbrook Tribute Garden and the Dyson Foundation to produce habitat maps for five northeastern Dutchess County towns over a period of five years. The Town of Washington (Tollefson and Stevens 2004) was the first of these, and Stanford was the second. We received strong support for the projecvt from the Stanford Town Board, Planning Board, and Conservation Advisory Council, as well as from many local landowners.

Kristen Bell (Biologist), Catherine Dickert (Biologist), Jenny Tollefson (Biodiversity Mapping Coordinator) and Gretchen Stevens (Director, Biodiversity Resources Center) conducted the work on this project from April 2004 through November 2005. Through map analysis, aerial photograph interpretation, and field observations we created a map of ecologically significant habitats in the Town of Stanford. Some of these habitats are rare or declining in the region, and some may support rare species of plants or animals, while others are high quality examples of common habitats or habitat complexes. The emphasis of this project was on identifying and mapping general habitat types, and not on conducting species-level surveys or mapping the known locations of rare species.

Hudsonia will soon be completing habitat mapping projects in several more towns in 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 that our methods and products will improve 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 (Stevens and Broadbent 2002), Washington (Tollefson and Stevens 2004), and Fishkill and Sprout Creek Corridors (Sullivan and Stevens 2005) reports without specific attribution. We have adapted the report, however, to address our findings in the Town of Stanford. We intend for each of these projects to build on the previous ones, and believe that the expanding body of biodiversity information will be a valuable resource for site-specific, town-wide, and region-wide planning and conservation efforts. We hope that this map and report will help landowners understand how their 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 Stanford.

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 roles of all organisms in an ecosystem and cannot fully predict the consequences of the extinction of any particular species, we do know that each organism, including inconspicuous organisms such as fungi or insect pollinators, plays a unique role in the maintenance of biological communities. Maintaining the full complement of native species in a region can allow an ecosystem to withstand stresses and adapt to changing environmental conditions.

What are Ecologically Significant Habitats?

For purposes of this project, a "habitat" is simply the place where an organism or population lives or where a biological community occurs, and is defined according to 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, this project focuses 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 invasive species, or those that provide connections between other important habitat units).
4. Complexes of connected habitats that, by virtue of their size, composition, or configuration, have significant biodiversity value.

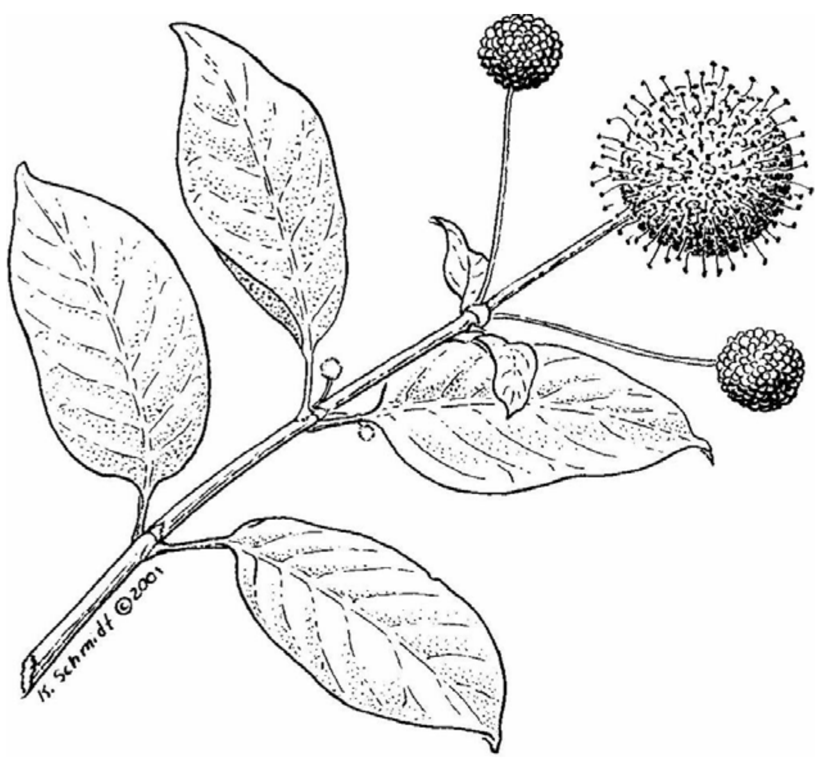
Because most wildlife species need to travel among different habitats to satisfy their basic needs for survival, landscape patterns can have a profound influence on wildlife populations. The size, connectivity, and juxtaposition of both common and uncommon habitats in the landscape all have important implications for biodiversity. By illustrating the location and configuration of ecologically significant habitats throughout the town, the 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 Stanford is located in northeastern Dutchess County. It is approximately 50 mi^2 (130 km^2) in area with a population of roughly 3,550 residents (2000 census). Wappinger Creek, a major tributary of the Hudson River, drains most of the town. Mountain Brook, Cold Spring Creek, Hunns Lake Creek, and Willow Brook are four of the larger tributaries of Wappinger Creek within Stanford. Other watersheds include those of Shekomeko Creek, a tributary of the Roeliff Jansen Kill, which begins near Stanford's border with the Town of Northeast; a tributary of Wassaic Creek, which drains the southeast corner of Stanford; and a tributary of Little Wappinger Creek, which drains the northwest corner. Elevations in Stanford range from 270 ft (82 m) along Wappinger Creek at the southwestern boundary of the town to 1,210 ft (369 m) on the hilltops on either side of Pugsley Hill Road on the eastern town boundary. A band of low-lying land along Wappinger Creek runs southwest through the town just west of Route 82. Large wetland complexes include the area along Wappinger Creek at the north boundary of the town (currently Mashomack Preserve) and the wetlands around Bontecou Lake on the Stanford-Washington border.

According to Fisher et al. (1970), Stanford’s bedrock geology is dominated by phyllite and large areas of schist and meta-graywacke (Fig. 1). Smaller areas of limestone and dolostone are scattered across the town, forming a discontinuous band of carbonate bedrock from southwest to northeast. According to Cadwell (1989), the surficial material is primarily glacial till. There are also extensive areas of exposed or nearly exposed bedrock. Recent alluvium is mapped on the Wappinger Creek floodplain in the southwest corner of town and in the Shekomeko Creek floodplain on the eastern town border. There are kame deposits scattered throughout the town and other outwash sand and gravel areas associated with the floodplains of Cold Spring Creek, Wappinger Creek, and Willow Brook.

Land uses in the Town of Stanford include farming, forestry, hunting preserves for upland game and waterfowl, horse stables and pastures, residential and commercial uses in the hamlets of Stanfordville and Bangall. There are no incorporated villages. Although this is historically a dairy-farming region, many farms have been converted to residential uses, including many second homes. Most privately owned parcels are of 5 acres (2 ha) or less, but 11 landowners hold parcels of over 300 ac (120 ha); the largest is 1205 ac (488 ha). Developed areas are scattered throughout the town and are mainly residences along roads. Stanford has large areas of open space (see Fig. 3).



Buttonbush

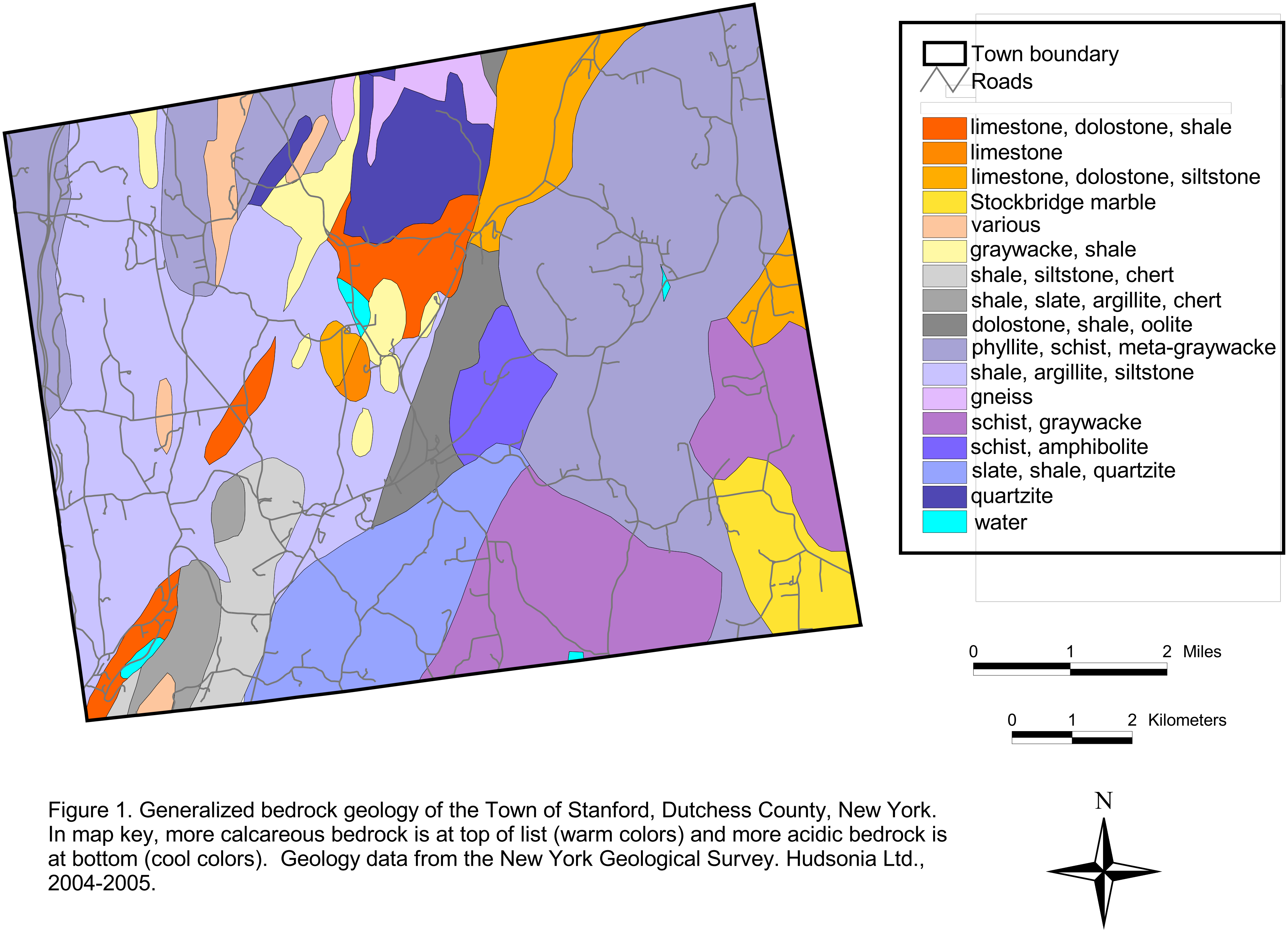


Figure 1. Generalized bedrock geology of the Town of Stanford, Dutchess County, New York. In map key, more calcareous bedrock is at top of list (warm colors) and more acidic bedrock is at bottom (cool colors). Geology data from the New York Geological Survey. Hudsonia Ltd., 2004-2005.

METHODS

Hudsonia employs a combination of laboratory and field methods in the habitat identification and mapping process, including map analysis, aerial photo interpretation, and field observation. Below we describe each phase in the Town of Stanford habitat mapping project.

Gathering Information and Predicting Habitats

During many years of habitat studies in the Hudson Valley, Hudsonia has found that, with careful analysis of map data and aerial photographs, we can accurately predict the occurrence of many habitats that are closely tied to topography and geology. The first step in the habitat mapping process is to assemble all of the necessary and relevant maps, Geographic Information System (GIS) data, and existing published and unpublished information from biologists who have worked in the area. We then use combinations of map features (e.g., 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 Stanford and biological data provided by the New York Natural Heritage Program, we also used the following resources for this project:

- *1:40,000 scale color infrared aerial photograph prints from the National Aerial Photography Program series taken in spring 1994, obtained from the U.S. Geological Survey.* Viewed in pairs, stereoscopic aerial photograph prints ("stereo pairs") provide a three-dimensional view of the landscape and are extremely useful for identifying vegetation cover types, wetlands, streams, and cultural landscape features. For interpretation of aerial photograph prints, we used an F-71 mirror stereoscope (Alan Gordon Enterprises, Inc).

- *High-resolution (1 pixel = 7.5 in [19 cm]) true color digital orthophotos taken in spring 2000, obtained from the Dutchess County Office of Real Property Tax.* These digital aerial photos were used for on-screen computer mapping.

- *U.S. Geological Survey topographic maps (Amenia, Millbrook, Millerton, Pine Plains, Rock City, and Salt Point, 7.5 minute quadrangles).* Topographic maps contain extensive information about landscape features such as elevation 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 (Faber 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 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 diverse habitats that are closely linked to local topography, geology, hydrology, and soil conditions. GIS also enables us to create detailed, spatially accurate maps. We obtained most of our GIS data layers from the Dutchess County Environmental Management Council (EMC), including roads, 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-ft (3-m) contour data for the Town of Stanford from the Dutchess Land Conservancy, and Town of Stanford tax parcel data from the Dutchess County Real Property Tax office.

Preliminary Habitat Mapping and Field Verification

We prepared a preliminary map of predicted habitats based on map analysis and stereo interpretation of aerial photographs. We digitized the predicted habitats onscreen over the orthophoto images using ArcView 3.2 computer mapping software. We then brought these draft maps with us into the field, where we visited as many of the mapped habitat units as possible to verify their presence and extent.

We identified landowners using tax parcel data, and before going into the field we contacted property owners for permission to enter their land. 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 fieldwork on private land, we also viewed habitats from adjacent properties, public roads, and other public access areas.

We estimate that we field checked part or all of the mapped habitat units on 68% of undeveloped land in Stanford. Inaccessible areas that could not be field-checked were mapped entirely by remote sensing. We assume that areas of the habitat map that were field checked are generally more accurate than areas we did not visit in the field. Once we had conducted fieldwork in one area, however, we were able to extrapolate our findings to adjacent parcels and similar settings. Because the schedule 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, driveways, other impervious surfaces) and habitats that we believed were insignificant are shown as white (no symbol or color) on the habitat map. Areas that have been developed since 2000 (the orthophoto date) were identified as such only if we observed them in the field. For this reason, it is likely that we underestimated the extent 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 seemed to provide important connections to other large habitat areas. We did, however, map wetlands within developed areas if they were identifiable on the aerial photographs or in the field. These wetland habitats can serve as important drought refuges for rare species and other species of conservation concern.

- *"Cultural" areas.* Intensively managed areas such as golf courses, cemeteries, and lawns were mapped as "cultural" habitats. It was difficult to distinguish extensive lawns from upland meadows using aerial photos, so in the absence of field verification some lawns may have been mapped as upland meadow. See page 43 for a more complete description of cultural habitats.

