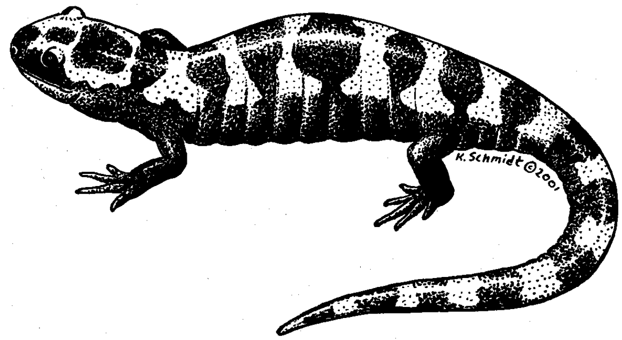

BIODIVERSITY ASSESSMENT MANUAL

for the Hudson River Estuary Corridor

By Erik Kiviat & Gretchen Stevens

Environmental Research and Education
Science for Conservation
Hudsonia Ltd.

New York State Department of Environmental Conservation
Erin M. Crotty, Commissioner
George E. Pataki, Governor

Action Plan Project
Hudson River Estuary

About Hudsonia

Hudsonia is an institute for research, education, and technical assistance in the environmental sciences. Hudsonia conducts pure and applied research on natural and social science aspects of the environment, offers technical assistance to public and private agencies and individuals, and produces educational publications on natural history and conservation topics. Hudsonia is a non-advocacy, non-profit, public interest organization that works to increase scientific knowledge and discover effective solutions to environmental management problems.

About the New York State Department of Environmental Conservation and Hudson River Estuary Action Plan

The Hudson River Estuary Action Plan, released by Governor George E. Pataki in 1996 and updated every two years, is administered by the New York State Department of Environmental Conservation and sets an agenda of immediate action projects to protect, restore and increase enjoyment of the river and its natural environment. The Action Plan includes biodiversity conservation as a major focal point of its efforts to protect habitats of the Hudson Estuary and its watershed. The Hudson Valley is one of the richest and most biologically diverse regions in all of New York State. This *Biodiversity Assessment Manual* is intended to support local governments and landowners in identifying significant local biodiversity resources and developing strategies for conservation. The Estuary Action Plan emphasizes measures which can be taken voluntarily and addressed locally in the context of local home rule and an individual's property rights.

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Foreword

The communities of the Hudson River Valley are well known for their love of the outdoors, and their pride in the region's natural richness. You don't have to sail on the Hudson River Sloop *Clearwater* or witness the majesty of Storm King Mountain to experience this region's natural beauty and heritage. Parks and preserves created by local and state governments and by nonprofit organizations are within easy access of even the most urban neighborhoods. Most of our children are exposed to some form of environmental education in the public schools. Most of our towns have a Conservation Advisory Council (CAC), or a similar agency, made up of knowledgeable citizen volunteers.

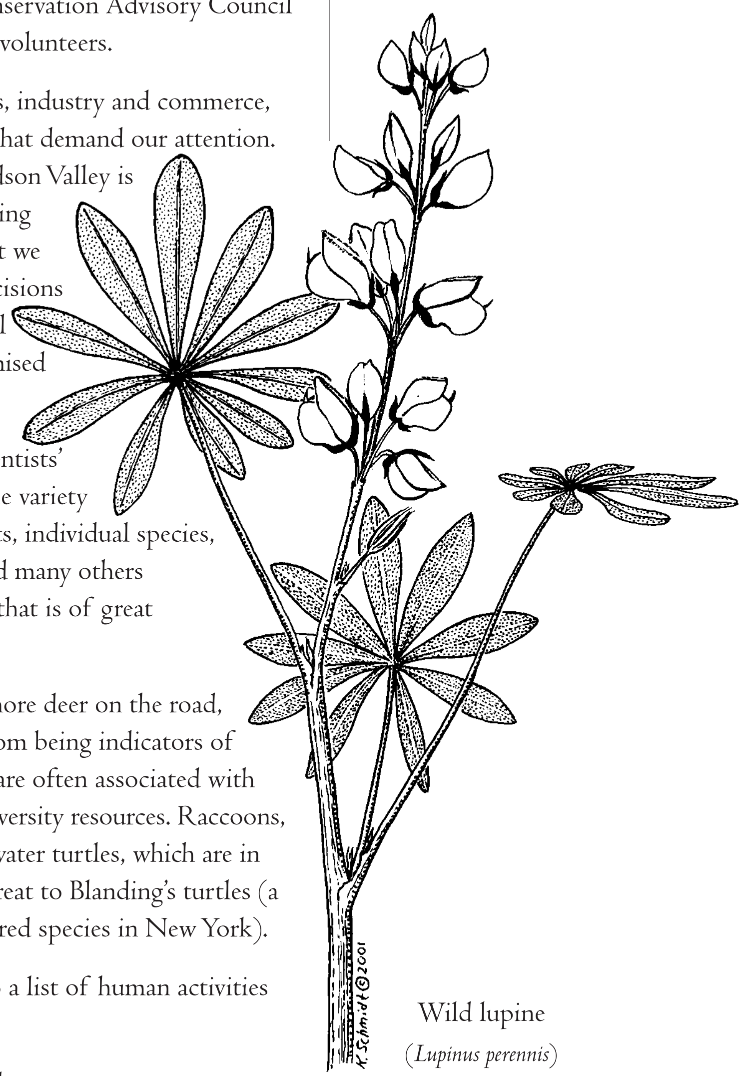
At the same time, our choices of land use patterns—for homes, industry and commerce, transportation, recreation—are fraying nature's fabric in ways that demand our attention. As one of the fastest developing regions in New York, the Hudson Valley is losing biological resources, both known and unknown. Preventing further loss requires that we know what resources exist and that we factor their conservation into the civic dialogue as we make decisions about this region's growth and development. Otherwise, we will inevitably diminish our own quality of life and leave a compromised legacy to our children.

"Biological diversity," and the shorthand "biodiversity," are scientists' terms for the entire web of life. Biodiversity encompasses all the variety of life on earth: ecosystems, communities of animals and plants, individual species, and the genes that make them distinct. Today, in our region and many others nationwide, native biological diversity is diminishing at a pace that is of great concern to ecologists.

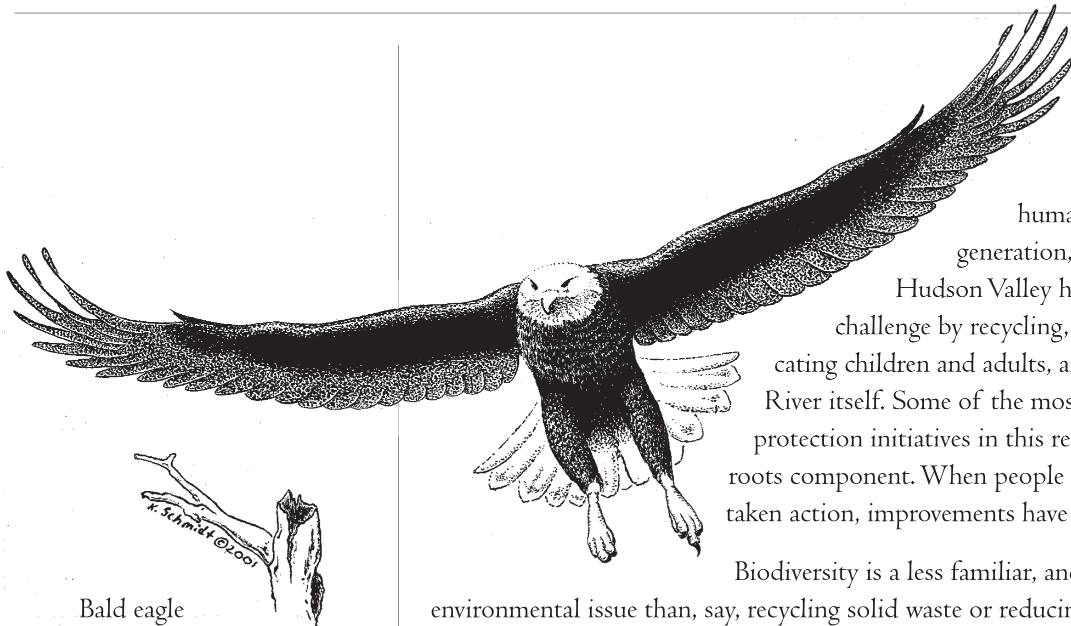
"*What* biodiversity crisis?" some may ask. "Lately, I have seen more deer on the road, and more raccoons around my yard, than ever!" Actually, far from being indicators of ecological well-being, burgeoning populations of such species are often associated with expanding human settlement and regional degradation of biodiversity resources. Raccoons, for example, are top predators on the eggs and young of freshwater turtles, which are in decline globally. The raccoon is thought to be an important threat to Blanding's turtles (a Threatened species in New York) and bog turtles (an Endangered species in New York).

The list of dangers to biodiversity in the Hudson Valley is also a list of human activities undertaken without environmental consequences in mind:

- habitats lost or fragmented due to patterns of human land uses;
- habitats degraded by pollution of air, water and soil;
- habitats altered due to human-caused climate change;
- native species displaced by the introduction of non-native plants and animals;
- animals endangered by preventable disposal of human trash.



Wild lupine
(*Lupinus perennis*)



Bald eagle
(*Haliaeetus leucocephalus*)

Because humans can choose, humans can change. In the past generation, the communities of the Hudson Valley have risen to the environmental challenge by recycling, protecting scenic lands, educating children and adults, and cleaning up the Hudson River itself. Some of the most important environmental protection initiatives in this region have had a strong grassroots component. When people have stepped forward and taken action, improvements have followed.

Biodiversity is a less familiar, and arguably more complicated environmental issue than, say, recycling solid waste or reducing a waterway's toxic pollution. Biodiversity is an aspect of whole ecological systems, and is not reducible to measures of single species or individual resources. Protecting biodiversity means wrestling with complex questions about which habitats and species to protect, how best to protect them, and at what costs.

There is widespread support for protecting and restoring species that have obvious value to humans for recreation, such as Hudson River waterfowl and fishes. Strong support also exists for protecting and restoring "charismatic" species that arouse wonder or have symbolic value, such as the nesting bald eagles that have recently returned to the Hudson. More controversy arises about protecting species that not everyone finds so attractive, such as the timber rattlesnake, the cricket frog, and the buck moth, which may be equally important to the ecosystem. The same is true of habitats. More people want to save a majestic forest than a bleak sand plain or an impenetrable—but ecologically essential—swamp.

This *Biodiversity Assessment Manual* is both a practical and an educational tool. It is designed to help local officials, environmental practitioners, developers, and citizens identify, assess, and protect habitats and species of special conservation importance in the towns and counties along the tidal Hudson River. The data generated through a careful biodiversity assessment will support more informed decision-making, as communities grapple with the complex development issues they face every day. The *Manual* does not presume to tell communities what to value or how to respond to the challenge. It simply offers information that can be used to support the priorities of community decision-makers, keeping in mind the wide range of citizens to whom they are accountable.

When the biodiversity assessment process is undertaken with curiosity and community involvement, citizens can work with professionals to identify habitats and devise conservation strategies. This can contribute to a stronger community fabric and improved civic dialogue, as well as a healthier environment.

I hope this *Manual* will remind readers of the biological richness of the region, the fragility of our habitats and ecosystems, and the importance of sound, scientific information as a basis for restorating and protecting biodiversity resources.

Melissa Everett

Executive Director, Hudsonia, Fall 2000

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While we have benefited immensely from the comments of the reviewers, the authors take full responsibility for any errors or omissions in the *Manual*. The views and recommendations

continued

expressed here are our own, and are not necessarily those of the reviewers, the funders, or the publisher.

The creation of the *Manual* was assisted in its early years by the encouragement of many of our colleagues and friends who felt the need for this kind of document to help stem the losses of biodiversity resources in the Hudson Valley. Grants from the Geoffrey C. Hughes Foundation, the Hudson River Foundation, the Norcross Wildlife Foundation, the Sweet Water Trust, and the Wildlife Conservation Society, and donations from numerous concerned and generous individuals and organizations, gave us the means and the inspiration to complete the *Manual* over a period of several years. This publication was supported by a subcontract with Cornell University and its Department of Natural Resources and the New York Cooperative Fish and Wildlife Research Unit, under MOU00024-34 from the New York State Department of Environmental Conservation. We are deeply grateful to these individuals, foundations, and agencies, without whose assistance and encouragement the *Manual* may never have been brought to life.

1.0

Introduction

1.0 Introduction

What is Biodiversity?

Biological diversity or "**biodiversity**" can be defined most simply as "the variety of life and its processes." The term refers to all the variation in nature, including ecosystems, biological communities, species, and their genes. It also refers to the interactions of organisms with each other, and with the non-biological components of their environments, such as soil, water, air, and sunlight.

Intact ecosystems help to create and support the world as we know it by providing such basic services as climate moderation, oxygen production, soil formation, nutrient transformation, and production and decomposition of organic matter. Despite much attention in the last century to the study of ecology, the ecological sciences are still in their infancy. Biologists understand very little about the interaction of organisms with their environment, and the role of individual species in maintaining ecosystem processes. We do know, however, that artificially simplified systems (a cornfield is an extreme example) can easily be wiped out by a single disease or weather event. We have come to believe that ecosystems containing their full natural complement of species and processes are best able to withstand both "normal" environmental extremes and catastrophic events, such as diseases, droughts, floods, fires, and climate change. Thus, protecting native biodiversity is a means to the larger goal of preserving the integrity and resilience of ecosystems.

Certain species may have surprising importance to the overall functioning of the system. Indeed, the loss of a fungus or a moth species could have more far-reaching effects on certain ecosystems than the loss of a large predator.

Throughout the world, the loss of species and ecosystems is occurring at an accelerating pace. Many parts of the world have already lost most of their natural ecosystems. These losses occur not only in the famously species-rich habitats such as tropical rainforests and coral reefs, but also throughout the temperate regions, and especially those regions with the densest human populations. Most of these declines are caused by destruction of physical habitat, displacement by introduced species, alteration of habitats by chemical pollutants, over-harvesting, and hybridization with other species (Wilson 1992). In the United States, 52% of the native freshwater mussel species, 25% of the native freshwater fishes, 22% of amphibian species, and 16% of flowering plant species are imperiled (20 or fewer occurrences) or presumed extinct (Stein et al. 2000).

Biodiversity is not measured simply by the number of species in a region or a habitat. Habitats with a high species richness (number of species) and habitats with low richness may be equally important to overall diversity. Indeed, low-richness habitats such as cattail marshes, woodland pools, intertidal shores, and sand plains support some species of plants and animals that do not occur or do not reproduce in higher-richness habitats. The loss of those biologically simple habitats can lead to the local loss of species.

For the most part, we cannot predict the effects of losing any particular species in a biological community or an ecosystem. Certain species may have surprising importance to the overall functioning of the system. Indeed, the loss of a fungus or a moth species could have more far-reaching effects on certain ecosystems than the loss of a large predator. We do not know which species are essential, and which, if any, are expendable, or *how much* biodiversity is needed to maintain ecosystems. Unfortunately, many species and communities will disappear before we can answer all those questions. In the face of our ignorance, we believe that the wisest course is to restore and maintain the native biological diversity as much as possible, using the best information available, even if there are still uncertainties.

What is Ecological Significance?

Certain rare species depend upon small and isolated habitats.

In this *Manual*, we describe certain habitats as "significant" in the sense of ecological significance. We recognize that there are many other kinds of significance—educational, scientific, aesthetic, commercial, and recreational—that communities, landowners, and planners must consider in their decisions about land use and conservation. Ecological significance can encompass a broad range of attributes related to the habitat's role in the larger ecosystem. Some of these are described below.

Rarity A habitat that is itself rare, or that supports one or more rare native species may be considered ecologically significant. Although biodiversity encompasses both common and rare communities, it is rare native species and populations, rare communities, and rare habitats that are generally in the greatest danger of disappearing from the overall "bank" of diversity. Therefore, the degree of rarity and of vulnerability should receive careful attention in setting priorities for conservation.

Extent Certain animal species require large, contiguous areas, often containing a complex of particular habitats. The large size may serve a variety of purposes—providing an effective buffer from competitors, predators, human intruders, and other disturbances (e.g., noise, lights), or providing for most or all of their life history needs, thus reducing or eliminating the need for offsite foraging or nesting migrations. In the absence of suitable large areas, some species will reproduce at a low rate or not at all. Due to the diffuse nature of land development in the Hudson Valley, extensive examples of certain habitats or habitat complexes are now rare.

Small Size and Isolation The ecological importance of certain habitats such as intermittent woodland pools, springs and seeps, and headwater streams may be enhanced by their small size or their isolation from other habitats such as fields, large wetlands, or large streams. Certain rare species depend upon the small size and isolation of those habitats to reduce competition from the generalist organisms that frequent larger or more common habitats.

Juxtaposition with Other Habitats The proximity of certain kinds of habitats to other habitats may help to determine their ecological significance. For example, an intermittent woodland pool will be important to breeding mole salamanders only if the surrounding forest (the salamanders' non-breeding habitat) is maintained in a more-or-less unaltered condition. Blanding's turtles use certain wetlands and uplands because of the proximity of those habitats to their overwintering pools and springtime foraging sites.

Vulnerability Some habitats are especially vulnerable to disease or to invasive species. The vulnerability of hemlock stands to the hemlock woolly adelgid, or the Hudson River aquatic communities to the zebra mussel are good examples. Other habitats are particularly vulnerable to human activities, human-associated predators (raccoon, dog, opossum), or other disturbances associated with the presence of humans. These disturbances may include overgrazing by deer, human recreation (crests, shoreline areas, shallows, ponds, and lakes are especially attractive for recreation), overharvesting of certain plant or animal species, pollution, and fragmentation. Undisturbed examples of these vulnerable habitats are rare or may soon become rare, even if the habitat type itself is not rare in the region.

Exemplary Nature The best examples of certain common habitats may have special ecological significance. For example, a mature hardwood forest that covers several hundred acres (or hectares), contains an especially diverse plant community, contains few non-native species, and is unfragmented by roads, trails, or developed parcels may act as a reservoir for species that do poorly in altered or fragmented forests. Thus, it may have particular regional importance, even though mature hardwood forests are not themselves rare in the region.

*This **Biodiversity Assessment Manual** is intended to help environmental practitioners and citizens identify, assess, and protect habitats and species of special conservation importance.*

Some habitat types provide an extraordinary breadth of services to other components of the landscape. Floodplains, for example, strongly influence stream water quality and stream flow, and are also primary breeding and foraging habitats for a large array of resident and permeant wildlife. The loss or degradation of floodplain habitats can affect organisms and processes far beyond the floodplain boundaries.

This Manual and Biodiversity Conservation

For the last several decades, protection of open space and of consumable natural resources have been prominent public issues in the Hudson Valley. Political debates, and public and private conservation efforts have focused on the protection of scenic beauty, farmland, fisheries, and recreational and historic resources. Other biological resources, however, have been largely overlooked, despite their relevance to many of those same concerns. Local, state, and federal environmental regulations offer some protection of wetlands, streams, and the Hudson estuary, but rarely address biodiversity or habitat conservation *per se.* While local planning agencies have successfully surveyed and mapped environmental opportunities and constraints such as water resources, steep slopes, and suitability of soils for septic systems, they lack comparable tools for identifying biological resources.

Political debates, and public and private conservation efforts have focused on the protection of scenic beauty, farmland, fisheries, and recreational and historic resources. Other biological resources have been largely overlooked, despite their relevance to many of those same concerns.

This *Biodiversity Assessment Manual* is intended to help fill these information gaps, and to help environmental practitioners and citizens identify, assess, and protect habitats and species of special conservation importance. The *Manual* takes a habitat approach to conserving biological resources using the biodiversity survey method Hudsonia scientists have developed during more than 25 years of study and collaboration with other scientists in the region. The core of the *Manual* is the Habitat Profiles section, which describes the physical and biological components of important habitats in the region, and considerations for conservation. Although the *Manual* also includes profiles of many rare and uncommon species that use those habitats, it is not designed to be an identification guide to species of plants and animals.

The habitat approach helps users identify areas of ecological sensitivity, and habitats likely to support rare plants or animals. The *Manual* will not turn non-naturalists into field biologists, but will nonetheless help users without particular knowledge of regional biology or natural history to:

1 conduct map analyses to predict the potential occurrence of significant habitats,

2 evaluate the biodiversity information in environmental documents such as Environmental Impact Statements; and

3 develop appropriate conservation plans for significant habitats and habitat complexes.

Biologists and naturalists can use the map analyses to focus their field surveys, and the habitat and species profiles to help identify special habitats in the field.

The core area covered by the *Manual* comprises the towns, cities, and villages adjoining both sides of the Hudson River Estuary (Table 2, Figure 1). Many of the habitats and species described herein, however, are also of conservation concern throughout the Hudson Valley and elsewhere in the northeastern U.S. While we intend to expand the geographic coverage of the *Manual* in future editions, we also intend that this edition of the *Manual* be used outside the "Hudson River corridor" to the extent that it is applicable.

1.1 Who Should Use This Manual

This *Manual* is designed for use not only by experienced naturalists and environmental professionals, but also by persons with little practical experience in natural sciences or map interpretation but with a strong interest in biodiversity conservation. Even the more technical portions of the *Manual* can be useful to non-biologists conducting in-office reviews of environmental assessment documents, as well as scientists and naturalists planning and conducting field studies. Table 1 lists some of the uses for the *Manual* for users with various interests and needs for information.

TABLE 1. USER GROUPS FOR THE MANUAL

	User Group	Users who are
Public Planners	County Planning Departments County Environmental Management Councils Municipal Planning Boards Conservation Advisory Councils Departments of Transportation and Public Works	► *designing biodiversity surveys* ► *designing master plans for development or infrastructure* ► *selecting potential sites for particular land uses* ► *designing conservation strategies for at-risk habitats and species* ► *designing open space areas to maximize the protection of biodiversity resources in a town or region*
Regulatory & Advisory Boards	Town Boards Municipal Planning Boards Municipal Zoning Boards Conservation Advisory Councils State Agencies Federal Agencies	► *assessing biodiversity resources on potential development properties* ► *reviewing environmental assessment documents for development proposals* ► *designing permit conditions to protect rare species and special habitats* ► *preparing constraint or factor maps of significant habitats* ► *preparing scoping documents for the SEQR process* ► *designing regulations, conservation policies, and land management policies to protect significant habitats and rare species* ► *setting priorities for ecological restoration and habitat management* ► *designing conservation strategies for at-risk habitats and species*
Other Public Agencies	NYS Office of General Services County Bureaus of Real Property Tax County Departments of Transportation Town Highway Departments County Departments of Health Water and Sewer Districts Mosquito Control Units	► *guiding use and disposal of surplus property, or lands on which taxes are delinquent* ► *designing roads and other infrastructure to minimize harm to significant habitats* ► *designing vector control programs that minimize harm to significant habitats and non-target species*

(continued)

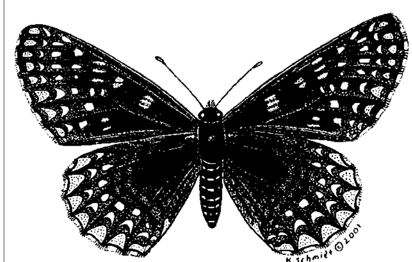
TABLE 1. USER GROUPS FOR THE MANUAL (cont.)

	User Group	Users who are
Private Organizations & Individuals	Conservation and Environmental Organizations Citizens' Groups Land Trusts Individual Landowners	► *assessing biodiversity resources on potential development sites* ► *assessing biodiversity resources of potential conservation lands* ► *assessing land use potential for design of conservation easements* ► *designing conservation strategies for at-risk habitats and species* ► *designing proactive surveys for rare species and significant habitats* ► *land management planning*
Land Developers, Engineers, & Environmental Consultants		► *assessing biodiversity resources on potential development sites* ► *choosing locations and designing projects to minimize impacts to significant habitats and rare species* ► *designing open space areas to maximize the protection of biodiversity resources on development sites*
Biologists & Naturalists		► *assessing habitat potential for rare species* ► *finding rare species and significant habitats* ► *advising on conservation for at-risk habitats and species*

1.2 How to Use the Manual

This *Manual* can be used both by persons with extensive knowledge of regional natural history, and by those without such knowledge but with particular needs for biodiversity information in land use planning or decision-making. Most users will not be inclined to read the *Manual* cover-to-cover, but instead will go right to the sections that serve their particular needs. We have organized the *Manual* with that in mind. Tabbed dividers mark the major sections in the body of the *Manual*, and the start of the appendices. Each page is clearly labeled with the name of the major section and subsection to which it belongs. Pull-out sentences in the margins offer some facts and ideas "at-a-glance" and give a sense of the information contained in the narrative sections.

Sections 1 and 2 of the *Manual* give general introductions to the concepts of biodiversity, ecological significance, and rarity. **Section 3** outlines the "how-tos" of a biodiversity assessment. **Section 4** gives some guidance on incorporating biodiversity protection into land use planning. **Sections 5 and 6** offer some instruction in map and photo analysis for predicting significant habitats. Detailed profiles of significant habitats and species are presented in **Sections 7 through 9**. The appendices contain a glossary of terms used in the *Manual*, lists of rarity ranks and explanations of ranking systems, scientific names of plants and animals, and soils and geology information. The appendices also give sources for maps and other documents useful for biodiversity assessments.



Baltimore
(Euphydryas phaeton)

Below are some examples of the ways the *Manual* might be used.

If you are a town planner considering which areas of town would be best for siting light industry and new residences, you could use the *Manual* in these ways:

1 Submit an inquiry to the NYNHP for known occurrences of rare species and rare communities (App. 2).

2 Conduct an in-office biodiversity assessment, using topographic, soils, and geology maps, aerial photographs, and your own knowledge of the area, to predict the occurrences of significant habitats, and to locate areas of existing developed land uses (Sects. 5.1, 5.2, and 6).

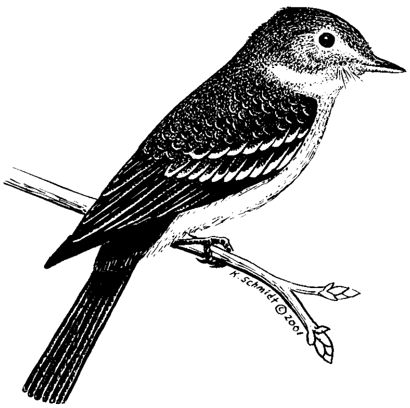
3 Consult the Habitat Profiles (Sect. 7) to learn about the species of conservation concern that might occur in the habitats predicted in (2) above, the particular sensitivities of those habitats, and recommendations for conservation.

4 Combine the habitat predictions with information from other in-house maps of features such as roads, utilities, aquifers, and prime farmland.

5 Consult Sect. 4 (Using Biodiversity Information in Land Use Planning) for some general advice about planning for development to minimize impact on the land.

6 Choose preferred locations for development that would:

- a avoid or minimize impacts to the most sensitive habitats;
- b avoid or minimize disturbance of previously undisturbed land;
- c maximize the use of existing transportation and utility infrastructure;
- d minimize the need for expanded vehicle use for access to the new developments; and
- e integrate the new developments with other community functions and services as much as possible.



Acadian flycatcher
(Empidonax virescens)

If you are a town planner considering which lands to recommend for town purchase for conservation purposes, you could use the *Manual* in these ways:

1 Submit an inquiry to the NYNHP for known occurrences of rare species and rare communities (App. 2).

2 Conduct an in-office biodiversity assessment, using topographic, soils, and geology maps, aerial photographs, and your own knowledge of the area, to predict the occurrences of significant habitats in the areas of interest, and to locate nearby areas of existing developed land uses (Sects. 5.1, 5.2, and 6). Use aerial photos to ascertain the spatial relationship of candidate properties to nearby lands of conservation importance.

3 Consult the Habitat Profiles (Sect. 7) to learn about the species of conservation concern that might occur in those habitats, the particular sensitivities of the habitats, and recommendations for conservation.

4 If appropriate habitat is present, obtain the services of one or more biologists to conduct surveys for selected rare species (Sect. 3).

5 Consult Sect. 4 (Using Biodiversity Information in Land Use Planning) for some general advice about planning for development to minimize impact on the land.

6 Prioritize candidate lands according to such attributes as:

a availability for purchase;

b presence of significant habitats or rare species;

c degree of threat or vulnerability to disturbance;

d connectivity with other conservation lands, and other lands of ecological significance; and

e compatibility of conservation with adjacent land uses.

If you are a member of a Conservation Advisory Council or Planning Board reviewing an Environmental Impact Statement (EIS) associated with a proposal for a new development, you could use the *Manual* in these ways:

1 Conduct an in-office biodiversity assessment, using topographic, soils, and geology maps, aerial photographs, and your own knowledge of the area, to predict the occurrences of significant habitats on and near the proposed development site (Sects. 5.1, 5.2, and 6). Use aerial photos to ascertain the spatial relationship of candidate properties to nearby lands of conservation importance.

2 Consult the Habitat Profiles (Sect. 7) to learn about the species of conservation concern that might occur in those habitats, the particular sensitivities of the habitats, and recommendations for conservation.

3 Consult Sect. 5.3 (How to Analyze Environmental Assessment Documents) to help assess the adequacy of the biological information contained in the EIS.

4 If the biological information in the EIS seems inadequate to draw informed conclusions about the presence of important biological resources (Sect. 5.3), ask the applicant to conduct further studies using appropriate survey techniques. These studies should include rare species surveys conducted by qualified experts, if suitable habitats are present (Sects. 3 and 5.3).

5 If rare species are present, learn about their particular habitat requirements and sensitivities (Sect. 9 and other sources).

6 Using that new information, and consulting Sect. 4 (Using Biodiversity Information in Land Use Planning), see if the project has been designed to:

   a avoid impacts to the most sensitive habitats and species;
   b avoid or minimize disturbance of previously undisturbed land;
   c maximize the use of existing transportation and utility infrastructure;
   d minimize the need for expanded vehicle use for access to the new development; and
   e integrate the new development with other community functions and services as much as possible.

   If not, ask the applicant to justify their design, or to redesign the development to minimize impacts to the land and to existing community functions.

If you are a biologist initiating a biodiversity assessment of a site proposed for development or conservation, you could use the *Manual* in these ways:

1 Review the general procedures for a biodiversity assessment (Sect. 3).

2 Submit an inquiry to the NYNHP for known occurrences of rare species and rare communities (App. 2).

3 Conduct an in-office biodiversity assessment of the site and nearby areas, using topographic, soils, and geology maps, aerial photographs, and your own knowledge of the area, to predict the occurrences of significant habitats in the areas of interest (Sects. 5.1, 5.2, and 6). Use aerial photos to ascertain the spatial relationship of the site to nearby areas of conservation importance.

4 Consult the Habitat Profiles (Sect. 7) to learn about the identification and assessment of those habitats, and the species of conservation concern the habitats might support.

5 Consult the Species Profiles (Sect. 9) and other sources (App. 8) to learn more about the ecology of those species.

6 Conduct field studies to verify the presence of the predicted habitats, to identify other significant habitats, and to assess their condition and suitability for potential rare species (Sects. 3, 7, and 9).

7 If appropriate to the needs of the study, conduct rare species surveys according to accepted protocols. If you are not an expert in the species to be surveyed, obtain the services of experts to conduct those surveys (Sect. 3).

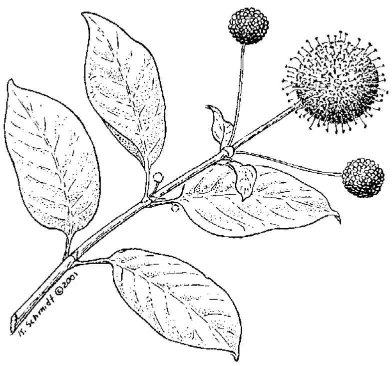
8 Document the habitat and species surveys in sufficient detail (Sect. 5.3) so that reviewers can determine whether the techniques, timing, weather conditions, and other aspects of the surveys were adequate, or whether further surveys should be conducted.

9 Make conservation recommendations according to the particular sensitivities of the habitats and the species that do or could occur there (Sects. 7 and 9, and other sources).

Jefferson salamander
(Ambystoma jeffersonianum)

If you are a citizen concerned about biodiversity protection, you could use the *Manual* in these ways:

1. Use Sects. 7–9 to learn about some of the habitats and species of conservation concern in the region, their sensitivities to disturbance, and some guidance for conservation.
2. Use Sect. 4 to help review your town's Master Plan (Comprehensive Plan) and zoning ordinance with respect to biodiversity conservation principles.
3. Use Sect. 4 to assess the location and design of proposed developments in your town or region with respect to biodiversity conservation principles.
4. Use Sects. 3, 5, and 6 to help assess the quality of biological information in environmental assessment documents associated with proposed developments.



Buttonbush
(Cephalanthus occidentalis)

Here's how to find other kinds of information in the *Manual.*

If you wonder what we mean by "**biodiversity**" and why it might matter to you...
go to Sects. 1 and 2.

If you want to know what we mean by the "**Hudson River Estuary Corridor**," and "**the study area**"...
go to Sect. 1.3 and Figure 1.

If you wonder about the meaning of any other term used in the *Manual*...
go to the **Glossary** (App. 1)

If you want to understand **the basic elements of a biodiversity assessment** for a particular site or a whole region...
go to Sect. 3.

If you want to see **how to make habitat predictions** on the basis of maps and aerial photographs...
go to Sects. 5 and 6.

If you want to know **how to analyze environmental assessment documents**, such as Environmental Impact Statements, for biodiversity information...
go to Sect. 5.3.

If you are curious about the **special attributes of a habitat**, or its potential rare species....
go to the Profile of that habitat (Sect. 7).

If you want to see **photographs** of the profiled habitats...
go to Sect. 8.

If you are looking for some **conservation recommendations** for a particular habitat...
go to the Profile of that habitat (Sect. 7).

If you want to learn something about the **habitat requirements** for one of our profiled species...
go to the Profile of that species (Sect. 9).

If you are looking for some information on **survey techniques** for a particular species, or group of species...
go to the Species Profiles (Sect. 9).

If you want to learn about **incorporating biodiversity protection into land use planning**...
go to Sect. 4.

If you want to learn about some **general measures for biodiversity protection**...
go to Sects. 4.2–4.4.

If you wonder about the delineation of the different **tidal zones** (subtidal, supratidal, etc.) mentioned in the *Manual*...
see Figure 3, p. 82.

If you want to know the **rarity rank** of a species mentioned in the *Manual*...
go to App. 2 (for an explanation of ranks) and App. 3 (for a listing of ranks).

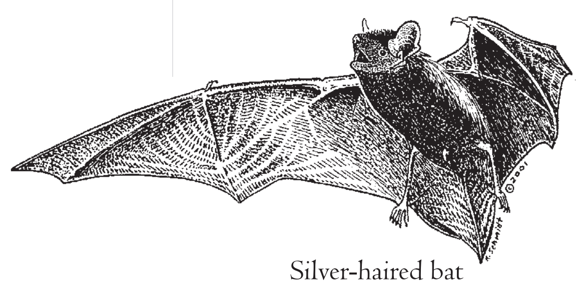
If you want to know **how to obtain maps, aerial photographs, and other documents** relevant to biodiversity assessments...
go to App. 7.

If you want to see a list of **useful field guides**, identification manuals, and other natural history resources...
go to App. 8.

If you want to know how to **locate qualified field biologists** to help with biodiversity studies...
go to App. 7.

If you want to know the **scientific names** of plants and animals mentioned in the *Manual*...
go to App. 4.

If you want to know **how to request information** about known occurrences of rare species and rare communities on a particular site...
go to App. 2.

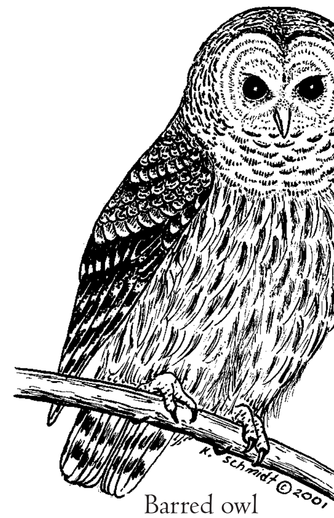


Silver-haired bat
(Lasionycteris noctivagans)

1.3 The Study Area

The *Manual* "study area" encompasses the towns and cities bordering both sides of the tidal Hudson River for the approximately 200 km (130 mi) from Westchester and Rockland counties at the south end to Albany and Rensselaer counties at the north end (Table 2 and Figure 1). We also refer to this area as the "Hudson River Estuary Corridor" or simply the "corridor." The study area excludes those portions of Troy and Colonie north of the Troy Dam. Our coverage of the river itself extends down to 2 m below mean low water (i.e., approximately the minus-6 foot contour on the USGS 7.5 minute topographic maps).

The *Manual* can also be used as a general ecological and conservation guide for many parts of the Hudson Valley that are outside the *Manual* study area but contain environments similar to those described herein. Certain regions outside the study area — e.g., the Catskill Mountains, Shawangunk Mountains, Black Dirt region, Harlem Valley, and Taconic Mountains — have a distinctive ecological character, however, including species not represented in the *Manual* study area, as well as habitats with major differences from the ones we describe. The study area and the Hudson Valley as a whole are very diverse physically, ecologically, and culturally. This variety results in great diversity of habitats and large numbers of plant and animal species.



Barred owl
(Strix varia)

The Hudson River and Local Topography

The tidal river varies from a maximum depth of 10 m (33 ft) in the dredged shipping channel south of Albany to a maximum depth of 60 m (200 ft) near West Point in the Hudson Highlands. (The *Manual* does not describe the habitats of the deep channel areas.) The river is at sea level (0 m/ft elevation). The highest elevations in the study area are about 430 m (1420 ft) in the Hudson Highlands and 970 m (3180 ft) in the narrow sliver of the Catskill Mountains that falls within our boundary. Large portions of the study area, however, are below 200 m (650 ft) elevation.

Because the river itself warms slowly in spring and cools slowly in fall, the tide-affected habitats and their margins tend to lag behind areas slightly inland as the spring and fall seasons advance. Our hills are not massive enough to have cooler microclimates at high elevations (although this occurs just west of the study area in the Catskill high peaks). The rocky, exposed crests of many of our hills and ridges warm quickly in the sun and represent warmer habitats, but the same crests are very exposed to wind, snow, and ice in winter. Cool microclimates occur in deep sheltered ravines and areas of cold air drainage just below these ravines. Plattekill Clove of the "mural front" of the Catskills (near Saugerties) is a highly-developed example, but even the Saw Kill ravine at Bard College (Town of Red Hook) has a cool microclimate. The warmth of exposed topographic "highs" in the sun, and the coolness of sheltered "lows" cause differences (usually subtle) in plant and animal communities.

The region is very diverse physically, ecologically, and culturally. This variety results in great diversity of habitats and large numbers of plant and animal species.

At any point on the river, there are two high tides and two low tides alternating in a 25-hour period. The "tidal amplitude," or the vertical distance between average high tide level (Mean High Water or MHW) and average low tide level (Mean Low Water or MLW), decreases southward from about 1.8 m (6 ft) at the Troy Dam to about 0.8 m (2.6 ft) in the Hudson Highlands, and increases farther southward to about 1.1 m (3.7 ft) at Yonkers. Although the reversing tidal currents in open water areas are sluggish, restricted passages such as those beneath railroad bridges have fast and turbulent flows. Only a certain group of animal species is adapted to the rigors of the tidal environment, and many animals move in and out at different seasons and tidal stages.

The river water is strictly fresh (although tidal) south as far as Hyde Park. During spring floods, the river is fresh throughout the study area. As the flow of freshwater from the watershed declines through the summer, the "salt front" (i.e., 100 parts-per-million [ppm] salinity) gradually moves upriver, reaching Beacon many years and penetrating as far as Poughkeepsie or Hyde Park during severe droughts. The freshwater tidal segment of the river has moderate alkalinity and pH near neutral. Levels of nitrogen and phosphorus, thus "fertility," are high in Hudson River water. The tidal wetlands and shallows support plants that thrive in a wet, fertile, circumneutral environment.

The river water is strictly fresh (although tidal) south as far as Hyde Park. During spring floods, the river is fresh throughout the study area.

The freshwater tidal shallows may freeze over for 1–4 months during winter. Marshes sheltered by the railroads are ice-covered longer. Only rarely does the river freeze over throughout the study area. Most inland ponds and lakes generally are frozen longer than even the upper river.

Three sections of the study area have high hills or ridges with rugged topography. The Hudson Highlands (part of the Old Appalachians) border both sides of the river from Newburgh and Beacon on the north almost to Peekskill and Haverstraw on the south. The New York Palisades border the west side of the river from a short distance south of Haverstraw south to the New Jersey state line. The Catskill Mountains eastern escarpment rises at the western edge of the towns of Catskill and Saugerties. The rest of the study area is not mountainous but locally has steep bluffs and hills on a smaller scale. Bluffs or banks 10–30 m (30–100 ft) high border large segments of the river north of the Hudson Highlands. The Westchester County shoreline has similar relief. Bold hills occur here and there, such as Mt. Merino and Church's Hill near the east end of the Rip Van Winkle Bridge (south of Hudson), Hussey Hill, Shaupeneak Mountain, Illinois Mountain, and Marlboro Mountain between Kingston and Marlboro, and Prickly Pear Hill near Croton-on-Hudson.

Geology and Soils

The bedrock of the New York Palisades (Rockland County) is diabase, a hard rock that intruded in molten form between layers of softer sandstone and shale. Diabase weathers into vertical columns that form steep cliffs on the riverside. Away from the river, the Palisades slope gently westward. Bedrock in the Hudson Highlands is diverse. Granite and gneiss, both hard rocks, are common. In many places these rocks have formed steep cliffs on one side of a ridge with a gentler "ramp" on the other side. Varied bedrock in the Highlands gave rise to soils that apparently vary greatly in pH, moisture, and other qualities. These differences in turn have influenced plant communities.

The entire study area was glaciated. Most of the soils in the study area are glacial tills, which contain mixtures of different particle sizes from clay to boulders.

Bedrock in Westchester County is gneiss, schist, and quartzite, with smaller areas of marble. These are all more or less hard rocks. North of the Hudson Highlands, however, sandstones, shales, or limestones predominate in many areas. These are softer rocks and less resistant to geological erosion. Topography is gentler and bedrock is less exposed in the softer rock terrains. Deeper, moister, more fertile soils have accumulated on softer rock areas and in depressions on harder rocks. These better-developed soils support larger trees and greater variety of plants, whereas shallower, rocky soils tend to support smaller, even stunted, trees.

Large areas near the river north of the Hudson Highlands are covered with clay deposits; these are especially prominent on the east side of the river north of Hyde Park, and on the west side north of Kingston. Clays tend to accumulate water on flat or depressed surfaces. On slopes, precipitation may accumulate within the soil causing instability and slumping or sliding.

Notable natural sand deposits occur at Croton Point, Haverstraw, Hyde Park, and Rhinecliff, inland at Rosendale, and especially in the Albany area. Many artificial sand deposits from the disposal of dredged material ("dredge spoil") occur in the river from about Saugerties northward. Sands, because they drain freely and erode readily, produce habitats that may be very dry at the soil surface in summer. The natural sands, especially those in the Albany Pine Bush, are acidic and infertile. The dredge spoil sands, however, are apparently more neutral in pH and somewhat more fertile, and they contain modest admixtures of organic matter and calcareous mollusk shell from the river bottom.

If left alone long enough by humans, large portions of the study area would be forested.

The entire study area was glaciated. Most of the soils in the study area are glacial tills, which contain mixtures of different particle sizes from clay to boulders. Sandy and gravelly materials were deposited as glacial outwash by streams flowing off the melting glaciers. Clayey and silty materials accumulated farther downstream in lakes. During the post-glacial period, streams deposited alluvial materials; on floodplains these deposits are often silty. Texture, pH, fertility, and hydrological characteristics of soils influence plants and animals. For example, gravelly glacial outwash contains the deep kettle wetlands that are most favorable for Blanding's turtle, whereas clays from glacial lake bottoms support wet meadows with distinctive plant communities.

Human Influences

If left alone long enough by humans, large portions of the study area would be forested (exceptions are most of the intertidal and all the subtidal habitats, as well as long-flooding inland areas and very rocky habitats). Prehistoric and historic human activity, however, has created a mosaic of forested areas and "open" areas dominated by herbs, shrubs, or even mosses, bare rock or soil. Most, perhaps all, of the study area has been subjected to deforestation and livestock grazing. Even an extremely rugged mountain, Breakneck Ridge, was grazed by goats in the 1800s, and most wetlands probably experienced livestock grazing as well. Many hills and knolls lost large amounts of soil. Extensive areas that were not too wet or dry, and not too steep, were cultivated. "Indian fields" already occupied some — perhaps many — favorable areas when Europeans arrived in the Hudson Valley. Now that farming is less a matter of survival, the wettest, driest, and rockiest areas have mostly been abandoned. The lowland areas with deep soils and intermediate moisture, however, were probably farmed continuously for centuries, and, during the past 50 years, many have been developed for residential, commercial, or industrial use. As a result, the biological communities that once characterized these habitats, including old growth forests with large trees and extensive shallow wetlands, are all but gone and we know little of their ecology. Thus lowland old growth forests like those at Montgomery Place (Town of Red Hook), and forest floors that have deep leaf litter and uncompacted soils, are rare remnants of features that may once have covered large areas.

Lowland old growth forests and forest floors that have deep leaf litter and uncompacted soils are rare remnants of features that may once have covered large areas.

Human influences on wetlands have been complex and pervasive. Aerial photographs, and careful exploration on the ground, often reveal remnants of drainage ditches or channelization in nontidal wetlands and the streams draining them. For centuries wetlands have also accumulated soil materials eroded from farmlands and construction sites. Although many wetlands have been destroyed by drainage, filling, or impoundment to create ponds and lakes, other wetlands have been created. Inadvertent wetland creation has occurred where surface drainage has been blocked by roads, or where small excavations made for watering livestock or mining later filled in with eroded soil. Even so, the net loss of wetlands in the

The net loss of wetlands in the region has been great, almost certainly more than 50% since European settlement.

region has been great, almost certainly more than 50% since European settlement. Furthermore, most of the remaining wetlands are of more common types (e.g., purple loosestrife marshes and meadows, shallow red maple swamps).

Current land use practices continue to influence flora and fauna. Horse or cattle pastures, corn fields, hayfields, parking lots, roadsides, house yards, flat roofs, woodlots at variable levels of harvest, groves of large trees, abandoned mines, recreation areas, nature sanctuaries, dumps, and ornamental ponds all have their own biological diversity. All these are components of the landscapes of the study area, a palimpsest inscribed by glaciation and other geomorphic processes, the random and nonrandom movements of plants and animals, and human activities.

TABLE 2. TOWNS AND CITIES IN THE HUDSON RIVER ESTUARY CORRIDOR

The "study area" covered by the Manual, and the counties and NYSDEC[a] regions in which it occurs.

Towns and Cities	Counties	NYSDEC[a] Region	Towns and Cities	Counties	NYSDEC[a] Region
Clarkstown	Rockland	Region 3	Poughkeepsie[c]	Dutchess (cont.)	Region 3 (cont.)
Haverstraw		845-256-3000	Red Hook		
Orangetown			Rhinebeck		
Stony Point			Wappinger		
Cortlandt	Westchester		Athens	Greene	Region 4
Greenburgh			Catskill		845-357-2234
Mt. Pleasant			Coxsackie		
Ossining			New Baltimore		
Peekskill[c]			Clermont	Columbia	
Yonkers[c]			Germantown		
Cornwall	Orange		Greenport		
Highlands			Hudson[c]		
New Windsor			Livingston		
Newburgh			Stockport		
Newburgh[c]			Stuyvesant		
Philipstown	Putnam		Albany[c]	Albany	
Esopus	Ulster		Bethlehem		
Kingston[c]			Coeymans		
Lloyd			Colonie		
Marlborough			Menands[c]		
Saugerties			Watervliet[c]		
Ulster			East Greenbush	Rensselaer	
Beacon[c]	Dutchess		North Greenbush		
Fishkill			Rensselaer[c]		
Hyde Park			Schodack		
Poughkeepsie			Troy[c]		

[a] New York State Department of Environmental Conservation.
[c] city

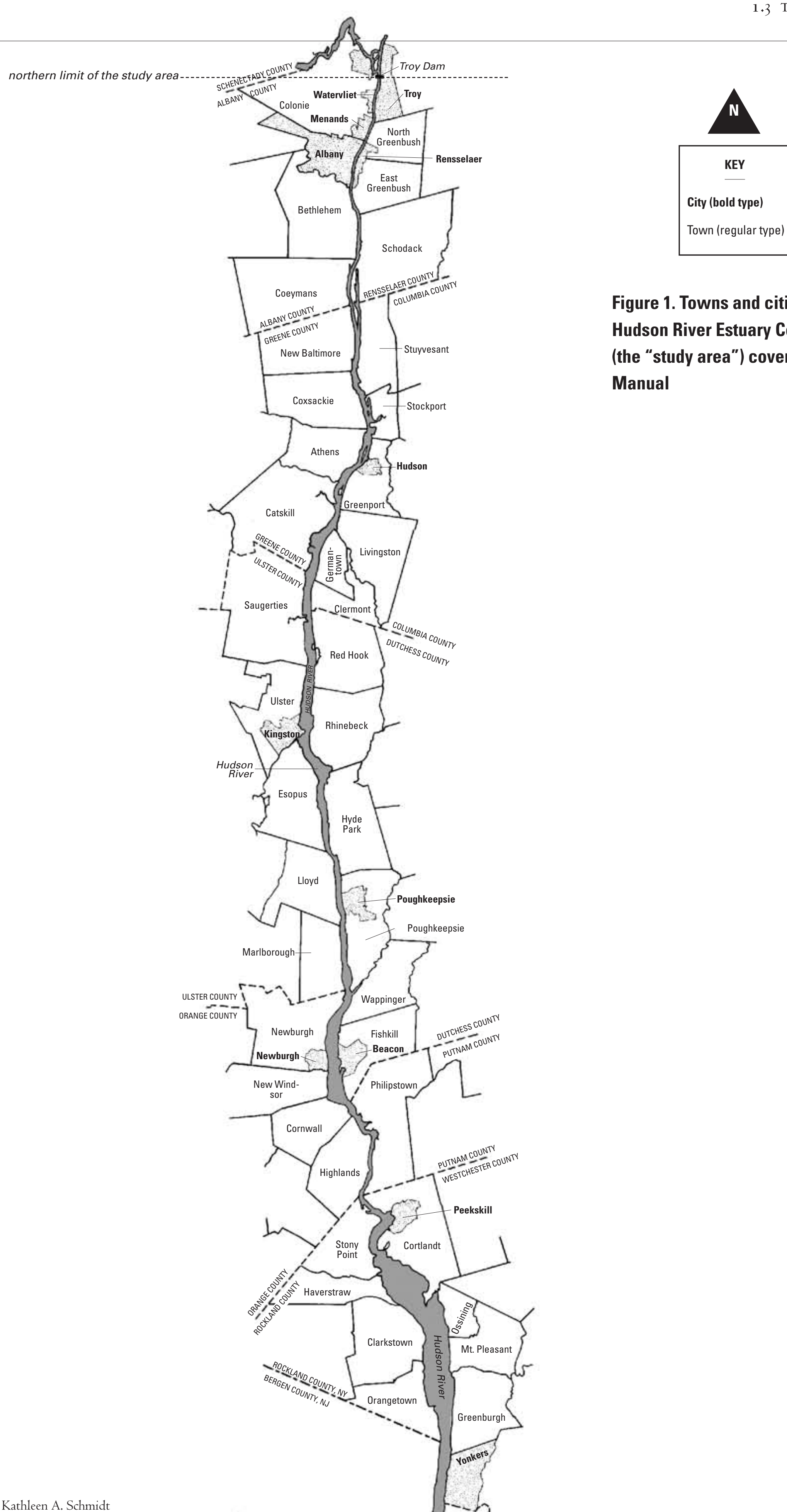


Figure 1. Towns and cities in the Hudson River Estuary Corridor (the "study area") covered by the Manual

Base map prepared by Kathleen A. Schmidt

Environmental Research and Education
Science for Conservation

2.0

Criteria of Rarity

2.0 Criteria of Rarity

In this *Manual* we consider rarity and ecological significance at national, state and regional geographic levels. Lists and evaluations of species at the national and state levels integrate information from many sources and provide a perspective that is not available on a regional or local level. Regional lists, however, can help alert biologists and planners to species and communities of regional significance, and perhaps help to avert the declines or disappearance of species that precede eventual listing at a higher geographic level. The eight kinds of rare and significant species classifications referred to in the *Manual* are listed in Table 3; each is described in subsections below.

TABLE 3. SUMMARY OF RARE SPECIES LISTS REFERRED TO IN THE MANUAL

A = all groups of animals; B = birds only; P = plants. An asterisk (*) indicates non-governmental lists.
See text below for explanation of each kind of list.

List	Group	Rankings
Federal Endangered and Threatened Species	AP	Endangered, Threatened
Other national lists:		
Migratory Nongame Birds of Management Concern*	B	Management Concern
Partners in Flight WatchList*	B	High Priority, Moderate Priority
Migrants in Jeopardy*	B	In Jeopardy
New York Endangered, Threatened, and Special Concern Species	A	Endangered, Threatened, Special Concern
New York Protected Native Plant List	P	Endangered, Threatened, Rare, Exploitably Vulnerable
New York Natural Heritage Program Active Inventory*	AP	various (see App. 2)
New York Natural Heritage Program Watch Lists*	AP	Watch List
Regional*	AP	Regionally-Rare, Regionally-Scarce, Declining, Vulnerable

While both common and rare native species and communities are important to the maintenance of intact ecosystems, rare species are of particular conservation concern because they may be in the greatest danger of disappearance. Moreover, the decline or disappearance of rare species often warns us of environmental deterioration, and may be part of (or may trigger) collapses in other parts of the ecosystem.

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Although some species are rare throughout the world, most of the rare species in any given region consist of small populations of otherwise well established species living near the margins of their geographical range. Populations of species occurring at their range margins often subsist close to the limits of their environmental tolerances, and are therefore more vulnerable to natural or human-caused stress. Biological conservation may be the most important at a species' range margins because that is where the bulk of the genetic variation in a species often occurs.

Biological conservation may be the most important at a species' range margins, where the bulk of the genetic variation in a species often occurs.

Many currently listed endangered and threatened species were once more prevalent, but were subjected to deteriorating ecological conditions of various kinds. This caused the eventual contraction or fragmentation of the species' geographic ranges and/or declines in the sizes of local populations. By the time species have become rare enough to be listed statewide or nationally, recovery is sometimes impossible. If conservation efforts begin at the level of regional rarity, however, then many of these species and their habitats might be restored to stability.

2.1 Federal Lists

The U.S. Fish and Wildlife Service oversees the listing of species under the federal Endangered Species Act. A species is classified as "**endangered**" if it is "in danger of extinction within the foreseeable future throughout all or a significant portion of its range." A species is classified as "**threatened**" if it is "likely to become endangered within the foreseeable future." Species of animals listed as federally endangered or threatened may not be killed, harmed, or otherwise taken. Listed plants may not be taken from federal lands without a permit, or taken from other lands if the taking violates state law. Updated lists are published in the Federal Register, and can be obtained from the website of the U.S. Fish and Wildlife Service: endangered.fws.gov/wildlife.html.

2.2 Other National Lists

The *Manual* refers to three national lists of birds of conservation concern: Migrants in Jeopardy, Partners in Flight Watch List, and Migratory Nongame Birds of Management Concern. These lists have no legal status; only those species included on state rare species lists are protected by state laws.

Neotropical "**Migrants in Jeopardy**" are 57 species of North American breeding birds (Table 13A in Appendix 3), mostly insect eaters, that winter in tropical forests and are "considered by many ornithologists to be at grave risk because of rapidly accelerating deforestation in Central and South America." Many of these species are also under stress from habitat fragmentation, brood parasitism, predation, and other factors on their breeding grounds in the Northeast and elsewhere. The list, published in *The Birder's Handbook* (Ehrlich et al. 1988), is based on the work of John Terborgh (1980) and David Wilcove.

If conservation efforts begin at the level of regional rarity, then many of these species and their habitats might be restored to stability.

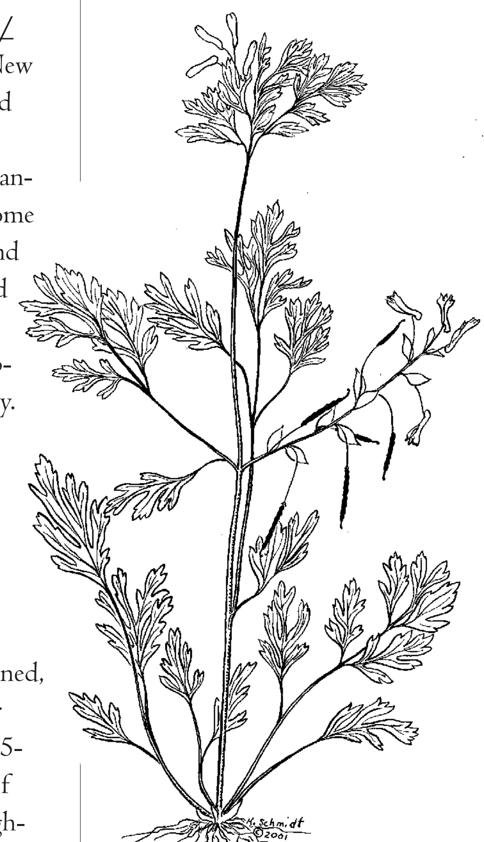
The **Partners in Flight WatchList** is a list of 105 bird species considered to be of the highest conservation concern, excluding those already designated as federally endangered (Table 13B in Appendix 3). The list was compiled by several federal and private associations, including the Colorado Bird Observatory, the American Bird Conservancy, Partners in Flight, and the U.S. Fish and Wildlife Service. The original list was published in Field Notes (Carter et al. 1996); the updated list is available at **www.audubon.org/bird/watch.**

The U.S. Fish and Wildlife Service Office of Migratory Bird Management published a list of 20 migratory, nongame bird species of the Northeast showing population decline or instability throughout a significant portion of their ranges (Schneider and Pence 1992) based on an earlier list of species for the United States as a whole (Office of Migratory Bird Management 1987). These birds are deemed "**Migratory Nongame Birds of Management Concern in the Northeast**," and were selected "because of their small or declining population sizes resulting from a host of assaults such as habitat loss and degradation, human disturbance, and contaminants." These are not the only such species of concern, but they represent those that have experienced the most dramatic declines. Nine of the listed species breed (or have bred) in the Hudson Valley (Table 13C in Appendix 3).

2.3 New York State Lists

Fish and Wildlife

The list of Endangered, Threatened, and Special Concern Fish and Wildlife Species of New York State became part of the state Environmental Conservation Law in 1983, and has been updated on an irregular schedule since then. The complete lists and subsequent updates are available on the NYSDEC website at **www.dec.state.ny.us/website/dfwmr/wildlife/endspec/etsclist.html**. **Endangered** species include any species occurring in New York and listed as endangered under the federal Endangered Species Act (see above), and other native species deemed to be in imminent danger of disappearing from New York State. **Threatened** species include any species listed as threatened under the federal Endangered Species Act, and other native species that have declined significantly and may become endangered in New York State if conditions in their environment continue to worsen and successful management actions are not undertaken. **Special Concern** species are believed to be declining or vulnerable in the state and may become threatened or endangered in the future. For many of the Special Concern species, too little is known about their population levels and ecology to reach conclusions about their actual status and vulnerability. "**Protected"** wildlife species are defined in the Environmental Conservation Law, and include protected wild birds, wild game, and endangered species. Protected species may not be taken, transported, possessed, or sold without a permit from NYSDEC. (See App. 2 for further information.)



Yellow harlequin
(Corydalis flavula)

Plants

The New York State Protected Native Plant List ranks species as Endangered, Threatened, Rare, or Exploitably Vulnerable. **Endangered** plants are native species "with 5 or fewer existing sites, or fewer than 1000 individuals, or restricted to fewer than four USGS 7.5-minute series maps, or species listed as endangered by the United States Department of Interior in the Code of Federal Regulations." They are "in danger of extinction throughout all or a significant portion of their ranges within the state and requiring remedial action to prevent such extinction." **Threatened** plants are native species "with 6 to fewer than 20 extant sites, or 1000 to fewer than 3000 individuals, or restricted to not fewer than four or more than seven USGS 7.5-minute series maps, or species listed as Threatened by the United States Department of Interior in the Code of Federal Regulations." **Rare** plants are those native species with 20–35 extant sites, or 3000–5000 individuals throughout the state. **Exploitably Vulnerable** plants are native species "likely to become threatened in the near future throughout all or a significant portion of their ranges within the state if causal factors continue unchecked." The Protected Native Plant list is updated irregularly. The complete list is available on the NYSDEC website at **www.dec.state.ny.us/website/regs/193b.htm#193.3**. Plant species listed as endangered, threatened, rare, or exploitably vulnerable may not be picked, removed, or damaged without the consent of the landowner. (See App. 2 for further information.)

2.4 New York Natural Heritage Program Lists

The New York Natural Heritage Program (NYNHP) surveys and monitors rare plants and animals, and significant ecological communities throughout the state. It publishes "active inventory" lists for rare plants and animals and updates them periodically. The active inventory lists for animals include species in all vertebrate groups, and selected invertebrate groups: butterflies, moths, beetles, dragonflies, damselflies, mayflies, and bivalve mollusks. The active inventory lists for plants include species of flowering plants, ferns, and fern allies only. A list of rare mosses was compiled in 1993, but there is no active survey program for mosses. The NYNHP active inventory lists have no legal status, but overlap substantially with the NYS Endangered, Threatened, and Special Concern lists. The NYNHP also publishes "Watch" lists of species that are not part of the active inventory, but while their status is uncertain they are still of conservation concern.

Some species may be rare statewide but have not been listed by NYNHP, because of a lack of adequate data, or delays in evaluating data. Many groups of invertebrate animals, as well as the liverworts, algae, lichens, and fungi have not been reviewed by NYNHP.

Each NYNHP-listed species has been assigned a global and a state rarity rank by the NYNHP; these rankings are reviewed and updated every year (plants) or every few years (animals) on the basis of an increasing body of data gathered by NYNHP and other biologists around the state. A detailed description of the NYNHP ranking system is given in Appendix 2. The NYNHP rare species lists are available at **www.dec.state.ny.us/website/dfwmr/heritage**, and obtainable by mail at Information Services, New York Natural Heritage Program, New York State Department of Environmental Conservation, 700 Troy-Schenectady Road, Latham, NY 12110-2400.

2.5 Regional Lists

Hudsonia has compiled preliminary lists of native plants and animals that are rare in the Hudson Valley but do not appear on statewide or federal lists of rarities. We use criteria similar to those used by the NYNHP for ranking statewide rare elements, 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. For vascular plants, we also consulted Clemants (1999) and the two Westchester County lists: Draft 2 (August 1999) of the Westchester County Endangered Species List, and the Rare and Significant Species Inventory of the Westchester County Department of Parks, Recreation and Conservation. We present the regional lists as provisional only, and hope to elicit responses from *Manual* users that will help us refine the lists for publication in the next edition of the *Manual*.

The concept of regional significance is intended to serve as a useful but not dogmatic tool for biodiversity assessment and conservation. Although we are not aware of all of the existing populations of all rare species in the region, the regional ranking serves as a measure of relative rarity. Regionally-rare and regionally-scarce plants and animals may be, but are not necessarily, declining or in danger of disappearing from the region. The presence or absence of these species may provide useful diagnostic information about habitats. They are often good indicators of rare or uncommon habitats, and their presence can alert us to the potential occurrence of statewide rare species. Many are sensitive to habitat conditions, and rely on habitats that are under particular pressure from land development or other human activities.

We use the following criteria for regional ranks:

- **regionally-rare:** 20 or fewer occurrences in the Hudson Valley (south of the Troy Dam) or a very few individuals of highly mobile species.

- **regionally-scarce**: 21–100 occurrences in the Hudson Valley (south of the Troy Dam).

- **declining:** Species believed to have declined in the Hudson Valley (south of the Troy Dam) during the past 1–4 decades. Some of these species are still common. Examples: smooth green snake, American black duck, American kestrel.

- **vulnerable:** Species that are not necessarily rare but are vulnerable to habitat loss and degradation, or to other likely changes in their environment. Some of these species have declined and recovered during the past 100–200 years. Examples: wood duck, eastern bluebird, spotted salamander.

Generally speaking, we do not consider of special conservation significance those species (particularly of birds, butterflies, and dragonflies) that are highly mobile and occasionally show up in our area as "accidentals" but do not use the Hudson Valley on a regular basis; examples are the sandhill crane, the western meadowlark, and the fiery skipper.

Hudsonia's preliminary list of regionally significant plant species is in Table 10 in Appendix 3. This list will be revised and updated in later editions of the *Manual*. Tables 11 and 12 in Appendix 3 list the regionally significant animal species that are mentioned in the *Manual* text. A complete list of regionally-rare and regionally-scarce animals has yet to be compiled. The regional lists are compiled for purposes of biodiversity assessments and conservation planning; they have no legal status.