- *Upland hardwood forests.* Although these forests are extremely variable in their species composition, size and age of trees, vegetation structure, soil drainage and texture, and other factors, we decided to map upland hardwood 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 hardwood forest" type therefore includes non-wetland hardwood forests of all ages, at all elevations, and of all species mixtures. Upland conifer-hardwood mixed forests and upland conifer forests were mapped separately. See page 23 for a detailed description of upland forest habitats.

- *Upland meadows and upland shrubland.* Pastures, agricultural fields, equestrian fields, abandoned fields, and mowed ornamental fields were mapped as "upland meadow." We mapped upland meadows divided by fences and hedgerows as separate polygons, to the extent that these features were visible on the aerial photographs. Because upland meadows often have a substantial shrub component, the distinction between upland meadows and upland shrubland habitats is somewhat arbitrary. In general, we defined upland shrubland habitats as those with widely distributed shrubs that accounted for more than 20% of the cover. See pages 30 and 32 for more detailed descriptions of upland shrubland and upland meadow habitats.

- *Crest, ledge, and talus habitats.* Because crest, ledge, and talus habitats are usually 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 as mapped by Faber (2002). The final overlay of crest, ledge, and talus habitats is therefore an approximation, and we expect that there are additional bedrock exposures outside the mapped areas. The precise locations and boundaries of 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 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 simply as crest, ledge, and talus. See page 37 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. Along stream corridors and in other low-lying areas with somewhat poorly-drained soils, it was often difficult to distinguish between upland forest and hardwood swamp without the benefit of onsite soil data. In the field, these areas were characterized by moist, fine-textured soils with common upland trees in the canopy and often 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 47-72 for detailed descriptions of wetland, pond, and stream 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 approximately 85 intermittent woodland pools between March 2004 and November 2005. The pools we did not visit in the field were mapped by remote sensing. 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 59 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 Stanford 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 71 for further description of spring and seep habitats.

- *Streams.* The Dutchess County EMC created a digital stream layer using 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 Stanford, however, we created a new stream coverage in our GIS that was based on these original data, field observations, and interpretation of topographic maps and 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 72 for a detailed description of perennial and intermittent stream habitats.

We produced the final large-format habitat map on four 36 x 44 inch sheets at a scale of 1:10,000, using a Hewlett Packard DesignJet 800PS plotter. We also printed the whole town on a single sheet at a scale of 1:19,000. The GIS database that accompanies the map includes additional information about many of the mapped habitats, such as the dates of field visits 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 Stanford 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

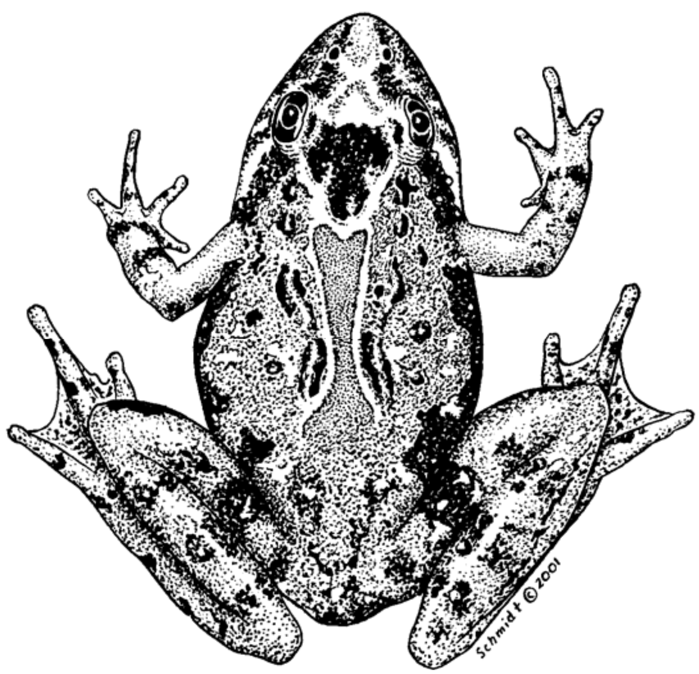
Overview

The large-format Town of Stanford 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 total 50-mi^2 (130-km^2) area comprising the Town of Stanford, approximately 90% is undeveloped (i.e., without structures, paved roads, etc.). Unfortunately, because existing development is widely dispersed throughout the town, undeveloped land has been fragmented into discontinuous patches. Figure 3 shows blocks of contiguous undeveloped habitat within the town that are <500, 500-1,000, and >1,000 ac (<202, 202-405, and >405 ha). Several types of common habitats cover extensive areas within these blocks. For example, approximately 53% of the town is forested, 30% is open meadow (agricultural areas and other managed and unmanaged grassland habitats), and 9% is wetland. Some of the smaller, more unusual habitats we documented include circumneutral bog lakes, fens, and buttonbush pools. In total, we identified 25 different kinds of habitats in the Town of Stanford that we consider to be of potential ecological importance (Table 1).

Table 1. Ecologically significant habitats documented by Hudsonia in the Town of Stanford, Dutchess County, New York, 2004-2005.

Upland Habitats	Wetland, Pond, & Stream Habitats
Upland Hardwood Forest Upland Conifer Forest Upland Mixed Forest Red Cedar Woodland Upland Shrubland Upland Meadow Crest/Ledge/Talus Oak-Heath Barren Orchard/Plantation Cultural Waste Ground	Hardwood & Shrub Swamp Conifer Swamp Mixed Forest Swamp Marsh Wet Meadow Calcareous Wet Meadow Fen Intermittent Woodland Pool Buttonbush Pool Circumneutral Bog Lake Open Water Constructed Pond Spring/Seep Stream & Riparian Corridor

Although the mapped areas represent potentially ecologically significant habitats, all have been altered to varying degrees by past and present human activities. Most areas of upland forest, for example, have been logged in the past 250 years, and many forested areas lack the structural complexity of older forests. Many of the wetlands in the town have been extensively altered by human activities such as damming, filling, and railroad and road construction. Purple loosestrife, one of the most widespread plants in marshes 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 Stanford, we have provided information on the quality and condition of these habitats in only a few cases.



Northern Cricket Frog
© K. Schmidt 2001

HABITAT DESCRIPTIONS

In the following pages we describe some of the ecological attributes of the habitats identified in the Town of Stanford and discuss some conservation measures that can help to protect those habitats and the species of conservation concern they may support. We have assigned a code to each habitat type (e.g., upland conifer forest = ucf; marsh = ma) that corresponds with the codes appearing on the large-format (1:10,000 scale) Town of Stanford habitat map sheets. All of the species we mention in individual habitat descriptions occur in the Hudson Valley and have the potential to occur in the Town of Stanford. We have indicated species of conservation concern in the text by placing an asterisk (*) after 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.

UPLAND HABITATS

UPLAND FORESTS

Ecological Attributes

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

Upland Hardwood Forest (uhf)

Upland hardwood forest is the most common habitat type in our region, and is used by a wide range of common and rare species of plants and animals. Common trees of upland hardwood 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, serviceberry, mountain laurel, and a wide variety of wildflowers, sedges, ferns, lichens, and mosses. Upland hardwood forests provide important nesting habitat for a number of raptors, including red-shouldered hawk,* Cooper's hawk,* sharp-shinned hawk,* broad-winged hawk,* and barred owl,* and many species of songbirds including warblers, vireos, thrushes, and flycatchers. Pileated woodpecker, Acadian flycatcher,* wood thrush,* cerulean warbler,* black-and-white warbler,* Kentucky warbler,* ovenbird,* and scarlet tanager,* are some of the birds that require large forest-interior areas to successfully nest. Large mammals such as black bear and bobcat also require large expanses of forest. Many small mammals are associated with upland hardwood forests, including eastern chipmunk, southern flying squirrel, and white-footed mouse. Eastern box turtle* spends most of its time in upland forests and meadows, finding shelter under logs and organic litter. Hardwood trees greater than 5 cm in diameter (especially shagbark hickory and black locust) can be used by Indiana bat* for summer roosting and nursery colonies. Upland hardwood forests are extremely variable in their species composition, size and age of trees, vegetation structure, soil drainage and texture, and other habitat factors. Many smaller habitats are frequently embedded within areas of upland hardwood forest, such as intermittent woodland pools and crest, ledge, and talus habitat.

Upland Conifer Forest (ucf)

This habitat includes pole-sized to mature conifer plantations and naturally occurring upland forests with more than 75% cover of conifer trees. Planted conifer stands were often of Scotch pine, red pine, European larch, or Norway spruce. Naturally occurring stands were of eastern hemlock, white pine, and eastern red cedar. In general, plantations are more uniform in size and age of trees, structure, and overall species composition than natural conifer stands. We mapped Christmas tree plantations with young trees as "orchard/plantation," and pitch pine-dominated communities on ridge tops with exposed bedrock as "oak-heath barren." Conifer stands provide important habitat for a variety of mammals, including eastern cottontail, red squirrel, and eastern chipmunk (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. Pine siskin,* red-breasted nuthatch,* black-throated green warbler,* evening grosbeak,* purple finch,* 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 and can be especially important during periods of deep snow cover.

Upland Mixed Forest (umf)

Upland 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 was the most common conifer found in mixed forest stands in Stanford. These areas were less densely shaded at ground level than pure conifer stands and supported a higher diversity and greater abundance of understory species.

Occurrence in the Town of Stanford

Figure 4 illustrates the location and distribution of forested areas (including forested wetlands as well as uplands) in the Town of Stanford, showing forest patches that are <100, 100-500, 501-1,000, and >1,000 ac (<40, 40-202, 203-405, and >405 ha). The largest areas of forest were those on Stissing Mountain; between Route 82 and Hunns Lake Road; south of Hunns Lake; and between Ludlow Woods and Shuman roads. Seventeen forest areas were greater than 250 ac (100 ha).

Upland deciduous forest is by far the most widespread habitat type in the Town of Stanford, accounting for nearly 39% of the total land area. We presume that all, or nearly all, forests in the Town of Stanford have been cleared or logged at one time and that no "virgin" stands remain. There may be old forest stands, however, that were not observed during fieldwork.

Large areas of upland conifer and mixed forests occurred on Stissing Mountain, totaling over 791 ac (320 ha). Smaller patches (rarely exceeding 25 ac (10 ha), with a mean of 3.7 ac (1.5 ha) were widely distributed in the Town of Stanford. Most of the natural conifer forests were composed of white pine and/or eastern hemlock, and these were often 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.

Sensitivities/Impacts

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

In addition to fragmentation, forest habitats can be degraded in several other ways. Clearing the forest understory destroys habitat for birds such as wood thrush* that nest on the forest floor or in dense understory vegetation. Selective logging can also damage the understory and cause erosion and sedimentation. Soil compaction and removal of dead and downed wood and debris removes habitat for cavity-nesters, amphibians, reptiles, small mammals, and insects. Where dirt roads or trails cut through forest, vehicle, horse, and pedestrian traffic can harm tree roots and cause erosion. Runoff from roads can pollute nearby areas with road salt and heavy metals (Trombulak and Frissell 2000), and mortality from road kills can reduce population densities of amphibians (Fahrig et al. 1995).

RED CEDAR WOODLAND (rcw)

Ecological Attributes

This is a late-stage oldfield 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, and red cedar woodlands are often transitional between upland meadow and young forest habitats. The seeds of red cedar are bird-dispersed, and the seedlings are successful at becoming established in the hot, droughty conditions of old pastures (Holthuijzen and Sharik 1984). Eastern red cedar, the dominant tree, 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 upland shrubland. Kentucky bluegrass is often dominant in the understory, particularly in more open stands; little bluestem is often dominant on poorer soils. Red cedars can persist in these stands for many years even after the hardwood forest grows up around them. We mapped areas where abundant red cedar occurs under a canopy of hardwoods as "upland mixed forest."

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

Occurrence in the Town of Stanford

Red cedar woodlands in the Town of Stanford ranged in size from 0.08 to 37 ac (0.03 to 15 ha). Large areas of red cedar woodland (totaling 83 ac [34 ha]) are located between Homan Road and Cold Spring Road. Two other large patches occurred in the southwest corner of town, east of Patricia Lane. The distribution of red cedar woodlands appears to be related to the agricultural history of 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).

Sensitivities/Impacts

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

UPLAND SHRUBLAND (us)

Ecological Attributes

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

Many bird species of conservation concern nest in upland shrublands and adjacent upland meadow habitats, including northern harrier,* brown thrasher,* blue-winged warbler,* golden-winged warbler,* prairie warbler,* yellow-breasted chat,* clay-colored sparrow,* field sparrow,* and eastern towhee.* Extensive upland shrublands and those that form large complexes with meadow habitats may be particularly important for these breeding birds. Several species of hawks and falcons use upland shrublands and adjacent meadows for hunting. Rare butterflies such as Aphrodite fritillary,* dusted skipper,* Leonard's skipper,* and cobweb skipper* may occur where their host plants are present. Upland shrublands and other non-forested upland habitats may be used by turtles (e.g., Blanding's turtle,* painted turtle, wood turtle,* spotted turtle,* and eastern box turtle*) for nesting. A few species of rare plants are known from calcareous shrublands in the region, such as stiff-leaf goldenrod,* butterflyweed,* and shrubby St. Johnswort.*

Occurrence in the Town of Stanford

Upland shrublands were distributed widely throughout the Town of Stanford and ranged in size from 0.03 to 35 ac (0.01-14 ha), for a total of 795 ac (322 ha). The largest shrublands were groups of abandoned pastures, such as those just east of Willow Brook Road at the northern border of Stanford, and southeast of the intersection of Homan and Bowen roads.

Sensitivities/Impacts

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

UPLAND MEADOW (um)

Ecological Attributes

This broad category includes active cropland, hayfields, pastures, equestrian fields, mowed ornamental fields, and abandoned fields. Upland meadows are typically dominated by grasses and forbs; cover by shrubs is generally less than 20 percent. The ecological values of these habitats can differ widely according to the types of vegetation present and the kinds of disturbance (e.g., 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 these distinct types of meadow as a single habitat for practical reasons, but also because, after abandonment, these open areas tend to develop similar general habitat 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 both for present and potential future ecological values that we considered all types of meadow habitat to be ecologically significant.

Grassland-breeding birds, such as northern harrier,* upland sandpiper* grasshopper sparrow,* vesper sparrow,* Henslow's sparrow,* eastern meadowlark,* and bobolink,* 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. Upland meadows often have large populations of small mammals (e.g., meadow vole) and can be important hunting habitat for raptors, foxes, and coyote.