Short-awn foxtail
(Alopecurus aequalis)

Environmental Research and Education
Science for Conservation

3.0

Outline of a Biodiversity Assessment

3.0 Outline of a Biodiversity Assessment

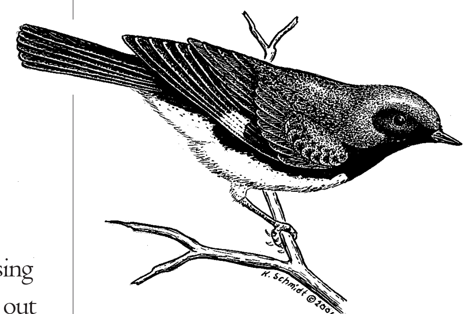
We recommend what we call the "ABCD" approach to a biodiversity assessment. This approach may be used for a particular site (e.g., a site proposed for development or conservation) or for a whole region (e.g., a watershed, town, or county). It entails the standard set of procedures outlined below.

A Map analysis and information review.

B Field reconnaissance and documentation.

C Rare species survey, if appropriate.

D Conservation planning and action.



Black-throated blue warbler
(Dendroica caerulescens)

Step A. Map Analysis and Information Review

The purpose of Step A is to predict the occurrence of significant habitats at your study site using maps, other existing documents, and communications with biologists. This step can be carried out effectively in the office by persons without experience in physical or biological field surveys.

Information about a site and nearby or similar areas can be obtained from a variety of sources, including published literature; agency files (such as the New York Natural Heritage Program); miscellaneous reports; field notes, photographs, and unpublished data from biologists and naturalists; historical documents; written records of nature clubs and research institutes; and museum specimen data. Those who regularly conduct in-office reviews will want to build a general library of published natural resource documents. Increasingly, these materials will become available on the Internet.

1. **Gather existing materials and information.** (See Appendix 7 for how to obtain this information.)

   i. Obtain maps, aerial photos, and soils surveys. Gather topographic maps, county soil surveys, state geology maps, state and federal wetland maps, and aerial photographs pertaining to your study site, and any available site-specific maps with more detailed natural resource information.

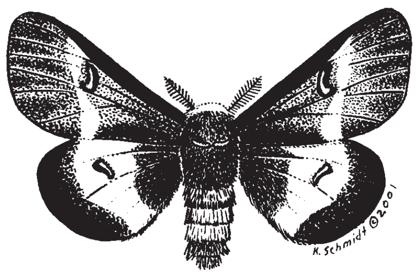
   ii. Obtain existing literature relevant to your study area. This may include environmental assessment documents (e.g., EAFs, EISs), published and gray literature on local biological research (obtainable through public agencies, research and academic institutions, and certain libraries), and newsletters from local nature clubs.

   iii. Submit an inquiry to the New York Natural Heritage Program (NYNHP). Contact NYNHP for records of state-listed rare communities and species in the vicinity of your study area. See Appendix 2 for further information about NYNHP inquiries.

   iv. Contact knowledgeable naturalists and biologists. Naturalists and biologists in the region can be valuable sources of unpublished information about the species and habitats in the vicinity of your study area. Inquire at nature clubs, and the science departments of local colleges and universities. Obtain secondary references to evaluate the reliability of your sources.

The map analysis can be carried out effectively by persons without experience in physical or biological field surveys.

2. **Analyze existing information to predict the occurrence of significant habitats and species.**



Inland barrens buckmoth
(*Hemileuca maia* ssp. 3)

i. Predict occurrences of significant habitats in and near your study area, using the maps, Habitat Keys (Sect. 6), Habitat Profiles (Sect. 7), and other information gathered in Step 1. Lots of basic information about a site—such as slopes, soils and geology characteristics, presence and character of wetlands and streams, and vegetation cover—can be obtained through map and aerial photo analysis. Section 5 provides some general instructions for map and photo interpretation for these purposes. Many kinds of habitats can be reliably predicted without ever setting foot on a site. Use the Habitat Keys to determine which habitats are indicated by the combination of physical and biological features present in your study area. Do not neglect to assess habitats *near* your study area, as well as those within the property boundaries of the site. Rare species of nearby habitats may use your study site for certain of their life history needs.

ii. Compile a list of all predicted habitats of interest and prepare a sketch map identifying their locations in your study area.

iii. Determine which rare species are likely to occur in your study area, using the Habitat Profiles (Sect. 7), the Species Profiles (Sect. 9), NYNHP data, and conversations with local naturalists. Some rare species are associated only with a limited geographic area (e.g., Blanding's turtle in the glacial outwash plains of Dutchess Co., or map turtle in the Hudson River estuary), or a particular geologic formation (e.g., dittany in the Hudson Highlands).

iv. Establish priorities for field assessment according to levels of conservation concern about particular habitat types and the rare species that could be associated with them. Priorities are especially important for large sites, where all areas cannot be surveyed thoroughly due to time, funding, or accessibility constraints.

Many kinds of habitats can be reliably predicted without ever setting foot on a site.

Step B. Field Reconnaissance

The purposes of this step are threefold:

- to verify the presence of habitats predicted in Step A,
- to identify other significant habitats, if any, and
- to assess their overall quality and suitability for particular rare species.

This step requires familiarity with local flora, and some knowledge of soils, geology, and landscape indicators. The habitat and species profiles in Sections 7 and 9 of the *Manual* are designed to aid in field identification and qualitative assessment of habitats. Use the information gathered in the office (Step A) to conduct a focused field investigation. Large areas often cannot be thoroughly surveyed when investigators are working under time and funding constraints. In those cases, the investigator should focus on the "biological highlights" of a site and its surroundings, predicted in Step A.

*Many **habitats** can be identified in the field at any time of year, but many of their component **species** can be found or identified only at certain times of the year.*

The field reconnaissance enables the investigator not only to positively identify significant habitats, if any, but also to assess the potential for the occurrence of rare species. While many biologically significant habitats can be identified in the field at any time of year, many of their component species can be found or identified only at certain times of the year.

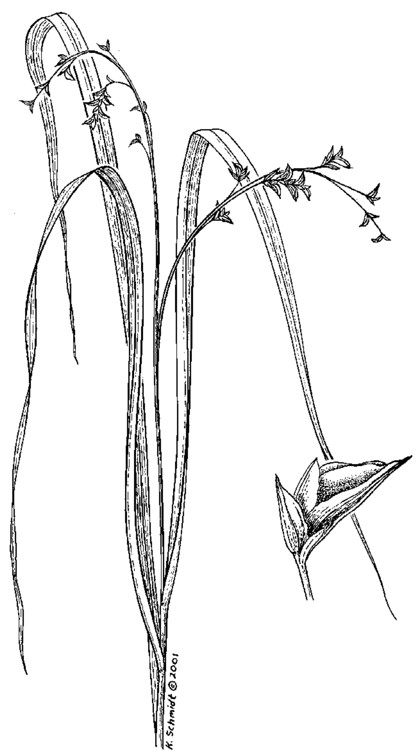
1. **Plan the field reconnaissance.**
   The nature and thoroughness of the habitat reconnaissance will depend on the season, the weather, and the time constraints relative to the size and accessibility of the study area. For large sites, use the results of Step A to focus the field effort on the locations most likely to contain significant habitats. Surveys from low altitude aircraft are a useful adjunct to ground surveys for reconnaissance of large sites or whole regions. Smaller sites can often be surveyed thoroughly.

Rare species surveys must be conducted by biologists who specialize in the particular groups of species to be surveyed.

2. **Conduct the field reconnaissance.**
   Use the Habitat Profiles (Sect. 7) to help identify habitats and assess habitat quality. Record detailed field notes that describe topography, surface water, surface soils, visible bedrock and other geological features, vegetation structure, plant species and abundance, animals (including animal sign), and human impacts. Note important features on a sketch map. Also describe weather conditions, snow cover (if any), and other factors that could affect the thoroughness of the reconnaissance. Photograph habitats or species that are unusual, rare, or exemplary.

3. **Document habitats according to field observations.**
   Prepare written habitat descriptions, and list the potential rare species, if any, in each of those habitats (see lists of Species of Conservation Concern in each of the Habitat Profiles [Sect. 7]).

4. **Determine if rare species surveys should be conducted.**
   The need for rare species surveys must be determined on a case-by-case basis, depending on the presence of suitable habitats, the purpose of the project (development, conservation, or general planning), the anticipated threats (if any) to habitats and species, and the needs for detailed information. Consultation with a local biodiversity expert may be necessary at this stage. Rare species surveys can be costly to conduct, and often must span two or more seasons. Rare species surveys are unnecessary for some kinds of planning and conservation projects; identification of significant habitats and the *potential* for rare species may be enough to inform the planning process or conservation design. Rare species surveys are often indicated, however, where a proposed activity may damage a habitat or cause harm to rare species. Conducting surveys for all potential rare species may be impossible. Establish priorities for rare species surveys on the bases of rarity and of vulnerability to the anticipated or proposed actions on or near your study site.



Diarrhena
(Diarrhena obovata)

Step C. Rare Species Surveys

This step applies only if the need for rare species surveys was determined in Step B. The purpose of this step is to ascertain whether rare species of plants or animals do occur in the habitats that have been identified on or near the site. These surveys must be designed and conducted by biologists who specialize in the particular species or groups of species to be surveyed (e.g., plants, mollusks, butterflies and moths, dragonflies and damselflies, other invertebrates, fishes, reptiles and amphibians, birds, mammals). Local nature clubs, academic or research institutions, or public agencies (NYSDEC, NYNHP, NY State Museum) may be able to direct you to qualified experts. State or federal permits may be needed for certain kinds of surveys.

Rare species survey techniques are particular to the target species, and are not addressed in the *Manual* except for some general suggestions given in the Species Profiles.

1. **Design the rare species surveys.**
   Design the surveys according to methods appropriate to each target species, to maximize the chances of detecting the species of concern. The design may entail surveys at particular seasons, during particular times of day, or in particular weather conditions; use of special equipment; or use of special survey techniques.

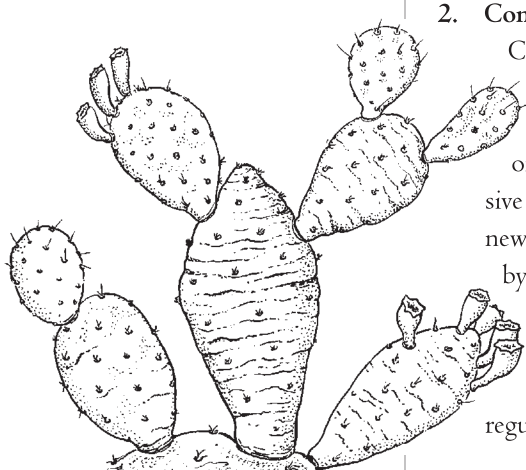
2. **Conduct the rare species surveys.**
   Conduct the surveys using standard protocols, or modified protocols designed to accommodate special site conditions.

3. **Document the surveys.**
   Document the rationale, methods, field conditions, and results of all surveys. Documentation should also describe the factors that might reduce the reliability of the survey. For example, if season, time of day, or weather conditions were inappropriate, or if local noise or other disturbance would affect the presence or visibility of the species at survey time, then those conditions should be fully described. This information will help others assess the reliability of the survey results, and the need for further surveys.

Step D. Conservation Planning and Action

1. **Conservation Planning.**
   Conservation action must be planned on a site-specific basis, depending on the results of Steps B and C, the overall conservation goals, and the potential threats, if any, to significant habitats and species. Some general considerations for conservation planning are discussed in Sect. 4. Combinations of regulatory and non-regulatory approaches to conservation will be the most effective in many situations. Some general conservation recommendations are given in the Habitat Profiles and the Species Profiles (Sects. 7 and 9).

2. **Conservation Action.**
   Conservation actions may be simple and inexpensive (such as installation of speed bumps to reduce turtle mortality on small roads in turtle migration corridors), or may be complex and more costly (such as a cluster of conservation easements on contiguous privately-held properties to protect raptor nesting habitat in extensive forest). Actions may include adoption of new regulations (such as prohibition of new structural development on floodplains), or encouragement of voluntary actions by landowners and developers. Conservation actions could involve reconfiguring a development design or a hiking trail system to avoid the most ecologically sensitive areas, or preparing and distributing educational flyers for residents in the vicinity of special habitats. Sect. 4 discusses some regulatory and non-regulatory means of implementing a conservation plan.

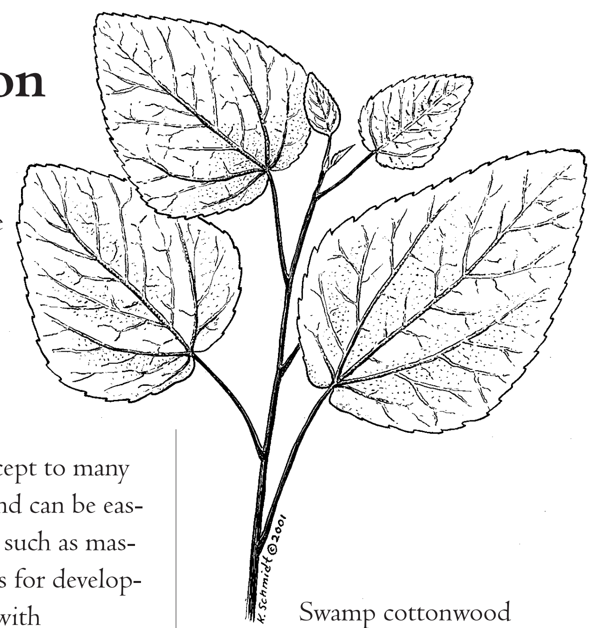


Eastern prickly-pear
(Opuntia humifusa)

4.0

Using Biodiversity Information in Land Use Planning

4.0 Using Biodiversity Information in Land Use Planning



Swamp cottonwood
(Populus heterophylla)

The land use decisions having the greatest effect on biodiversity in our region are often made by local decision-makers about local development projects. County and municipal planners, planning boards, and town boards thus have vital responsibility for shaping the ecological landscape for the foreseeable future.

Land use considerations such as open space, aquifer and stream protection, and historic preservation have gained widespread support among citizens and local governments. Biodiversity protection, however, is still an unfamiliar concept to many planners. Fortunately, it is often compatible with other planning objectives, and can be easily incorporated into land use planning using the common tools of the trade, such as master plans and zoning ordinances. In so doing, planners can establish guidelines for development that reduce the risks, uncertainties, and public controversies connected with development decisions. A better understanding of local biodiversity resources also enables planners and decision-makers to direct limited conservation resources and efforts to the places where they will have the greatest impact.

Below we discuss ways of integrating biodiversity protection and land use planning. Although we refer to land use planning by "communities" or municipalities, many aspects of this approach apply equally to planning and decision-making by other entities such as land trusts, conservation organizations, and individual landowners.

Biodiversity protection is still an unfamiliar concept to many planners.

4.1 Identifying and Mapping Biodiversity Resources

The general procedures and techniques for identifying biodiversity resources on a particular site, or in a whole town, watershed, or region are outlined in Sections 3 and 5 of the *Manual*. The maps resulting from that biodiversity assessment will show the locations of significant habitats in your study area. These maps can be the basis for a "biodiversity map overlay" to be used in the planning process along with existing map overlays of land use constraints such as steep slopes, watercourses, aquifers, wetlands, and prime farmland.

Biodiversity map overlays should include the extent of known significant habitats (e.g., mature forests, fens, crests, and intermittent woodland pools), known rare species occurrences, and the extent of potential habitat for those species. The biodiversity map layer should be accompanied by written descriptions of the conditions and processes that sustain each unit, sensitivities to disturbance, and lists of compatible land uses, to the extent that these are known. The overlays and accompanying information should be updated periodically as new information is gathered.

4.2 Setting Conservation Goals and Priorities

Conservation goals and priorities will vary among communities, depending on the nature of the local resources, and the character of existing, anticipated, and desired land uses in the region. Thus, urban and suburban areas will necessarily have different conservation goals from those of rural areas. Here are some examples of goals for consideration:

- Restoration and protection of intact, self-regulating ecosystems (including, for example, reintroduction of missing biotic components).
- Restoration and protection of an array of representative and exemplary communities and habitats.
- Protection of rare, declining, and vulnerable habitats and native species.
- Protection of habitats that are compatible with moderate to intensive human recreational uses (as in urban and suburban areas).

Planners should keep in mind some basic precepts when establishing conservation priorities and developing strategies for achieving biodiversity conservation goals:

- ☐ While protection of rare species and rare habitats are important objectives, overall biodiversity conservation will be best assured by conservation of functional ecological landscapes that sustain the full complement of natural communities and the systems that support them.
- ☐ Maintaining the biological and non-biological conditions, processes, and interactions (e.g., fires, floods, seasonal drawdowns, predator-prey or pollinator-plant relations) that sustain regional biodiversity is just as important as protecting the spatial footprint of a special habitat, community, or species occurrence.
- ☐ Large tracts of undeveloped land, and connectivity among diverse habitats are important to many species of rare, declining, and vulnerable plants and animals of the Hudson Valley, and to the maintenance of ecologically functional landscapes.
- ☐ Dispersal and seasonal migration corridors can be just as important to populations of certain mobile species as their primary breeding or foraging habitats (see Habitat Profiles for Blanding's turtle, timber rattlesnake, and mole salamanders, for example).
- ☐ Broad buffer zones of undisturbed vegetation adjacent to streams, woodland pools, lakes, and ponds are important to preserving the integrity of the aquatic and upland environments required by sensitive species of those habitats.
- ☐ Relatively unaltered sites are generally more important for biodiversity conservation than altered sites.
- ☐ Old systems, such as mature forests or wetlands with deep organic soil, may be more important to native biological diversity than young counterparts of those systems, such as a young forest or a recently created marsh.
- ☐ Open space preserved for moderate or intensive recreation, or for visual relief in highly developed areas may be valuable to the human community, but may do little for biodiversity. The different goals of open space and of biodiversity protection should not be confused; they are sometimes but not always compatible.

Biodiversity conservation will be best assured by conservation of functional ecological landscapes that sustain their full complement of biological communities and the natural systems that support them.

With the maps and written descriptions that emerge from a biodiversity assessment, planners can begin to identify the most ecologically valuable, the rarest, and the most sensitive elements in the study area, and the processes that support them. Using other maps of existing land uses, and anticipated future activities and developments, planners can also identify the biodiversity resources that are most vulnerable to existing and future threats. With that information, planners can develop a priority list of areas, habitats, and systems for conservation, based on such attributes as size, connectivity, habitat quality, local habitat diversity, local ecological importance, "conservability," and compatibility with existing and anticipated community needs.

Planners can identify the biodiversity resources that are most vulnerable to existing and future threats.

For example, the highest priority classification should include any known species on the federal or state endangered or threatened species lists, because these are protected by federal and state law. The highest priority might also be given to protection of 100-year floodplains, because of their widely-acknowledged importance to a large array of wildlife species, as well as to stream water quality, stream ecology, and downstream human infrastructure. Similarly, forest tracts exceeding 100 acres in size (or 50 acres, or 200 acres) might be accorded the highest level of protection, because of their special values to wildlife and plants that are not duplicated by small forested tracts, and their importance to protecting groundwater and surface water quality and quantity. One town might institute a "green necklace" policy for restoring and protecting broad buffer zones around lakes, ponds, and wetlands and along streams, to protect the ecological integrity of those habitats as well as their recreational, aesthetic, and water supply values. Another town might place a high priority on protection of the best examples of 6–7 selected upland habitats deemed of special ecological importance and vulnerability to disturbance.

If we are ultimately to stem the loss of species and habitats in the region, we will need to rethink our fundamental approach to planning and development.

Each community will establish its own criteria and classification scheme for conservation priorities, based on local resources, land uses, and community needs. Goals and priorities should be reviewed and revised periodically to accommodate new information about biodiversity status and protection, and changes in the regional environmental setting.

4.3 Developing a Biodiversity Conservation Plan

Biodiversity protection can be fostered in many small ways, but, if we are ultimately to stem the loss of species and habitats in the region, we will need to rethink our fundamental approach to planning and development. Biodiversity protection involves habitat complexes and ecological processes that often straddle property and political boundaries. As such, it requires a comprehensive view of potential land uses, addressing not only their isolated effects, but also their cumulative impacts on habitats and species. Urban and suburban "sprawl" is associated with large scale degradation and destruction of habitats, and with loss of regional biodiversity. Planning, zoning, and conservation initiatives should begin to focus on ways to limit or prevent sprawl and reduce the impacts of existing diffuse development.

Contrary to commonly-held perceptions, the kinds of development associated with sprawl often represent economic liabilities instead of assets to communities. For example, residential developments usually demand more in community services than they generate in taxes, while the reverse is true for active farms (Lerner and Poole 1999). Protection of naturally functioning floodplains costs far less than repairing flood damage, or installing structural solutions (such as dams, levees, and channelization) to control flooding (Federal Emergency Management Agency 1998). Maintaining watersheds with predominantly intact natural habitats helps to keep streams, groundwater, and reservoirs clean, and can reduce the costs of drinking water purification. Intact forests help to retain stormwater, maintain clean runoff into surface water bodies, foster groundwater recharge, and clean the air of pollutants. Indeed, natural systems have values to the human community that far exceed our ability to measure them. These systems are often irreplaceable, and their protection and restoration will serve many acknowledged community interests while helping to conserve regional biodiversity.

Contrary to commonly-held perceptions, the kinds of development associated with sprawl often represent economic liabilities instead of assets to communities.

Although a comprehensive biodiversity assessment of a large area could take several years to complete, many aspects of a general biodiversity conservation plan can be designed and implemented before the assessment is completed. The *general* conservation plan should describe general treatments of significant habitats and general approaches to biodiversity conservation. For example, it could include a list of the known and expected habitats in the geographic area of concern, with accompanying lists of compatible land uses, restrictions, and special measures recommended for each habitat type. These treatments can then be routinely incorporated into general planning and designs for new development.

Listed below are some practices that could be encouraged by a general biodiversity conservation plan, even before a biodiversity assessment is completed.

- **Protect large, contiguous, unaltered tracts** wherever possible.
- **Preserve links** between natural habitats on adjacent properties.
- **Preserve natural disturbance processes**, such as fires, floods, tidal flushing, seasonal drawdowns, landslides, and wind exposure, wherever possible. Discourage development that would interfere with these processes.
- **Restore and maintain broad buffer zones** of natural vegetation along streams, along the shores of other water bodies and wetlands, and at the perimeter of other sensitive habitats.
- In general, **encourage development of altered land** instead of unaltered land wherever possible.
- **Promote redevelopment of brownfields**, other post-industrial sites, and other previously-altered sites (such as mined lands), "infill" development, and "adaptive re-use" of existing structures wherever possible, instead of breaking new ground in unaltered areas.
- **Encourage pedestrian-centered developments** that enhance existing neighborhoods, instead of isolated developments requiring new roads or expanded vehicle use.
- **Concentrate development along existing roads**; discourage construction of new roads in undeveloped areas. Promote clustered development wherever appropriate, to maximize extent of unaltered land.
- **Direct human uses toward the least sensitive areas**, and minimize alteration of natural features, including vegetation, soils, bedrock, and waterways.
- **Preserve farmland potential** wherever possible.
- **Minimize area of impervious surfaces** (roads, parking lots, sidewalks, driveways, roof surfaces) and maximize onsite runoff retention and infiltration to help protect groundwater recharge, and surface water quality and flows.
- **Restore degraded habitats wherever possible**, but do not use restoration projects as a "license" to destroy existing intact habitats.

The conservation plan should include strategies for conservation of the most important biodiversity resources.

The conservation plan should include strategies for conservation of the most important biodiversity resources. Combinations of regulatory and non-regulatory means (see below) will be necessary to accomplish significant protection of resources over large areas, due to the diverse nature of land ownership, land uses, and community needs. For example, protection of all 100-year floodplains in a town might require a combination of municipal zoning regulations, public education, voluntary efforts by individual landowners, and perhaps purchase of key parcels from willing sellers (or conservation easements on those parcels) by public or private agencies.

To determine the kinds of conservation efforts that will be most effective and realistic at any particular location, the *site-specific* conservation plan must be designed according to the particular habitats and species present at a given site, and the local environmental setting, including nearby human uses. A thorough biodiversity assessment on sites proposed for development or significant land use change will give landowners, developers, and regulatory authorities a solid foundation for an effective conservation plan. The more detailed the biodiversity information available, the more specific the conservation plan can be. The Habitat Profiles and Species Profiles in Sects. 7 and 9 of this *Manual* explain some of the particular sensitivities of those habitats and species, and offer recommendations for conservation.

4.4 Implementing a Biodiversity Conservation Plan

Throughout the Hudson Valley, communities are authorized to develop a Master Plan (or Comprehensive Plan) that identifies the community's values and preferred avenues for future development. To carry out the Master Plan, the community adopts a zoning ordinance which defines the permitted uses of land and buildings. One of the original purposes of zoning was to geographically segregate incompatible uses of land; for example, to separate industrial from commercial or residential land uses. Many zoning ordinances have since been designed to isolate other community functions such as housing, work, shopping, and recreation in single-use districts. An unintended effect has been to encourage dispersed development or sprawl instead of compact communities and neighborhoods with an array of local services, amenities, and functions.

An unintended effect of zoning to date has been to encourage dispersed development or sprawl instead of compact communities and neighborhoods.

To help reverse the trends toward sprawl, states and communities elsewhere have developed non-regulatory means of promoting compact development, including selective use of state and local development aid, home-buying assistance funds, and tax benefits to promote development in targeted areas, to discourage diffuse development, and to strengthen existing local centers with a range of community functions (Benfield et al. 1999). Numerous other planning, regulatory, and non-regulatory tools are available to municipalities for implementing biodiversity conservation plans:

- **Master Plan.** The Master Plan is intended to address land use issues on a community-wide basis. It ordinarily includes maps showing preferred districts for certain kinds of development, overlay districts of sensitive areas - such as aquifer zones, steep slopes, and wetlands - and guidelines for acceptable land uses in each district. Biodiversity information can be used to define additional habitat-based overlay districts, each with lists of compatible human uses. Wherever possible, the Master Plan should seek to combine the benefits of open space, farmland, scenic vistas, clean water resources, intact floodplains, and recreation with the protection of biodiversity.
- **Zoning ordinance.** Zoning is intended to separate incompatible uses of land, and to insure that land uses do not exceed the capacity of the land and the community infrastructure to support them. Several zoning innovations have been developed to help reduce the impacts of human uses on the land:

  Cluster zoning is a device used to preserve open space or natural features by concentrating development in a small area, usually with reduced minimum lot sizes.

  Overlay zoning applies one zoning district (usually with more restrictive requirements) over one or more other districts. For example, a turtle migration corridor overlaid on a rural residential district might require special measures for protection of turtles during nesting or drought migrations.

  Incentive zoning encourages developers to adopt certain approaches (such as infill development, or redevelopment instead of breaking new ground), or include certain features in their project designs (such as habitat restoration or provision of open space), in return for benefits such as increased density allowances, or rapid processing of applications.

- **Permit conditions.** Municipal agencies issuing development permits may attach conditions that outline specific mandated measures designed to avoid or mitigate the adverse effects of development.
- **Tax incentives.** Tax codes can be revised to offer tax relief to developers who adopt development approaches that reduce the impact on land; for example, redevelopment or infill instead of diffuse development on previously undisturbed land.
- **Development and design recommendations.** Developers often welcome guidance on reducing the impact of development on natural resources. In addition to zoning regulations and mandated conditions attached to permits, municipalities can recommend further voluntary measures to promote protection of natural systems and biodiversity.
- **Voluntary conservation efforts.** Landowners are often pleased to participate in voluntary conservation programs, especially when they understand how their own land fits into the larger ecological landscape. Biodiversity maps showing the locations of regionally significant habitats can be used as an education tool to encourage landowners to initiate habitat protection measures on their own lands.
- **Land purchase.** For lands of particular ecological importance, public agencies may want to consider outright purchase of land from willing sellers. This is sometimes less costly than the environmental consequences of unsuitable development.
- **Conservation easements.** Limited funds often make outright purchase of land impossible for municipalities, land trusts, or conservation organizations. Purchase of conservation easements or development rights by a land trust or other responsible agency can provide similar protection of ecologically important lands, at a much lower cost. Municipalities can encourage and facilitate those arrangements, even if the municipality itself is not the recipient of the easement.

4.5 Some Planning Resources for Biodiversity Conservation

Numerous resources are available to communities and individuals wishing to initiate local biodiversity protection. The Biodiversity Project (214 N. Henry St., Suite 203, Madison, WI 53703; 608-250-9876; www.biodiversityproject.org) is a national clearinghouse for information on the growing body of research on public attitudes and effective communication strategies for implementing biodiversity protection plans. Other organizations active in New York, such as those listed below, are developing programs and educational materials to help communities and landowners with conservation planning and implementation.

Organizational Resources for Conservation Planning and Action

(Quoted passages below are from organization literature or website materials.)

American Farmland Trust

The AFT works to prevent the loss of productive farmland, and to promote environmentally sound farming practices. It produces publications, recommends "best practices," advises landowners and communities, and collaborates with land trusts and governmental agencies to protect farmland from urban sprawl.

American Farmland Trust
1200 18th St., NW, Suite 800
Washington, D.C. 20036
Phone: (202) 331-7300, Fax: (202) 659-8339
Email: info@farmland.org
www.farmland.org

The Catskill Center for Conservation and Development

The Catskill Center conducts research, produces publications, and sponsors public programs to promote the environmental and economic well-being of the Catskill Region. The Center provides technical assistance to rural communities on planning, zoning, and land use matters, and seeks to create thriving rural communities through careful use of Catskill resources.

The Catskill Center for Conservation and Development
Erpf House
Route 28
Arkville, NY 12406
Phone: (845) 586-2611
Email: cccd@catskillcenter.org
www.catskillcenter.org

The Conservation Fund

The Conservation Fund seeks to integrate economic goals with sustainable conservation solutions. It designs innovative long-term measures to conserve land and water resources, using real estate transactions, demonstration projects, education, and community-based activities.

1800 N. Kent Street, Suite 1120
Arlington, VA 22209-2156
Phone: (703) 525-6300, Fax: (703) 525-4610
www.conservationfund.org

The Land Trust Alliance

The LTA "promotes voluntary land conservation and strengthens the land trust movement by providing leadership, information, skills, and resources land trusts need to conserve land for the benefit of communities and natural systems."

The Land Trust Alliance
1319 F St NW, Suite 501
Washington, DC 20004
Phone: (202) 638-4725, Fax (202) 638-4730
www.lta.org

The Land Trust Alliance — New York Program
PO Box 792
Saratoga Springs, NY 12866
Phone: (518) 587-0774
www.lta.org/regionallta/northeast.htm

Metropolitan Conservation Alliance

The MCA develops planning strategies that address ecosystem loss and urban sprawl in the New York City region. It brings together stakeholders and experts to discuss and understand the biological, social, economic and legal aspects of land-use planning, provides biological information that integrates science into planning practices, and communicates these ideas to land-use decision-makers and the public.

Metropolitan Conservation Alliance
68 Purchase Street
Rye, New York 10580
Phone: (914) 925-9175, Fax: (914) 925-9164
Email: mca@wcs.org
www.wcs.org/home/wild/northamerica/740

New York Planning Federation

The NYPF promotes sound planning, land use, and zoning practices to facilitate orderly growth and development in balance with natural resource conservation. Their membership includes many municipal and county governments throughout the state as well as individuals, corporations, and non-governmental organizations.

New York Planning Federation
44 Central Avenue
Albany, NY 12206
Phone: (518) 432-4094, Fax: (518) 427-8625
E-mail: nypf@wizvax.net
www.nypf.org

(continued)

Pace University Land Use Law Center

"The Center provides training, technical assistance, publications, conferences, and the development of strategic options for sustainable community development." Some current initiatives are a community leadership program, a Local Leader's Guide to Land Use Practices, and developing strategic options for preservation of the Great Swamp.

Pace University School of Law
78 North Broadway
White Plains, NY 10603
Phone: (914) 422-4128
www.law.pace.edu/pacelaw/environment/landuse.html

Regional Plan Association

The RPA recommends policy initiatives, develops long-term comprehensive plans, and promotes their implementation across political boundaries in the 31-county New York-New Jersey-Connecticut metropolitan area.

Regional Plan Association
4 Irving Place, 7th Floor
New York, NY 10003
Phone: (212) 253-2727, Fax: (212) 253-5666
www.rpa.org

Scenic Hudson, Inc.

Scenic Hudson focuses on land preservation, environmental quality, riverfront improvements, and public outreach in the Hudson Valley region between New York Harbor and Albany. Their Riverfront Community Program works with waterfront communities on the Hudson River to advance long-term sustainability in the region. The program provides local decision-makers with information to help insure that development along the river complements compatible economic development, protects scenic views and historic resources, mitigates environmental impacts, provides access to the waterfront, and enhances the river's natural, scenic, historic, and recreational assets. Their Technical Assistance Program addresses a wide range of topics, from Master Plan advice to model sign ordinances and transportation analysis.

Scenic Hudson, Inc.
9 Vassar St..
Poughkeepsie, NY 12601
Phone: (845) 473-4440, Fax: (845) 473-2648
E-mail:info@scenichudson.org
www.scenichudson.org

Smart Growth Network

The Smart Growth Network is a growing coalition of developers, planners, government officials, lending institutions, community development organizations, architects, environmentalists and community activists. The Smart Growth Network encourages more environmentally and fiscally responsible land use, growth, and development by building coalitions and partnerships, developing information and analytical tools and programs, and establishing dialogues among development stakeholders.
The organizational home of the Smart Growth Network is:

International City/County Management Association
ICMA - Smart Growth Network
777 North Capitol St., N.E., Suite 500
Washington, DC 20002-4201
Phone: (202) 962-3591, Fax: (202) 962-3500
www.smartgrowth.org

Trust for Public Land

The TPL works with landowners, government agencies, and community groups "to create urban parks, gardens, greenways, and riverways; build livable communities by setting aside open space in the path of growth; conserve land for watershed protection, scenic beauty, and close-to-home recreation; and safeguard the character of communities by preserving historic landmarks and landscapes." TPL's Public Finance Program works with citizen groups, elected officials, and public agencies to craft and implement public finance measures for conservation.

Trust for Public Land
116 New Montgomery Street, 4th Floor
San Francisco, CA 94105
Phone: (415) 495-4014, Fax: (415) 495-4103
www.tpl.org

TPL Mid-Atlantic Regional Office:
666 Broadway
New York, NY 10012
Phone: (212) 677-7171, Fax: (212) 353-2052

Urban Land Institute

The Urban Land Institute promotes "responsible use of land to enhance the total environment." ULI offers publications, educational opportunities, meetings and forums, and advisory services. It works to provide relevant and current information about land use and development, and to bring together the people able to influence the outcome of important land use issues.

Urban Land Institute
1025 Thomas Jefferson Street, NW
Suite 500 West
Washington, DC 20007
Phone: (202) 624-7000 or 1-800-321-5011, Fax: (202) 624-7140
www.uli.org

The Wildlands Project

The Wildlands Project is an organization of conservation biologists and citizen conservationists working to develop a wilderness recovery strategy for North America. It uses partnerships with other conservation organizations and cooperative relationships with scientists, activists, and grassroots organizations to protect and restore evolutionary processes and biodiversity.

The Wildlands Project
1955 W Grant Road, Suite 145
Tucson, AZ 85745
Phone: (520) 884-0875, Fax: (520) 884-0962
Email: information@twp.org
www.twp.org

Other organizations, such as those listed below, acquire land, manage conservation easements, or broker the purchase of land for conservation purposes. Many of these organizations also serve other important conservation functions.

Albany County Land Conservancy

P.O. Box 567
Slingerlands, NY 12159
Phone: (518) 436-6346

American Farmland Trust

1200 18th St., NW, Suite 800
Washington, D.C. 20036
Phone: (202) 331-7300, Fax: (202) 659-8339
Email: info@farmland.org
www.farmland.org

The Catskill Center for Conservation & Development

Erpf House
Route 28
Arkville, NY 12406
Phone: (845) 586-2611
Email: cccd@catskillcenter.org
www.catskillcenter.org

Columbia Land Conservancy

P.O. Box 299
49 Main Street
Chatham, NY 12037
Phone: (518) 392-5252, Fax: (518) 392-3099
www.clctrust.org

Croton Community Land Conservancy

Finney Farm Road
Croton-On-Hudson, NY 10520

Dutchess Land Conservancy

RR2, Box 13
Route 44 West
Millbrook, NY 12545
Phone: (845) 677-3002, Fax: (845) 677-3008

Durham Valley Land Trust

Box 52
Sutton Road
Cornwallville, NY 12418
Phone: (518) 239-6760

Hudson Highlands Land Trust

P.O. Box 226
Garrison, NY 10524
Phone: (845) 424-3358

Hudson River Heritage

P.O. Box 287
Rhinebeck, NY 10572

The Nature Conservancy

4245 North Fairfax Drive
Suite 100
Arlington, VA 22203-1606
Phone: 1-800-628-6860
www.tnc.org

The Nature Conservancy — Eastern New York Chapter

(northern office)
200 Broadway, 3rd Floor
Troy, NY
Phone: (518) 272-0195

(southern office)
19 North Moger Ave.
Mt. Kisco, NY 10549
Phone: (914) 244-3271

Oblong Land Conservancy

P.O. Box 601
Pawling, NY 12564
Phone: (845) 855-3266, Fax: (845) 855-0369

Open Space Institute

666 Broadway, 9th Floor
New York, NY 10012-2317
Phone: (212) 505-7480, Fax (212) 353-2052

Orange County Citizens Foundation

P.O. Box 56
Goshen, NY 10924
Phone: (845) 294-8226, Fax: (845) 294-9343

Orange County Land Trust

P.O. Box 2442
Middletown, NY 10940
Phone: (845) 343-0840, Fax: (845) 342-8655

Pound Ridge Land Conservancy

P.O. Box 71
Pound Ridge, NY 10577
Phone: (914) 764-4262, Fax: (914) 764-4263

Putnam County Land Trust: Save Open Spaces

P.O. Box 36
Brewster, NY 10509
Phone: (914) 279-2675

Rails-to-Trails Conservancy

National Headquarters
1100 17th Street, NW, 10th Floor
Washington, D.C. 20036
Phone: (202) 331-9696, Fax: (202) 331-9680
Email: RTCMail@Transact.org
www.railtrails.org

Rensselaer-Taconic Land Conservancy

P.O. Box 40
Lansingburgh Station
Troy, NY 12182
Phone: (518) 283-2832, Fax: (518) 238-2832

Rondout-Esopus Land Conservancy

P.O. Box 345
High Falls, NY 12440
Phone: (845) 687-7553

Schodack Area Land Trust

P.O. Box 204
East Schodack, NY 12063
Phone: (518) 477-2630, Fax: (518) 477-4919

Wallkill Valley Land Trust

PO Box 208
New Paltz, NY 12561
Phone: (845) 255-4915

Westchester Land Trust

31 Main Street
Bedford Hills, NY 10507
Phone: (914) 241-6346, Fax: (914) 241-4508
E-mail: wlandtrust@aol.com
www.westchesterlandtrust.org

Winnakee Land Trust

P.O. Box 610
Rhinebeck, NY 12572
Phone: (845) 876-4567

Woodstock Land Conservancy

Box 864
Woodstock, NY 12498
Phone: (845) 679-9355

Some useful publications for planners and citizens:

Baskin, Y. 1997. The work of nature: How the diversity of life sustains us. Island Press, Washington, D.C. 263 p.

Daily, G.C. ed. 1997. Nature's services: Societal dependence on natural ecosystems. Island Press, Washington, D.C. 392 p.

Peck, S. 1998. Planning for biodiversity. Island Press. 221 p.

Stein, B.A., L.S. Kutner, and J.S. Adams. eds. 2000. Precious heritage: The status of biodiversity in the United States. The Nature Conservancy, and Association for Biodiversity Information. Oxford University Press, New York. 399 p.

The Biodiversity Project. 1998. Engaging the public on biodiversity: A road map for education and communication strategies. The Biodiversity Project, Madison, WI. 118 p.

The Biodiversity Project. 1999. Life, nature, the public; making the connection: A biodiversity communications handbook. The Biodiversity Project, Madison, WI. 64 p.

Wilson, E.O. 1999. Biological diversity: The oldest human heritage. Educational Leaflet 34, New York State Museum, Albany, NY.

Wilson, E.O., and D. Perlman. 1999. Conserving earth's biodiversity. (CD-Rom.) Island Press, Washington, D.C.

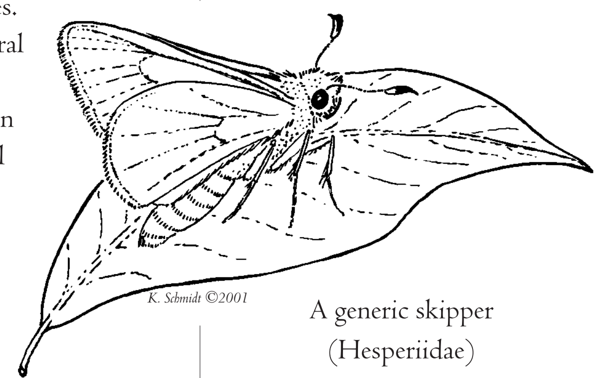
5.0

Analyzing and Using Information

5.0 Analyzing and Using Information

5.1 Analyzing Maps and Photographs for Biodiversity Assessments

Review of maps is fundamental to site-specific or regional biological studies. Maps of geology, topography, soils, wetlands, and other physical and cultural features may be used effectively to explore the environment and assess the potential for significant habitats and rare species before one ever sets foot on a site. Map analysis prior to field work is essential for an efficient biological diversity survey.



A generic skipper (Hesperiidae)

Because all maps are generalizations of actual features, appropriate map interpretation requires an understanding of the map scale and precision. Map users should avoid over-interpretation of map information. For example, a soil map drawn at a scale of 1:15,840, or a geology map at a scale of 1:250,000 cannot accurately depict the soils or geologic features on a site plan at a scale of 1:2400. Although maps are excellent resources for *predicting* the occurrences of particular habitats, onsite field observations are necessary to determine actual site conditions.

The subsections below describe the kinds of information that can be easily obtained from standard maps and aerial photographs in the public domain. Appendix 7 describes how to acquire these materials.

5.1.1 USGS Topographic Maps

U.S. Geological Survey (USGS) topographic maps are an invaluable tool for predicting physical and ecological features of a site or a region. Topographic maps show elevations, landscape contours, surface water bodies, significant cultural features (e.g., railroads, roads, urban areas, mines, and buildings), general vegetation cover (forested vs. non-forested), and some wetlands.

The USGS publishes an index to topographic map coverage for New York, and an instruction pamphlet, entitled *Topographic Map Symbols*, for interpreting symbols on topographic maps. These are available from the county Soil and Water Conservation District offices, commercial map outlets, and by mail from USGS distribution centers. Refer also to geomorphology textbooks (e.g., Easterbrook 1969) for geologic and topographic map reading techniques.

Elevation contour lines on topographic maps can be used to delineate watersheds of streams and wetlands, determine slope and aspect at particular locations, identify permanent streams, ponds, and lakes, and predict the occurrence of cliffs, intermittent woodland pools, intermittent streams, floodplains, and other habitats. Topographic maps in conjunction with soil and geologic maps can be used to predict the occurrence of wetlands and wetland types, seeps, cliffs, crests, dredge spoil deposits, and numerous other habitats.

Users of USGS topographic maps must recognize that the scale (usually 1:24,000) and the contour intervals (10 ft or 20 ft) are such that small but often important landscape features may be omitted. Users are also cautioned that landscape and infrastructure changes since the maps were prepared will not be depicted. The mapped forested areas, shown as green overlays, are often outdated. Recently built roads, buildings, ponds, dams, or powerlines may have changed the landscape dramatically since the maps were created or revised 20–40+ years ago. The dates of original mapping and photorevisions are given in the lower left corner of each map sheet. Map interpretation can improve the focus and efficiency of ecological field investigations, but the actual conditions on any site must be determined in the field.

Recently built roads, buildings, ponds, dams, or powerlines may have changed the landscape dramatically since the maps were created or revised 20–40+ years ago.

In the subsections below we describe some of the ways in which USGS topographic maps can be used to predict the occurrence of significant habitats. We do not provide here a complete guide to topographic map interpretation, but mention some aspects of interpretation that are especially useful for biodiversity assessment.

Perennial and Intermittent Streams

USGS topographic maps depict Perennial Streams as solid blue lines. Intermittent Streams (see Habitat Profile) are sometimes shown as a broken dashed and dotted line, but in many cases are not shown explicitly. Intermittent streams can often be predicted, however, where there is a distinct series of adjacent, v-shaped contours (the “v” pointing upslope), as in Figure 2a.

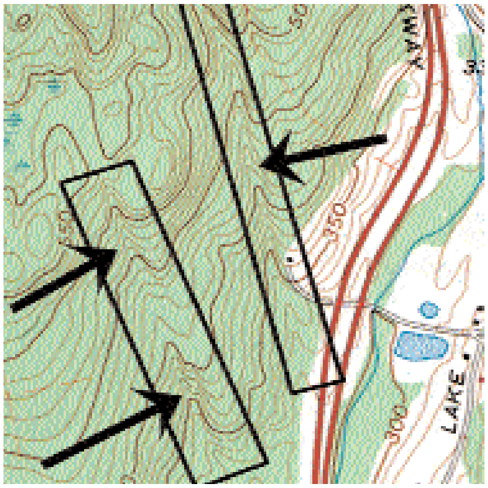
Floodplains and Stream Terraces

Widely-spaced contour lines near perennial streams, as in Figure 2b, indicate floodplains or former floodplains (see Habitat Profile for Riparian Corridor). These areas often contain wetlands not depicted on topographic maps or wetland maps. Field assessment is always necessary to positively identify the presence, locations, and extent of wetlands. Due to natural events and human activities, certain floodplains are no longer flooded during storms or snow melt. If the stream has become more deeply incised, if its alignment has changed, or if it has been artificially straightened or channelized, the former floodplain may flood less frequently or not at all. Many existing and former floodplains are used for agriculture; some have buildings, roads, or other infrastructure.

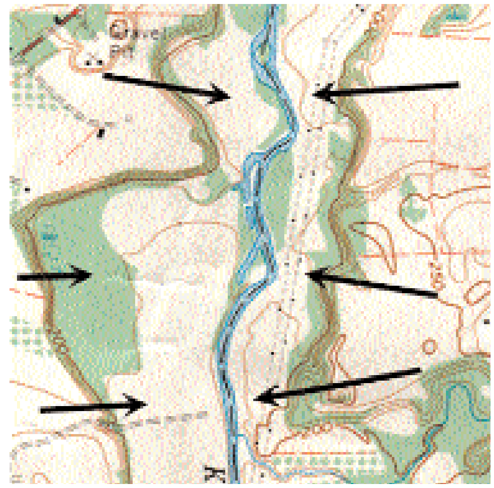
Map interpretation can improve the focus and efficiency of ecological field investigations, but the actual conditions on any site must be determined in the field.

Seepage Slopes

Springs and Seeps (see Habitat Profile) occur where groundwater emerges at the ground surface due to gravity or artesian pressure. Springs or seeps can occur in a great variety of geologic and physiographic settings, and are difficult to predict from maps alone. Most springs and seeps can only be detected in the field. Hillsides with especially abundant springs or seeps often have a characteristic appearance on topographic maps, looking like numerous intermittent streams in close proximity to each other (Figure 2c). In some cases these are indeed intermittent streams, but such hillsides are also prone to being generally seepy. Springs and seeps may be present in a variety of other settings, including but not limited to cliff faces and bases, and the toes of other steep slopes.

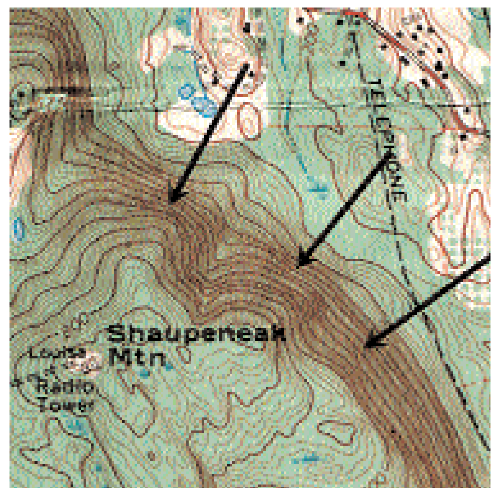


a. intermittent stream



b. floodplain

c. seepage slope



d. very steep slope

e. nearly level terrain

f. knoll and basin terrain: potential for intermittent pools

Figure 2. Topographic indicators of landscape features.
Scale is 1:24,000; contour interval is 10 feet for a, b, d, e, and f, and 20 feet for c.

Steep Slopes

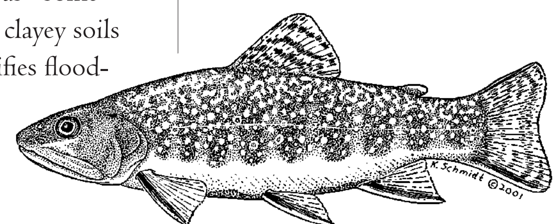
Widely-spaced contour lines indicate flat or gently-sloping terrain; the closer the contour lines, the steeper the slopes. Very steep slopes are depicted by lines so close they are barely distinguishable from each other (Figure 2d). Slopes of 25 degrees or steeper, indicated where mapped 10-foot contour lines are spaced at 42 or more per cm (or 27 per inch), can be predictive of various significant habitats, depending on other characteristics of the physiographic setting: Crest, Ledge, and Talus; Bluffs and Ravines; Springs and Seeps (see Habitat Profiles).

Using topographic maps in conjunction with soil maps is the most efficient way to predict the occurrence of wetlands.

Steep, high slopes may indicate Ledge and Talus habitat (Section 7.33 and 7.34). Check soil maps and geology maps to determine the depth of soil, the type of bedrock, and the amount of bedrock exposure. Very steep, high slopes on each side of a stream may indicate a Cool Ravine habitat. Steep, high slopes with a generally east, southeast, south, southwest, or west aspect may have potential for rattlesnake den habitat (see Species Profile), particularly if the soil map indicates rock outcrops. Springs and seeps are often present on or at the base of steep rocky slopes, but are not limited to such terrain.

Flat Terrain

Flat or nearly flat terrain, indicated by widely-spaced contours (Figure 2e), is often worth checking further for the presence of wetlands. Flat terrain with soils mapped as "somewhat poorly drained" or wetter is likely to contain wetlands. Flat terrain with clayey soils may contain Wet Clay Meadows. Flat terrain adjacent to streams usually signifies floodplain or former floodplain. (See Habitat Profiles.)



Brook trout
(Salvelinus fontinalis)

Wetlands

USGS topographic maps are not the most reliable map resource for predicting wetlands, but can nonetheless be helpful, especially when used in conjunction with other kinds of maps. Wetlands occur in a variety of topographic settings, including on steep hillsides, so the presence or absence of wetlands cannot be determined on the basis of topography alone. The wetland symbol on topographic maps generally indicates the locations of the larger or wetter wetlands, and a few small ones, but many wetlands are not shown explicitly on those maps. Using topographic maps in conjunction with soil maps (see below) is the most efficient way to predict the occurrence of wetlands.

In any setting, however, flat terrain should be field-checked for wetlands. Level "terraces" or "benches" on hillsides can also support wetlands. Some areas of rugged "pocked" terrain with small basins between low knolls (Figure 2f) contain small woodland pools that are not specifically mapped as such on the topographic map. They are often omitted from wetland maps and can be difficult to detect on aerial photographs. Field observations may be the only reliable means of detecting woodland pools.

Other Uses for Topographic Maps

Because USGS topographic maps show cultural features such as roads, powerline rights-of-way, railroads, buildings, and mine sites, they are useful for assessing existing cultural influences on, or threats to, nearby habitats.

Because USGS topographic maps show cultural features such as roads, powerline rights-of-way, railroads, buildings, and mine sites, they are useful for assessing existing cultural influences on, or threats to, nearby habitats. For example, a road located between a Kettle Shrub Pool and nearby Hoosic soil units, could pose a threat to female Blanding's turtles during their nesting migrations. A road between an Intermittent Woodland Pool and an upland hardwood forest could be hazardous to salamanders moving between their breeding pools and their terrestrial habitats. A road through a large forested tract could subject forest-interior birds to nest predation by cowbirds, and to other predators such as raccoon or opossum. Remember, however, that USGS topographic maps show only the cultural features present at the date of the aerial photos upon which the most recent photorevision of the map was based (stated in the lower left corner of the map sheet).

Topographic maps can help to identify Waste Ground habitats, such as abandoned mines which are depicted by a "pick and shovel" mine symbol. Geology and soil maps can then be used to determine the character of the waste ground habitat. For example, an abandoned soil mine could support nesting habitat for turtles or bank swallows. An abandoned rock mine could support a variety of rare plants or animals associated with crests or ledges.

5.1.2 County Soil Surveys

The county soil maps and the accompanying soil descriptions are indispensable tools for biodiversity assessments.

County soil surveys contain soil maps and soil descriptions for the entire county. The descriptions include parent material, texture, depth of soil, drainage class, depth to seasonal high water table, pH, and many other soil characteristics. The soil maps depict the locations of general soil types, and also include symbols for such features as springs, stony spots, bedrock outcrops, wet spots in drier soil units, sandy or gravelly spots in finer textured soil units, and clayey spots in non-clayey soil units. The map scales in the published surveys differ from county to county, but most are either 1:15,840 or 1:24,000.

Soil maps are perhaps the most reliable single resource for predicting the presence of wetlands. Soil maps are also useful for predicting types of wetlands and non-wetland habitats associated with particular soil qualities, such as texture, depth, pH, and drainage. For example, map locations of soils with pH approximately 7.0 or greater may indicate calcareous habitats favorable to certain rare species of plants and animals. Acidic, coarse-textured (usually sandy or gravelly) soils may indicate Sand Barrens habitats (see Habitat Profiles). Acidic, shallow, rocky soils may indicate rocky pine barrens or acidic Crest habitats.

Soil maps are perhaps the most reliable single resource for predicting the presence of wetlands.

County soil maps are prepared by soil scientists using field observations and aerial photointerpretation. The thoroughness and accuracy of the soil map is limited by the map scale, the extent of field work, and the skill of the soil scientists in field identification and photointerpretation of landscapes and soils. The smallest mapped soil unit (polygon) may be approximately 1 ha (2.5 ac) on some maps and 2.4 ha (6 ac) on others, and only the smallest soil units are assumed to be pure (i.e., consist of only the mapped soil type); larger mapped units may contain one or more other soil types. Furthermore, not all mapped soil units have been confirmed in the field. The county soil maps and the accompanying soil descriptions provide invaluable information about the general character of the soils in the vicinity of a site, and are indispensable tools for biodiversity assessments. Field observations are necessary, however, to determine the soil types at any particular location.

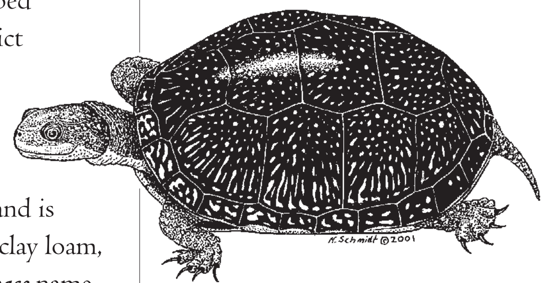
Soil texture, reaction (pH), drainage, slope, and depth to bedrock are among the most useful soil features for predicting habitats. Table 17 (Appendix 6) describes these features for all the mapped soils in the 10 counties of the Hudson River corridor.

Soil Series and Phases

A ***soil series*** is a group of soils having similar layers, in terms of color, structure, texture, and chemistry, except for the texture of the surface layer. A ***soil phase*** is a subdivision of a soil series. Phases within a series differ according to the texture of the surface layer, the slope, erosion potential, and stoniness. The map units in county soil surveys are generally differentiated at the phase level.

We understand only a few of the associations of habitats or species with particular soil series or phases, and hope that future research will reveal many more such associations. For example, Blanding's turtle habitat complexes usually contain Hoosic gravelly loam soils, and bog turtle habitats are often underlain by Sun silt loam, Wayland silt loam, Palms muck, or Carlisle muck. Post-agricultural lands on Livingston silty clay loam, Kingsbury and Rhinebeck soils, or Hudson and Vergennes soils often contain Wet Clay Meadows. (See Habitat and Species Profiles). These mapped soil types have proven effective in predicting the occurrence of those habitats and species.

Apart from those few known direct associations with soil type, we use the described characteristics (e.g., texture, pH, drainage) of the mapped soil types to help predict habitats. Some of these characteristics are discussed below.



Blanding's turtle
(Emydoidea blandingii)

Soil Texture

Soil texture is defined by the relative proportion of sand, silt, and clay particles, and is referred to by descriptive texture classes, such as sand, loam, silt, clay, loamy sand, clay loam, silty clay, and fine sandy loam. The general texture of a soil type is given in the ***phase*** name listed in the Detailed Soil Map Units section in the county soil survey. For example, "Paxton fine sandy loam" is the fine sandy loam phase of the Paxton soil series. The specific texture of each soil layer is given in the Soil Properties section of the county soil survey.

Many habitats are closely associated with soil texture. For example, Sand Barrens habitats occur on sandy soils; Clay Bluffs and Wet Clay Meadows on clayey soils; Crest Habitats are often on shallow silt loam soils; and Kettle Shrub Pools are usually surrounded by sandy or gravelly soils.

Soil Reaction

The soil reaction is "a measure of the acidity or alkalinity of a soil, expressed in pH values" (Case 1989). The kinds of plant and animal communities that become established at any location are closely associated with the pH of the substrate. In this region, a high pH is usually attributable to the presence of calcium carbonate, or other calcium salts or carbonate in the soil, the bedrock, the surface water, or the groundwater. Circumneutral (pH 6.6–7.3) and more alkaline soils tend to support distinctive biological communities. Indeed, so reliable is this that field ecologists routinely use plant indicators to help assess the alkalinity of the soil. In this region, circumneutral and alkaline soils are limited in extent, and often support rare habitats and rare species.

We use the described characteristics (e.g., texture, pH, drainage) of the mapped soil types to help predict habitats.

Soil Drainage Class

The "soil drainage class" refers to the frequency and duration of soil saturation during soil formation. There are seven drainage classes used to describe the range of drainage conditions. In order from the driest to the wettest, the drainage classes are:

- excessively drained
- somewhat excessively drained
- well drained
- moderately well drained
- somewhat poorly drained
- poorly drained
- very poorly drained

In this region, circumneutral and alkaline soils are limited in extent, and often support rare habitats and rare species.

Soil drainage classes are the most reliable predictors of wetlands, but field checking is always necessary for a positive determination. Soils described in the soil surveys as "very poorly drained" and "poorly drained" usually support wetlands; those described as "somewhat poorly drained" often support wetlands. A cautionary note: not only are mapping inaccuracies common, but field conditions have sometimes changed since the soil mapping field work was conducted (e.g., wetland areas may have been drained or filled). Also, areas mapped as moderately well drained, well drained, or drier soils could contain unmapped wetland soil inclusions. Topographic maps and stereo aerial photographs are sometimes helpful for detecting areas of soil inclusions, but only onsite field observations are conclusive.

The term "hydric soil" is commonly used by federal and state regulatory agencies to describe wetland soils (Environmental Laboratory 1987, Browne et al. 1995). The county soil surveys, however, do not use the "hydric" or "non-hydric" classifications used for identification of state and federal jurisdictional wetlands. As a general rule, the "hydric" classification encompasses all "very poorly drained," virtually all "poorly drained," and some manifestations of the "somewhat poorly drained" soil types. The Soil Conservation Service published a list of hydric soils and soils with potential hydric inclusions in New York (Soil Conservation Service 1989).

Excessively drained soils, especially those that are shallow or sandy, may indicate xeric (very dry) habitats such as Crests, Ledge, and Talus, or Sand Plains (Sections 7.33, 7.34, 7.36).

Depth to Bedrock

The soil survey describes the approximate depth of soil above bedrock to a depth of 5 feet from the soil surface. Certain kinds of habitats occur only on shallow soils ($\leq$ 20 inches deep); for example, Carbonate and Non-Carbonate Crests, Ledge, and Talus, Rich Rocky Woodland, Cool Ravine, Hudson River Rocky Shore, Hudson River Rocky Island (see Habitat Profiles).

Soil drainage classes are the most reliable predictors of wetlands, but field checking is always necessary for a positive determination.

Slope

The third letter in the soil symbol denotes the approximate slope. The typical slope range for each letter code is as follows:

A	0–3%	level to gently sloping
B	3–8%	gently sloping
C	3–15%	gently to strongly sloping
D	15–35%	strongly sloping to steep, or hilly
E	25–45%	moderately steep to very steep
F	35–60%	very steep

For example, in Greene Co., Oquaga soils on a gentle slope are coded as "OrB," where "Or" signifies Oquaga very channery silt loam, and "B" signifies a 3–8% slope.

The soil maps are an easy way to obtain approximate, at-a-glance estimates of slope. They are not of sufficient accuracy, however, and should not be used for, interpretation of slopes for jurisdictional purposes (as for local steep-slope ordinances).

5.1.3 New York State Geology Maps

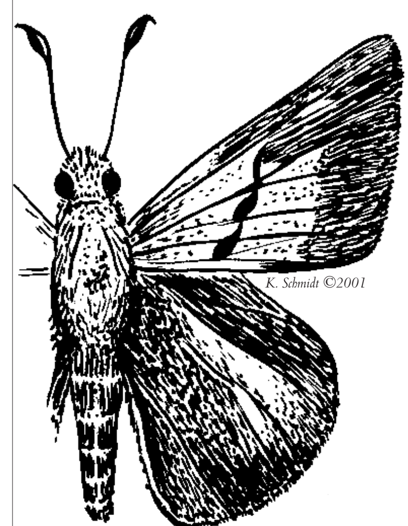
The surficial geology (loose deposits above the bedrock) and bedrock geology strongly influence the development of particular soil properties, and aspects of groundwater and surface water chemistry, and thus have important implications for the biotic communities that become established on any site.

Our current knowledge of specific biological associations closely tied to bedrock and surficial geology is elementary, however. We hope that this first edition of the *Manual* will elicit from users more information on such associations. Our use of bedrock maps for biodiversity surveys is limited to assessment of a few characteristics, mostly related to the calcareousness or acidity, and the "hardness" of the rock. Much of this information cannot be obtained directly from the New York State Bedrock Geology maps (Fisher et al. 1970) except by users already familiar with state geology. Therefore, we have compiled Table 18 (Appendix 6) to help interpret the New York State Bedrock Geology maps for use in biodiversity surveys. Table 18 gives the map codes for geologic units in the Hudson River corridor, and the associated geologic characteristics that we find most useful for predicting biodiversity resources.

Crest habitats underlain by "soft" bedrock such as sandstone, will support plant and animal communities quite different from those of crests on hard bedrock.

"Hard" metamorphic (e.g., schist, gneiss, quartzite) and igneous (e.g., granite, diabase) bedrock types are most likely to support acidic habitats. Carbonate bedrock types (limestone, dolostone, marble) are most likely to support alkaline or calcareous habitats. Mysterious exceptions occur in the Hudson Highlands, where calcicolous communities sometimes occur on hard metamorphic bedrock, typically on south- or east-facing slopes facing the Hudson River (Spider Barbour, personal communication). Crest habitats (see Habitat Profiles) underlain by "soft" bedrock such as sandstone, will support plant and animal communities quite different from those of crests on hard bedrock.

The surficial geology maps depict the kinds of glacial deposits and other loose sediments lying above the bedrock, using such categories as till, outwash, sand and gravel, kame deposits, lacustrine silt and clay, and alluvial fan. These maps are useful for determining the overall surficial character of a region. Soils formed in glacial outwash tend to be coarse textured (sandy or gravelly), and those formed in lacustrine (lake-laid) deposits of the Hudson Valley tend to be fine textured (silt and clay), and somewhat calcareous. The more detailed characteristics of soils on a site must be obtained from county soil maps or from onsite surveys.



Dion (sedge) skipper
(Euphyes dion)

5.1.4 Wetland Maps

The New York State Freshwater Wetland Maps are prepared using aerial photointerpretation and some field checking, but are not intended to be accurate depictions of the limits of state wetland jurisdiction on any site. The maps depict mainly large wetlands ($\geq$5 ha or 12.4 ac) and a few smaller ones with special attributes, but most small wetlands and even some large ones are omitted. Locations of wetlands, and the actual wetland boundaries, must always be determined in the field.

The U.S. Fish and Wildlife Service is conducting a National Wetland Inventory (NWI) and preparing wetland maps for the entire country. Wetlands of all sizes are mapped onto USGS topographic quadrangles (1:24,000) using aerial photointerpretation and some field checking. Many of the NWI maps for the New York State region are completed or in a usable draft. Like other such maps, they cannot be relied on to depict all wetlands or accurate wetland boundaries, but the NWI maps can nonetheless be useful for planning field studies. Wetlands shown on NWI maps are classified according to the Cowardin (1979) habitat classification scheme which incorporates the water regime (frequency and duration of standing water), vegetation cover, and other variables.