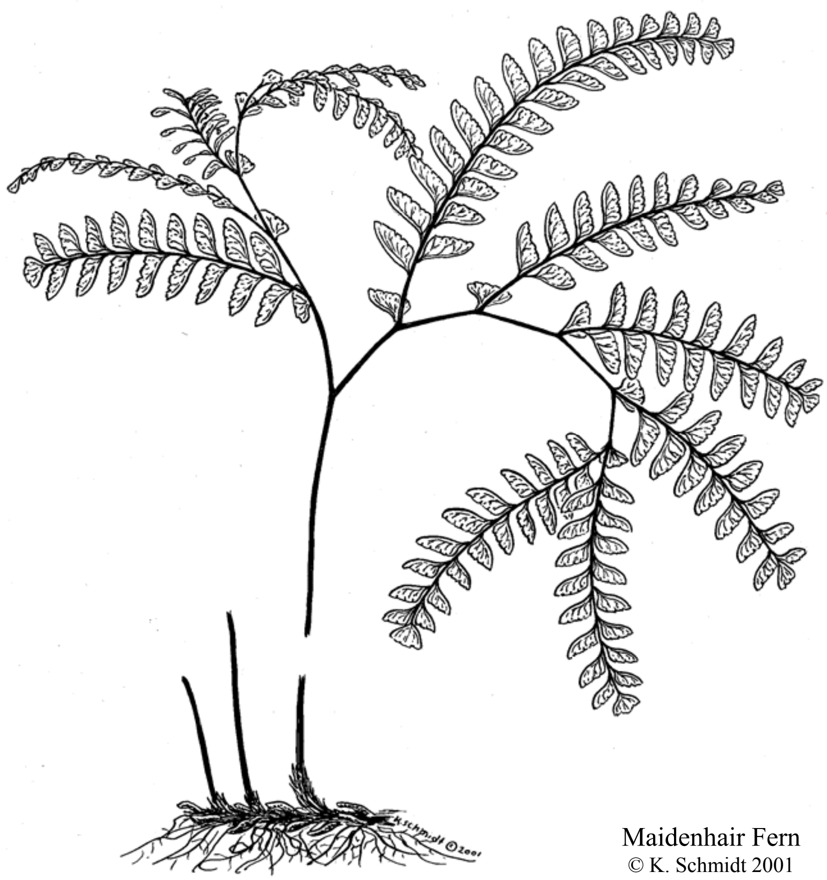
Occurrence in the Town of Stanford

Upland meadow was the second most common habitat type in the Town of Stanford, accounting for approximately 29% of the total land area. Figure 5 illustrates the location and distribution of contiguous meadow habitat in the town (including upland meadow, upland shrubland, and wet meadows), showing those areas that were <50, 50-100, and >100 ac (<20, 20-40, and >40 ha). The largest areas of open meadow are in the southwest quarter of Stanford. Other extensive upland meadows occur along eastern Hunns Lake Road and Carpenter Road, and in the Market Lane-Bulls Head Road area. Fences and hedgerows dividing fields can significantly alter the habitat value for many birds; if these arere treated as fragmenting features, then the largest meadows were 96 and 99 ac (39 and 40 ha; Fig 5). The most common kinds of upland meadow in the town were row crops, hayfields, pastures, and equestrian fields. Less intensively managed upland meadows were much less common.

Sensitivities/Impacts

Principle causes of meadow habitat loss are the intensification of agriculture, regrowth of forest after abandonment, and residential and commercial development (Askins 1993, Brennan and Kuvlesky 2003). The catastrophic decline of grassland-breeding birds in the Northeast has been attributed to the loss of large patches of suitable meadow habitat; many of these birds need large meadows undivided by fences and hedgerows, which can harbor predators (Wiens 1969). Another threat to upland meadow habitats is the soil compaction and erosion caused by ATVs, other vehicles, and equipment, which can reduce the habitat value for invertebrates, small mammals, nesting birds, and nesting turtles. Destruction of vegetation can reduce viable habitat for butterflies and rare plants, and mowing of upland meadows during the bird nesting season can cause extensive mortality of eggs, nestlings, and fledglings. Farmlands where pesticides are used have a reduced capacity to support biodiversity. The maintenance of high-quality meadow habitat often requires active management, and specific recommendations are listed on page 90.

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 valuable 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.



Maidenhair Fern
© K. Schmidt 2001

CREST/LEDGE/TALUS

Ecological Attributes

Rocky crest, ledge, and talus habitats often (but not always) occur together, so are described together here. Crest and ledge habitats occur where soils are very shallow and bedrock is partially exposed at the ground surface. They can occur at any elevation, but may be most familiar on hillsides and hilltops in the region. Talus is the term for the fields of rock fragments of various sizes that often accumulate at the bases of steep ledges and cliffs. We also included large glacial erratics (glacially-deposited boulders) in this habitat type. Some crest, ledge, and talus habitats support well-developed forests, while others have only sparse, patchy, and stunted vegetation. Oak-heath barren (see below) is a special kind of crest habitat with special biodiversity value, usually occurring in association with other crest and ledge habitats. 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,* smooth 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 plant species, such as walking fern,* yellow harlequin,* and Carolina whitlow-grass.* Non-calcareous crests often have trees such as red oak, chestnut oak, eastern hemlock, and occasionally pitch pine; shrubs such as low blueberries, chokeberries, and scrub oak; and herbs such as Pennsylvania sedge, little bluestem, hairgrass, bristly sarsaparilla, and rock polypody. Rare plants of non-calcareous crests include mountain spleenwort,* clustered sedge,* and slender knotweed.*

Breeding birds of crest habitats include blackburnian warbler,* worm-eating warbler,* and cerulean warbler.* Golden eagle overwinters regularly on Stissing Mountain. Habitats with larger fissures, cavities, and exposed ledges may provide shelter, den, and basking habitat for eastern hognose snake,* worm snake,* and northern copperhead. Northern hairstreak* (butterfly) occurs with oak species, its larval host plants, and olive hairstreak* occurs on crests with its host eastern red cedar. Five-lined skink* uses rocky ledges for shelter and basking. Bobcat* and fisher* use high-elevation crests and ledges for travel, hunting, and cover. Slimy salamander* occurs in non-calcareous wooded talus, and bobcat uses talus habitats for denning.

Occurrence in the Town of Stanford

Crest, ledge, and talus habitats occurred throughout the town. Extensive areas were found on the east and west slopes of Stissing Mountain, between Route 82 and Hunns Lake Road, and in the southwest part of the town. Large areas of calcareous crest occurred north of Homan Road, between Route 82 and Hunns Lake Road, and just west of Stissing Mountain. We found colonies of walking fern in at least five locations. The Rocky Reef, a ridge of exposed rock in Audubon New York's Buttercup Farm Sanctuary, is a noteworthy example of calcareous crest and ledge habitat in Stanford. Set within upland hardwood forest, the Rocky Reef's exposed rock provides habitat for the rare ferns wall-rue and smooth cliffbrake,* as well as many other calcicoles.

Sensitivities/Impacts

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 and 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.

OAK-HEATH BARREN (ohb)

Ecological Attributes

A special subset of rocky crest habitat (see above), oak-heath barren occurs on hilltops and shoulders with exposed noncalcareous bedrock, shallow, acidic soils, and vegetation dominated by some combination of pitch pine, scrub oak, other oaks, and heath (Ericaceae) shrubs. Schist, gneiss, and quartzite are among the common types of exposed bedrock. The soils are extremely thin, excessively well drained, and very nutrient poor. Due to the open canopy, oak-heath barrens tend to have a much warmer microclimate than the surrounding forested habitat, especially in the spring and fall. The exposed nature of these habitats also makes them particularly susceptible to wind, ice, and, at least historically, fire disturbance. The droughty, infertile, and exposed conditions have a strong influence on the composition and structure of the plant community; trees are often sparse and stunted. Our definition corresponds to Edinger et al.'s (2002) "pitch pine-oak forest" and "pitch pine-oak-heath rocky summit." There may be a continuous canopy of pitch pine or pitch pine-oak with a scrub oak understory, or the shrub layer (predominately scrub oak and heath shrubs) may dominate, with only scattered pines. Dominant trees include pitch pine, chestnut oak, red oak, and scarlet oak; the shrub layer may include scrub oak, eastern red cedar, blueberry, black huckleberry, and sweetfern. Common herbs include Pennsylvania sedge, poverty-grass, common hairgrass, and bracken, and lichens and mosses are sometimes abundant.

Oak-heath barrens can have significant habitat value for timber rattlesnake* and northern copperhead.* Deep rock fissures can provide crucial shelter habitat for these species and the exposed ledges provide basking and breeding habitat in the spring and early summer. The rare five-lined skink* uses oak-heath barrens and other crest, ledge, and talus habitats for hibernation, basking, breeding, and foraging. Birds of this habitat include common yellowthroat, Nashville warbler, prairie warbler,* field sparrow,* eastern towhee,* and whip-poor-will.* A number of rare butterflies that use scrub oak, little bluestem, lowbush blueberry, or pitch pine as their primary food plant tend to concentrate in barrens habitats, including northern hairstreak,* Edward's hairstreak,* Horace's duskywing,* cobweb skipper,* dusted skipper,* Leonard's skipper,* brown elfin,* and eastern pine elfin.* Oak-heath barrens also appear to be refuges for several rare oak-dependent moths. Rare plants of oak-heath barrens include reflexed sedge,* clustered sedge,* mountain spleenwort,* and dittany.*

Occurrence in the Town of Stanford

Stissing Mountain has several areas of oak-heath barren on its western slopes, the largest of which is 6.6 ac (2.7 ha). The only other mapped occurrence was in the southwest corner of Stanford, reported to us by Ginger Hagan of the Dutchess Land Conservancy.

Sensitivities/Impacts

Oak-heath barren habitats are often used by humans as scenic overlooks and some of the more disturbed areas contain campsites, foot paths, ATV trails, and garbage. Trampling, soil compaction, and soil erosion can damage or eliminate rare plants, discourage use by rare animals, and encourage invasions of non-native plants. Barrens on hilltops can be disturbed or destroyed by the construction and maintenance of communication towers. Construction of roads and houses in the low-lying valleys between oak-heath barrens can fragment important migration corridors for snakes, lizards, and butterflies, thereby isolating neighboring populations and decreasing their long-term viability. Because rare snakes tend to congregate on oak-heath barrens at certain times of the year, they are also highly susceptible to killing or collecting by poachers.

ORCHARD/PLANTATION (or/pl)

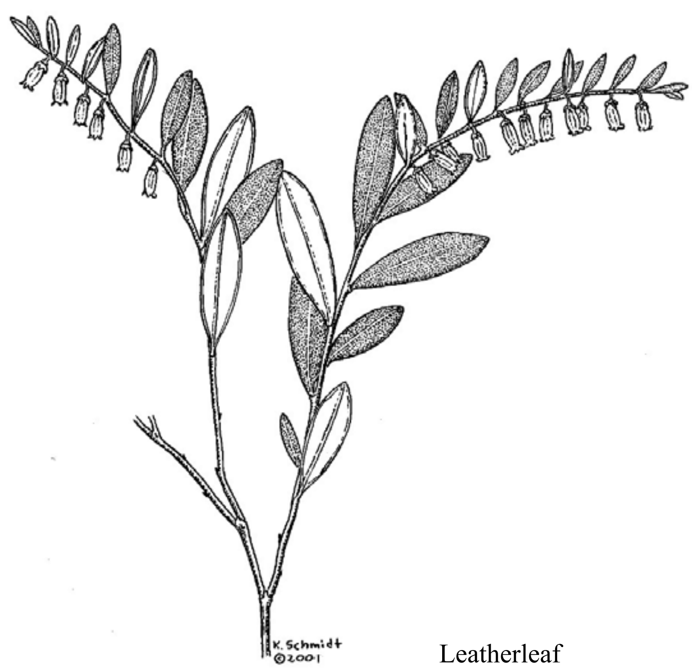
This habitat type includes actively maintained or recently abandoned fruit orchards and Christmas tree farms. Conifer plantations with larger, older trees were mapped as "upland conifer forest." Christmas tree farms are potential northern harrier* breeding habitat, and fruit orchards with old trees are potential breeding habitat for eastern bluebird* and may be valuable to other cavity-using birds, bats, and other animals. However, we mapped orchard/plantation as an ecologically significant habitat type more for its future ecological value after abandonment than its current value, which is often compromised by frequent mowing, application of pesticides, and other human activities. These habitats have some of the vegetation structure and ecological values of upland meadows and upland shrublands, and will ordinarily develop into young forests if left alone after abandonment. In the Town of Stanford, all orchard/plantation areas were small (less than 3 ha [7.5 ac]). Most were Christmas tree plantations, conifer windbreaks (shelter belts), and private fruit orchards; one was an American chestnut cultivation project. There were relatively few active fruit orchards in the Town of Stanford. Abandoned apple orchards that had lost their ordered structure were mapped either as upland hardwood forest or as upland shrubland depending on their character.

CULTURAL (c)

We define cultural habitats as areas that are significantly altered and intensively managed (e.g., mowed), but are not otherwise developed with pavement or structures. In the Town of Stanford, cultural habitats included gardens, golf courses, playing fields, riding rings, cemeteries, and lawns. Like orchards and plantations, we mapped this as an ecologically significant habitat type for its potential future ecological value rather than its current value, which is reduced by frequent mowing, application of pesticides, or other types of management. Nonetheless, eastern screech owl* and barn owl* are known to nest and roost in cultural areas. Ornamental trees can provide microhabitats for bats (including Indiana bat*), cavity-nesting birds, and other animals. 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 cultural habitats 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 is a botanists' term for land that has been severely altered by previous or current human activity, but lacks pavement or structures. This category encompasses a variety of highly impacted areas such as active and abandoned gravel mines, rock quarries, mine tailings, dumps, wetland fill, landfill cover, 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. Although waste ground often has low habitat value, there are notable exceptions. Several snake and turtle species of conservation concern, including eastern hognose snake,* Blanding's turtle,* and wood turtle,* may use the open, gravelly areas of waste grounds for burrowing, foraging, or nesting habitat. Several rare plant species are also known to inhabit waste ground environments, including rattlebox,* slender pinweed,* and slender knotweed.* Rare lichens may potentially occur in some waste ground habitats. The biodiversity value of waste ground will often increase over time as it develops into a higher quality habitat. However, on sites where species of conservation concern are absent or unlikely, it is usually preferable to site new development in these areas instead of in relatively unaltered habitats



Leatherleaf

WETLAND HABITATS

SWAMPS

Ecological Attributes

A swamp is a wetland dominated by woody vegetation. We mapped three general types of swamp habitat in the Town of Stanford: hardwood and shrub swamp, conifer swamp, and mixed swamp.