The state and federal wetland maps are not of sufficient accuracy to depict wetland jurisdictional boundaries, and should not be used for that purpose.

The NWI maps are not of sufficient accuracy to depict actual federal wetland jurisdictional boundaries, and should not be used for that purpose. But the maps include wetlands as small as 0.4 ha (0.1ac) so are much more useful for biodiversity surveys than are the New York State Freshwater Wetland Maps.

Some municipalities have adopted wetland ordinances and prepared maps of locally regulated wetlands. In some cases these maps are simply overlays of state or federal wetland maps onto local base maps. In other cases, the municipality has had the wetlands mapped independently according to criteria in the local wetland ordinance. Before using such maps it is important to know the source of the mapping, the wetland identification criteria, and the presumed map accuracy.

5.1.5 Aerial Photographs

Aerial photographs can be useful for identifying vegetation cover types, wetlands, streams, other waterbodies, and cultural landscape features. They are extremely useful for determining the spatial relationships among habitats—relationships that are often crucial for conservation planning.

Vertical aerial photos for stereoscopic interpretation are produced as a series of overlapping images shot from low-altitude aircraft flying directly above the target area. Viewed through a stereoscope, adjacent paired photos (stereo pairs) produce a three-dimensional image which conveys much more detailed information than do single photos. Topographic contours, detailed ground features (such as seepage meadows, wetland boundaries, and intermittent stream channels), and fine distinctions between vegetation cover types often can be discerned using stereo pairs with some practice and field verification. Oblique aerial photographs, which can be taken by any competent photographer from a small, low-altitude, high-wing aircraft, are also useful for biological reconnaissance. See Appendix 7 for information on how to acquire aerial photographs.

Topographic and detailed ground features are best identified on photos taken during leaf-off seasons. Many kinds of vegetation cover are best identified on photos taken during the growing season. For identifying significant habitats, aerial photographs must be at an appropriate scale. We recommend vertical aerial photographs at scales between 1:4800 and 1:40,000 for prediction and identification of significant habitats.

Satellite imagery (e.g., scale = 1:1,684,500) is now widely available, but usually requires the aid of sophisticated computer software for the kind of detailed analysis useful to biodiversity surveys. Without such technology, satellite imagery may be suitable for identifying broad categories of habitats or vegetation cover, but less so for distinguishing between habitats with fairly subtle differences in image signatures, or for identifying small areas.

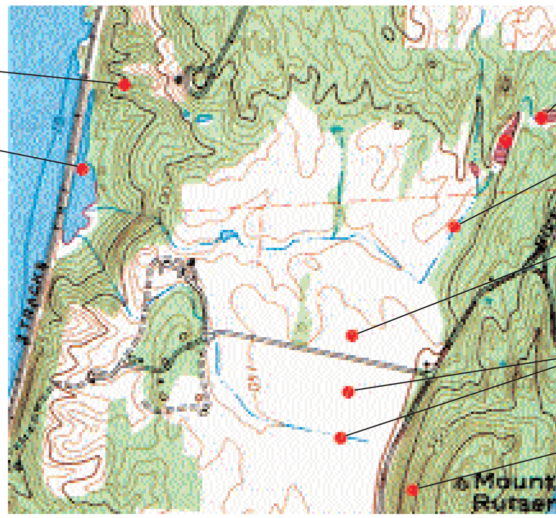
5.2 Sample Map Analysis

This section will lead you through a map analysis for the purpose of predicting the occurrence of significant habitats. We will use topographic and soils maps to identify landscape features, and then use the Habitat Keys (Sect. 6) to make habitat predictions based on those features.

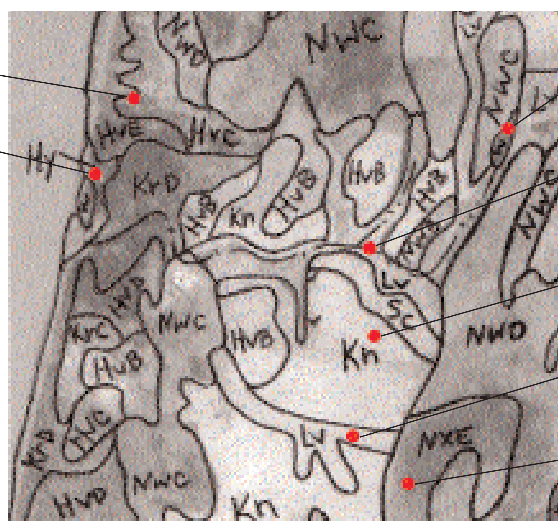
Step 1. Identify mapped features.

Figures A and B below depict the identical geographic area on a USGS topographic map and a county soil survey map. The arrows point to mapped features that serve as clues for habitat predictions.

A. USGS topographic map



B. Dutchess County soil survey map



Step 2. Interpret mapped features.

Use Table 17 (Appendix 6) or the Dutchess County soil survey Users Guide (Anonymous 1991) to find soil descriptions. Lower-case letters (a, b, e, f, g) correspond to mapped features in the topographic and soil map figures on previous page.

a **Hudson and Vergennes.** In the figures above, this soil complex occurs on rolling to steep, forested and non-forested terrain. These are calcareous silt loam and silty clay loam, deep, moderately well drained, mineral soils, with clay content ≥ 25%.

b **Hydraquents and Medisaprists.** In the figures above, these soils occur below Mean High Water. They are very poorly drained soils in tidal environments, of variable depths and soil reactions.

e **Kingsbury and Rhinebeck silty clay loam.** In the figures above, these soils occur on non-forested, nearly level terrain. These are calcareous, deep, clayey, somewhat poorly drained, mineral soils.

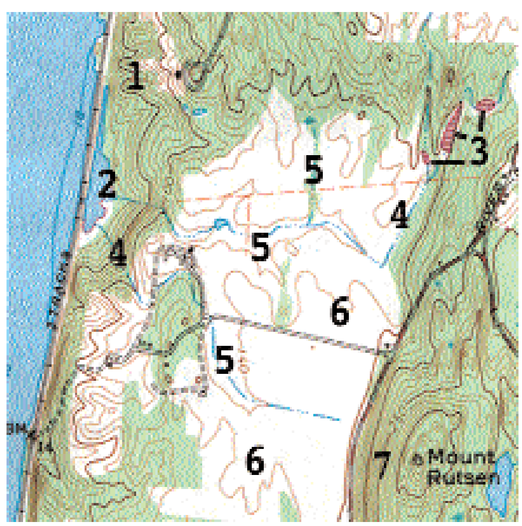
f **Livingston silty clay loam.** In the figures above, this soil type occurs in non-forested, nearly-level terrain along intermittent streams. This is a calcareous, deep, very poorly drained, clayey, mineral soil.

g **Nassau–rock outcrop**. In the figures above, these soils occur on very steep, forested terrain. These are non-calcareous, shallow, somewhat excessively drained, silt loam (mineral) soils, with shale rock outcrops.

Step 3. Predict habitats.

Use Habitat Keys (Sect. 6) and features depicted on topographic and soils maps (identified and interpreted in Steps 1 and 2) to predict the presence of significant habitats. The numbered habitat locations in Figure C correspond to the numbered items in the list below.

C. Habitat predictions



1. Steep, forested land on clayey soils near Hudson River (Keys 1 and 5) = **Clay Bluff and Ravine**

2. Non-forested Hydraquents and Medisaprists in the intertidal zone of the Hudson River (Keys 1 and 2) = **Intertidal Marsh**

3. **Constructed Ponds** (Keys 1 and 3)

4. **Intermittent Stream** (Keys 1 and 3)

5. **Intermittent Stream** (Keys 1 and 3), flanked by very poorly drained, calcareous, clayey soil, non-forested, nontidal land (Keys 1 and 4) = **Nontidal Marsh, Wet Clay Meadow,** or **Fen or Calcareous Wet Meadow**. (Wetland type must be identified in the field.)

6. Non-forested, somewhat poorly drained, clayey soils (Kingsbury and Rhinebeck) near the Hudson River (Keys 1 and 4) = **Wet Clay Meadow**

7. Steep, forested land on somewhat excessively drained, rocky, shallow, noncalcareous soils (Keys 1 and 5) = **Non-Carbonate Crest**

Step 4. Verify and assess habitats in the field.

Any habitats predicted from maps and keys should be verified in the field. Use the Habitat Profiles (Sect. 7) and the Species Profiles (Sect. 9) to help identify habitats in the field, and to assess their quality and their potential for supporting rare species.

5.3 Analyzing Environmental Assessment Documents

Environmental assessment documents of various kinds are produced for proposed development projects requiring federal, state, or local approvals. They are usually prepared by the permit applicant, or by consultants retained by the applicant, and are the primary basis on which environmental permit decisions on large development projects are made.

The environmental review process under SEQRA allows for substantial participation by interested agencies and the general public.

The biological report sections of these documents are meant to describe the existing biological resources on and near the proposed development site, and the potential effects of the development on those resources.

New York State Environmental Quality Review Act (SEQRA)

In New York, procedures for environmental reviews are set forth in the State Environmental Quality Review Act (SEQRA) and described at 6 NYCRR Part 617 under the statutory authority of Article 8 of the Environmental Conservation Law. Part 617 describes the kinds of documents to be prepared at each stage of the environmental review; the schedule for submittals, reviews, hearings, and decision-making; and the criteria for decision-making. Table 4 briefly outlines the SEQRA process.

Bald eagle
(Haliaeetus leucocephalus)

The environmental review process under SEQRA allows for substantial participation, not only by "involved agencies" with regulatory authority over the proposed activities, but also by other interested agencies and the general public. Many decision-making agencies, however, may be unaware of their ability under SEQRA to effect significant environmental protection, and many citizens are unaware of the ways to participate meaningfully in the process. Gerrard (1997) gives a concise description of the scope and limitations of municipal authority under SEQRA.

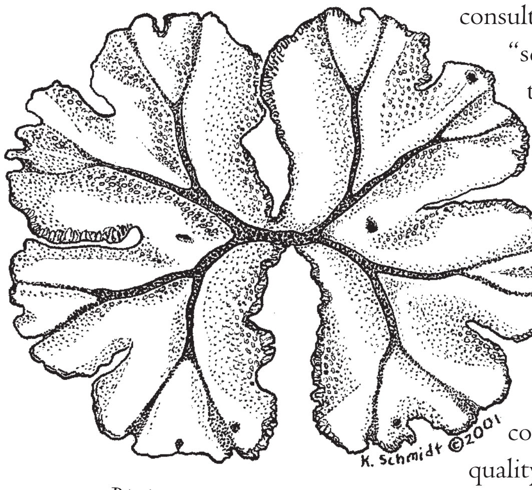
The "lead agency," which coordinates the required SEQRA review for a proposed development project, is sometimes a state agency such as the Department of Environmental Conservation, but often is a local agency such as the municipal planning board or the town board. The lead agency has substantial authority to determine whether an environmental impact statement (EIS) is needed, the scope of issues to be addressed in the EIS, whether to hold public hearings, and how to respond to comments from other agencies and from the public. The lead agency must identify the issues of environmental concern, take a "hard look" at those issues, and explain the basis for decisions in a "findings" statement. The lead agency may hire consultants to help review an EIS, and may pass those consultant costs on to the applicant.

Many decision-making agencies may be unaware of their ability under SEQRA to effect significant environmental protection, and many citizens are unaware of the ways to participate meaningfully in the process.

Under SEQRA, the lead agency may decide whether to give greater precedence to environmental, economic, or social considerations in their decision-making. SEQRA requires, however, that adverse environmental impacts be minimized or avoided, and gives the lead agency considerable latitude in deciding when that requirement has been met. Involved agencies and local governments may impose "substantive conditions" on a permit, or may deny the permit altogether if significant adverse environmental impacts cannot be avoided or mitigated.

Analyzing an Environmental Impact Statement (EIS)

The EIS is the most comprehensive of the environmental assessment documents. The discussion below focuses mainly on the EIS, but is applicable in many respects to other related environmental reports, including the standard Environmental Assessment Form (EAF) required at the preliminary stages of the SEQRA review.



Ricciocarpus natans
(a liverwort)

The array of issues to be addressed in the EIS is determined by the lead agency, usually in consultation with the permit applicant and other interested parties, in a process called "scoping." A final written scope of work is used to guide the preparation and content of the EIS. To insure that the important issues are addressed thoroughly, this scope should describe specific methods for addressing each issue of concern.

For many projects, the EIS should include thorough biological studies, so that important biodiversity resources are not overlooked in the environmental review. An EIS held to a rigorous standard of thoroughness and accuracy can serve a very useful purpose in environmental planning and decision-making, and in the conservation of biological resources.

A thorough biological report in an EIS will have habitat descriptions sufficiently comprehensive and detailed so that experienced ecologists can assess the habitat quality and the potential for rare or sensitive species without seeing the site themselves. Descriptions of rare species surveys will name the species or groups of species surveyed, and will describe the methods employed, the timing and duration of each kind of survey, and the qualifications of the investigator(s). The limitations of the surveys will also be fully described, so that reviewers can judge whether further surveys are needed.

To help determine the reliability and thoroughness of the biological information in an EIS and other environmental assessment documents, consider the questions below.

A thorough biological report in an EIS will have habitat descriptions sufficiently comprehensive and detailed so that experienced ecologists can assess the habitat quality and the potential for rare or sensitive species without seeing the site themselves.

1. Does the EIS provide enough information for an experienced biologist to assess the actual or potential biodiversity resources of a site? Are the setting and habitats described in enough detail to judge the habitat quality, the potential for rare organisms, and the potential project impacts?

Vegetation descriptions, habitat descriptions, and species lists in EISs should be sufficiently detailed, complete, and specific to the site that the reader can reasonably determine whether significant biodiversity resources could occur on or near the site.

Use of generic cover type categories such as "upland hardwood forest" or "shrub swamp," combined with generalized lists of plants and animals have the effect of making one site look no more biologically significant than the next. In fact, though, a "hardwood forest" could include a Crest habitat (Sect. 7.33 or 7.34), a Rich, Rocky Woodland (Sect. 7.27), or a Mature Mesophytic Lowland Forest (Sect. 7.26), or could have special attributes such as large trees, contiguity with large forested tracts, unusual species composition, or microhabitats especially suitable for certain rare species. Similarly, a "shrub swamp" could be an Acidic Bog (Sect. 7.19) or a Kettle Shrub Pool (Sect. 7.14), and a "wet meadow" could be a Fen (Sect. 7.12). Any of these habitats could harbor rare species.

The presence of special habitats and the potential for rare species cannot be inferred from generic habitat descriptions and species lists, and can thus be easily overlooked in the project environmental review.

The presence of special habitats and the potential for rare species cannot be inferred from generic habitat descriptions and species lists, and can thus be easily overlooked in the project environmental review. An EIS that fails to identify the biodiversity resources at risk, will also fail to adequately address the potential biological impacts of the proposed development.

In addition to providing useful biodiversity information, a thorough habitat assessment can also quell spurious concerns about a rare species, and thus increase the efficiency of the environmental review. For example, bog turtles occur only in certain parts of our region and only in certain, very specialized habitat types. If a habitat assessment indicates that the likelihood of bog turtle occurrence is low on a particular site, then the species can be eliminated from further consideration in the environmental review.

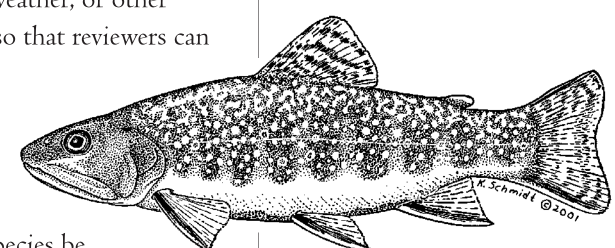
2. Were any field studies conducted? If so, are the field workers and their qualifications identified? Are field dates, times, and methods given? Were the season(s) and time(s) of day appropriate for the subject(s) of the studies?

Biological *assessment* requires certain specialized knowledge and skills, and biological *surveys* for particular species or groups of species are even more specialized. Many kinds of biological field studies can be conducted effectively only at certain seasons and times of day.

Many kinds of biological field studies can be conducted effectively only at certain seasons and times of day.

Reptile and amphibian surveys must be designed according to the life history and habits of the particular species of interest, and require different survey methods in different seasons. Thorough surveys for some species require combinations of methods. These may include trapping, netting, call surveys, night migration surveys, cover object surveys, and binocular surveys. Surveys for many reptiles and amphibians should be conducted in spring, after the onset of warm weather, but before hot daytime temperatures force the animals into cover or nocturnal activity. Surveys for many species of breeding birds must be carried out in early mornings of the spring when birds are vocalizing and displaying. Certain other bird species are best detected at dusk or at night. The timing and methods for butterfly surveys must coincide with the various life history stages that make each species most visible. These are often closely tied to the development stages of host plants and nectar sources for butterfly larvae and adults.

Time or funding constraints are often obstacles to thorough field work. A thorough biological report in an EIS will explain not only the survey timing and methods, but also the limitations of surveys, if any. When surveys have been less than thorough, or when their reliability has been compromised by timing, duration, weather, or other circumstances, then the report will explain those limitations fully, so that reviewers can determine whether further surveys are warranted.



Brook trout
(Salvelinus fontinalis)

3. If the EIS states that no rare species are present, is that claim based on actual field surveys described in the EIS?

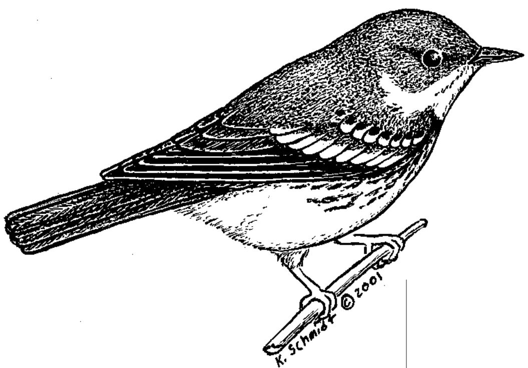
The official scope of an EIS often requires that the issue of rare species be addressed. An inquiry to NYNHP or NYSDEC about existing records of rare species or rare natural communities is an important first step in addressing this question. Most sites have never been surveyed by biologists, however, so the absence of records does not establish that rare elements are absent from a site. An onsite habitat assessment is the best way to determine the presence or potential for rare species or rare natural communities. If suitable habitats are present, then onsite rare species surveys by knowledgeable biologists are the only way to determine whether rare species are present.

The standard NYNHP letter response to rare species inquiries states the following:

> "The absence of [NYNHP] data does not mean...that rare or state-listed species, natural communities or other significant habitats do not exist on or adjacent to the proposed site....For most sites, comprehensive field surveys have not been conducted....This information should *not* be substituted for *on-site* surveys that may be required for environmental assessment" (emphasis in original).

Rare species surveys should be conducted by biologists who are experts at finding and recognizing the particular species in question.

If rare species surveys are necessary, they should be designed and conducted by biologists who are experts at finding and recognizing the particular species in question. The surveys must be designed so that the season, the time of day and weather conditions (in some cases), and the survey methods combine to maximize the chances of detecting the species. Incidental observations by field workers in the course of other work on the site do not constitute a rare species survey.



Cerulean warbler
(Dendroica cerulea)

A general rare plant survey, for example, must often include field work during spring, summer, and fall, to detect the species that are only visible or identifiable during certain seasons. Certain spring-blooming plant species are obscure or invisible by mid-summer. Certain sedges and grasses shatter (the fruits fall and flower parts disintegrate) by mid-summer, and are difficult or impossible to identify by late summer or fall. Certain rare forbs are reliably distinguished only by the mature fruit, not present until early fall. Nelson (1985) provides a thorough and thoughtful discussion of how to plan and conduct rare plant surveys for assessing impacts of development.

A thorough biological report in an EIS will describe in detail the timing and methods of rare species surveys, and the rationale for the survey design. The results of surveys inconsistent with accepted search protocols (such as those conducted at inappropriate seasons or times of day, in unsuitable habitats, or in unsuitable weather conditions) should be considered inconclusive.

4. Were offsite impacts adequately addressed, such as wetland, stream, and air pollution, habitat fragmentation, other habitat degradation?

Most land development projects have potential environmental impacts that extend beyond the project footprint or property boundaries. Some of these impacts may be as or more severe than those visited on the project site itself. For this reason, a thorough biological report in an EIS may need to address offsite impacts as thoroughly as onsite impacts. This might include detailed descriptions of offsite habitats potentially affected by the development project, and the significant species that use those habitats. Some rare animals of offsite habitats, for example, may migrate onto the proposed development site to forage, nest, overwinter, or seek refuge from flood or drought. These regular, seasonal, or occasional uses can be of critical importance to the survival of a rare species population.

The cumulative impacts of incremental losses associated with small projects probably account for greater total environmental degradation than those from the relatively few large projects that receive much public attention.

5. Were cumulative impacts addressed adequately?

The cumulative impacts of development projects and other activities are important components of the total impacts to biological resources. The cumulative impacts of incremental losses associated with small projects probably account for greater total environmental degradation than those from the relatively few large projects that receive much public attention.

For example, discharge of polluted effluent from one industrial plant might seem to have a minor incremental effect on stream water quality, but combined with discharges from several other plants on the same stream, the water quality degradation becomes substantial. The loss of 1/2 acre of mature hardwood forest may seem inconsequential by itself, but, combined with similar losses associated with other nearby projects, could amount to substantial forest loss and fragmentation, perhaps even the disappearance of the last large tract of forest in the town or region, and in turn the disappearance of local breeding habitats for area-sensitive bird or mammal species. The filling of a small, intermittent woodland pool could result in the disappearance of salamander breeding habitat over a large area. Small, incremental, and cumulative losses such as these can transform, within just a few years, a biologically rich region into a biologically impoverished one, characterized by small, degraded habitats supporting only generalist species.

Adjacent towns and counties would benefit from sharing information about existing and proposed projects that will affect shared natural resources.

The lead agency should consider requiring the following information about cumulative impacts:

1) The regional status of the significant habitats and species on the project site,
2) the offsite habitats and species in the vicinity of the project site that could be affected by the project,
3) the number of proposed and active projects with similar impacts in the region,
4) the likelihood of future projects with similar impacts, and
5) other activities that might compound, exacerbate, or intensify this project's impacts.

We recommend that regulatory reviewers develop standard procedures for evaluating cumulative impacts of development projects. Adjacent towns and counties would benefit from sharing information about existing and proposed projects that would affect shared natural resources.

6. Can the conclusions about environmental impacts be substantiated from the data presented in the EIS?

All conclusions in the EIS about environmental impacts should be substantiated by verifiable data or other information.

Smooth cliffbrake
(Pellaea glabella)

TABLE 4. OUTLINE OF THE NEW YORK STATE ENVIRONMENTAL QUALITY REVIEW (SEQR) PROCESS.

1	Applicant notifies an involved state or local regulatory agency about a proposed new development project or action.
2	Agency determines whether action is subject to SEQR.
3	If so, agency requests Environmental Assessment Form (EAF); request for "full" or "short" form depends on size of project or magnitude of anticipated environmental impacts.
4	Applicant submits Part 1 of EAF to agency.
5	Agency completes EAF, and circulates it to other concerned state and local agencies to establish a "lead agency."
6	Agencies jointly select a "lead agency" to coordinate the preparation and review of environmental assessment documents.
7	Lead agency determines the significance of the potential environmental impacts of the project or action, and issues a "positive declaration" or "negative declaration"of significance. A negative declaration means that preparation of an Environmental Impact Statement (EIS) is not required, although certain other conditions may be specified. A positive declaration means that potential environmental impacts are significant enough to warrant preparation of an EIS.
8	Ordinarily, a "scoping" process precedes preparation of the EIS to identify the array of issues to be addressed in the EIS. Involved agencies are invited to participate in the scoping. At the discretion of the lead agency, the public and other interested agencies may also be invited.
9	Ordinarily, the applicant (or consultants to the applicant) prepares the <u>Draft</u> EIS (DEIS), and submits it to the lead agency.
10	Lead agency determines whether the DEIS is adequate and complete. If not, the lead agency requests revisions.
11	After the DEIS has been accepted as complete, it is circulated for public comment; public hearings may be held at the discretion of the lead agency.
12	Lead agency determines whether <u>Final</u> EIS (FEIS) must be prepared, and, if so, specifies scope of FEIS, based in part on comments from other agencies and public. (If the agency determines, on the basis of the DEIS, that the action will cause no significant environmental harm, then an FEIS will not be requested.)
13	FEIS is submitted to agency; lead agency determines whether FEIS is complete. Supplemental DEIS (SDEIS) may be requested to cover any changes in the proposed project, or new information not available at the time the FEIS was completed.
14	The lead agency determines whether the FEIS and any supplemental EIS is complete; requests revisions as necessary. When complete, documents are circulated to all involved agencies, and comments are solicited.
15	Lead agency decides whether to approve, disapprove, or require changes to the project or action. Agency issues findings statement explaining basis for decision. If project is approved, findings statement will include conditions and mitigation measures, as appropriate.

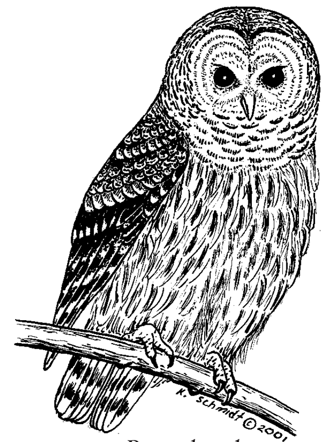
6.0

Keys to Habitats

6.0 Keys to Habitats Profiled in the Manual

These keys are designed to be used with USGS topographic maps, county soil surveys, state bedrock and surficial geology maps, and aerial photographs, to help predict the occurrence of habitats profiled in the *Manual*. The keys are not designed for use in the field. Because maps have inherent inaccuracies due to scale, methods of data collection and map making, and changes in the landscape since the map data were gathered, the actual presence of any habitats must be verified by field observations. Certain habitats—such as springs, seeps, intermittent woodland pools, and intermittent streams—are not reliably detectable on maps or aerial photographs, and usually require thorough field surveys.

Each of the five keys below comprises a series of choices, based on features detectable on maps and aerial photos, that will lead the user to the identification of habitats. These habitat "predictions" along with the Habitat Profiles (Sect. 7) and Species Profiles (Sect. 9) can help users assess the potential for occurrence of important biodiversity resources, even without visiting the study site themselves.



Barred owl
(Strix varia)

Using the Keys

The keys are designed to break down the features identifiable on maps and aerial photos into general groups (e.g., forested or non-forested) and then into successive subsets of groups (e.g., deciduous or coniferous; shallow or deep soils, etc.) that lead eventually to particular habitats. The keys are in a modified "dichotomous" format, where the user chooses between two or more contrasting sets of conditions, and each choice leads to two or more subsets of conditions, each of which leads to further subsets, and so forth. Each primary division in the key is denoted by an identical letter indented at the same level. For example, in the sample key below, the user first chooses between the two "a" options, tidal or non-tidal. If the topographic map shows that the area is non-tidal, then the user chooses between the three "c" options, based on slope and soil characteristics. If the topographic and soil maps show that the area has steep slopes and rocky, shallow soils, then the user considers the "d" options, and so forth. The user continues to make choices between the options bearing the same letter until arriving at a habitat, a group of habitats, or directions to other keys. Consulting the Habitat Profile(s) will help the user confirm or refine those predictions, and begin to assess the biodiversity potential for each study area.

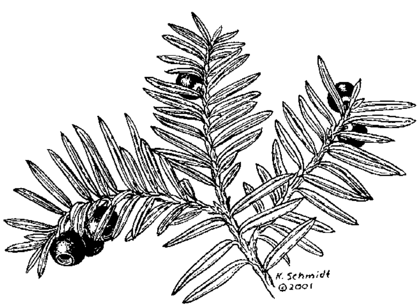
These keys are to be used with topographic, geology, and soils maps, and aerial photos; they are not designed for use in the field.

Sample key, for demonstration only

a Area in the intertidal zone
- b Area forested or shrubby . . . . Tidal Swamp
- b Area non-forested . . . . Tidal Marsh or Tidal Tributary Mouth

a Area non-tidal
- c Slopes steep, soils clayey . . . . Clay Bluff and Ravine
- c Slopes steep, soils rocky and shallow
  - d Deep ravine flanking a perennial stream . . . . Cool Ravine
  - d Not a ravine
    - e Bedrock carbonate . . . . Carbonate Crest, Ledge, and Talus
    - e Bedrock non-carbonate . . . . Non-Carbonate Crest, Ledge, and Talus
- c Slopes or soils other than above . . . . (Go to Key X)

Use KEY 1, the GENERAL KEY (next page), to separate the major habitat groups (tidal habitats, dredge spoil habitats, nontidal wetlands, etc.), and keys 2-5 to identify the habitats in each of those groups. Use Tables 17 and 18 (in Appendix 6) to help interpret county soil surveys and state bedrock geology maps.



American yew
(Taxus canadensis)

KEY 1 General Key (start here)

a In Albany County, and underlain primarily by loamy fine sands, especially those in the Colonie, Elnora, Granby, and Stafford soil series . . . . .possible Sand Plains and Barrens (Sect. 7.36)

a On the eastern slope of the Catskill Mountains in the towns of Catskill, Saugerties, and Woodstock (Greene and Ulster counties) . . . . .Catskill Eastern Escarpment (Sect. 7.38)

a Soils mapped as Udorthents (non-wet), dump, landfill, sand and gravel pits, quarry pits or smoothed Udipsamments . . . . .Waste Ground (Sect. 7.37)

a Location or soils not as above

b In, adjacent to, or near the Hudson River

c Soils mapped as dredged Udipsamments . . . . .Hudson River Dredge Spoil Habitats (Sect. 7.9)

c Underwater habitats; <u>or</u> lands at elevations below the first positive contour with soils mapped as Ipswich, Saprists, Hydraquents or Medisaprists, Fluvaquents-Udifluvents, or Freshwater Marsh; <u>or</u> (on streams) below the first dam; or Hudson River islands . . . . .Tidal, Supratidal, and Island Habitats, Key 2

c Soils rocky, adjacent to Hudson River or to a tidal tributary . . . . .Tidal, Supratidal, and Island Habitats, Key 2

c Soils mapped as wet Udorthents . . . . .wetlands on non-dredged fill, not profiled in *Manual*

c Soils other . . . . .other shoreline habitats, not profiled in *Manual*

b Distant from the Hudson River, <u>or</u> above the first positive contour line and not underlain by Udipsamments and not an island

d Area depicted as perennial stream, intermittent stream, lake, or pond on USGS topographic map, or identifiable as such on other map or on aerial photos . . . . .streams, lakes, and ponds, Key 3

d Area not depicted as a perennial stream, lake, or pond

e Area shown as a distinct series of adjacent, v-shaped contours (the "v" Pointing upslope), as in Figure 2a . . . . .probable Intermittent Stream[1] (Sect. 7.21)

e Multiple series of adjacent, v-shaped contours (the "v's" pointing upslope), as in Figure 2c . . . . .probable Springs and Seeps[1] (Sect. 7.16)

e Area within first contour adjacent to a perennial stream (first 10-ft or 20-ft contour, depending on the map standard), <u>or</u> within mapped 100-year floodplain (e.g., on FEMA maps), <u>or</u> is known to have flooded in the past . . . . .Riparian Corridor (Sect. 7.23); also, go to f

e Not as above

f Soils described as Very Poorly Drained or Poorly Drained . . . . .probable nontidal wetland, Key 4

f Soils described as Somewhat Poorly Drained . . . . .possible nontidal wetland, or with potential wetland inclusions, Key 4

f Soil drainage other . . . . .probable non-wetland, Key 5

[1] Many intermittent streams, and most springs and seeps cannot be detected by map or photo interpretation, but must be identified by field observations.