Hardwood and Shrub Swamp (hs)

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

Swamps are important to a wide variety of birds, mammals, amphibians, reptiles, and invertebrates, especially when swamp habitats are contiguous with other wetland types or embedded within large areas of upland forest. Red-shouldered hawk,* barred owl,* great blue heron,* wood duck,* prothonotary warbler,* Canada warbler,* and white-eyed vireo* potentially nest in hardwood swamps. Pools within swamps are used by several breeding amphibian species, including the blue-spotted salamander.* 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 from only five or six locations in the Hudson Valley. Hardwood and shrub swamps along the floodplains of clear, low-gradient streams can be an important habitat component for wood turtle.* Other turtles such as Blanding's turtle,* spotted turtle,* and box turtle* frequently use swamps for summer foraging and winter hibernation. Swamps in low-lying valleys are often heavily used as travel corridors by these turtles as they move among upland nesting areas, drought refuge pools, summer foraging wetlands, and overwintering wetlands.

Conifer Swamp (cs)

Conifer swamp is a special type of forested swamp (see above) where conifer species occupy 75 percent or more of the upper tree canopy. The dense canopy has a strong influence on the plant community and habitat structure of these swamps. The shrub and herbaceous layers are typically sparse and low in species diversity. Shading also creates a cooler microclimate, thereby allowing snow and ice to persist longer into the early spring growing season. Conifers growing in wetlands frequently have very shallow root systems and are therefore prone to windthrow. The resulting tip-up mounds, root pits, and coarse woody debris all contribute to the habitat's complex structure and microtopography.

Mixed Forest Swamp (ms)

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

Occurrence in the Town of Stanford

Hardwood and shrub swamp is by far the most extensive wetland habitat type in the Town of Stanford (Fig. 7), with a total of 2,057 ac (832 ha). Swamps ranged in size from <1 to 84 ac (<0.4 to 34 ha), with an average extent of 2.5 ac (1 ha), and they were often contiguous with other wetland habitats such as marsh, wet meadow, and open water (including beaver ponds). Large swamps are located in the Wappinger Creek watershed, west of the intersection of Market and Bulls Head roads, and east of Ludlow Woods Road, among other areas. Small swamps are widely scattered throughout the town. We encountered only two small conifer swamps and nine mixed forest swamps. Most of these were on or near Stissing Mountain, where large patches of mixed forest occurred.

Swamps occurred in a variety of settings, such as on seepy slopes, along streams, and in depressions. Some were shrub-dominated (native or exotic); others had a full canopy of maple and ash. Water depth ranged from a centimeter or two up to a meter or more. Some swamps, because of their isolation from streams and other wetlands, may have ecological roles similar to those of intermittent woodland pools, providing a seasonal source of water with fewer aquatic predators, breeding habitat for amphibians, and refuge for turtles. During fieldwork, we identified several calcareous swamps, and in one of these we found phantom cranefly,* an uncommon insect that seems to be associated mainly with calcareous environments (Kiviat and Stevens 2001); we also encountered this species in wet meadows, a calcareous wet meadow, a calcareous marsh, and a non-calcareous swamp.

Of particular interest to us were the swamps with deep water, a significant shrub layer dominated by swamp azalea and highbush blueberry, and high plant diversity. Often these "heath swamps" were calcareous, supporting plants such as buttonbush, poison sumac, and *Riccia fluitans* (an aquatic liverwort). Heath swamps were often in depressions isolated from other wetlands, and they appeared to be excellent habitat for uncommon plants, pool-breeding amphibians, and other rare species. 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 buttonbush pools such as Blanding's turtle* and spotted turtle.* We marked these heath swamps on the map when we had sufficient information on vegetation and structure. However, they should be interpreted as examples of this habitat rather than a complete survey; there are probably many more heath swamps in the town that we did not visit.

Sensitivities/Impacts

Swamps are threatened by a variety of land uses. Small swamps embedded in upland forest are often overlooked in wetland protection, although these can have extremely high biodiversity value, and similar ecological roles to those of intermittent woodland pools (see page 59). Many of the larger swamps are located in low-elevation areas where human land uses are also concentrated. These are often surrounded by 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 the ecological condition of the swamp and associated streams, and the quality of drinking water if the swamp is connected to a public water supply. 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. Ponds for ornamental or other purposes are sometimes excavated in swamps, but the loss of habitat values of the pre-existing swamp far outweighs any habitat value gained in the new artificial pond environment

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. We found two swamps in Stanford with dead trees in which great blue heron had built nests over open water. One of these swamps is located in the Stissing Mountain Multiple Use Area and the other is on private property adjacent to the Multiple Use Area. Another has been reported on the border between Mashomack Preserve and Buttercup Farm Sanctuary west of Route 82. Any swamps with great blue heron rookeries that are on unprotected lands should be considered priority conservation areas.

MARSH (ma)

Ecological Attributes

A marsh is a wetland that has standing water for most or all of the growing season and is dominated by herbaceous (non-woody) vegetation that is submergent, floating, or emergent above the water surface. 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 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 emergent marsh plants in this region. Deeper water may have floating-leaved plants such as pond-lilies, or submergent aquatic plants such as pondweeds, bladderworts, and watermilfoils.

Marshes are important nesting and nursery habitats for numerous bird species, such as marsh wren,* common moorhen,* American bittern,* least bittern,* great blue heron,* Virginia rail,* king 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 marshes in the region, including spiny coontail* and buttonbush dodder.*

Occurrence in the Town of Stanford

We mapped 109 marshes in the Town of Stanford, covering a total of 172 ac (70 ha). Marshes in the Town of Stanford 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 or wet meadow on aerial photographs, all mapped marsh boundaries should be considered approximate. Most of the marshes we observed in the field were dominated by purple loosestrife and cattail and many were influenced by beaver activity. In some cases we mapped areas of open water within marshes as a distinct habitat (see "open water" below). In areas where beavers are active, the location and extent of open water areas likely changes from year to year. Most of the mapped marshes within the town were small (< 3 ac [1.2 ha]). Some of these were constructed ponds that had filled with sediment and vegetation over time. The largest marsh areas were located in the Wappinger Creek watershed along the Stanford-Pine Plains border and in the northernmost part of Millbrook Marsh in the southeast corner of the town. Many marshes also occurred along Willow Brook.

Sensitivities/Impacts

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 carries 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 Stanford. 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. Its period of inundation is longer than that of an upland meadow, but shorter than that of a marsh. Some wet meadows are dominated by purple loosestrife, common reed, reed canary-grass, or tussock sedge, while others have a diverse mixture of wetland grasses, sedges, forbs, and scattered shrubs. Bluejoint, mannagrasses, woolgrass, soft rush, blue flag, sensitive fern, and marsh fern are some typical plants of wet meadows.

Wet meadows 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. 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 meadow habitats for foraging.

Occurrence in the Town of Stanford

Wet meadows were widely distributed throughout the Town of Stanford 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. We mapped almost 600 wet meadows, for a total of 333 ac (135 ha) in the town. Most wet meadows were small, averaging 0.6 ac (0.2 ha). The largest wet meadows occurred along Pugsley Hill Road, Carpenter Hill Road, and around the northern and southern ends of Market Lane.

Sensitivities/Impacts

Some wet meadows are able to withstand light grazing by livestock, but heavy grazing can destroy the structure of the surface soils, eliminate sensitive plant species, and invite non-native weeds. Mowing often causes similar negative consequences; see page 90 for general recommendations about mowing practices. It is less damaging to the plant community to mow when soils are dry, e.g., in late summer. Wet meadows are often part of larger complexes of meadow and shrubland 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 environmental reviews of development proposals. Wet meadows should be accurately delineated onsite and mapped, and should be regarded as potentially important habitats during the environmental review process.

CALCAREOUS WET MEADOW (cwm)

Ecological Attributes

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

Many common wetland animals use 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.* Ribbon snake* and spotted turtle* also use calcareous wet meadows for basking and foraging. Bog turtles* use calcareous wet meadows that are adjacent to fens for summer foraging and even nesting habitat.

Occurrence in the Town of Stanford

We documented over 50 calcareous wet meadows in the Town of Stanford (Fig. 8), totaling 62 ac (25 ha). The largest of these was 11 ac (4.6 ha), but most were less than 2 ac (0.7 ha). Calcareous wet meadows cannot be distinguished from ordinary wet meadows by remote sensing because 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 Stanford were contiguous with swamps, upland meadows, or fens.

Sensitivities/Impacts

Calcareous wet meadows possess similar sensitivities to disturbance as other wet meadows (see above) as well as fens (see below). They are particularly vulnerable to nutrient enrichment and siltation, which often facilitate the spread of invasive species. Like other small wetland habitats they are often omitted from wetland maps and consequently 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. Therefore, we recommend that calcareous wet meadows near suitable fens be treated as potential bog turtle habitat and given the same level of protection as fens.

FEN (f)

Ecological Attributes

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

Fen is a rare habitat type because of the limited distribution of carbonate bedrock, soils, and groundwater seepage, as well as the historic alteration of wetlands. Fens support many species of conservation concern, including rare plants, invertebrates, reptiles, and breeding birds. They comprise the core habitat for the endangered bog turtle* in southeastern New York. Fens are also used by other reptiles of conservation concern such as the spotted turtle* and ribbon snake.* The rare sedge wren* nests almost exclusively in shallow, sedge-dominated wetlands like fens. Large open fens, especially those associated with extensive meadow complexes, can also be important hunting grounds and potential nesting areas for northern harrier.* Rare butterflies such as Dion skipper* and black dash,* as well as rare dragonflies such as forcipate emerald* and Kennedy's emerald,* are largely restricted to fen habitats. More than 12 plant species of conservation concern are found almost exclusively in fen habitats, including handsome sedge,* Schweinitz's sedge,* ovate spikerush,* bog valerian,* scarlet Indian paintbrush,* spreading globeflower,* and swamp birch.*

Occurrence in the Town of Stanford

We mapped 22 fens in the Town of Stanford (Fig. 8). Most were less than 1 ac (0.4 ha), and the largest was 4 ac (1.6 ha). Most fens were concentrated in the Wappinger Creek valley south of Stissing Mountain, and in the Wassaic Creek drainage in the southeast part of town. Most 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. 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.

Sensitivities/Impacts

Fens are highly vulnerable to degradation from activities in nearby upland areas. Nutrient pollution from septic systems, fertilizers, or road runoff, disruption of groundwater flow from wells or excavation, sedimentation from construction activity, or direct physical disturbance can lead to changes in the character of the habitat, including a significant decline in overall plant diversity and invasion by non-native species and tall shrubs (Aerts and Berendse 1988, Panno et al. 1999, Richburg et al. 2001, Drexler and Bedford 2002). Such changes can render the habitat unsuitable for the bog turtle and other fen animals and plants that require the special structural, chemical, or hydrological environment of an intact fen. It is likely that the fen habitats in the Town of Stanford have deteriorated due to many of these factors. Conservation of fens therefore requires attention not only to the fen itself, but also to surrounding land uses. Because many of the highest quality fen complexes in the Town of Stanford cross multiple privately owned parcels, fen conservation also requires coordinating across property boundaries.

INTERMITTENT WOODLAND POOL (iwp)

Ecological Attributes

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

Intermittent 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, 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, common yellowthroat, and northern waterthrush.* Springtime physa,* is a regionally rare snail associated with intermittent woodland pools. Large and small mammals use these pools for foraging and water sources. Featherfoil,* a NYS Threatened plant, occurs in intermittent woodland pools in the lower Hudson Valley.

Occurrence in the Town of Stanford

We mapped 125 intermittent woodland pools in the Town of Stanford (Fig. 9). Pools were distributed widely, and all but one were smaller than 1 acre (0.4 ha), with an average size of 0.2 ac (0.06 ha). One notable concentration of pools occurred north of Homan Road, extending to north of Shelly Hill Road. Because these pools are small and often difficult to identify from aerial photographs, we expect there are other intermittent woodland pools that we missed.

Sensitivities/Impacts

We consider intermittent woodland pools to be one of the most imperiled habitats in the region. Although they are widely distributed, the pools are small (often less than 0.1 ac [0.04 ha]) and their ecological importance is often undervalued. They are frequently drained or filled by landowners and developers and overlooked in environmental reviews of proposed developments. Some have been 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, that make woodland pools uniquely suited to species that do not reproduce or compete successfully in most larger wetland systems.

BUTTONBUSH POOL (bp)

Ecological Attributes

A buttonbush pool is a seasonally or permanently flooded, shrub-dominated pool, with buttonbush normally the dominant plant. Other shrubs such as highbush blueberry, swamp azalea, and willows may also be abundant and buttonbush may be absent (buttonbush seems to appear and disappear over the years in a given location). In some cases, a shrub thicket in the middle of the pool is entirely or partly surrounded by an open water moat. The buttonbush pool may have some small trees such as red maple or green ash in the pool interior, but usually lacks a forest canopy. Buttonbush 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 kettle shrub pool, a specific type of buttonbush pool, has all the previous characteristics but is 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. Hudsonia has found two state-listed rare plants (spiny coontail* and buttonbush dodder*) and three regionally-rare plants (the moss *Helodium paludosum*,* short-awn foxtail,* and pale alkali-grass*) in kettle shrub pools in nearby towns. Kettle shrub pools are used by spotted turtle,* wood duck,* mallard, and American black duck,* and are the primary core habitat of the Blanding's turtle,* a Threatened species in New York. Because buttonbush pools have many of the same characteristics as kettle shrub pools, including open water, vegetation dominated by buttonbush and other shrubs, and no canopy, they have the potential to support many of these rare species as well. Buttonbush pools also have many of the habitat attributes of intermittent woodland pools, and are used by many intermittent woodland pool species.

Occurrence in the Town of Stanford

We documented 24 buttonbush-dominated pools and swamps in the Town of Stanford. Because all pools were more than 492 ft (150 m) away from mapped glacial outwash soils, we classified none as kettle shrub pools. Buttonbush pools were defined by having the following structural and vegetation characteristics: a semi-round or oblong basin containing open, fairly deep water either surrounding (moat) or surrounded by shrubs (pool), including a large percentage of buttonbush. We mapped 17 of these wetlands as buttonbush pools, three as intermittent woodland pools, and four as heath swamp (a special type of hardwood and shrub swamp, described above and noted in Fig. 7. Buttonbush pools were widely distributed in Stanford (Fig. 10), with two notable concentrations: in the Homan-Bowen Road area (see page 116), and east of Cold Spring Road in the Stissing Mountain area.

Sensitivities/Impacts

Buttonbush pools may be particularly sensitive to changes in hydrology. Groundwater extraction in the vicinity could alter the pool's hydroperiod and water depth; and altering surface water entering or leaving the pool can drastically change its character. These pools are also sensitive to changes in water chemistry; inputs from roads, agricultural fields, lawns, and construction sites all negatively affect water quality. To provide high-quality winter and spring habitat for Blanding's turtle, a pool must retain an undisturbed bottom of deep organic muck. Development and habitat fragmentation threaten the habitat connections between buttonbush pools and other wetland and upland habitats. Like intermittent woodland pools, buttonbush pools are frequently excavated for ornamental ponds and overlooked in environmental reviews of proposed developments. More information about this habitat is in Kiviat (1993), Kiviat and Stevens (2001; under "Kettle Shrub Pool" and "Blanding's Turtle"), and Kiviat and Stevens (2003).

CIRCUMNEUTRAL BOG LAKE (cbl)

Ecological Attributes

A circumneutral bog lake is a spring-fed, calcareous water body that commonly supports vegetation of both acidic bogs and calcareous marshes. The bottom is a deep organic layer, and floating peat rafts are often present. Open water is often covered with pond-lilies; peat rafts and shoreline areas may support cattails, purple loosestrife, water-willow, alder, or leatherleaf. This is a rare habitat type in the 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,* spotted turtle,* ribbon snake,* blue-spotted salamander,* river otter,* and marsh wren.* These habitats have also been found to support diverse communities of mollusks, dragonflies, and damselflies.

Occurrence in the Town of Stanford

We identified two circumneutral bog lakes in the Town of Stanford: Ryder Pond and Shaw Pond (Fig. 8). We did not field check all water bodies in the town, however, so other such lakes may be present. Ryder Pond measured approximately 42 ac (17 ha), and Shaw Pond was 29 ac (12 ha). Ryder Pond was surrounded by cattail, purple loosestrife, and shrubs, including alder, buttonbush, leatherleaf, and red osier dogwood. Peat rafts and abundant pond-lilies were present. Pied-billed grebe, king rail,* American bittern,* and breeding wood duck* have been reported from this lake, and it has also been influenced by past beaver activity. Shaw Pond was ringed by a diverse shrub swamp with swamp azalea, high blueberry, winterberry holly, tussock sedge, and scattered buttonbush and leatherleaf. Open water was dominated by pond-lilies. We visited too late in the season (late October) to observe floating peat rafts, which may have been present earlier. We observed wood duck,* mallard, red-shouldered hawk,* and sharp-shinned hawk.*

Sensitivities/Impacts

Circumneutral bog lakes are often used for activities such as boating, fishing, or hiking. Any recreational use can be a source of garbage and toxins, and motorized boats can be very destructive to organisms and their habitats. We believe that circumneutral bog lakes are extremely sensitive to changes in surface and groundwater chemistry and flows, and could be affected by any significant alterations to the watershed such as tree removal, soil disturbance, applications of fertilizers or pesticides, groundwater extraction, or altered drainage. Mechanical disturbance or changes in surface water levels or chemistry could disrupt the floating vegetation mats. Maintaining a forested buffer around the lake is critical for preserving habitat quality. If land use changes are proposed in the vicinity of a circumneutral bog lake, 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. Information about a circumneutral bog lake in the Town of Pine Plains is in Busch (1976).

OPEN WATER (ow)

Ecological Attributes

Open water habitats include natural ponds and lakes, substantially unvegetated pools within marshes and swamps, and ponds that may have originally been constructed but have since reverted to a more natural state (e.g., surrounded by unmanaged vegetation). Open water areas are important habitat for many common species, including invertebrates, fishes, frogs, turtles, waterfowl, muskrat, beaver, and bats. 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. 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 that can provide important habitat for aquatic invertebrates and fish.

Occurrence in the Town of Stanford

Natural open water areas are far less common than constructed ponds (see below) in the Town of Stanford. Of the 45 open water habitats we mapped, all were smaller than 2.5 ac (1 ha). The three largest open water areas were: a woodland pond that appeared natural, a beaver-flooded area of marsh, and an old constructed pond surrounded by forest and fen. At least five of the open water areas we mapped were created by beaver activity. Areas of open water within beaver wetlands are dynamic habitats that increase or decrease in size depending on the degree of beaver activity, and these areas are often transitional to emergent marshes or wet meadows. Most of the open water habitats in the town were mapped from aerial photographs. During fieldwork, 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."

Sensitivities/Impacts

The habitat value of natural open water areas can be greater than that of constructed ponds if they are less intensively managed, less disturbed by human activities, and surrounded by undeveloped land. Open water habitats are, however, vulnerable to human impacts, such as shoreline development, aquatic weed control, and runoff from roads, lawns, and agricultural areas. Aquatic weed control, which may include use of herbicides, harvesting, or grass carp, is an especially important concern in open water habitats, and the potential negative impacts should be assessed carefully before any such activities are undertaken (Heady and Kiviat 2000). Because they are often located within larger wetland and stream complexes, any disturbance to the open water habitat may also have 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. This can be accomplished by harvesting aquatic vegetation only where necessary to create open lanes or pools for boating, fishing, or swimming.

CONSTRUCTED POND (cp)

Ecological Attributes

Constructed ponds include those water bodies that have been excavated or dammed by humans, either in existing wetlands or stream beds, or in upland terrain. These ponds are deliberately created for such purposes as fishing, watering livestock, irrigation, swimming, boating, and aesthetics. Some ponds are constructed near houses to serve as a source of water in the event of a house fire. We also included the water bodies created during mining operations in the constructed pond category. 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 Stanford

The majority of the open water bodies we mapped in the Town of Stanford were constructed ponds. Most of these were apparently maintained for ornamental purposes and were located within landscaped areas in close proximity to residences. Many others were used for livestock, some were lakes surrounded by residential development, and a few were located in gravel mines. Overall, we mapped over 400 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 15 of the constructed ponds we mapped were smaller than 5 ac (2 ha). The largest constructed ponds were Bontecou Lake (118 ac [47 ha]), Hunns Lake (67 ac [27 ha]), and Upton Lake (46 ac [19 ha]). Hunns Lake and Upton Lake are both surrounded by residential development and are used for recreation. Bontecou Lake, which straddles the Washington/Stanford town boundary, was a large tamarack swamp with a central bog lake prior to flooding in 1956. 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 livestock. Constructed ponds with substantial cover of floating-leaved or emergent vegetation (e.g., pondweeds, duckweeds, cattail, purple loosestrife, common reed) were mapped as "marsh."

Sensitivities/Impacts

The habitat value of constructed ponds varies depending on the landscape context and the extent of human disturbance. In general, the habitat value 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 sufficient natural vegetation and soil, they are vulnerable to the adverse impacts of agricultural runoff, septic leachate, and pesticide or fertilizer runoff from private yards. We expect that many of those maintained as ornamental ponds are treated with herbicides and perhaps other toxins, or contain introduced fish such as grass carp. 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 value gained 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. Springs and seeps help maintain the cool temperature of many streams, an important habitat characteristic for some of our rare and declining fish species; they also serve as water sources for animals during droughts, and during winter when these habitats may remain free of ice.

Very little is known, or at least published, on the ecology of seeps in the Northeast. Golden saxifrage is a plant more-or-less restricted to springs and groundwater-fed wetlands and streams. A few rare invertebrates are restricted to springs in the region. 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.

Occurrence in the Town of Stanford

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 Stanford that we did not map. More detailed inventories of seeps and springs should be conducted as needed on a site-by-site basis.

Sensitivities/Impacts

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

STREAMS & RIPARIAN CORRIDORS

Ecological Attributes

Perennial streams flow continuously throughout years with normal precipitation, but some may dry up during droughts. Perennial streams provide essential water sources for wildlife throughout the year, and are critical habitat for many vertebrate and invertebrate species. We loosely define “riparian corridor” as the zone along a perennial stream that includes the stream banks, the floodplain, and adjacent steep slopes. Although we did not delineate riparian zones on the Town of Stanford habitat map, it is such an important part of the ecological landscape that we are including it in this report in the hope that town officials and residents will consider it as a critical factor when undertaking land-use planning or reviewing development proposals. We did map buffers of a set width on either side of streams (Fig. 11), as a conservation zone to protect the water quality and wildlife of streams. These do not necessarily cover the whole riparian corridor for any stream, however, which varies in width depending on local topography and the size of the stream's catchment area.

Riparian zones tend to have high species diversity and high biological productivity, and most fish and wildlife depend upon riparian habitats in some way for their survival (Hubbard 1977, McCormick 1978). Perennial streams and their riparian zones provide nesting or foraging habitat for many species of birds, such as spotted sandpiper, belted kingfisher, tree swallow, bank swallow, Louisiana waterthrush, great blue heron* and green heron. Red-shouldered hawk,* willow flycatcher, and cerulean warbler* nest in areas with extensive riparian forests, especially those with mature trees. Bats, including Indiana bat,* use perennial stream corridors for foraging. Wood turtle* uses perennial streams with pools and recumbent logs, undercut banks, and muskrat or beaver burrows. The fish and aquatic invertebrate communities of perennial streams may be diverse, especially in clean-water streams with unsilted bottoms. Brook trout* and slimy sculpin* are two native fish species that require clear, cool streams for successful spawning. Wild brook trout, however, are now confined largely to small headwater streams in the region, due to degraded water quality and competition from brown trout, a non-native species stocked in many streams by the New York State Department of Environmental Conservation and by private groups. Muskrat, beaver, mink, and river otter* are some of the mammals that use riparian corridors regularly. We know of many rare plants of riparian zones, such as cattail sedge,* Davis' sedge,* and goldenseal.*

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 (Lowe and Likens 2005). Although intermittent streams have been little studied by biologists, they have nonetheless been found to support rich aquatic invertebrate communities, including regionally rare mollusks (Gremaud 1977) and dragonflies. Both perennial and intermittent streams provide breeding, larval, and adult habitat for northern dusky salamander* and northern two-lined salamander. The forests and sometimes the meadows adjacent to streams provide foraging habitats for adults and juveniles of these species.

Occurrence in the Town of Stanford

Perennial streams and their riparian corridors are distributed widely throughout the Town of Stanford. The largest is Wappinger Creek, with its major tributaries Cold Spring Creek, Willow Brook, and Hunns Lake Creek. Intermittent streams are most common in the more hilly terrain on the eastern and western edges of the town (Fig. 11).

Sensitivities/Impacts

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*

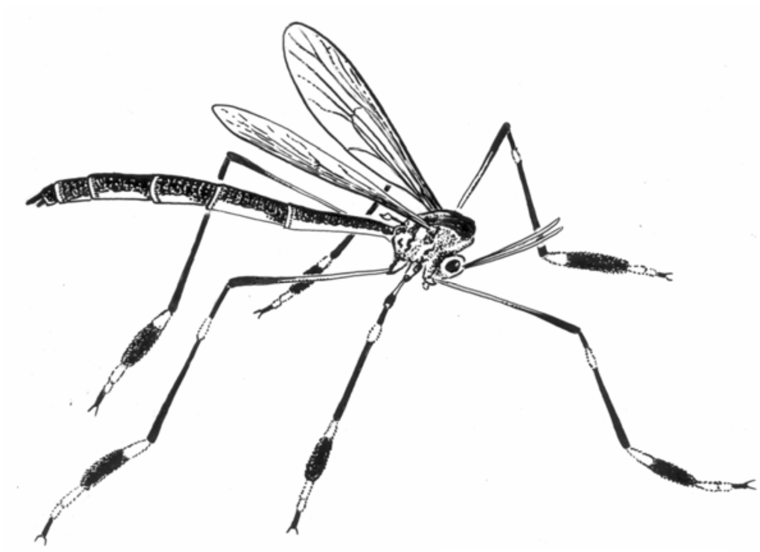
and maintenance of viable functioning communities of native stream organisms is a realistic objective."

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. 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. Hardening of the streambanks with concrete, riprap, gabions, or other materials reduces the biological and physical interactions between the stream and floodplain, and tends to be harmful both to stream and floodplain habitats. Removal of snags from the streambed degrades habitat for fishes, turtles, snakes, birds, muskrats, and their food organisms. Stream corridors with road crossings or other soil disturbance are especially prone to invasion by Japanese knotweed, an introduced plant that is spreading in the Hudson Valley (Talmage and Kiviat 2004).

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. 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.



Phantom Cranefly
(K. Schmidt © 2001)

Fig. 11 (streams)

CONSERVATION PRIORITIES IN STANFORD

PLANNING FOR BIODIVERSITY

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 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.

Because biological communities, habitats, and ecosystems do not respect property boundaries, the best approach to biodiversity conservation is from the perspective of whole landscapes. The Town of Stanford habitat map facilitates this approach by illustrating the location and configuration of 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. In the following pages, we outline recommendations for: 1) using the map to identify priorities for town-wide conservation and land use planning; 2) using the map as a resource for reviewing site-specific land use proposals; and 3) developing general strategies for achieving conservation goals.

Using the Habitat Map for Town-wide Conservation Planning

The Town of Stanford habitat map is useful for visualizing the sizes of habitat units, the degree of connectivity between habitats, and the juxtaposition of habitats in the landscape, all of which have important implications for regional biodiversity. 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, unbroken blocks of 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. Habitat fragmentation is among the primary threats to global biodiversity (Davies et al. 2001). Habitat patches surrounded by human development function as islands, and species unable to move between habitats are vulnerable to genetic isolation and possible extinction over the long term. Landscapes with interconnected networks of unfragmented habitat, on the other hand, are more likely to support a broad diversity of native species and the ecological processes and disturbance regimes that maintain those species. The Town of Stanford still contains many large habitat patches (see Figure 3), and careful siting of new development can preserve these patches and maintain corridors between them.

The habitat map can also be used to locate priority habitats for conservation (see page 85), those that are rare or support rare species, or that otherwise are particularly important to regional biodiversity. For instance, the fens and buttonbush pools in Stanford may support some of the few remaining populations of bog turtle* and Blanding's turtle* in the Hudson Valley. The two circumneutral bog lakes are likely the only places in Stanford that northern cricket frog* could breed successfully. Figures 6 through 11 illustrate the areas we have identified as priority habitats and the conservation zones associated with them. These habitats are especially valuable if they are located within larger areas of intact and connected habitat.

Finally, this report identifies several Priority Conservation Areas (Fig. 12; pages 115-118). Each of these contain several priority habitats in a relatively unfragmented landscape, and would be good places to focus conservation efforts.

The town-wide habitat map and this report provide a landscape perspective that can help the town establish conservation goals, priorities, and strategies. These are practical tools that will facilitate selecting areas for protection and identifying 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. As habitat maps are completed in adjacent towns, the maps can also be used for conservation planning across town boundaries.