KEY 2 Tidal, Supratidal, and Hudson River Island Habitats

a Elevation below the minus-6 ft contour . . . . .deep water habitats, not profiled in *Manual*

a Elevation between the minus-6 ft contour and Mean Low Water[1] . . . . .Fresh or Brackish Subtidal Shallows (Sect. 7.1)

a Elevation between Mean Low Water[1] and Mean High Water[1] (the intertidal zone)

b Intertidal zone nearly flat or gently sloped (except steep banks of tidal creeks), mostly not rocky

c Forested or shrubby . . . . .Intertidal Swamp (Sect. 7.4)

c Not forested or shrubby

d Intertidal zone includes mouth of tributary (may be rocky) . . . . .Tidal Tributary Mouth (Sect. 7.6)

d Intertidal zone not a tributary mouth . . . . .Fresh or Brackish Intertidal Marsh (Sect. 7.3)

b Intertidal zone steep or gently sloped

e Soils rocky . . . . .Estuarine Rocky Shore (Sect. 7.2)

e Soils clayey . . . . .base of Clay Bluff (Sect. 7.32)

a Elevation between Mean High Water and 3.3 ft (1 m) above Mean High Water (the supratidal zone)[2]

f Railroad or road causeway detectable on
topographic map . . . . .Supratidal Railroad and Road Causeway (Sect. 7.8)

f Soils mapped as Fluvaquents-Udifluvents, or described as
Very Poorly Drained, Poorly Drained, or Somewhat Poorly Drained

g Forested or shrubby . . . . .Supratidal Swamp (may include Supratidal Pool) (Sect. 7.4)

g Not forested . . . . .Supratidal Marsh (may include Supratidal Pool) (Sect. 7.3)

f Soils mapped as dredged Udipsamments . . . . .Hudson River Dredge Spoil Habitats (Sect. 7.9)

f Not a railroad or road causeway, and soils not as above . . . . .other non-wetland supratidal habitats,
some are covered in Keys 1 & 5

a Elevation other, area mapped as an island

h Soils described as rocky, or as having exposed bedrock . . . . .Hudson River Rocky Island (Sect. 7.7)

h Soils mapped as Udipsamments . . . . .Hudson River Dredge Spoil Habitats (Sect. 7.9)

h Soils other . . . . .island with native, non-rocky substrates, not profiled in *Manual*

[1] The shoreline shown on USGS topographic maps is intended to represent Mean High Water (MHW). Wetland contiguous with the MHW line should be assumed to be tidal, wholly or in part. Mean Low Water is not shown explicitly, but lies between MHW and the minus-6 ft contour.

[2] The supratidal zone is not shown explicitly on USGS topographic maps, but can be roughly inferred from general topography.

KEY 3 Streams, Lakes, and Ponds

a Area depicted as a perennial stream on USGS topographic map . . . . .Perennial Stream (Sect 7.22)

a Area depicted as an intermittent stream on USGS topographic map . . . . .Intermittent Stream[1] (Sect. 7.23)

a Area depicted as an open-water pond or lake on USGS topographic map, or identifiable as such on aerial photo

b Dam evident at outlet of waterbody on USGS map, other map, or aerial photo . . . . .Constructed Lakes and Ponds (Sect. 7.24)

b Dam not evident on maps or aerial photos

c Waterbody depicted with purple hatching on photorevised USGS map . . . . .Constructed Lakes and Ponds (Sect. 7.24)
or Beaver Pond (Sect. 7.17)

c Waterbody with no purple hatching . . . .(may be natural or constructed waterbody; check in field)

d Waterbody in a fault basin (see bedrock geology map) in calcareous bedrock terrain, with peat soils . . . . .probable Circumneutral Bog Lake (Sect. 7.18)

d Waterbody as above, but not in fault basin . . . . .possible Circumneutral Bog Lake (Sect. 7.18)

d Waterbody in or near glacial outwash (see surficial geology map or soil map) . . . . .possible Kettle Shrub Pool (Sect. 7.14)
or Intermittent Woodland Pool (Sect. 7.11)
or Beaver Pond (Sect. 7.17) (see Key 4)

d Waterbody in other geologic setting . . . . .Beaver Pond (Sect. 7.17)
or other lake or pond, not profiled in *Manual*

[1] See Key 1 for identifying intermittent streams not shown explicitly on maps.

KEY 4 Nontidal Wetlands [1, 2]

a Wetland forested

b Wetland dominated by broadleaf deciduous trees . . . . .Nontidal Hardwood Swamp (Sect. 7.15)

b Wetland dominated by conifers . . . . .conifer swamp, not profiled in *Manual*

a Wetland not forested (although may be surrounded by forest)

c Soils clayey (>25% clay in one or more surface layers) and Somewhat Poorly Drained or wetter, especially those in the Hudson, Vergennes,[3] Kingsbury, Livingston, Madalin, or Rhinebeck soil series . . . . .Wet Clay Meadow (Sect. 7.10)

c Soils not clayey, drainage various

d Bedrock calcareous and soils circumneutral or alkaline (ph $\geq$ 6.5 in surface layers)

e Wetland in fault basin (see bedrock geology map) . . . . .possible Circumneutral Bog Lake (Sect. 7.18)

e Wetland not in fault basin

f Wetland lacking perennial inlet and outlet streams

g Wetland shallowly or not at all flooded . . . . .possible Fen or Calcareous Wet Meadow (Sect. 7.12)
or shrub swamp, not profiled in *Manual*

g Wetland seasonally flooded, small (usually less than 0.5 ha [1.2 ac]), surrounded by forest . . . . .Intermittent Woodland Pool (Sect. 7.11)

g Wetland deeply flooded, with floating or emergent vegetation . . . . .Circumneutral Bog Lake (Sect. 7.18)
or Nontidal Marsh (Sect. 7.20)

f Wetland with perennial inlet and outlet streams . . . . .Nontidal Marsh (Sect. 7.20)
or Beaver Pond (Sect. 7.17)
or shrub swamp, not profiled in *Manual*

d Bedrock non-calcareous or soils acidic (ph < 6.5 in surface layers)

h Wetland lacking perennial inlet and outlet streams

i Wetland shallowly or not at all flooded

j Wetland dominated by low (<1 m [<3.3 ft]) heath shrubs and peat mosses, and underlain by peat or muck soils . . . . .Acidic Bog (Sect. 7.19)

j Wetland not as above . . . . .Non-Calcareous Wet Meadow (Sect. 7.13)
or shrub swamp, not profiled in *Manual*

i Wetland flooded seasonally

k Wetland dominated by low (<1 m [<3.3 ft]) heath shrubs and peat mosses, and underlain by peat or muck soils . . . . .Acidic Bog (Sect. 7.19)

(continued)

k Wetland not dominated by low heath shrubs

l Wetland otherwise shrubby

m Wetland located near glacial outwash . . . . Kettle Shrub Pool (Sect. 7.14)

m Surficial geology various, wetland small and surrounded by forest . . . . Intermittent Woodland Pool (Sect. 7.11)

m Surficial geology various, wetland size and surroundings various . . . . shrub swamp, not profiled in *Manual*

l Wetland dominated by herbaceous vegetation; surficial geology various . . . . Nontidal Marsh (Sect. 7.20)

i Wetland more or less permanently flooded, with floating or emergent herbaceous vegetation . . . . Nontidal Marsh (Sect. 7.20)

h Wetland with perennial inlet and outlet streams

n Wetland dominated by low heath shrubs and peat mosses, and underlain by peat or muck soils . . . . Acidic Bog (Sect. 7.19)

n Wetland otherwise shrubby . . . . shrub swamp, not profiled in *Manual*

n Wetland dominated by herbaceous vegetation . . . . Nontidal Marsh (Sect. 7.20)
or Beaver Pond[4] (Sect. 7.17)

[1] See KEY 1 for springs and seeps.

[2] Intermittent woodland pools are often not shown explicitly on USGS topographic maps, and may be obscure on aerial photographs; reliably detected only by field surveys.

[3] Vergennes soils are described as Well Drained, but often contain Somewhat Poorly Drained inclusions.

[4] Beaver dam often not detectable on aerial photos; reliably detected only by field surveys.

KEY 5 Non-Wetlands (use KEY 1 to eliminate non-wetland habitats not treated in this key)

a Area forested

b Slopes steep (≥ 15 %)

c Soils clayey (≥ 25% clay in one or more surface layers), near Hudson River . . . . . Clay Bluff and Ravine (Sect. 7.32)

c Soils rocky, shallow (≤ 20 inches)

d Depicted as steep-sided ravine, with perennial stream at bottom . . . . . Cool Ravine (Sect. 7.25)

d Steep slope, but not a ravine

e Soils or bedrock calcareous . . . . . Carbonate Crest, Ledge, and Talus (Sect. 7.34)

e Soils or bedrock not calcareous (as mapped) . . . . . Rich Rocky Woodland (Sect. 7.27) or Non-Carbonate Crest, Ledge, and Talus (Sect. 7.33)

c Soils other

f Elevation ≤ 800 ft . . . . . possible Mature Mesophytic Lowland Forest (Sect. 7.26)

f Elevation > 800 ft . . . . . other steep, wooded habitats, not specifically profiled in *Manual*

b Slopes moderate or gentle

g Soils rocky, shallow (≤ 20 inches)

h Soils or bedrock calcareous . . . . . Carbonate Crest, Ledge, and Talus (Sect. 7.34)

h Soils or bedrock not calcareous . . . . . Non-Carbonate Crest, Ledge, and Talus (Sect. 7.33)

g Soils deeper

i Trees coniferous, evidently planted (grid pattern may be detectable on aerial photo) . . . . . Conifer Plantation (Sect. 7.29)

i Trees coniferous or deciduous, not evidently planted

j Trees mature, elevation ≤ 800 ft . . . . . Mature Mesophytic Lowland Forest (Sect. 7.26)

j Trees mature, elevation > 800 ft . . . . . Other mature forest, not profiled in *Manual*

j Trees younger and smaller, elevations various . . . . . Young Woods (Sect. 7.28)

a Area not forested

k Soils rocky, shallow (≤ 20 inches)

l Soils or bedrock calcareous . . . . . Carbonate Crest, Ledge, and Talus (Sect. 7.34)

l Soils or bedrock not calcareous . . . . . Non-Carbonate Crest, Ledge, and Talus (Sect. 7.33)

k Soils deeper

m Vegetation mixed shrubby and herbaceous . . . . . Shrubby Oldfield (Sect. 7.30)

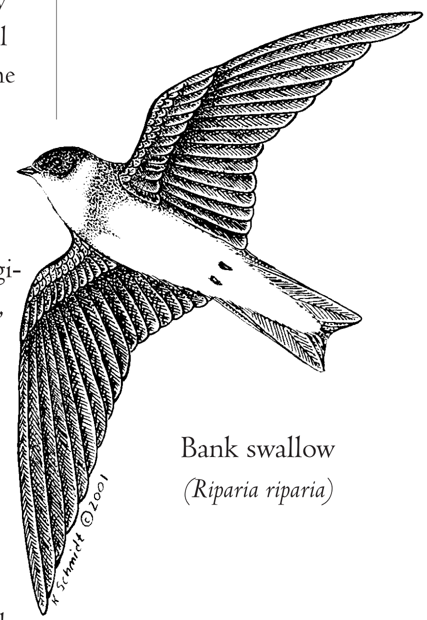
m Vegetation predominantly herbaceous . . . . . Upland Meadow (Sect. 7.31)

7.0

Habitat Profiles

7.0 Habitat Profiles

The subsections below contain descriptions ("profiles") of broadly defined habitat types that are significant to biological conservation in the Hudson River estuary corridor. They are principally habitats that may support state-rare or regionally-rare species or ecological communities (as well as common species and communities), and they include many of the habitats characteristic of Hudson Valley ecosystems.



Bank swallow
(Riparia riparia)

What is a habitat?

A "habitat" is the place, or the type of place, where a particular species or group of species might reasonably be expected to occur. Habitats are defined by a variety of biological and non-biological features, such as their bedrock; soil; characteristics of water depth, flows, and chemistry; exposure (e.g., to sun, wind, or waves); vegetation; fauna; and cultural impacts. A "community," on the other hand, is a group of plants and animals that interacts with one another, and shares a common environment. A single habitat may support many communities.

Because this *Manual* is intended for use by non-biologists as well as biologists, we have defined and profiled habitats that can be easily recognized on the basis of vegetation structure, a few indicator species, and a few non-biological features. The classification is intended to be functional and consistent with the purposes of the *Manual*. We have found that it works well for biodiversity assessment in our region.

Some of the profiled "habitats" are actually complexes of habitats or whole physiographic areas. For example, a Riparian Corridor could include perennial stream, wooded swamp, wet meadow, crest and ledge habitats, cool ravine, and upland meadow habitats. The Catskill Eastern Escarpment is a large area occurring at the interface of the Catskill Mountains and the Hudson Valley, and containing numerous habitats such as mature mesophytic lowland forests, cool ravines, intermittent and perennial streams, crest, ledge, and talus.

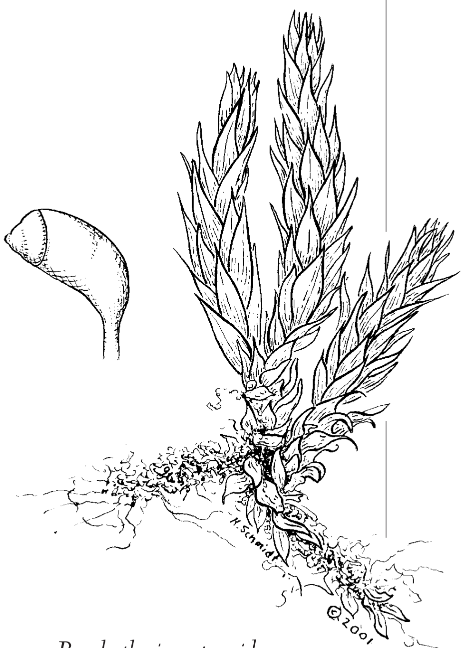
Most habitats described in the *Manual* support one or more of the communities included in *Ecological Communities of New York State* (Reschke 1990), which describes the rare and common ecological communities recognized by the New York Natural Heritage Program (NYNHP). For example, our "Fen and Calcareous Wet Meadow" habitat encompasses Reschke's "rich sloping fen," "rich graminoid fen," and "rich shrub fen," and calcareous examples of Reschke's "sedge meadow." We describe several habitats containing communities not treated by Reschke, but, wherever possible, the profiles in the *Manual* are cross-referenced to Reschke's community names.

Users of the *Manual* should be aware that habitat descriptions (in the *Manual* and elsewhere) will not exactly match habitats in the field. Species composition will differ somewhat from one location to another. We have tried, however, to make our habitat definitions and descriptions broad enough for easy recognition in the field.

This is not an exhaustive list of habitats in the Hudson River corridor, and undoubtedly the user will find habitats that do not fall within one of our categories, yet support a rarity. We encourage users to avoid trying to squeeze an area into our habitat definitions, but rather to be alert to features and species that may occur in the habitats you are studying.

The habitat profiles

Most of the profiles are presented in a consistent format, with a common series of subsections (e.g., vegetation, fauna, indicators and identification, biodiversity values). These subsections are fairly self-explanatory, but the general contents of each are briefly described below:



Brachythecium turgidum
(a moss)

Vegetation: The typical plant community and structure of the habitat, including some of the characteristic plant species.

Fauna: Some of the typical animals that reside in or frequent the habitat.

Indicators and Identification: The biological and physical features most useful for identifying the habitat on maps or in the field. This may include plant or animal species, or characteristics of geology, water, or topography, for example.

Biodiversity Values: Lists and discussions of some of the rare or otherwise significant ecological communities, and plant and animal species that do or could occur in the habitat. These include species listed as federal Endangered or Threatened species (**Federal List**), New York State Endangered, Threatened, and Special Concern Species, and New York Natural Heritage Program Rare Elements (**State Lists**), Partners in Flight Watch List, Migrants in Jeopardy, and Migratory Nongame Birds of Management Concern (**National Bird Lists**), and Regionally-Rare, Regionally-Scarce, Declining, and Vulnerable (**Regional Lists**). The lists of Species of Conservation Concern presented in each habitat profile include species that are known to occur in the habitat currently or recently, species that have occurred historically in the habitat, and some that use similar habitats outside the Hudson River corridor and could occur here. These lists are by no means comprehensive; they are merely a sample of the species that might occur in each habitat. The rarity ranks (as of November 2000) of all rare species mentioned in the *Manual* are given in Appendix 3. Scientific names of plants and animals mentioned in the profiles and elsewhere in the *Manual* are given in Appendix 4.

Substrates: The general character of the soil, bedrock, or other substrates of the habitat, in terms of texture, structure, chemistry, disturbance, and other attributes relevant to the identification or ecology of the habitat.

Surface Waters: The general character of surface waters, in terms of depths, seasonal fluctuations, tidal influence, flows, and chemistry.

Extent: The typical range of sizes (e.g., acreage) of the habitat in the Hudson River estuary corridor.

Distribution: The longitudinal and elevational distribution of the habitat in the Hudson River estuary corridor.

Quality: Some indicators and subjective measures of higher or lower ecological "quality," based on similarity to known or assumed attributes of undisturbed, natural examples of the habitat. Determinations of quality are based on such factors as size, diversity of native flora and fauna, presence and abundance of non-native species, degree of human disturbance, and influence of natural processes such as floods, tidal flushing, and fires.

Human Uses: Contemporary or past human uses of the habitat, such as logging, mining, agriculture, recreation, and commercial fishing.

Sensitivities, Impacts: Some of the known effects on the habitat of direct or indirect human activities and influences.

Conservation and Management: Some recommendations for restoration, protection, or maintenance of the ecological well-being of the habitat type.

Examples on Public Access Lands: A few examples of places where the habitat type occurs on properties accessible to the public. Refer to Table 2 and Figure 1 to identify the county and location of the towns referred to here and elsewhere in the profiles.

References: Some examples of published and gray literature with descriptions of, or ecological information about, the habitat type.

A few of the habitat profiles, such as those that are widespread and easily recognized (e.g., Waste Ground, Young Woods), or those for which we have only limited biodiversity information (e.g., Springs and Seeps), are presented in an abbreviated format without subsections.

The habitat profiles are arranged in the following categories according to general physiographic characteristics:

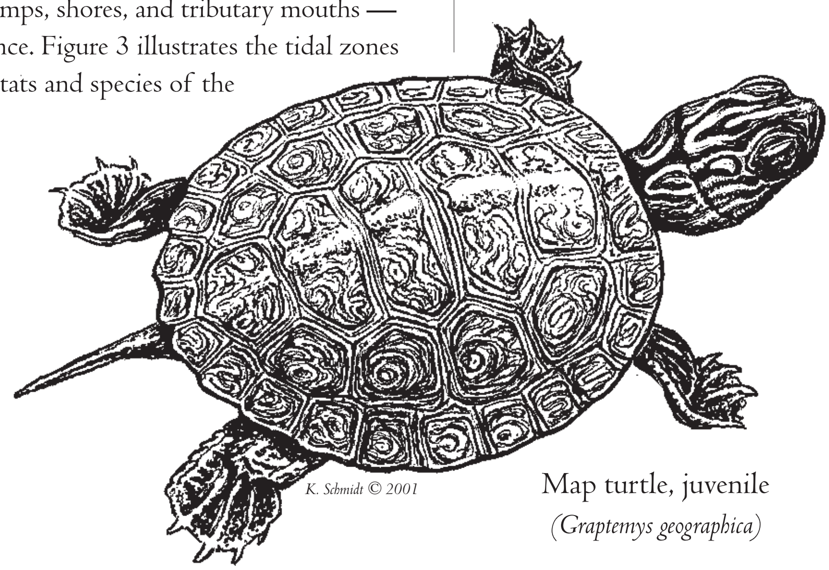
Tidal and Supratidal Habitats

Dredge Spoil Habitats

Nontidal Habitats (wetlands; streams, lakes, and ponds; terrestrial, and various)

Tidal and Supratidal Habitats

The Hudson River is tidal for the approximately 240 km (150 mi) from its mouth at the southern end of Manhattan to the Troy dam. The salinity varies seasonally with changes in freshwater runoff and other factors. Normally the river is brackish (somewhat salty) south of Newburgh and substantially fresh to the north. The tidal amplitude is variable, depending on the shape of the river channel and shoreline at any location. For example, at West Point, the mean amplitude is approximately 0.8 m (2.7 ft), and at Catskill approximately 1.2 m (4.1 ft). The ebb and flow of the tides, along with other forces such as wind, currents, waves, and ice, help to create habitats distinct from those in nontidal environments. These habitats — shallows, mudflats, marshes, swamps, shores, and tributary mouths — are defined in part by the nature of the tidal influence. Figure 3 illustrates the tidal zones referred to in the habitat profiles below. Many habitats and species of the tidal Hudson occur nowhere else in the state.



Map turtle, juvenile
(Graptemys geographica)

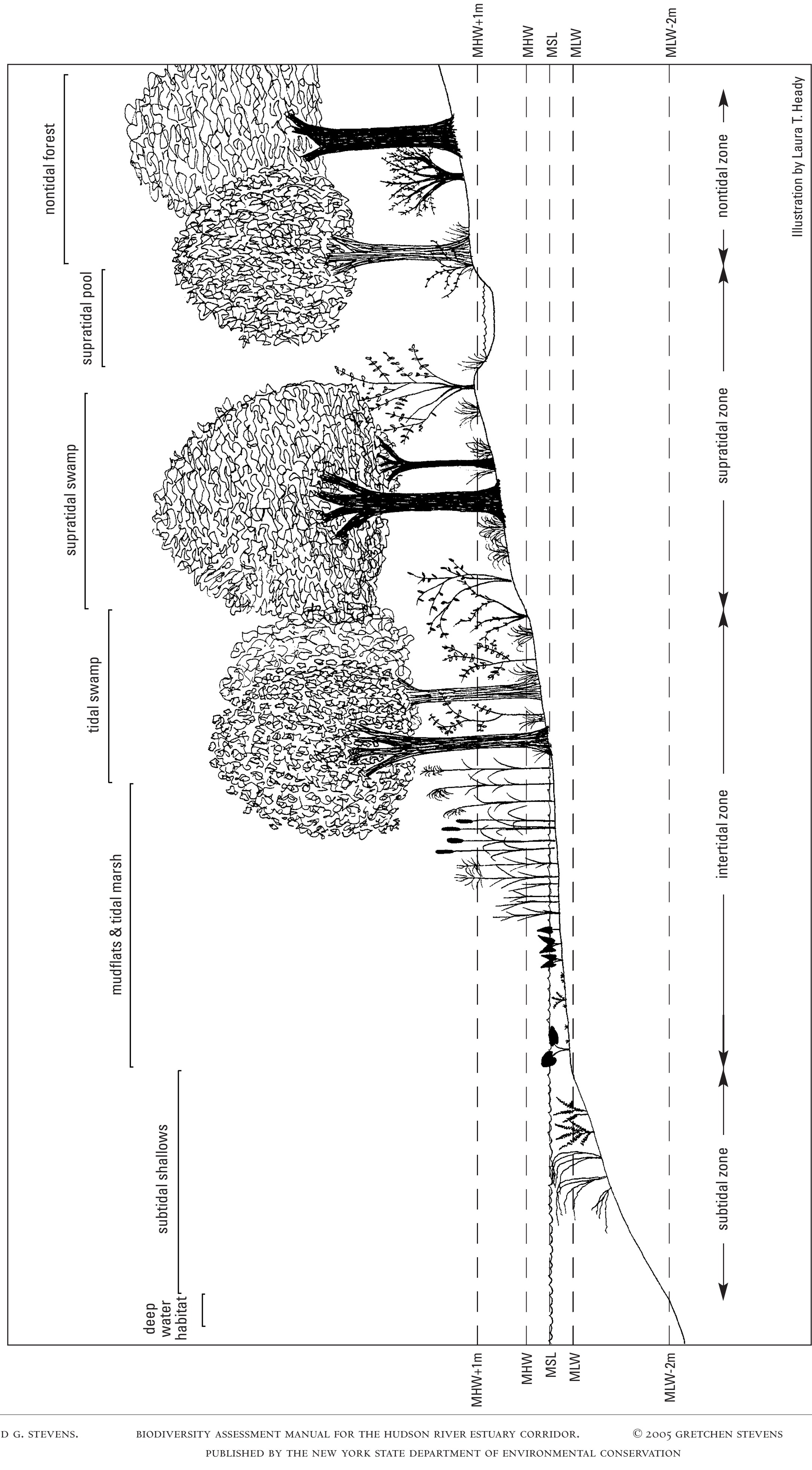
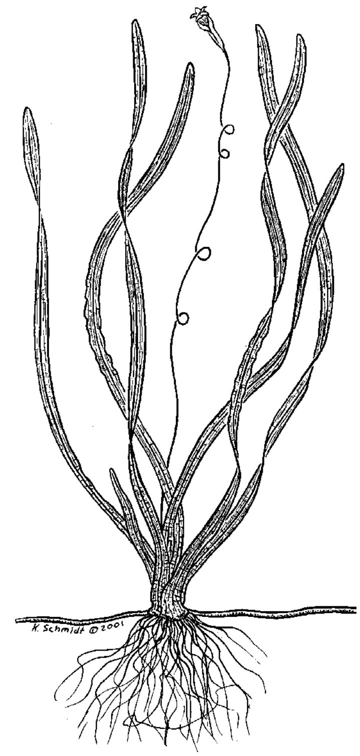


Figure 3. Hudson River tidal zones. MHW = mean high water; MSL = mean sea level; MLW = mean low water.

7.1 Fresh and Brackish Subtidal Shallows

THE SUBTIDAL SHALLOWS IS THE ZONE BETWEEN the mean low water (MLW) elevation and approximately 2 m (6.5 ft) below mean low water. This zone supports beds of submerged aquatic vegetation, which are well-known for their importance to fish and waterfowl. In some areas, the subtidal shallows extend into portions of Tidal Tributary Mouths (Sect. 7.6).



Water celery (*Vallisneria americana*)
leaves 3–10 mm (0.1–0.4 in) wide

Vegetation

Beds of limp-stemmed, "true aquatic" plants that depend on support by water. Subtidal vegetation is often referred to as "submersed," "submerged," or "submergent" aquatic vegetation (SAV), or subtidal aquatic beds (SAB), although portions of these beds may be exposed at low tide. One abundant species, water-chestnut, has floating leaves that are not submerged at all when mature.

SAV species with the most extensive coverage in the Hudson are water-chestnut, wild-celery, Eurasian watermilfoil, clasping pondweed, curly pondweed, and sago pondweed. Less abundant species include water star-grass, horned pondweed, flat-stemmed pondweed, and naiads. Common coontail and waterweeds (*Elodea*) are common in sheltered areas.

Subtidal plant communities may be dominated by water-chestnut, wild-celery, Eurasian watermilfoil, or clasping pondweed, singly or in combinations, or may comprise more diverse mixtures of species. The more sheltered and shallow areas are usually dominated by water-chestnut at least as far south as Garrison (Town of Philipstown), below which summer salinities are too high for water-chestnut to thrive (although it occurs in small beds as far downriver as Iona Island). Higher-energy areas (more exposed to wind, waves, and currents) and more brackish areas are usually dominated by wild-celery, watermilfoils, or pondweeds. Many small areas in stream mouths or tidal creeks have waterweeds and other species. The charophyte algae (stoneworts) appear to be very rare now, but may have been more common in the 1930s (Muenscher 1937). In the Tivoli Bays area, watermilfoil has declined and wild-celery increased since the early 1970s (Kiviat, observations); we do not know if this is a river-wide trend.

Large areas of subtidal bottom are bare of vascular vegetation or nearly so. Such areas may have been denuded by storms or ice and not yet recolonized, or may be unsuitable due to unstable substrate, adverse materials (e.g., cinder or organic matter), pollution, chronic ice scouring or wave and current stress, variable salinity, or animal activities. Small subtidal areas within intertidal marshes may be occupied by mixtures of species quite different from those in more open areas (e.g., waterweeds and common coontail). Tidal creeks with bottoms below mean low water (MLW) have subtidal habitat although they may conveniently be considered part of tidal marsh complexes.

Fauna

Many fishes reside in, or enter, subtidal habitats either as adults or at immature stages. Subtidal areas are especially important to juvenile striped bass, alewife, blueback herring, American shad, and both juveniles and adults of the tessellated darter, spottail shiner, banded killifish, white perch, and pumpkinseed. Turtles use subtidal areas more than other tidal habitats. Subtidal shallows are important feeding areas for waterfowl (ducks, geese, and swans) and several species of gulls. Double-crested cormorant, great blue heron, American coot, common moorhen, and a few other water birds also use this habitat. Muskrat, beaver, and river otter use the shallows for foraging and as movement corridors.

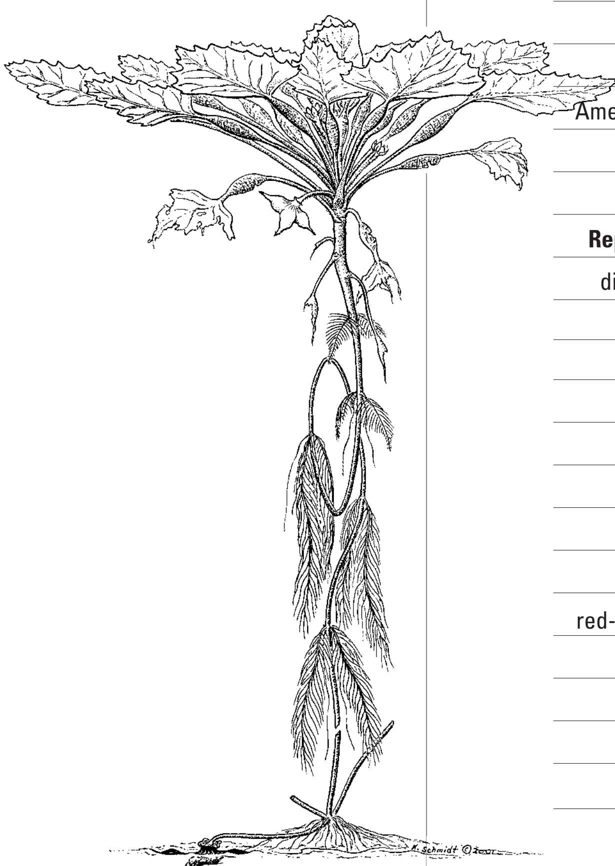
Indicators and Identification

The bottom elevation (depth) range and tidal influence identify this habitat. Vegetation may be present or lacking.

Biodiversity Values

SPECIES OF CONSERVATION CONCERN. See Sect. 2.0 and App. 3 for rarity ranks.

	Federal Lists	State Lists	Regional Lists
Plants			
river quillwort		•	
kidneyleaf mud-plantain		•	
Hudson River water-nymph		•	
Invertebrates			
alewife floater (mussel)		•	
yellow lampmussel (mussel)		•	
tidewater mucket (mussel)		•	
Fishes			
shortnose sturgeon	•	•	
American brook lamprey			•
northern hog sucker			•
Reptiles & Amphibians			
diamondback terrapin			•
map turtle			•
Birds			
American bittern		•	
least bittern		•	
redhead			•
oldsquaw			•
red-breasted merganser			•
ruddy duck		•	
osprey		•	
bald eagle	•	•	
common moorhen			•



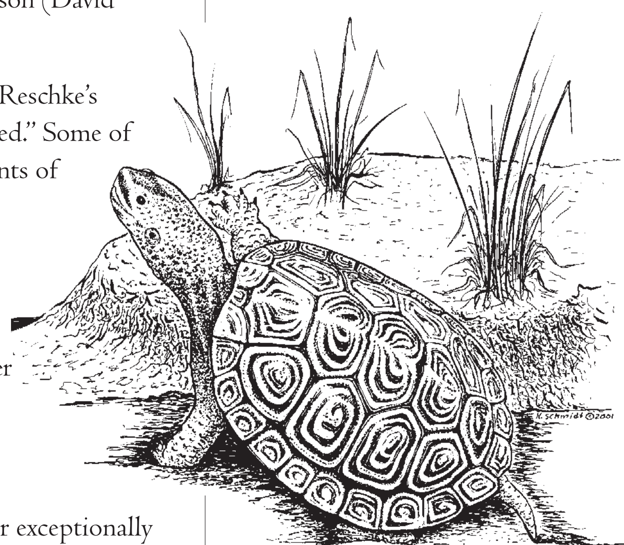
Water chestnut (*Trapa natans*)

leaves 2–5 cm (0.8–2 in)

Rare plants of the tidal shallows include river quillwort and kidneyleaf mud-plantain, which, although more typical of the lower intertidal zone, may extend just below low tide level. Hudson River water-nymph is endemic to (occurs only in) the Hudson River estuary.

Bald eagle and osprey forage in the shallows. American bittern and least bittern forage in the edges of shallows at low tide. Shortnose sturgeon forages extensively in subtidal shallows in New Brunswick (Canada), but this behavior has not been reported for the Hudson River. Several rare waterfowl species use the shallows, including ruddy duck, oldsquaw, redhead, and red-breasted merganser. The diamondback terrapin spends much of its time in this habitat in the brackish areas of the Hudson. Regionally-rare species include map turtle, and several poorly-known fishes such as the American brook lamprey and northern hog sucker. Three mussels of deepwater and shallows habitats have been eliminated, or nearly so, from the Hudson River due to the zebra mussel invasion: yellow lampmussel, alewife floater, and tidewater mucket; the latter two species were formerly abundant in the Hudson (David Strayer, personal communication).