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

In addition to town-wide land use and conservation planning, the habitat map and report can also be used for reviewing site-specific development proposals and other land use proposals. The habitat map can provide ecological information about both the proposed development site itself, and the surrounding areas that might be affected. The map and report 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 and management recommendations for each. Pay particular attention to priority habitats and their recommended conservations zones.
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. Examples of design modifications 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 quantity or quality of groundwater available to onsite or offsite fens.
   - Channeling stormwater runoff from paved areas or fertilized turf into detention basins or "rain gardens" instead of directly into streams, ponds, or wetlands. Oil-water separators can also be installed where runoff leaves paved areas.

- Locating human activity areas as far as possible from the most sensitive habitats.
- Locating developed features such that broad corridors of undeveloped land are maintained between habitats.

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

General Strategies for Achieving Conservation Goals

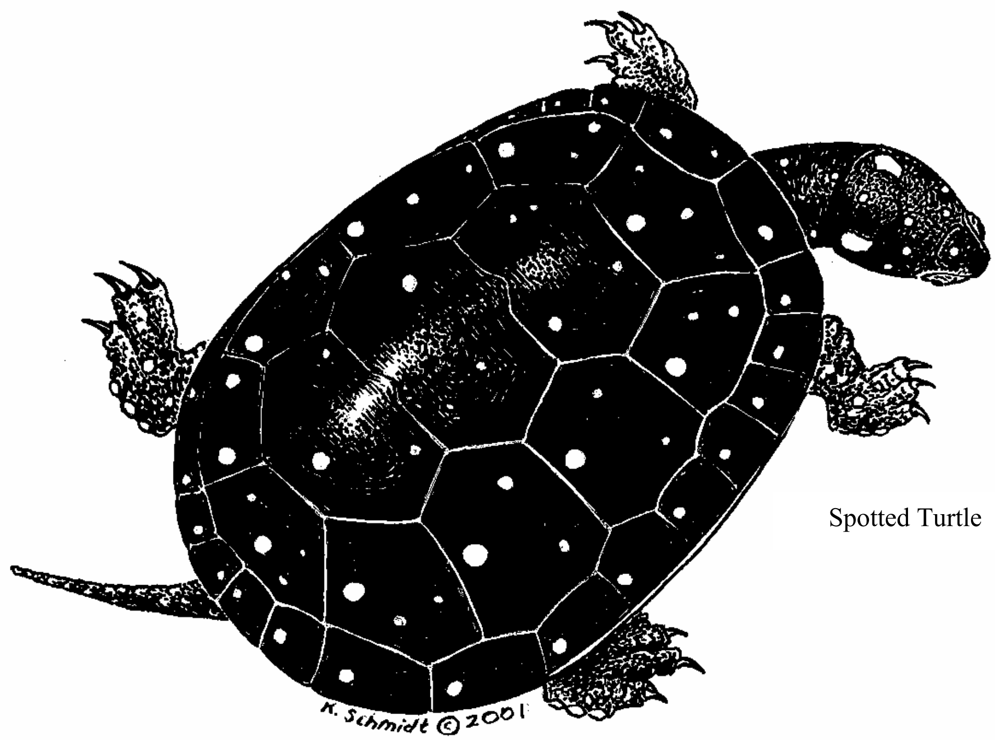
We hope that the Town of Stanford habitat map and report will help landowners understand how their land fits into the larger ecological landscape, and will inspire them to implement habitat protection measures voluntarily. We also hope that the town will engage in proactive land use and conservation 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.

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. The *Local Open Space Planning Guide* (NYS Department of Environmental Conservation and NYS Department of State 2004) describes how to take advantage of laws, programs, technical assistance, and funding resources available to pursue open space conservation; and provides contact information for relevant organizations.

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

- Protect large, contiguous, undeveloped tracts wherever possible.
- 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.
- 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.
- 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.
- Restore degraded habitats wherever possible, but do not use restoration projects as a license to destroy existing habitats.
- Protect habitats associated with resources of special economic, public health, or aesthetic importance to the town. These include aquifers or other sources of drinking water, active farms, and scenic views.



Spotted Turtle

PRIORITY HABITATS IN STANFORD

Although much land in Stanford 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 Stanford 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, local government agencies 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 Stanford. While we hope this information will help the town think strategically about future land-use planning, it must be understood that this is not an exhaustive list of important habitats.

We used the requirements of a selected group of species to help identify some of the areas where conservation efforts might yield the greatest return for biological diversity. We chose several species or groups of species that have large home ranges, specialized habitat needs, or acute sensitivity to disturbance (see Table 2). Many of these 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 2). If the habitats of the highly sensitive species of concern are protected, many other rare and common species that occur in the same habitats will also be protected.

Table 2. Special habitats, species of concern, and associated priority conservation zones identified by Hudsonia in the Town of Stanford, 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.	Melvin 1999
Oak-heath barren	Northern copperhead (snake)*	3300 ft (1000 m)	Encompasses most of the summer foraging habitat.	Fitch 1960
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
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*	(200 meters)	Encompasses most of the critical habitat including winter hibernacula, nesting areas, spring basking sites, foraging habitat, and overland travel corridors.	Carroll and Ehrenfeld 1978, Harding and Bloomer 1979, Buech et al. 1997, Foscarini and Brooks 1997

* Species of statewide conservation concern. See Appendix A.

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 4. There are 31 patches greater than 100 ac (40 ha). Our map does not take into account the actual size of forest patches that extend beyond Stanford's boundary, but this is an important consideration in understanding the habitat value of these patches. Forested areas along the Taconic Parkway may provide a travel corridor for wildlife, although the highway itself is a major source of road mortality and threatens surrounding habitats with noise and polluted runoff.

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. This environment favors 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 decreased by forest fragmentation (Lampila et al. 2005). Large forests, particularly those that are more round and less linear, support forest species that are highly sensitive to disturbance and predation along forest edges. In landscapes with 30-40% forest cover, such as the Town of Stanford, scarlet tanager requires patches of at least 175 ac (71 ha) for suitable breeding habitat (Rosenberg et al. 1999); forest thrushes need a minimum of about 400 ac (162 ha) (Rosenberg et al. 2003).

Forest fragmentation can also hamper or prevent animals from moving across the landscape, and can result in either a loss 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). Additionally, road mortality of migrating amphibians and reptiles can result in decreased density (Fahrig et al. 1995) or changes in sex ratios in nearby populations (Marchand and Litvaitis 2004).

Recommendations

We recommend that the remaining blocks of large forest within the Town of Stanford 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 Stanford, special emphasis should be placed on protecting the integrity of the remaining large forested areas. Hudsonia mapped habitats in the Town of Washington in 2004, and in the next three years will be mapping habitats in at least three other towns in northeastern Dutchess County. Once complete, this regional map will enable town officials and private landowners to plan strategically across town boundaries to ensure that large forested areas are conserved.

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 Stanford, some of these meadow complexes exceeded 250 ac (100 ha). The largest single meadow is 99 ac (40 ha); this and two other extensive meadows are located near the intersection of Market Lane and Bulls Head Road. Other large meadows occurred along the eastern part of Bangall-Amenia Road, at the intersection of Conklin Hill and Carpenter Hill Roads, and all along the eastern side of the town. 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. The largest wet meadows occurred along Pugsley Hill Road, Carpenter Hill Road, and around the Market Lane intersections with Willow Brook Road and Bulls Head Road.

Conservation Issues

While there can be significant habitat value in small patches of upland meadow (e.g., for invertebrates and small mammals), large patches are especially important for grassland-breeding birds. Grassland-breeding birds in the Northeast have declined dramatically in recent decades due to habitat loss, as meadows are 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 (Melvin 1999). Fences and hedgerows can cause decreased nesting success for grassland-breeding birds by providing cover and perching sites for raptors and other species that prey 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 Stanford has over 10,000 ac (> 4,000 ha) of upland meadow, only 56 of those are greater than 25 ac (10 ha), the preferred area for savannah sparrow to nest, and just 15 are large enough to support vesper sparrow (50 ac [20 ha]). The largest single meadow is 99 ac (40 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.

The Town of Stanford 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.

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

Target Areas

There are five patches of oak-heath barren on the western slopes of Stissing Mountain, and one patch in the southwest corner of Stanford. Extensive areas of crest, ledge, and talus occur on the east slope of Stissing Mountain, between Route 82 and Carpenter Hill Road, between Route 82 and Hunns Lake, and just west of Stissing Mountain. The latter two sites include large areas of calcareous crest.

Conservation Issues

Oak-heath barrens are uncommon in the Hudson Valley and may provide core habitat for several rare reptiles that require rocky outcrops and exposed conditions at crucial stages in their life cycle. Five-lined skink* typically uses oak-heath barrens and associated crest, ledge, and talus habitats throughout the year for basking, foraging, and shelter. Snakes such as northern copperhead* may only use these open rocky habitats at key times of the year, including for spring basking and breeding. During late spring and summer the copperhead may travel 3,300 ft (1,000 m) or more from these habitats to forage in the surrounding forests, wetlands, and fields (Fitch 1960). Individuals also occasionally disperse to nearby barrens and talus to interbreed with individuals of neighboring populations (thereby maintaining the genetic health of the populations) or to colonize new habitats as habitat quality changes. Thus, both the oak-heath barrens and the surrounding habitat matrix are important to the long-term viability of this and other species.

In the past, oak-heath barrens and other rocky crests were not often threatened by development because the steep rocky terrain made the construction of houses, roads, and other structures expensive; recently, however, increasing numbers of houses are being constructed on or near crests. Barrens occurring along hill summits and ridge tops may be viewed as prime sites for communication (cell) towers. These barrens and crests are also frequented by people seeking scenic views, and thus are often subjected to ATV and foot traffic. All of these disturbances can severely degrade oak-heath barren habitat and expose the rare reptiles to fatal human encounters. Perhaps one of the greatest threats to the long-term viability of the rare animals associated with oak-heath barrens is the fragmentation of habitat complexes from one another. The low-lying valley areas between ridge-top barren complexes are often seen as prime development sites. The construction of houses, roads, and other structures in these areas can isolate habitat complexes and the animal populations they support by preventing migration, dispersal, and genetic exchange. This, in turn, can limit the ability of these populations to adapt to changing climatic or environmental conditions and make them more prone to local extinction.

Recommendations

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

1. ***Protect oak-heath barren habitats.*** All oak-heath barrens and their closely associated crest, ledge, and talus habitats should be protected from disturbances of any kind including, but not limited to, the construction of communication towers, mining, housing and road construction, and high intensity human recreation.

Posting cautionary signs that warn of the fragile nature of the habitat may be an important first step (Kiviat 2001).

2. ***Protect critical adjoining habitats within 3,300 ft (1,000 m) of the barrens***. As discussed above, the various upland and wetland habitats surrounding oak-heath barrens can provide important summer foraging habitat and travel corridors for rare reptiles. We recommend that habitats within at least 3,300 ft (1,000 m) of an oak-heath barren be considered critical components of the barren habitat "complex." New development of any kind, including roads, should be avoided within this 1,000-m zone. If development cannot be avoided, it should be concentrated in a manner that maximizes the amount and contiguity of undisturbed habitat. Special measures may also need to be taken (in consultation with the New York State Department of Environmental Conservation) to restrict the potential movement of rare snakes into the newly developed areas, thereby minimizing the likelihood of human-snake encounters (which are often fatal for the snake) and road mortality. Protecting large areas of contiguous habitat surrounding oak-heath barrens will not only protect potential foraging habitats and travel corridors, but may also help support the ecological and natural disturbance processes (e.g., fire) that help sustain these barrens habitats.
3. ***Maintain corridors between oak-heath barren habitat complexes***. It is important that the intervening areas between habitat complexes remain intact to provide long-distance migration corridors for these species for interbreeding.
4. ***Consult with the Endangered Species Unit of the New York State Department of Environmental Conservation*** about any activity proposed in the vicinity of an oak-heath barren.

FENS AND CALCAREOUS WET MEADOWS

Target Areas

Twenty-two fens and over 50 calcareous wet meadows were mapped in the Town of Stanford. 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 high concentrations in the Willow Brook area and Wappinger Creek valley south of Stissing Mountain. Fens were concentrated in the latter location, as well as in the southeast corner of the town.

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). One of the most imperiled species associated with fens in Dutchess County is the bog turtle,* listed as Endangered in New York and Threatened on the federal list. Fens are the core habitat of bog turtle in 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 Stanford 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 itself is not disturbed, activities in areas surrounding a fen can affect the fen habitat. Furthermore, although bog turtles spend most of their lives in fens and associated wetlands, they also require safe travel corridors between fens for dispersal and other long-term 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 et al. 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 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 habitats is important for population dispersal and to accommodate turtles displaced from degraded habitats. The US Fish and Wildlife Service recommends the following (excerpted from Klemens [2001]):

1. *Protect wetland habitat*. The entire wetland, not just those portions that have been identified as, or appear to be, optimal for nesting, basking, or hibernating, should be protected from direct destruction and degradation. The following activities (not an inclusive list) should be avoided within the wetland:
    - Development of roads, residences, driveways, parking lots, sewer lines, utility lines, stormwater or sedimentation basins, or other structures.
    - Wetland draining, ditching, tiling, filling, excavation, stream diversion, or construction of impoundments.
    - Herbicide, pesticide, or fertilizer application (except as part of approved bog turtle management plan).
    - Mowing or cutting of vegetation (except as part of approved bog turtle management plan).
    - Delineation of lot lines for development, even if the proposed building or structure will not be in the wetland.
2. *Establish a 300-ft buffer zone*. A protective "buffer" 300 ft (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, residences, driveways, parking lots, sewer lines, utility lines, stormwater or sedimentation basins, or other structures.
- Mining.
- Herbicide, pesticide, or fertilizer application.
- Farming (with the exception of light to moderate grazing).
- Stream bank stabilization (e.g., rip-rapping).
- Delineation of lot lines for development, even if the proposed building or structure will not be in the wetland.

3. *Assess potential impacts within at least 2500 ft (750 m) of the fen.* Despite the distance, development activities occurring within the drainage basin of the fen or at least one-half mile from the boundary of the buffer zone may adversely affect bog turtles and their habitat. Development within this area may also sever important travel corridors between wetlands occupied or likely to be occupied by bog turtles, thereby isolating populations and increasing the likelihood of road mortality as turtles attempt to disperse.
    - Activities such as the construction of roads and other impervious surfaces, groundwater extraction (e.g., wells), septic/sewer facilities, and mining have a high potential to alter the hydrology and chemistry of the fen habitat.
    - Construction of new roads and bridges should be avoided within this area.
    - Existing roads with medium to high volume traffic may be ideal candidates for "turtle underpasses" that may provide safer travel passageways for this species.
    - All activity proposed within this zone should be thoroughly reviewed in consultation with the Endangered Species Unit of the New York State Department of Environmental Conservation using the most up-to-date scientific information on this species and its sensitive habitat.