The vegetated portions of Hudson River subtidal shallows correspond to Reschke's (1990) "brackish subtidal aquatic bed" and "freshwater subtidal aquatic bed." Some of the Hudson River subtidal shallows with extensive SAV beds are components of "Waterfowl Concentration Areas" listed by NYNHP.



Diamondback terrapin
(*Malaclemys terrapin*)
carapace 10–23 cm (4–9 in)

Substrates

Diverse bottom types range from clay (very local) to silt, sand, gravel, rock rubble, bedrock, cinder, or other materials. Silt is very widespread. In the upper estuary (approximately Saugerties to Albany), muddy sands are widespread.

Surface Waters

The shallows are nearly always flooded, although spring low tides and other exceptionally low tides may expose extensive areas just below mean low water. The upriver shallows are ice-covered up to four months during the winter, but certain downriver areas do not freeze at all in some winters.

Extent

Areas may be <1 ha (<2.5 ac) or as large as hundreds of hectares (500+ ac).

Distribution

This habitat is found throughout the tidal Hudson, but is more extensive in shallower reaches of the river including the Haverstraw Bay-Tappan Zee (Westchester and Rockland counties) and areas north of Saugerties (Ulster Co.). Elevations range from mean low water (MLW) to 2 m (6.5 ft) below MLW; the lower limit is approximately the minus-6 foot contour on the USGS topographic maps. Deeper water habitats are not considered in the Manual.

Quality

The higher quality subtidal shallows habitats have low densities of introduced (non-native) plants such as water-chestnut and Eurasian watermilfoil, and smaller fractions of artificial materials (cinder, demolition debris, railroad ties) in the sediments. (Actually, there is little information from the Hudson comparing the habitat values of Eurasian watermilfoil with wild-celery and other native SAV. Although we know that large areas of water-chestnut are unfavorable for fish and waterfowl, watermilfoil requires further study.) Shallows underlain by sandy dredged material have lower activity of macroinvertebrates, fishes, and birds. We have no evidence that smaller areas are necessarily used less by rare biota, but more extensive shallows may still be more valuable. Shallows where water movement is tidal but substantially blocked by fill or other artificial structures may be somewhat less valuable to fish and waterfowl than less-altered shallows.

Human Uses

Dredge spoil deposition (formerly), boating, waterfowl hunting.

Sensitivities, Impacts

Dredge spoil disposal in the last century eliminated large areas of subtidal shallows, especially between Saugerties and Albany. Large areas have also been filled for construction of the railroads and for urban-industrial development, especially in the Westchester and Albany areas. Boat wrecks, railroad ties, duck blind materials, and other such debris are common in Hudson River shallows. Pervasive chemical pollution, such as PCB and metals, has contaminated the water and substrates of the Hudson tidal habitats. Power boating and jet skiing in the shallows can have numerous effects, including pollution by petroleum and combustion products and the toxic effects on aquatic organisms (Mele 1993, Moore 1998), disturbance of benthic communities (Buchsbaum 2000), resuspension of sediments, increased turbidity, shearing of vegetation from wakes and propellers (McCarthy and Mele 1998), disruption of biological functions of fishes (Balk et al. 1998), and noise disturbance (Nisbet 1977, Buchsbaum 2000).

Conservation and Management

Motorized craft, including jet skis, should be excluded from subtidal shallows as much as possible to prevent pollution, and disturbance of the animals and plants of the shallows. New marinas and boat launches should be located such that incoming and outgoing boat traffic will not disturb subtidal aquatic beds. Abandoned or derelict duck blinds should be removed. Duck hunters should be encouraged to use temporary blinds that are removed each season. The U.S. Army Corps of Engineers and the NYSDEC are studying the potential for "restoring" some of the subtidal and intertidal habitats altered by spoil disposal.

Examples on Public Access Lands

Most subtidal shallows are publicly-owned as "lands under water" with the exception of small areas granted to private owners as "water grants." Most public and private boat landings and marinas in the Hudson are within short distances of subtidal shallows. Extensive shallows with subtidal aquatic beds include the mouth of Little Nutten Hook Creek, Stockport Flats, Cheviot Flats, "the Saddlebags" (offshore of the hamlet of Glasco, Town of Saugerties), Kingston Flats, Doodletown Bight, Haverstraw Bay, the area east of Piermont Marsh, and the area south of Croton Point.

References

Foley & Taber (1951), McVaugh (1958), Weinstein (1977), Kiviat (1978b), Schmidt and Kiviat (1988); also see the bibliographies of Kiviat (1981) and Anonymous (1994).

7.2 Estuarine Rocky Shore

THIS BROAD CATEGORY INCLUDES BEACHES OF GRAVEL, cobble, and rock rubble, and rock outcrops, ledges, and cliffs, of various rock types, in and above the intertidal zone. Little information is available on these habitats in the Hudson. Rocky Shore habitats are a component of Hudson River Rocky Island habitats (Sect. 7.7).

Vegetation

Shoreline bedrock and gravel or cobble beaches are harsh habitats subject to extreme wetting and drying, rapid heating and cooling, ice scouring, wind, and wave disturbance. In the intertidal zone, vascular vegetation is sparse and poorly documented. Above mean high water, vegetation cover varies from very sparse (nearly bare rock) to moderately dense. Plants generally are rooted in rock crevices or in shallow soils over bedrock. Many of the plants of rocky Crest habitats (Sects. 7.33 and 7.34) occur on the drier portions of rocky shores; certain *Carex* sedges and other plants (e.g., sneezeweed) adapted to frequent wetting and drying occur near the high water mark and in the splash zone just above.

Fauna

Poorly known. A few birds nest above high water; e.g., eastern phoebe under overhanging ledges, mallard, and American black duck. Mollusks may be prominent inhabitants, including native snails as well as the introduced zebra mussel.

Indicators and Identification

Exposed, sparsely vegetated bedrock or very coarse sediments (gravel, cobble, rock rubble) in and near the intertidal zone where they are subject to tidal inundation or wetting by wave splash or wind spray, or where rock ledges or talus extend continuously upwards from the splash zone.

Biodiversity Values

SPECIES OF CONSERVATION CONCERN. See Sect. 2.0 and App. 3 for rarity ranks.

	State Lists	Regional Lists
Plants		
river quillwort	•	
estuary beggar-ticks	•	
heartleaf plantain	•	
Long's bittercress	•	
terrestrial starwort	•	
northern white cedar		•
eastern prickly-pear		•
Invertebrates		
falcate orange tip	•	
hackberry butterfly	•	

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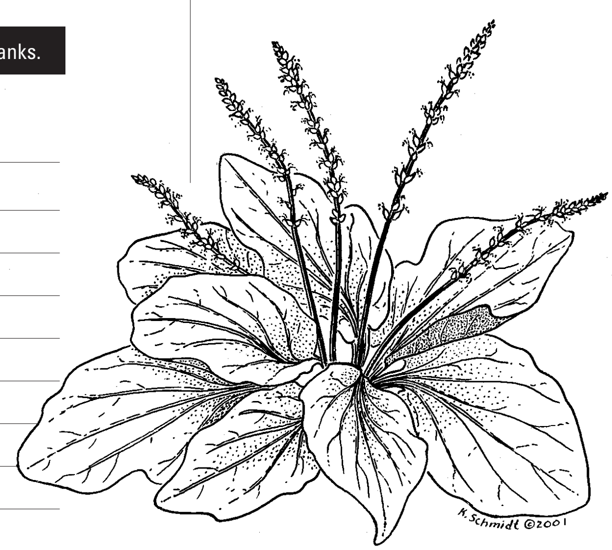


Heartleaf plantain
(*Plantago cordata*)
leaves 12–25 cm (5–10 in) long

SPECIES OF CONSERVATION CONCERN (cont.)	National Lists	State Lists	Regional Lists
Reptiles & Amphibians			
map turtle			•
Birds			
American black duck	•		•
Mammals			
harbor seal		•	

The largest population of heartleaf plantain in the state occurs on a cobble shore in Columbia County. Northern white cedar occurs on cliffs and rocky shores in Dutchess and Columbia counties. Estuary beggar-ticks occur on gravel-rubble-silt intertidal beach. Long's bittercress can occur on rocky shores with pockets of silty substrates. Eastern prickly-pear has been found on a rocky shore in Rockland Co. (Mitchell 1995). We suspect many other rare plants will be found in difficult-to-reach places. Bryophytes (mosses and liverworts) bear investigation, especially on limestone. Some of the rare plants of Hudson River Rocky Islands (Sect. 7.7) could occur on rocky shores.

The falcate orange tip butterfly could occur where rock-cresses (*Arabis lyrata, A. laevigata*) are abundant on cliffs, but to date has been found only on the west side of the Hudson River. Hackberry butterfly occurs on calcareous rocky shores. Harbor seal will haul-out on isolated segments of rocky shores. Map turtle basks and nests on rocky shores.

Reschke (1990) describes four communities of this general habitat: "shoreline outcrop," "calcareous shoreline outcrop," "brackish intertidal shore," and "freshwater intertidal shore."

Substrates

The rocky shores represent most of the bedrock types that border the Hudson, including shale, sandstone, limestone, gneiss, and diabase. The unconsolidated areas (especially of cobble texture) are known as "shingle." In a few places in the Hudson Highlands and New York Palisades, unaltered scree or talus (gravel or coarser materials, respectively, forming steep slopes) border tidal waters.

Surface Waters

Principally tidal waters of the Hudson River. At some locations, streams or seepage may flow across rocky shores into the river.

Extent

The habitat may be very localized (e.g., a few meters or feet in any dimension) to very extensive (hundreds of meters or feet long). Portions of the Hudson Highlands and Palisades shorelines, where a railroad or road does not directly border the intertidal zone, have rocky habitats that extend for several kilometers.

Distribution

Widely distributed in the study area, the habitats span the intertidal zone and above. In some cases, cliffs reach 10–20+ m (33–66+ ft) above mean high water.

Quality

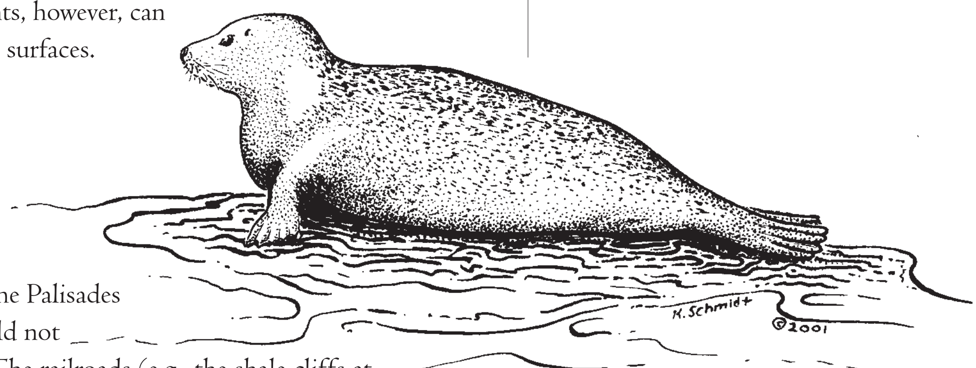
In the absence of good data, we believe that the least-altered shores are generally of higher quality. Areas that have been subjected to human trampling and climbing may be degraded due to loss of soil and vegetation. Rare plants, however, can still potentially occur on mined or trampled surfaces.

Human Uses

Mining, railroads, hiking.

Sensitivities, Impacts

Past mining has affected shoreline areas in the Palisades and elsewhere; presumably new mining would not be permitted at the shoreline in the future. The railroads (e.g., the shale cliffs at Rhinecliff) and many roads (e.g., the shore path under Hook Mountain in the Palisades) have altered rocky shores along large reaches of the river (Kiviat 1978b). Some local areas have been severely damaged by climbing and trampling.



Harbor seal *(Phoca vitulina)*
length to 1.5 m (5 ft)

Conservation and Management

Remaining areas of estuarine rocky shore unaffected by major alterations should be preserved and protected from intensive use. Existing trails should be well-maintained, and new trails carefully designed to encourage visitors to stay on trails. Trails approaching rocky shores may need sturdy observation platforms to allow visitor access without damage to the substrate. Bicycles, motorcycles, all-terrain vehicles, and snowmobiles should not be permitted on footpaths close to the shoreline, to prevent damage to vegetation, soil compaction, and accelerated erosion in this habitat. For similar reasons, the use of wheeled or tracked vehicles should be minimized on unpaved roads directly adjoining the shoreline.

Examples on Public Access Lands

The western shore of Cruger Island (Tivoli Bays), and the shoreline of Norrie State Park north of the boat basin, on interbedded sandstone and shale; the knoll north of the causeway at Iona Island (gneiss), and the north and south knolls at Nutten Hook (various rock types) are examples. Many other areas may be seen from a boat without setting foot on lands of uncertain ownership.

7.3 Fresh and Brackish Intertidal and Supratidal Marsh

AN INTERTIDAL MARSH IS THE HERBACEOUS WETLAND (i.e., dominated by non-woody plants) and mudflat zone between mean low water (MLW) and mean high water (MHW). A supratidal marsh is a predominantly herbaceous wetland occurring at elevations between MHW and approximately 1 m (3.3 ft) above MHW. Possibly the best-studied Hudson River habitat, the marshes attract attention because of their documented importance to fish and birds. These habitats also support many rare plant species, are important for recreation, and appear to play a beneficial role in Hudson River water quality. Our profile includes the "flats" (see the USGS maps) in midriver areas where spatterdock or occasionally other emergent plants dominate large areas (e.g., Green Flats and Upper Flats above Tivoli, and areas south of Rogers Island). It also includes areas of "mudflats" (Reschke 1990) where mud or sand in the lower intertidal zone bears scant, short vegetation such as strapleaf arrowhead.

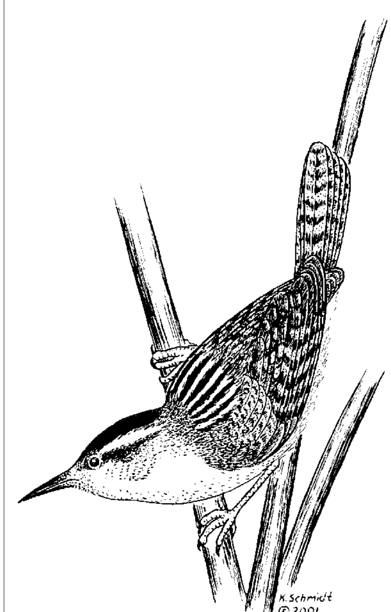
Vegetation

The fresh and brackish tidal marshes of the Hudson estuary support distinctive plant communities that include common brackish-water and freshwater species, as well as rare species, some of which are restricted to tidal environments. Many of the typical freshwater marsh plants, such as narrow-leaf cattail, purple loosestrife, arrow arum, pickerelweed, spatterdock, and broadleaf arrowhead, reach a large size in the tidal marshes. The leaf blades and inflorescences of arrow arum and broadleaf arrowhead are much wider and longer than in nontidal wetlands.

The lower intertidal zone in the freshwater marshes (north of the Hudson Highlands, and locally in the Highlands), is dominated by spatterdock, common three-square, strapleaf arrowhead, pickerelweed, or softstem bulrush. There are also substantial areas of mudflats. "Submerged aquatic vegetation" (SAV) such as common coontail, Eurasian watermilfoil, waterweeds, and water-chestnut, may occur as stunted but abundant shoots in the lower intertidal. In the more brackish areas, most of these species drop out, and the lower intertidal tends to be bare or nearly bare of vascular plants.

The middle intertidal zone in the fresh marshes may have a variety of plants including pickerelweed, arrow arum, broadleaf arrowhead, three-square, wild-rice, rice cutgrass, dotted smartweed, spotted jewelweed, narrow-leaf cattail, hybrid cattail, river bulrush, big bur-reed, and water-hemp. In the brackish marshes, swamp rose-mallow, tall cordgrass, and narrow-leaf cattail are typical.

The upper intertidal zone in the fresh marshes tends to be dominated by extensive stands of narrow-leaf cattail, purple loosestrife, arrow arum, common reed, or cattail-loosestrife mixtures. Many of the middle intertidal species are also present and some, such as broadleaf arrowhead and spotted jewelweed, may be common. In the brackish marshes, narrow-leaf cattail or common reed tends to dominate; purple loosestrife is abundant in some of the less-brackish areas. The highest intertidal areas and the supratidal areas (just above mean high water) in the brackish reaches may have common reed, saltgrass, salt meadow cordgrass, swamp rose-mallow, and marsh-straw sedge (Buckley and Ristich 1977, Kiviat 1979, Stevens 1991). Some areas, such as Piermont Marsh, have "salt meadows," influenced by the concentration of salts by evaporation.



Marsh wren *(Cistothorus palustris)*
10–14 cm (4–5.5 in)

Subtidal pools (pools that hold water at low tide) and sluggish subtidal reaches of tidal creeks may have subtidal plants such as Eurasian watermilfoil, wild-celery, water-chestnut, or pondweeds. These habitats (really shallows rather than marshes) generally comprise small percentages of the marsh surface. Marsh habitats influenced by tributary mouths, railroads, woody plants, islands, tidal restriction, wind and tidal erosion, channelization of tidal creeks, duck blinds, muskrat or beaver activity, and other factors may differ from the "typical" plant communities described here. The same is true of plant assemblages on logs, rotting timbers, or the bases of isolated trees. The upper edge of the intertidal zone and the lower supratidal areas along the upland shorelines support many plants that are not found in the marsh proper; some of these are showy wildflowers such as cardinal-flower and sneezeweed.

Fauna

The tidal marshes have many fish species, both resident and permeant (part-time), including freshwater fishes, estuarine fishes, and marine migrants. Birds are also diverse, but away from shorelines and woody vegetation, the bird community is distinctive and not rich in species. Mammals, reptiles, and amphibians are species-poor, but a few species such as muskrat and snapping turtle are abundant. Little is known of tidal marsh invertebrates in the Hudson; insects, mollusks, crustaceans, and annelids are important groups. Mosquitoes appear to breed little in freely-draining Hudson River tidal marshes, although this is not necessarily true of supratidal marsh pools, salt meadows, tidal swamp, or damaged marsh where pools of water stand near mean high tide level.

Indicators and Identification

Regular tidal flooding and drawdown, the saturated and usually soft sediments (except in sandy or rocky habitats), a wrack line of broken, dead plant material washed up by the tides, and a thin, gray coating of silt on plant and rock surfaces identify the intertidal zone. In the study area, some plants are restricted (or nearly so) to the tidal marshes, including three-square, strapleaf arrowhead, wild-rice, river bulrush, water-hemp, and the cordgrasses. The larger size of plants such as arrow arum and pickerelweed may be a useful indicator, but large size may be retained in habitat units that have been largely or entirely cut off from the tides (e.g., marshes bordering Ferry Road at Nutten Hook).

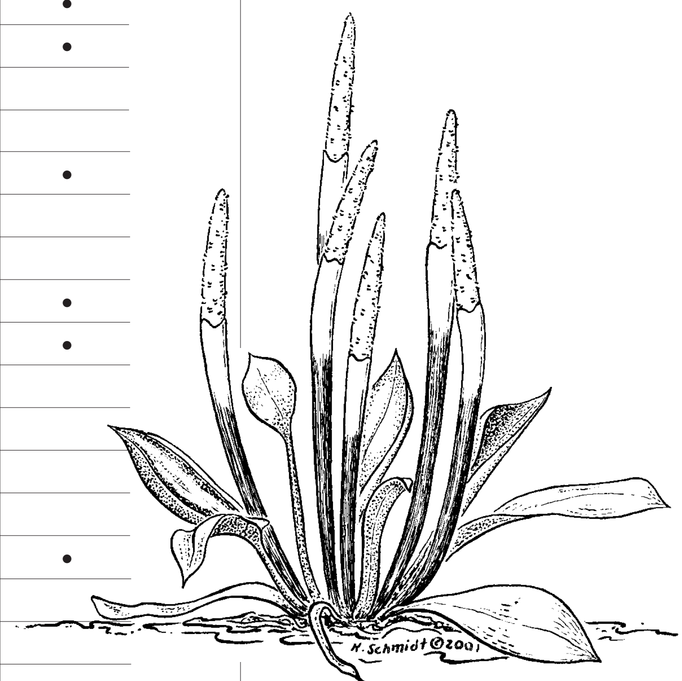
Biodiversity Values

SPECIES OF CONSERVATION CONCERN. See Sect. 2.0 and App. 3 for rarity ranks.

	Federal Lists	National Lists	State Lists	Regional Lists
Plants				
Fernald's sedge			•	
Long's bittercress			•	
mudwort			•	
strapleaf arrowhead			•	
spongy arrowhead			•	
kidneyleaf mud-plantain			•	
goldenclub			•	

(continued)

SPECIES OF CONSERVATION CONCERN (cont.)	Federal Lists	National Lists	State Lists	Regional Lists
winged monkey-flower			•	
estuary beggar-ticks			•	
American waterwort			•	
smooth bur-marigold			•	
heartleaf plantain			•	
swamp rose-mallow				•
closed gentian				•
Invertebrates				
coastal broad-winged skipper				•
Reptiles & Amphibians				
northern leopard frog				•
map turtle				•
Birds				
American bittern		•	•	
least bittern		•	•	
blue-winged teal				•
osprey			•	
bald eagle	•		•	
northern harrier		•	•	
black rail		•	•	
king rail			•	
Virginia rail				•
sora				•
common moorhen				•
marsh wren				•
saltmarsh sharp-tailed sparrow		•	•	
seaside sparrow		•	•	



Goldenclub *(Orontium aquaticum)*
leaf blades 6–40 cm (2.4–16 in)

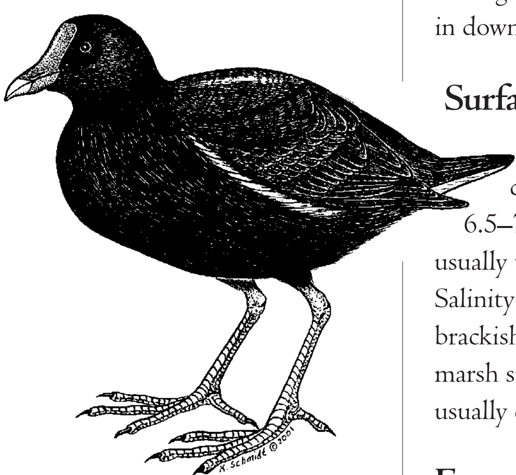
Many state-listed rare plants (e.g., Long's bittercress, spongy arrowhead, estuary beggar-ticks, smooth bur-marigold, goldenclub, Fernald's sedge), and other species that in the Hudson Valley are restricted to the Hudson or virtually so (wild-rice, swamp rose-mallow, the cord-grasses, water-hemp, etc.) depend upon tidal marsh habitats. The marsh-upland edge may have other rarities including winged monkey-flower and closed gentian (*Gentiana andrewsii*).

The extensive cattail stands (and to some extent, mixed cattail-loosestrife, sweetflag, softstem bulrush, and possibly common reed and reed canary grass) support breeding populations of birds that depend to a variable degree on grass-like marsh plants (least bittern, American bittern, sora, Virginia rail, king rail, common moorhen, marsh wren). Black rail could use brackish marshes, but has not been reported from Hudson River habitats. Bald eagle forages on the mudflats. Northern harrier uses the marshes extensively during migration and is an historic breeder (Bull 1974) that could breed here again. Formerly, salt marsh sharp-tailed sparrow and seaside sparrow apparently bred in the salt meadows at Piermont Marsh, and breeding or migrant sharp-tails occurred at Croton (Bull 1964). The salt meadows at Piermont have since shrunk due to reed invasion. Ospreys forage at marsh creeks and pools, especially where the water clears around low tide. Northern leopard frog enters the more sheltered marshy areas. The coastal broad-winged skipper (butterfly) has been observed in tidal marsh in the towns of Red Hook and Stuyvesant.

These habitats support Reschke's (1990) "brackish tidal marsh," "brackish intertidal mudflats," "freshwater tidal marsh," and "freshwater intertidal mudflat" communities. Reschke does not describe supratidal marsh communities. They resemble tidal and nontidal marsh communities in many respects, but the irregular tidal influence makes them ecologically distinct. The cattail-muskrat-marsh bird community is ecologically important, and many of the region's most extensive examples occur in the Hudson River tidal marshes.

Substrates

Peat, muck, silt, or sand. The finer-textured and more organic sediments tend to occur at the higher elevations. Peat, however, seems to be limited to the older (pre-railroad) marshes in downriver areas such as Piermont Marsh and Iona Island (Newman et al. 1969).



Common moorhen
(*Gallinula chloropus*)
26 cm (10.2 in)

Surface Waters

Flooded twice daily by the Hudson's tides, many marshes are also watered by discharge from nontidal tributary streams. Hudson River water is circumneutral (pH 6.5–7.3), and high in suspended sediment, nutrients, and some toxicants. The water is usually well-oxygenated, but low dissolved oxygen can occur at certain places and times. Salinity varies from fresh (less than 0.1 parts-per-thousand [ppt] salinity) to moderately brackish (approximately 13 ppt), and can be higher where water evaporates from downriver marsh surfaces during summer and fall. Hudson River tidal marshes, unless very small, usually contain branching tidal channels ("tidal creeks") and often large pools as well.

Extent

The combined intertidal and subtidal zones (from the minus-6 ft contour to the apparent upland shoreline on the USGS 7.5 minute topographic maps) cover approximately 26% of the 24,400 ha (58,000 ac) high-tide surface area of the tidal Hudson River between the Rip Van Winkle Bridge and the New York-New Jersey state line (Kiviat 1979). The intertidal marshes probably comprise somewhat less than half of the 26%.

Distribution

Tidal marshes occupy the intertidal zone between mean low tide level and mean high tide level. The vertical extent of the intertidal zone (mean tide range) is approximately 0.8–1.8 m (2.6–5.9 ft) with higher values at the southern and northern ends of the Hudson River estuary and the lowest values in the middle (in the vicinity of the Hudson Highlands).

Quality

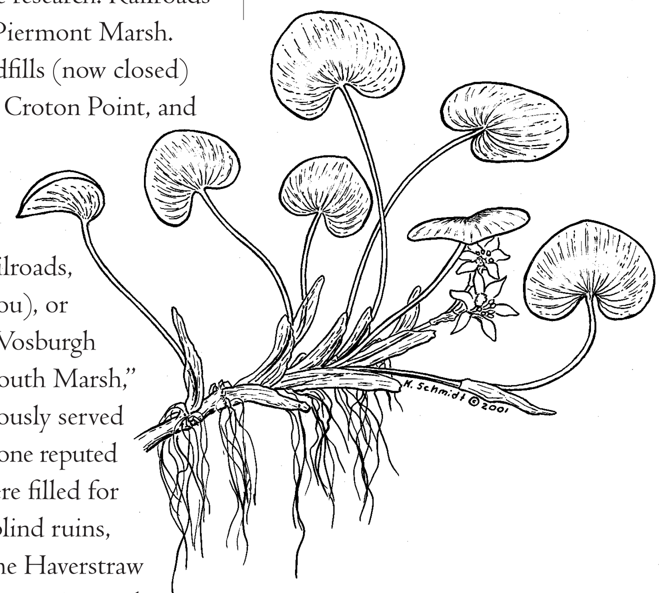
The higher quality marshes tend to be those that are larger; have less of their perimeter bordered by railroad or other artificial structures; have a higher percentage of their shoreline perimeter forested; contain less garbage (including railroad ties and coal cinders or clinkers); experience less direct human disturbance; and contain smaller areas of introduced vegetation such as purple loosestrife or water-chestnut. The role of common reed in reducing marsh quality is unclear. This apparently native but invasive species may degrade nesting habitat for some birds, but supports insects that are potentially important food for certain birds and fishes. Marshes with tidal flow partly restricted by the railroad or other structures may have lower quality for fish but not necessarily for birds, plants, and other groups of organisms. Large areas of hybrid cattail or sweetflag may indicate lower quality marshes.

Human Uses

Birdwatching, canoeing, kayaking, power boating, jet skiing, sport fishing, baitfish collecting, hunting, fur trapping, education activities, visual arts, and scientific research. Railroads cross many of the Hudson River tidal marshes. A gas pipeline crosses Piermont Marsh. Dredge spoil was deposited in tidal marshes in the past. Municipal landfills (now closed) are located in or adjoining Hudson North Bay, Kingston Point Marsh, Croton Point, and Piermont Marsh; small private dumps are present at other sites.

Sensitivities, Impacts

In the past, many tidal marshes were altered for transportation uses (railroads, docks, piers, canals). Some marshes were ditched (Constitution, Manitou), or partly or completely impounded (Nutten Hook, Little Nutten Hook, Vosburgh Swamp, small coves east of the railroad at Stockport, Cruger Island "South Marsh," Constitution Island, Manitou, "Sylvania Cove"). These alterations variously served for cheaper railroad crossings, water supply, dredge spoil disposal, at least one reputed agricultural attempt, and probably mosquito control. Some marshes were filled for industrial and other uses in the past. Refuse in marshes includes duck blind ruins, railroad dumping, and jetsam from the tides. Hudson South Bay and the Haverstraw (Grassy Point) marshes are examples of extreme damage done by transportation and industry. Even these two highly disturbed wetlands, however, still have biodiversity values.



Kidneyleaf mud-plantain
(*Heteranthera reniformis*)
leaf to 5 cm (2 in)

Vegetation in the tidal flats, marshes, and creek banks is sensitive to physical disturbance of the soil and plant roots (Warren and Fell 1996, Winogrond and Kiviat 1997, Connors and Kiviat 2000). Disturbance from the construction and use of duck blinds in Hudson River tidal marshes (vegetation clearing, soil compaction, introduction of invasive plant propagules) may encourage the invasion of common reed and purple loosestrife (Kiviat, observations). Repeated trampling by visitors can damage soil and vegetation. Certain plants, however, such as smooth bur-marigold seem to increase with moderate disturbance. The impacts of local water and air pollution sources on the tidal marshes are unclear.

Conservation and Management

Physical disturbances to tidal marshes should be avoided or minimized, and tidal flushing should be fully maintained. Abandoned duck blinds should be removed, and duck hunters encouraged to use temporary blinds that are removed each season. Use of motorized craft in tidal creeks draining the marshes should be discouraged, to minimize pollution, disturbance of sediments and subtidal vegetation, and noise disturbance of wildlife.

Currently there is discussion (and small-scale experiments) of repairing some forms of damage or improving ecological function in degraded tidal habitats on the Hudson River. Successful restoration, however, will need to be based on sound science, much of which is as yet unavailable. It must be recognized that "restoration" often involves trading one habitat type for another; e.g., making supratidal marsh into low marsh, shallows into intertidal marsh, or reed stands into other plant communities. Some of these changes will benefit certain species and functions, while harming others. The restoration planning should involve careful consideration of the ecological trade-offs inherent in various courses of action.

Examples on Public Access Lands

Most of the Hudson River tidal marshes are public, but not easily accessible by foot or by canoe. Tidal marshes can be seen at Norrie State Park, at Scenic Hudson's Brett Park in the City of Beacon, and at the Ramshorn-Livingston Sanctuary (Northern Catskills Audubon Society and Scenic Hudson). Interpretive literature, guided field trips, and other services are available at the Hudson River National Estuarine Research Reserve (HRNERR) sites at Stockport, Tivoli, Iona, and Piermont.

References

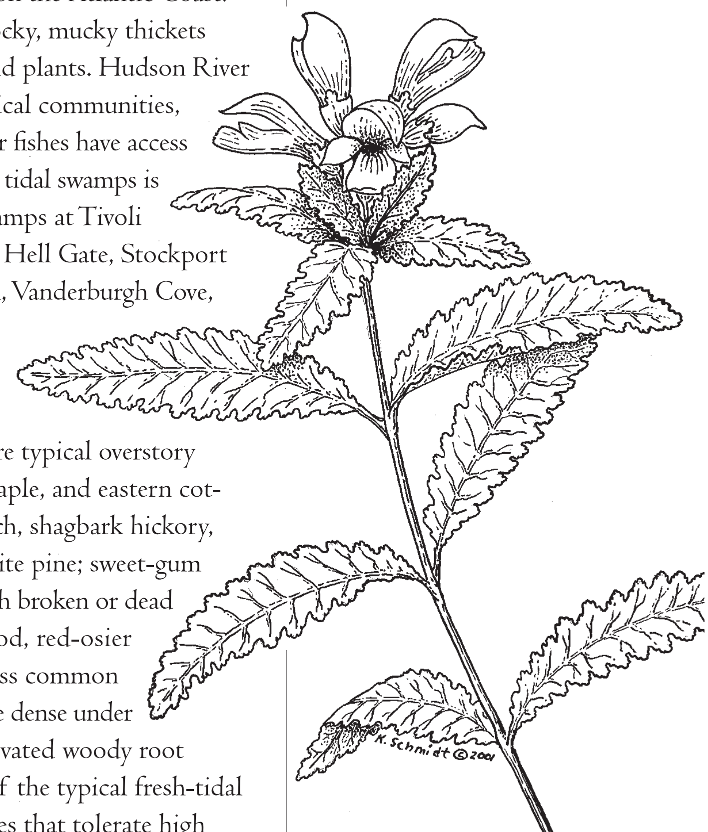
Foley and Taber (1951), McVaugh (1958), Kiviat (1976, 1978b, 1979), Weinstein (1977), Odum et al. (1984); also see the bibliographies of Kiviat (1981) and Anonymous (1994).