INTERMITTENT WOODLAND POOLS

Target Areas

More than 120 intermittent woodland pools were identified and mapped in the Town of Stanford, 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 have trouble crossing open fields due to a high risk of desiccation and predation in that exposed environment (Rothermel and Semlitsch 2002).

Populations of these amphibian species depend not 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 serves as 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. Wherever possible, forested connections between individual pools should be identified and maintained to provide overland dispersal corridors.

We also recommend the following for all development activity proposed within the critical terrestrial habitat zone 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 affects on the adults. Activities such as groundwater extraction (e.g., from wells) or the redirection of natural surface water flows can decrease the pool hydroperiod below the threshold required for successful egg and larval development. Increasing impervious surfaces

or channeling stormwater runoff toward pools can increase pool hydroperiod, which can also adversely affect the ability of amphibians to reproduce successfully in woodland pools. Protective measures include:

- 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.
- 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.

BUTTONBUSH POOLS

Target Areas

Sixteen buttonbush pools were identified in the Town of Stanford. These were widely distributed across the town (Fig. 10), with two notable concentrations: in the Homan Road-Bowen Road area (see page 116), and east of Cold Spring Road in the Stissing Mountain Area.

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 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 within the surrounding landscape. 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 travel corridors. 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 both wetlands and upland nesting habitats, as well as the 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; habitat fragmentation from roads and 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 Stanford, and the town almost certainly contains one or more viable populations of this Threatened species. To help protect Blanding's turtles and the habitat complex they require, we recommend the following measures (adapted from Hartwig et al., in prep.):

Within the 2000-m Area of Concern, 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 <u>1000-m Conservation Zone</u> 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 spaces or openings to allow safe turtle passage. Spaces 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 Stanford are Ryder Pond, on Bangall-Amenia Road, and Shaw Pond, on the town's southern border. Ryder Pond is bordered on two sides by road and on the remaining sides by agricultural fields. Shaw Pond is bordered entirely by forest and agricultural fields, and is surrounded by a strip of trees.

Conservation Issues

The unusual water chemistry, hydrology, and sediments of circumneutral bog lakes may together provide critical habitat for a number of organisms. Northern cricket frog,* for example, is rapidly declining in the northern part of its range, and is listed as Endangered in

New York, where it occurs in only three counties. In most of this region, its breeding habitat is restricted to circumneutral bog lakes (Dickinson 1993), 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 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 they disperse overland or use riparian corridors.

Recommendations

1. *Maintain water quality.* Reduce or eliminate use of fertilizers and pesticides on nearby agricultural fields and lawns; minimize soil disturbance around the circumneutral bog lake and upstream; upgrade nearby septic systems to prevent nutrient enrichment; minimize runoff from roads and other impervious surfaces.
2. *Maintain hydrology.* Avoid changing water levels or patterns of inflow and outflow. This requires attention to activities in the lake watershed such as road and building construction, stormwater management infrastructure, and groundwater extraction (e.g., wells).
3. *Ban use of motorized boats.* Motorized boats pollute water, physically damage plant and animal life, and may introduce non-native species.
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 sever important travel corridors between northern cricket frog breeding habitat.
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 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, west of the intersection of Market Lane and Bulls Head Road is a high quality wetland complex containing hardwood swamp, marsh, wet meadow, and calcareous wet meadow. Just east of Stissing Mountain is an extensive area of swamp, marsh, calcareous wet meadow, buttonbush pool, and fen. West of the Shelly Hill Road - Cold Spring Road intersection is a complex of swamp and wet meadow adjacent to a large hardwood and mixed forest. Between Cold Spring Road and Route 82 is a large beaver-flooded swamp, with adjacent wet meadows, fens, and large areas of upland meadow. Between Conklin Hill and Attlebury Hill roads are many small, isolated swamps, surrounded by extensive hardwood forest. There are many other examples in the Town of Stanford.

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 uplands.

This species follows an annual pattern of activity: it usually overwinters in bottomland hardwood swamps or wet meadows, spends spring and early summer in one to several seasonal and permanent pools, travels up to 1,870 ft (570 m) to nest in open upland habitat, and spends late summer aestivating (quiescent) in upland forest. It can travel 3,300 ft (1,000 m) or more between wetlands. Because of this intricate annual pattern of habitat use, whole complexes of wetland and upland habitats are required to support spotted turtle populations (Joyal et al. 2001).

Recommendations

1. ***Protect intermittent woodland pools, buttonbush pools, and fens and their conservation zones*** as described elsewhere in this report (pages 93-101). These are habitats used by spotted turtle especially in the summer.
2. ***When these wetland habitats are located within 3,280 ft (1,000 m) of a swamp, marsh, or wet meadow (wintering habitat),protect the intervening upland habitats.*** These upland areas encompass spotted turtle travel corridors, and nesting, aestivation, and basking sites.
3. ***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, Cold Spring Creek, Willow Brook, and Hunns Lake Creek are some of the major perennial streams in Stanford. 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.

Conservation Issues

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

Conserving wood turtles requires protecting not only their core habitat (e.g., 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). In order to protect water quality and habitat in intermittent streams (as well as downstream), the adjoining uplands or wetlands should be protected 160 ft (50 m) on each side. This protective buffer can help by filtering sediment, nutrients, and contaminants from runoff, stabilizing stream banks, preventing channel erosion, regulating microclimate, and protecting ecosystem process (Saunders et al. 2002).

Recommendations

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

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, regardless of whether or not they are used by wood turtles. Buffer zones should remain naturally vegetated and undisturbed by construction, conversion to impervious surfaces, agriculture and livestock use, pesticide and fertilizer application, and installation of septic leachfields or other waste disposal facilities. 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 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

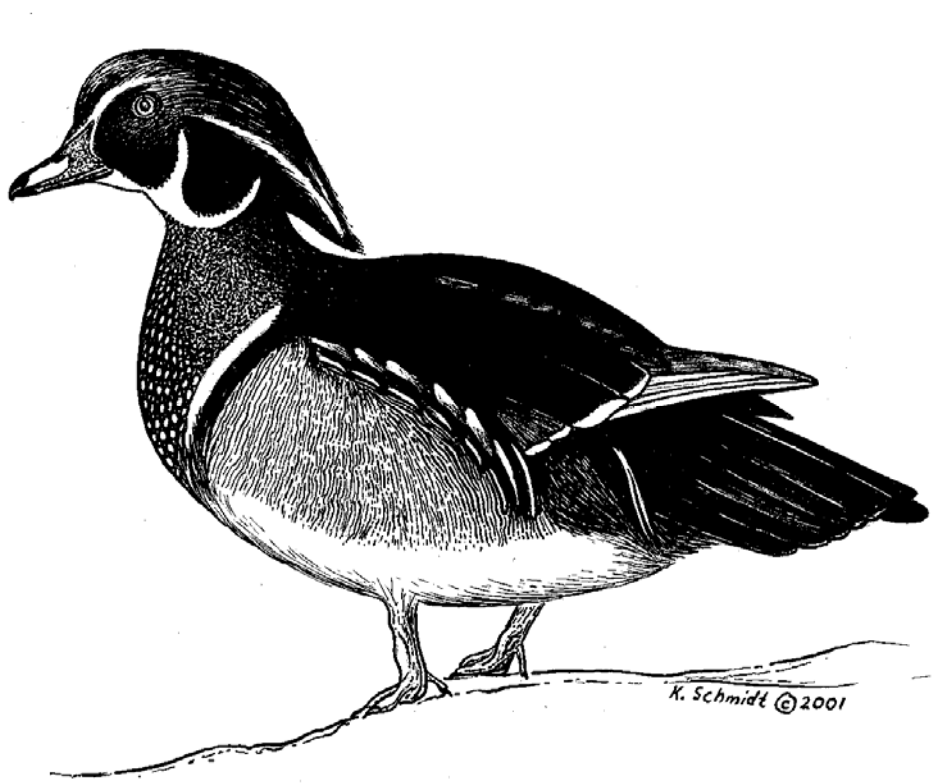
length, measured in meters). Higher openness ratio values mean that more light is able to penetrate into the interior of the crossing. Brighter conditions beneath a crossing may be more favorable for the passage of animals including wood turtles.

- 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, 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.



Wood Duck

Figure 12. Priority conservation areas.

PRIORITY CONSERVATION AREAS IN STANFORD

In addition to the priority habitats discussed above, there are locations in Stanford that deserve special attention because they each contain several priority habitats. 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 Stanford. For conservation issues and recommendations for each habitat type, refer to the preceding sections.

Stissing Mountain Area

The southern part of Stissing Mountain and the adjacent Wappinger Creek wetlands were designated as a Critical Environmental Area by Stanford based on recommendations made in a Hudsonia report (Kiviat 1990), which stated that "the Stissing Mountain Area is one of Dutchess County's top natural area complexes, top birdwatching areas, and premier localities for rare habitats and rare species." This area, bordered by Cold Spring Road, Stissing Road, and Route 82, is the largest contiguous forest area in Stanford, and also contains examples of virtually all the rare habitats we encountered in the town. Noteworthy features include:

- Extensive hardwood, mixed, and conifer forests. Whip-poor-will,* hermit thrush, blackburnian warbler,* worm-eating warbler,* and bobcat* are forest species recorded from the mountain.
- The eastern face of Stissing Mountain is largely forested ledge and talus, one of the most extensive examples of such habitats in the county. Acidic crests with chestnut oak and white pine are also abundant. Records of animals associated with these habitats include boreal red-backed vole,* golden eagle,* and possibly northern copperhead.*
- Oak-heath barren, a special subset of crest habitat, is found in several places on the mountain.
- Many intermittent woodland pools and isolated swamps (including conifer swamps) occur in folds and dips on the mountain. Spotted salamander* and marbled salamander* are known from this site.

- Buttonbush pools occur on the mountain's west side, along with other swamps and pools that may comprise good Blanding's turtle habitat. Also on the west side is a cool perennial stream supporting brook trout* and slimy sculpin.*
- To the east of Stissing Mountain, extensive wetlands border Wappinger Creek, forming one of the largest nontidal wetland complexes in Dutchess County. This includes several calcareous wet meadows and fens, as well as extensive hardwood and shrub swamps and marshes. Documented wildlife in and around these wetlands includes blue-spotted salamander,* spotted turtle,* wood turtle,* king rail* and other rare marsh birds, river otter,* large populations of muskrat, and a great blue heron rookery.

Homan-Bowen Road Area

This area includes land on both sides of Bowen Road continuing north to the intersection of Shelly Hill Road and Cold Spring Road. According to Kiviat (unpublished data) there are about 25 ac (10 ha) of good Blanding's turtle habitat in this area. This area contains:

- A large area of continuous upland hardwood forest.
- Several buttonbush pools, dominated by shrubs such as highbush blueberry, swamp azalea, buttonbush, and winterberry holly. Three of these were unusual calcareous pools with deep, clear water.
- Many (at least 45) intermittent woodland pools and isolated swamps.

This is excellent habitat for Blanding's turtle and pool-breeding amphibians. Wood turtle,* spotted turtle,* Jefferson salamander,* and spotted salamander* have been found in this area.

Millbrook Marsh

Millbrook Marsh is a large wetland complex that continues into the towns of Washington and Amenia. Important features include:

- Extensive marsh, calcareous wet meadow, and swamp habitats (a fen is located just over the Washington border), containing several rare plants.
- 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 Area

The area between Duell Road and Ludlow Woods Road in the southern part of town is noteworthy for the following features:

- Fairly large upland hardwood forest.
- Shaw Pond, a circumneutral bog lake. Red-shouldered hawk,* sharp-shinned hawk,* and wood duck* were sighted during this study.
- Several calcareous swamps and a small fen.
- A buttonbush pool.

This appears to be good habitat for northern cricket frog,* Blanding's turtle,* and spotted turtle.*

Ryder Pond Area

This area extends from Ryder Pond (on Bangall-Amenia Road) to the north about 4,500 ft (1,370 m). The priority habitats include:

- Ryder Pond, a circumneutral bog lake.
- A large intermittent woodland pool.
- Extensive hardwood and shrub swamp.
- Upland forest with crest, ledge, and talus habitat.

This wetland complex is another possible location for Blanding's turtle,* northern cricket frog,* and spotted turtle,* as well as for pool-breeding amphibians, pied-billed grebe,* and other marsh birds.

Bloodstock Farm Area

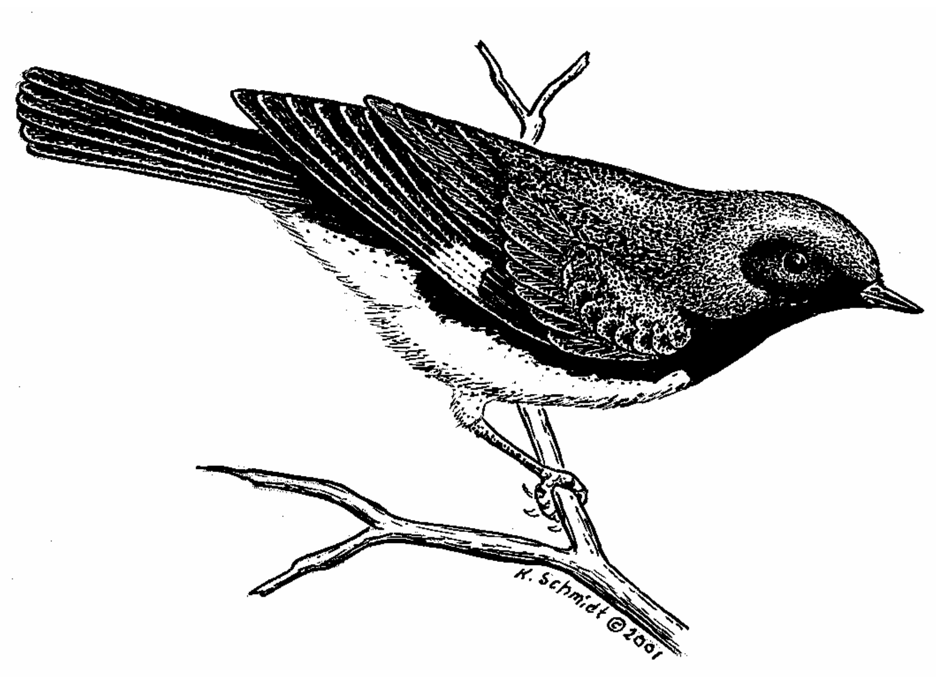
Located between Cold Spring Road and Route 82, this is a large agricultural area that has:

- Large upland meadows.
- A permanent spring and several large, high-quality fens.
- An extensive beaver-enlarged swamp.

This wetland complex appears to be high-quality habitat for bog turtle* as well as other turtles. Upland meadows provide nesting habitat for turtle species.

Wappinger Creek Corridor

Wappinger Creek is the largest stream in the Town of Stanford, and an important tributary of the Hudson River. Because it runs through the entire town from north to south, its riparian corridor is an important link between habitats throughout the town. Also, maintaining water quality in the Town of Stanford is important for all downstream reaches.



Black-Throated Blue Warbler

CONCLUSION

In the rural landscapes of northern Dutchess County, including the Town of Stanford, 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 Stanford, 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, but the map should never be considered a substitute for site visits by qualified professionals. During site visits, the presence and boundaries of important habitats should be verified, and the site should be assessed for additional ecological values. Based on this information, decisions can be made about the need for rare species surveys. Detailed, up-to-date ecological information is essential to making informed decisions about specific development proposals. Because the natural landscape and patterns of human land use are dynamic, it is important for the town to consider refining and/or updating the habitat map over time.

Conservation of habitats is one of the best ways to protect biological resources. We hope that the information contained in the habitat map and in this report will help 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.

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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 Partners in Flight as high conservation priorities at the continental (PIF1) and regional (PIF2) level. These ranking systems are explained in Appendix B.

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

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

RED CEDAR WOODLAND		
Plants	***Vertebrates***	***Vertebrates (cont).***
Carolina whitlow-grass (T, S2)	Blanding's turtle (T, S2S3)	long-eared owl (S3)
yellow wild flax (T, S2)	wood turtle (SC, S3)	short-eared owl (E, S2, PIF1)
Bi*cknell's sedge (T, S3)	eastern box turtle (SC, S3)	eastern bluebird (RG)
Invertebrates	eastern hognose snake (Sc, S3S4)	eastern towhee (PIF2)
olive hairstreak (butterfly) (RG)	northern harrier (T, S3B, S3N)	brown thrasher (PIF2)
	northern saw-whet owl (S3)	field sparrow (PIF2)

UPLAND SHRUBLAND		
Plants	***Vertebrates***	***Vertebrates (cont.)***
stiff-leaf goldenrod (T, S2)	wood frog (RG)	golden-winged warbler (SC, PIF1)
shrubby St. Johnswort (T, S2)	Blanding's turtle (T, S2S3)	prairie warbler (PIF1)
butterfly weed (RG)	spotted turtle (SC)	yellow-breasted chat (SC, S3)
Invertebrates	eastern box turtle (SC)	clay-colored sparrow (P, S2)
aphrodite fritillary (butterfly) (RG)	wood turtle (RG)	vesper sparrow (SC)
dusted skipper (butterfly) (S3)	northern harrier (T, S3B, S3N)	grasshopper sparrow (SC, PIF2)
Leonard's skipper (butterfly) (RG)	short-eared owl (E, S2, PIF1)	Henslow's sparrow (T, S3B, PIF1)
cobweb skipper (butterfly) (RG)	northern saw-whet owl (S3)	eastern towhee (PIF2)
	loggerhead shrike (E, S1B)	brown thrasher (PIF2)
	blue-winged warbler (PIF1)	field sparrow (PIF2)

UPLAND MEADOW

Invertebrates

aphrodite fritillary (butterfly) (RG)
dusted skipper (butterfly) (S3)
Leonard's skipper (butterfly) (RG)
swarthy skipper (butterfly) (RG)

Vertebrates

Blanding's turtle (T, S2S3)
spotted turtle (SC, S3)
eastern box turtle (SC, S3)
wood turtle (SC, S3)
northern harrier (T, S3B, S3N)
upland sandpiper (T, S3B, PIF1)
sedge wren (T, S3B, PIF2)

Vertebrates (cont.)

eastern bluebird (RG)
vesper sparrow (SC)
grasshopper sparrow (SC, PIF2)
Henslow's sparrow (T, S3B, PIF1)
bobolink (RG)
eastern meadowlark (RG)

NON-CALCAREOUS CREST/LEDGE/TALUS

Plants

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

Invertebrates

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

Vertebrates

eastern box turtle (SC, S3)
five-lined skink (S3)
black rat snake (RG)
northern copperhead (S3)
eastern hognose snake (SC, S3S4)
worm snake (SC, S3S4)
timber rattlesnake (T, S3)

Vertebrates (cont.)

slimy salamander (RG)
marbled salamander (SC, S3)
Fowler's toad (RG)
turkey vulture (RG)
golden eagle (E, S1N)
whip-poor-will (SC, PIF2)
common raven (RG)
winter wren (RG)
eastern bluebird (RG)
hermit thrush (RG)
blackburnian warbler (RG, PIF2)
cerulean warbler (SC, PIF1)
worm-eating warbler (RG, PIF1)
small-footed bat (SC, S2)
boreal redback vole (RG)
porcupine (RG)
fisher (RG)
bobcat (RG)

CALCAREOUS CREST/LEDGE/TALUS

Plants

walking fern (RG)
smooth cliffbrake (T,S2)
side-oats grama (E, S1)
Emmons' sedge (S3)
yellow wild flax (T, S2)
Carolina whitlow-grass (T, S2)
hairy rock-cress (RG)

Plants (cont.)

yellow harlequin (S3)
Dutchman's breeches (RG)
pellitory (RG)
New England blazing-star (T, S2)
small-flowered crowfoot (T, S3)
roundleaf dogwood (RG)

Invertebrates

anise millipede (RG)

Invertebrates (cont.)

olive hairstreak (butterfly) (RG)

Vertebrates

five-lined skink (S3)
eastern hognose snake (SC, S3S4)
northern black racer (RG)
black rat snake (RG)
northern copperhead (S3)

OAK-HEATH BARREN

Plants

reflexed sedge (E, S2S3)
clustered sedge (T, S2S3)
mountain spleenwort (T, S2S3)
dittany (RG)

Invertebrates

northern hairstreak (butterfly) (S1S3)
Edwards' hairstreak (butterfly) (S3S4)
Horace's duskywing (butterfly) (RG)

Invertebrates (cont.)

cobweb skipper (butterfly) (RG)
dusted skipper (butterfly) (S3)
Leonard's skipper (butterfly) (RG)
brown elfin (butterfly) (RG)
eastern pine elfin (butterfly) (RG)

Vertebrates

timber rattlesnake (T, S3)
northern copperhead (S3)
five-lined skink (S3)
eastern fence lizard (T, S1)
whip-poor-will (SC, PIF2)
prairie warbler (PIF1)
eastern towhee (PIF2)
field sparrow (PIF2)

WASTE GROUND

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

Plants (cont.)
slender knotweed (R, S3)

Vertebrates
Blanding's turtle (T, S2S3)
wood turtle (SC, S3)
Fowler's toad (RG)
eastern hognose snake (SC, S3S4)
northern copperhead (S3)

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

SWAMP

Plants
swamp cottonwood (T, S2)
ostrich fern (RG)
wood horsetail (RG)

Invertebrates
phantom cranefly (RG)

Vertebrates
blue-spotted salamander (SC, S3)

Vertebrates (cont.)
four-toed salamander (RG)
spotted turtle (SC, S3)
wood turtle (SC, S3)
Blanding's turtle (T, S2S3)
eastern box turtle (SC, S3)
great blue heron (RG)
wood duck (RG, PIF2)

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

MARSH

Plants
winged monkey-flower (R, S3)
buttonbush dodder (E, S1)
spiny coontail (T, S3)

Vertebrates
northern cricket frog (E, S1)
northern leopard frog (RG)
Blanding's turtle (T, S2S3)

Vertebrates (cont.)
spotted turtle (SC, S3)
American bittern (SC)
least bittern (T, S3B, S1N)
great blue heron (RG)
wood duck (RG, PIF2)
American black duck (RG, PIF1)
king rail (T, S1B, PIF1)

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

WET MEADOW

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

Invertebrates (cont.)
Milbert's tortoiseshell (butterfly) (RG)
phantom cranefly (RG)

Vertebrates
ribbon snake (RG)
spotted turtle (SC, S3)
northern harrier (T, S3B, S3N)
American bittern (SC)

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

FEN/CALCAREOUS WET MEADOW

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

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

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

Invertebrates (cont.)
Dion skipper (butterfly) (S3)
two-spotted skipper (butterfly) (RG)
Baltimore (butterfly) (RG)
mulberry wing (butterfly) (RG)
black dash (butterfly) (RG)

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

INTERMITTENT WOODLAND POOL

Plants	***Vertebrates***	***Vertebrates (cont.)***
featherfoil (T, S2)	four-toed salamander (RG)	spotted turtle (SC, S3)
false hop sedge (R, S2)	Jefferson salamander (SC, S3)	wood turtle (SC, S3)
Invertebrates	marbled salamander (SC, S3)	wood duck (RG, PIF2)
black dash (butterfly) (RG)	spotted salamander (RG)	American black duck (RG, PIF1)
mulberry wing (butterfly) (RG)	wood frog (RG)	northern waterthrush (RG)
springtime physa (snail) (RG)	Blanding’s turtle (T, S2S3)	

BUTTONBUSH POOL

Plants	***Vertebrates***	***Vertebrates (cont.)***
pale alkali-grass (RG)	blue-spotted salamander (SC, S3)	wood duck (RG, PIF2)
short-awn foxtail (RG)	Blanding’s turtle (T, S2S3)	American black duck (RG, PIF1)
spiny coontail (T, S3)	spotted turtle (SC, S3)	
buttonbush dodder (E, S1)	ribbon snake (RG)	

CIRCUMNEUTRAL BOG LAKE

Plants	***Plants (cont.)***	***Vertebrates (cont.)***
ovate spikerush (E, S1S2)	olivaceous spikerush (RG)	ribbon snake (RG)
floating bladderwort (T, S2)	spiny coontail (T, S3)	American bittern (SC)
hidden-fruit bladderwort (S3)	water-marigold (T, S3)	least bittern (T, S3B, S1N)
inflated bladderwort (E, S1)	southern dodder (E, S1)	great blue heron (RG)
spotted pondweed (T, S2)	***Vertebrates***	wood duck (RG, PIF2)
water-thread pondweed (E, S1)	wood frog (RG)	American black duck (RG, PIF1)
Hill’s pondweed (T, S2)	blue-spotted salamander (SC, S3)	red-shouldered hawk (SC)
prairie sedge (RG)	four-toed salamander (RG)	sharp-shinned hawk (SC)
twig-rush (RG)	northern cricket frog (E, S1)	king rail (T, S1B, PIF1)
pipewort (RG)	Blanding’s turtle (T, S2S3)	marsh wren (RG)
horned bladderwort (RG)	bog turtle (E, S2)	river otter (RG)
roundleaf sundew (RG)	spotted turtle (SC, S3)	

OPEN WATER/CONSTRUCTED POND

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

SPRING/SEEP

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

STREAM & RIPARIAN CORRIDOR

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

R **Rare Species (plants only)**. Species with 20-35 extant sites or 3,000-5,000 individuals statewide.

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.

P **Protected Wildlife**. Wild game, protected wild birds, and endangered species of wildlife, defined in Environmental Conservation Law section 11-0535.

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.

Partners in Flight Priority Species Lists

Based on August 2003 lists for physiographic areas # 17 (Northern Ridge and Valley) and # 9 (Southern New England).

PIF1 High continental priority (Tier IA and IB species)
PIF2 High regional priority (Tier IIA, IIB, and IIC species)
PIF1* Two species were not included in the watch lists for this region; however, they are listed as "High Continental Priority" in PIF's national North American Landbird Conservation Plan (Rich et al. 2004).

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

(CONTINUED)

Common Name	Scientific Name	Common Name	Scientific Name
lady's-tresses, slender	*Spiranthes lacera*	rush, soft	*Juncus effusus*
larch, European	*Larix decidua*	sarsaparilla, bristly	*Aralia hispida*
laurel, mountain	*Kalmia latifolia*	sedge	*Carex*
leatherleaf	*Chamaedaphne calyculata*	sedge, Bicknell's	*Carex bicknellii*
leatherwood	*Dirca palustris*	sedge, bronze	*Carex aenea*
lobelia, Kalm's	*Lobelia kalmii*	sedge, Bush's	*Carex bushii*
loosestrife, purple	*Lythrum salicaria*	sedge, cattail	*Carex typhina*
mannagrass	*Glyceria*	sedge, clustered	*Carex cumulata*
mallow, swamp rose	*Hibiscus moscheutos*	sedge, Davis'	*Carex davisii*
maple, red	*Acer rubrum*	sedge, Emmons'	*Carex albicans* v. *emmonsii*
maple, sugar	*Acer saccharum*	sedge, false hop	*Carex lupuliformis*
mayflower, Canada	*Maianthemum canadense*	sedge, handsome	*Carex formosa*
meadowsweet	*Spiraea latifolia*	sedge, lakeside	*Carex lacustris*
milkweed, blunt-leaf	*Asclepias amplexicaulis*	sedge, Pennsylvania	*Carex pensylvanica*
milkweed, whorled	*Asclepias verticillata*	sedge, porcupine	*Carex hystericina*
milkwort, whorled	*Polygala verticillata*	sedge, prairie	*Carex prairea*
monkey-flower, winged	*Mimulus alatus*	sedge, reflexed	*Carex retroflexa*
(moss)	*Anomodon*	sedge, Schweinitz's	*Carex schweinitzii*
(moss)	*Helodium paludosum*	sedge, sterile	*Carex sterilis*
moss, peat	*Sphagnum*	sedge, tussock	*Carex stricta*
mountain-mint, blunt	*Pycnanthemum muticum*	sedge, woolly-fruit	*Carex lasiocarpa*
mountain-mint, Torrey's	*Pycnanthemum torrei*	sedge, yellow	*Carex flava*
nettle, false	*Boehmeria cylindrica*	serviceberry	*Amelanchier*
oak, black	*Quercus velutina*	sheep-laurel	*Kalmia angustifolia*
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*
pipewort	*Eriocaulon septangulare*	sweet-gale	*Myrica gale*
pitcher-plant	*Sarracenia purpurea*	sweet-gum	*Liquidambar styraciflua*
pod-grass	*Scheuchzeria palustris*	tamarack, eastern	*Larix laricina*
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/Lasallia*
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*
reed, common	*Phragmites australis*	watershield	*Brasenia schreberi*
riverweed	*Podostemum ceratophyllum*	water-willow	*Decodon verticillatus*
rock-cress, hairy	*Arabis hirsuta* v. *pycnocarpa*	whitlow-grass, Carolina	*Draba reptans*
rose, multiflora	*Rosa multiflora*	willow	*Salix*
rush, toad	*Juncus bufonius*	willow, autumn	*Salix serissima*
sandwort, rock	*Minuartia michauxii*	witch-hazel	*Hamamelis virginiana*
		woolgrass	*Scirpus cyperinus*