American bittern
(*Botaurus lentiginosus*)
60–85 cm (24–33 in)

7.4 Intertidal and Supratidal Swamp

AN INTERTIDAL SWAMP IS A WOODED WETLAND, dominated by trees or shrubs, occurring in the upper intertidal zone, but below mean high water (MHW). A supratidal swamp is a wooded wetland lying between MHW and approximately 1 m (3.3 ft) above MHW. It thus receives tidewater only during the highest tides (e.g., spring tides and storm tides). Many swamps grade from intertidal to supratidal without obvious physical indicators of the transition.

Tidal swamps have been studied little in the Hudson or elsewhere on the Atlantic Coast. The difficulty humans have in penetrating the often dense, hummocky, mucky thickets makes these habitats refuges from direct disturbance for animals and plants. Hudson River intertidal and supratidal swamps are known to support rich biological communities, including numerous rare plants and a few rare animals. Hudson River fishes have access to tidal swamps that are traversed by tidal creeks. Our description of tidal swamps is based principally on the Cruger Island "Neck" and "Big Bend" swamps at Tivoli Bays and the Mudder Kill Mouth, with additional observations on Hell Gate, Stockport Flats, Nutten Hook, Mill Creek, Rogers Island, Rams Horn Creek, Vanderburgh Cove, Iona Island Marsh, and Piermont Marsh.



Swamp lousewort
(Pedicularis lanceolata)
3–8 dm (12–31 in)

Vegetation

Dominated by trees or shrubs. Red maple, red ash, and black ash are typical overstory trees. Slippery elm, American sycamore, swamp white oak, silver maple, and eastern cottonwood are also common. Other trees include willows, yellow birch, shagbark hickory, quaking aspen, American hornbeam, northern white cedar, and white pine; sweet-gum occurs at Piermont Marsh. Many trees may be dead or damaged, with broken or dead tops, tipped-up, or semi-fallen. Common shrubs are silky dogwood, red-osier dogwood, willows, alder, northern arrowwood, and nannyberry. Less common species include buttonbush, winterberry, and spicebush. Shrubs can be dense under trees or may dominate swamps that have few trees. Hummocks (elevated woody root crowns) are well developed in older swamps. Herbs include some of the typical fresh-tidal marsh species (e.g., arrow arum, purple loosestrife), a few fen species that tolerate high nutrient levels and shade (e.g., spreading goldenrod), and many common nontidal wetland species. Bryophytes (mosses and liverworts) are fairly diverse and typically lush on the bases of living woody plant stems and hummocks, and on coarse woody debris, but peat mosses (*Sphagnum*) are rare (peat moss is present in the small swamp in the southwestern corner of Iona Island Marsh). The lichen flora is poor in both species and coverage, presumably due to air pollution (Feeley-Connor 1978).

Fauna

No data are available on the macroinvertebrates of tidal swamps. Some of the common Hudson River fishes find their way into tidal swamp creeks (e.g., banded killifish, mummichog, common carp, largemouth bass). A few common species of amphibians and reptiles, apparently at low population densities, use the tidal creeks (e.g., green frog, snapping turtle, and eastern painted turtle). There is a diverse bird fauna of mostly common species. Ruffed grouse and wild turkey forage in tidal swamps in winter. There are a few common mammals (e.g., eastern cottontail, muskrat, raccoon, gray squirrel, red squirrel, white-tailed deer); eastern cottontail uses the habitat in winter. Beaver have been prominent at Tivoli, Stockport, Nutten Hook, Rams Horn, and Mill Creek during the past approximately 15 years. At Mill Creek, mink are regular inhabitants, and river otter tracks have been observed in winter (Paul F. Connor, personal communication).

Indicators and Identification

Tidal swamps comprise tree- or shrub-dominated wetland in the upper intertidal zone or in irregularly flooded areas just above mean high tide level. On the USGS topographic maps, look for green-overprinted wetland below the first contour (10 or 20 ft); see, for example, the vicinity of Rams Horn Creek on the Hudson South quadrangle. Tidal swamps may grade upwards gently into supratidal and nontidal swamp, which (at least at Tivoli Bays) is distinguished principally by the reduced development of woody hummocks at the bases of trees and shrubs.

Biodiversity Values

SPECIES OF CONSERVATION CONCERN. See Sect. 2.0 and App. 3 for rarity ranks.

	Federal Lists	State Lists	Regional Lists
Plants			
Aneura pinguis (liverwort)			•
Trichocolea tomentella (liverwort)			•
Brachythecium turgidum (moss)		•	
Desmatodon obtusifolius (moss)		•	
Fissidens fontanus (moss)		•	
Lindbergia brachyptera (moss)		•	
Orthotrichum ohioense (moss)		•	
Orthotrichum sordidum (moss)		•	
Othotrichum stellatum (moss)		•	
Philonotis muhlenbergii (moss)		•	
Taxiphyllum taxirameum (moss)		•	
goldenclub		•	
swamp lousewort		•	
heartleaf plantain		•	
winged monkey-flower		•	
green dragon			•
small purple fringed orchid			•
vetchling			•
Sprengel's sedge			•
spring cress			•
Invertebrates			
Baltimore (butterfly)			•
coastal broad-winged skipper (butterfly)			•

(continued)

SPECIES OF CONSERVATION CONCERN (cont.)	Federal Lists	National Lists	State Lists	Regional Lists
Reptiles and Amphibians				
northern leopard frog				•
wood turtle			•	
Birds				
osprey			•	
bald eagle	•		•	
barred owl				•
red-headed woodpecker		•	•	
white-eyed vireo				•

Goldenclub, green dragon, or heartleaf plantain may occur at the edges of tidal swamps. Numerous rare plants occur in the interior: swamp lousewort, small purple fringed orchid, winged monkey-flower, vetchling, Sprengel's sedge, spring cress. Several rare mosses and liverworts (see above table) have been found in tidal swamps in Dutchess Co. (Leonardi 1991).

Red-headed woodpecker has been recorded twice at Tivoli Bays, without evidence of breeding. White-eyed vireo has been recorded several times at Tivoli, sometimes singing persistently, and is a probable breeder. Osprey and bald eagle use larger or damaged trees for perches. Great blue heron and barred owl could nest in tidal swamps, but we have no such records to date. Wood turtle populations in the Hudson (the only known estuarine occurrence of this species) are associated with tidal swamps (Barbour and Kiviat 1994). The Baltimore and the coastal broad-winged skipper (butterflies) have been observed at Tivoli (Barbour and Kiviat 1986).

The regularly tidal portion of this habitat supports Reschke's (1990) "freshwater tidal swamp," but she does not describe supratidal swamps. The tidal swamp communities *per se* are rare in the study area.

Substrates

Muck over sand (Cruger Island "Neck"), clayey (Mudder Kill Mouth); and sandy dredge spoil (Nutten Hook).

Surface Waters

Tidal waters of the Hudson River, ranging from fresh to moderately brackish (approximately 13 ppt salinity), are quieted by the sheltered locations and dense vegetation. Thick ice may form on creeks but the high-elevation areas with woody vegetation normally have very thin ice layers separated by air, resulting from brief freezing at high tide (observations at Tivoli).

Extent

Tidal swamp units range from <0.1 ha – 50+ ha (0.25–120+ ac).

Distribution

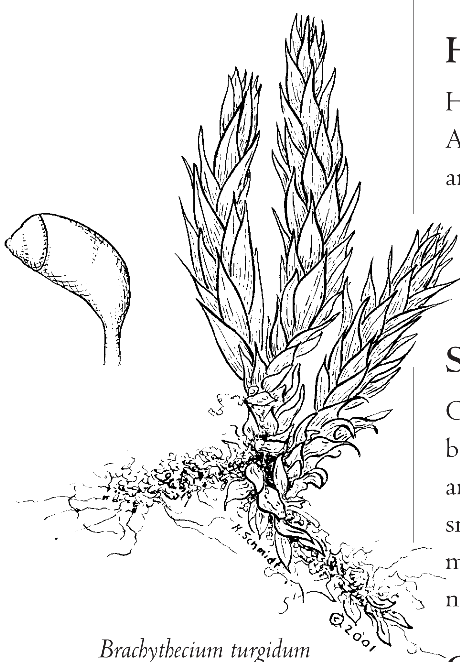
Most tidal swamp is in highly sheltered areas where tidal wetland predated the Hudson River railroads, on dredge spoil deposits between the railroad and mainland, or at stream mouths, between islands and the mainland, and in protected coves. The largest examples are at Mill Creek, Stockport Flats (Town of Stockport), Rogers Island (Town of Greenport), Rams Horn Creek (Town of Catskill), and Tivoli Bays (Town of Red Hook). The restricted size of tidal swamps downriver may be due to increasing salinity. Tidal swamps are at sea level (0 m).

Quality

In the absence of firm information, we think quality is proportional to extent, size of trees, and lack of direct human disturbance. Shrub-dominated swamps may also be of high quality.

Human Uses

Hunting, timber harvest, and passive recreation are the most frequent uses of tidal swamps. A boardwalk provides access by foot to the tidal swamp at Mill Creek. Other boardwalks are proposed or under construction, partly or entirely in tidal swamps, at Constitution Island Marsh, Saugerties Lighthouse, and Rams Horn Creek. Logging has occurred in some tidal swamps recently and in the past. Causeways have been built through tidal swamps for private road construction, and watercourses have been channelized.



Brachythecium turgidum
(a moss)
5–10 cm (2–4 in) tall

Sensitivities, Impacts

Channelizing, ditching, filling, dumping, causeway construction, and other such disturbance can damage tidal swamp habitat by altering tidal flows, destroying tidal vegetation, and introducing inappropriate or polluting materials. Cutting of trees and removal of snags can destroy important wildlife habitat, alter the understory plant and animal communities, and cause long-term damage to the swamp floor. Intensive human use can eliminate the most sensitive wildlife from an area, and disrupt wildlife use patterns in general.

Conservation and Management

Judicious boardwalk design and construction at swamp edges may help to minimize certain impacts of human foot traffic. Boardwalks and other disturbance should avoid interior areas of swamps, which serve as wildlife refuges from certain predators, invasive species, and human activities. We recommend that boardwalks not follow creek banks or upland edges extensively, as these may be zones of high biodiversity and animal activity. Reduction of ambient water and air pollution would benefit tidal swamps.

Examples on Public Access Lands

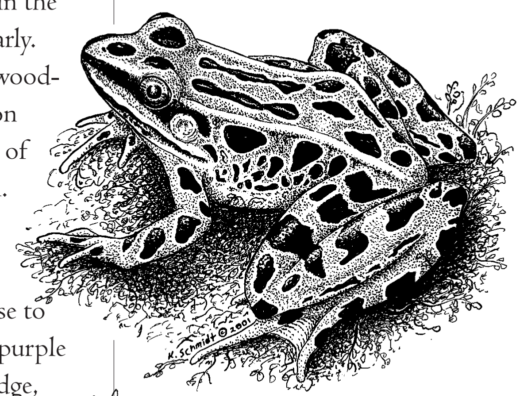
Extensive tidal swamps may be visited at the Ramshorn-Livingston Sanctuary (Town of Catskill); at Tivoli Bays along the lower Cruger Island Road and across Stony Creek from the boat landing (Town of Red Hook); at the Rogers Island Wildlife Management Area (Town of Greenport); and at the Lewis A. Swyer Preserve (Town of Stuyvesant). A small area is accessible at Norrie State Park (Town of Hyde Park) at the mouth of the Indian Kill.

References

McVaugh (1958), Feeley-Connor (1978), Kiviat (1978b, 1979, 1983), Barbour and Kiviat (1986), Westad and Kiviat (1986), Westad (1987), Kiviat and Westad (1989), Leonardi and Kiviat (1990), Leonardi (1991).

7.5 Supratidal Pool

LIKE OTHER SUPRATIDAL HABITATS, SUPRATIDAL POOLS occur within the zone between MHW and 1 m above MHW , so they receive tidewater only irregularly. This habitat combines some of the features of small nontidal ponds, intermittent woodland pools, and intertidal marsh pools. It occurs on islands, in supratidal swamps, on dredge spoil deposits, and where artificial or natural berms have formed at the heads of coves and along other shorelines. We believe this habitat is scarce along the Hudson.



Northern leopard frog
(Rana pipiens)
5–9 cm (2–3.5 in)

Vegetation

Common swamp and marsh plants that are typical of nontidal wetlands form a sparse to moderately dense cover. Species may include red ash, red maple, alder, buttonbush, purple loosestrife, yellow iris, cattail, common reed, arrow arum, lakeside sedge, tussock sedge, other sedges, skunk-cabbage, common duckweed, ivy-leaf duckweed, and the liverwort *Riccia*. One large, sunny, peaty pool on Constitution Island has elements of a bog flora.

Fauna

Many species appear typical of nontidal woodland pools, but many supratidal pools have small fishes that enter with the tides. A rare introduced species, the central mudminnow, has been found in pools on Constitution Island, Cruger Island, and Nutten Hook. Eastern bluebird may forage at supratidal pools.

Indicators and Identification

This habitat is identified by its physiographic position rather than by its biology.

Biodiversity Values

SPECIES OF CONSERVATION CONCERN. See Sect. 2.0 and App. 3 for rarity ranks.

	State Lists	Regional Lists
Plants		
ivy-leaf duckweed		•
spiny coontail	•	
swamp lousewort	•	
Invertebrates		
phantom cranefly		•
Amphibians and Reptiles		
northern leopard frog		•
wood frog		•
spotted salamander		•
spotted turtle	•	

Ivy-leaf duckweed, a scarce species, swamp lousewort, and spiny coontail have each been found in supratidal pools. The *Carex* sedges should be investigated.

Spotted salamander, wood frog, and northern leopard frog breed in some supratidal pools in Dutchess and Columbia counties. Spotted turtle is expected to occur in supratidal pools; a spotted turtle shell was found near a supratidal pool at Nutten Hook.

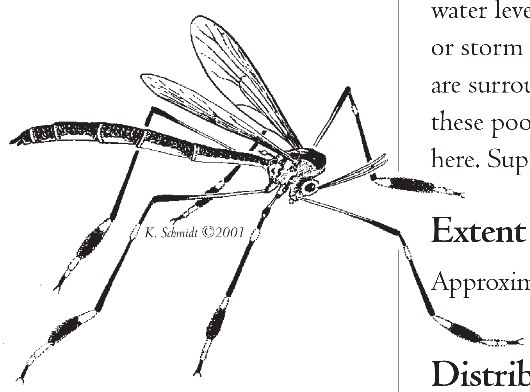
Communities of these habitats resemble Reschke's (1990) "vernal pool" communities in some respects, but the presence of fish (and presumably other estuarine organisms that enter with the tides) makes them ecologically distinct.

Substrates

The surface layer (at least) is organic, and muck or peat may be deep in larger pools. Hummocks (woody root crowns) or tussocks (herbaceous root crowns) may occur across the pool or only at the edges or the pool interior.

Surface Waters

Some pools are flooded by the estuary frequently (a few pools even daily at seasonal high water levels in spring), but some are flooded only during exceptionally severe spring tides or storm surges. The most frequently flooded pools may actually be intertidal pools that are surrounded by supratidal habitat (e.g., Supratidal Swamp, see Section 7.4), but because these pools are more similar to supratidal pools than to intertidal marsh, they are included here. Supratidal pools also receive direct precipitation and very local runoff.



Phantom cranefly
(Bittacomorpha clavipes)
body length approximately
2 cm (0.8 in)

Extent

Approximately 0.01–3 ha (0.03–7 ac).

Distribution

At or just above the mean high tide level. We also include pools filled and drained regularly by the tides through long, narrow channels, and that are semi-isolated from other intertidal habitats by supratidal habitats.

Quality

Depends on biota more than habitat features *per se*; a pool of any size may be ecologically important. Pools lacking local sources of water pollution (e.g., dumps, the railroad) may be of higher quality, other factors being equal.

Human Uses

We have identified no specific uses of supratidal pools, but it is possible that furbearers, baitfish, firewood, and other "economic" biota could be harvested from some pools.

Sensitivities, Impacts

Dumping, filling, impoundment, drainage, siltation and spraying of pesticides for mosquito control would have obvious impacts to supratidal pools. Unfortunately, many supratidal pools are near the railroads so are subject to considerable alteration and pollution.

Conservation and Management

Supratidal pools and buffer zones should be protected from disturbance, and pool outlets should be maintained to permit natural flooding and draining.

Examples on Public Access Lands

Cruger Island (Town of Red Hook) has three pools; Constitution Island (Town of Philipstown, U.S. Military Academy, access by special permission only) has one very large pool; Sleightsburg Spit (Town of Esopus) has a small one next to the trail; Nutten Hook (Town of Stuyvesant) has multiple pools; and the Gay's Point dredge spoil peninsula (Town of Stuyvesant) has two supratidal pools.

References

Kiviat (1997c) and Stevens (in prep.) describe supratidal pools in Columbia Co.; we know of no other references describing this habitat on the Hudson River.

7.6 Tidal Tributary Mouth

THIS PROFILE PERTAINS TO THE TIDAL REACHES of Hudson River tributary streams. The mouths of tributaries, where nontidal and tidal waters mix, differ in substrate and chemistry from the adjoining aquatic habitats of the tributary and the Hudson River. Tidal tributary mouths often have relatively scoured, rocky bottoms, fluctuating turbidity, and a shorter ice season than the adjoining bays or coves. These areas are important foraging habitats for fishes and water birds, and important spawning habitats for ocean and Hudson River fishes. This profile pertains principally to the mouths of perennial streams; intermittent streams are too small to scour down to hard substrates and maintain the habitat we describe.

Our description is based primarily on the Saw Kill and Stony Creek (both Town of Red Hook), with observations from Stockport Creek (Town of Stockport), Sparkill Creek (Town of Orangetown), Indian Brook (Town of Philipstown), Doodletown Brook (Town of Stony Point), and fish data from many streams studied by Schmidt and Limburg (1989), Limburg and Schmidt (1990), Schmidt and Stillman (1994), Schmidt and Cooper (1996), and Schmidt and Lake (1999).

Vegetation

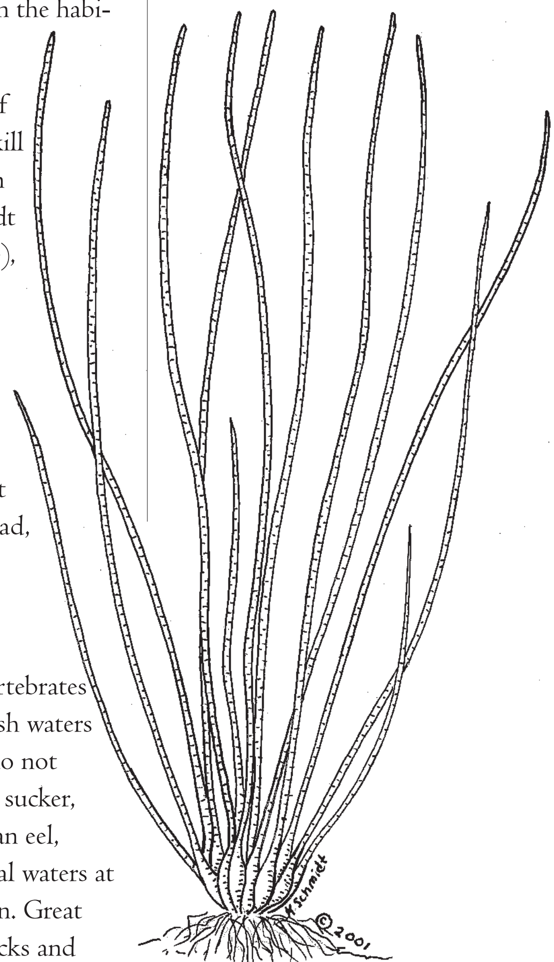
Vascular vegetation is sparse on the characteristically hard substrates. In the mouths of some streams, however, such as the Saw Kill (Town of Red Hook), wild-rice and dotted smartweed grow on gravel bars, and a variety of emergent species occur sparsely on the gravel-and-mud margins, including stiff arrowhead, yellow iris, silky dogwood, and false-indigo.

Fauna

Diverse macroinvertebrates, fishes, and birds are typical. Many of the macroinvertebrates are freshwater taxa that are able to tolerate tidal fluctuation, or seasonally brackish waters in some cases. These taxa are generally not considered estuarine organisms and do not seem to have been reported in that literature (e.g., Gosner 1971). Alewife, white sucker, smallmouth bass, striped bass, yellow perch, white perch, chain pickerel, American eel, common carp, and spottail shiner move into the stream mouths from deeper tidal waters at higher tide stages to spawn or forage, or en route farther up the streams to spawn. Great blue heron, osprey, bald eagle, and belted kingfisher forage for fish. Dabbling ducks and diving ducks are often conspicuous in spring and fall, among them American black duck, mallard, and common merganser.

Indicators and Identification

Presence of an otherwise nontidal, perennial tributary discharging into tidal waters of the Hudson River. On the USGS topographic maps, the potential habitat occurs no higher (farther upstream) than the first contour line (10 or 20 ft) or the first dam, whichever is lower; and no lower (farther into the Hudson River) than the minus-6 ft contour; the actual habitats are generally much more restricted (Schmidt & Cooper 1996).



River quillwort
(Isoetes riparia)
10–20 cm (8–12 in)

Biodiversity Values

SPECIES OF CONSERVATION CONCERN. See Sect. 2.0 and App. 3 for rarity ranks.

	Federal Lists	National Lists	State Lists	Regional Lists
Plants				
lizard's-tail				•
river quillwort			•	
estuary beggar-ticks			•	
smooth bur-marigold			•	
winged monkey-flower			•	
goldenclub			•	
Nuttall's micranthemum			•	
Invertebrates				
Pteronarcys (stonefly)				•
Pomatiopsis lapidaria (snail)				•
Fishes				
American brook lamprey			•	
northern hog sucker				•
rainbow smelt				•
Birds				
American bittern		•	•	
osprey			•	
bald eagle	•		•	

River quillwort, smooth bur-marigold, and estuary beggar-ticks occur in the stream bed. Winged monkey-flower, lizard's-tail, and goldenclub (Sect. 9.53) may occur on adjoining soft substrates. Nuttall's micranthemum may now be extinct in the Hudson.

A rare snail, *Pomatiopsis lapidaria*, has been collected in the mouth of a Dutchess Co. tributary (Jokinen 1992). The macroinvertebrates bear further investigation. American brook lamprey has been recorded once from a stream mouth in Dutchess Co., and northern hog sucker a few times in Dutchess and Columbia counties. Many tributaries formerly supported large spawning runs of rainbow smelt. The Hudson River corridor supports the southernmost spawning population of rainbow smelt in the world, but spawning runs in Hudson River tributaries have declined dramatically in the last few decades. Climate warming or other factors could eliminate the species. American bittern, osprey, and bald eagle forage in stream mouths.

Reschke (1990) does not describe communities of this habitat.

Substrates

Hard substrates (rock rubble, cobbles, gravel, small areas of bedrock) dominate some areas (e.g., Saw Kill) and portions of others (Stony Creek, Stockport Creek). Many stream mouths, small and large, are dominated by soft substrates (silt, clay), at least in the intertidal zone, and are associated with extensive tidal swamp, tidal marsh, or tidal flat habitats (e.g., Fishkill Creek, Rondout Creek, Esopus Creek, Mudder Kill).

Surface Waters

The tributaries themselves are perennial or intermittent, fresh to moderately brackish (more brackish farther downriver and during drier seasons, reaching a maximum of perhaps 13 ppt salinity). Other chemical and physical characteristics vary, depending on the character of the local stream water and river water. Conditions also fluctuate with streamflow and tide. There is intense scouring by tidal ice and by freshets, although stream flow and the channeling of tidal flow reduces the length of the frozen period in portions of the stream mouths.

Extent

Tidal stream mouths cover relatively small areas if they are considered separately from the larger, soft-bottomed wetlands and shallows with which stream mouths are often associated. The length of the stream reaches in which these habitat conditions occur ranges from <100 m to >1000 m (<325 ft to >3280 ft).

Distribution

Tidal stream mouths are at sea level. They are found throughout the estuary, although in urban areas some streams have been diverted into culverts or artificial channels (e.g., Fallkill Creek in Poughkeepsie, Saw Mill River in Yonkers).

Quality

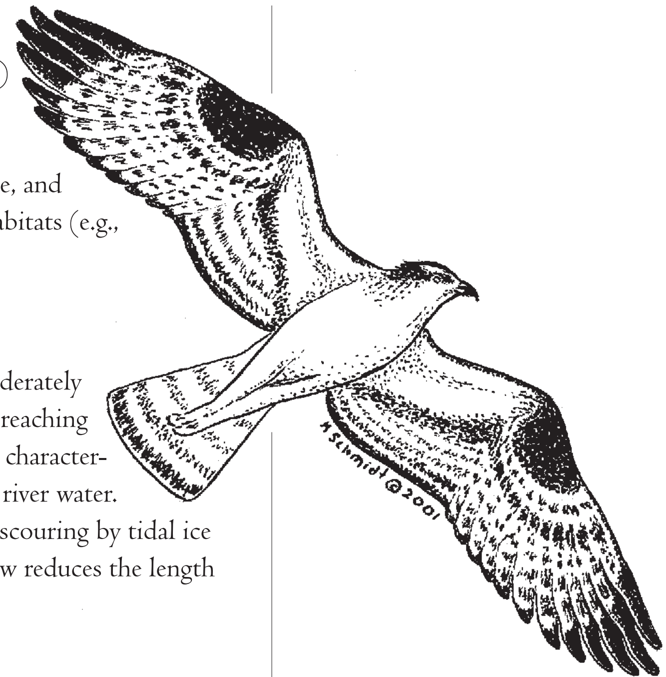
Quality is mainly related to lower levels of stream channel alteration and water pollution.

Human Uses

Recreational fishing for alewife, striped bass, largemouth bass, and other species is popular at tributary mouths. Many of the large tributary mouths are adjoined by industrial sites and urban development. Old dams, docks and marinas, road bridges, railroad trestles, waste outfalls, and storm drains are present at many of these sites.

Sensitivities, Impacts

Many stream mouths are in or near urban-industrial areas and appear highly polluted (e.g., Stevens et al. 1994). Petroleum has leaked from a tank farm at Rondout Creek. Boat traffic in some areas (e.g., Rondout Creek, Catskill Creek) constitutes intense disturbance of the tributary mouth habitats.



Osprey
(Pandion haliaetus)
53–61 cm (21–24.5 in)

Conservation and Management

Any future development (such as marinas) in tidal tributary mouths needs to be sensitive to the biological impacts to stream and estuary communities. Remediation of water pollution, removal of derelict structures (including some obsolete dams), and the restoration of stream bank plant communities would improve habitat quality. It may be feasible and beneficial to construct fishways (fish ladders) to provide fish access for spawning above dams that cannot be removed (Schmidt and Cooper 1996). Foot access for fishing and well-constructed landings for nonmotorized craft (e.g., using removable floating docks) might have relatively little impact.

Examples on Public Access Lands

Stony Creek (Tivoli Bays, Town of Red Hook) is accessible by trail, and by car to a canoe landing. Stockport Creek (Town of Stuyvesant) is accessible by car to a canoe landing. Doodletown Brook at Iona Island (Town of Stony Point) is accessible from an unimproved parking area on the east side of Rt. 9W. Van Cortland Manor offers foot access to the Croton River. The Saw Kill (Town of Red Hook) can be reached by foot from Bay Road at Bard College. Norrie State Park affords foot access to the Indian Kill (Town of Hyde Park) from the Norrie Point Environmental Museum. The mouth of Fishkill Creek can be viewed from Brett Park (City of Beacon).

References

Curran and Ries (1937), Kiviat (1978b, 1979), Schmidt and Cooper (1996), Schmidt and Lake (1999).

7.7 Hudson River Rocky Island

THIS PROFILE PERTAINS TO THE HUDSON RIVER ISLANDS with extensive exposed bedrock substrates. Islands in estuaries, rivers, lakes, and oceans are of great biological and conservation interest. The relative isolation of islands by water reduces human disturbance, predation by terrestrial predators (mammals and snakes), and possibly other biological interactions. Some organisms sensitive to disturbance or predation might be expected to thrive on islands; nesting water birds and raptors are examples. The gradient of ecological isolation ranges from small islands isolated by large expanses of deep water, through large islands closer to shore, to islands connected to the mainland by causeways or fill (e.g., Cruger and Iona islands), to natural peninsulas and points (like Stony Point and Little Stony Point). Along much of the east shore and portions of the west shore of the Hudson River, islands and peninsulas contain most of the areas that have not been directly altered by the railroad.

Bedrock islands are natural bedrock, but the sandy islands, bars, peninsulas, and shoreline flats from Saugerties north are largely artificial, built by dredge spoil deposition (see Sect. 7.9). Some islands have a bedrock core with added sandy spoil (e.g., Rogers Island). The shores of rocky islands are often Estuarine Rocky Shore habitat (Sect. 7.2). Rocky islands have similarities to rocky Crest habitats (Sects. 7.33 and 7.34) due to shallow, infertile, droughty soils, wind exposure, and other features. Species mentioned in this profile are those resident in or using upland (terrestrial) habitats of islands; species of intertidal and subtidal habitats around islands are discussed in other profiles.

Vegetation

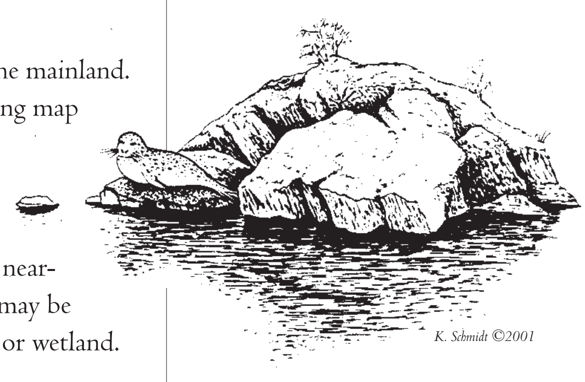
Vegetation is variable, depending on the rock and soil substrates and degree of exposure to wind and waves. An island on gneiss bedrock in the Hudson Highlands has a rocky crest flora, including red, chestnut, black, white, and scrub oaks, pitch pine, red maple, gray birch, blueberries, black chokeberry, mountain laurel, poverty grass, and hairgrass. Because islands were popular for recreation, gardens, and in a few cases homes (e.g., Cruger Island, and the south end of Constitution Island), during the 1800s and early 1900s, some have large numbers of introduced woody species. Some introductions are bizarre (e.g., banana-vine [*Akebia quinata*]), whereas other species are near their natural range limits and may be difficult to identify as native or planted (sweet-gum on Cruger Island and river birch on Astor Point). Prehistoric human use of rocky islands apparently resulted in enrichment of soils by calcium and other nutrients from the remains of food organisms discarded in middens; midden areas often have calcicolous plants.

Fauna

The larger, forested islands have many bird and mammal species common to the mainland. American black duck and mallard nest on rocky islands. Turtle nesting, including map turtle, is important on some islands.

Indicators and Identification

Rocky islands are recognized by their rocky foundations and their isolation or near-isolation (at least at high tide) from the mainland. Historic and current maps may be ambiguous or conflicting with regard to the degree of isolation by open water or wetland.



Biodiversity Values

SPECIES OF CONSERVATION CONCERN. See Sect. 2.0 and App. 3 for rarity ranks.

	Federal Lists	National Lists	State Lists	Regional Lists
Plants				
Caloplaca scotoplaca (lichen)				•
Acarospora subfuscescens (lichen)				•
Sphagnum compactum (peat moss)				•
eastern prickly-pear				•
downy arrowwood				•
fragrant sumac				•
dwarf sumac				•
wild lupine				•
Dutchman's-breeches				•
small-flowered crowfoot			•	
racemed pinweed			•	
yellow harlequin			•	
violet wood-sorrel			•	
clustered sedge			•	
river birch			•	
Invertebrates				
swarthy skipper				•
Amphibians and Reptiles				
map turtle				•
Birds				
turkey vulture (nesting)				•
American black duck		•		•
osprey			•	
bald eagle	•		•	
Mammals				
harbor seal			•	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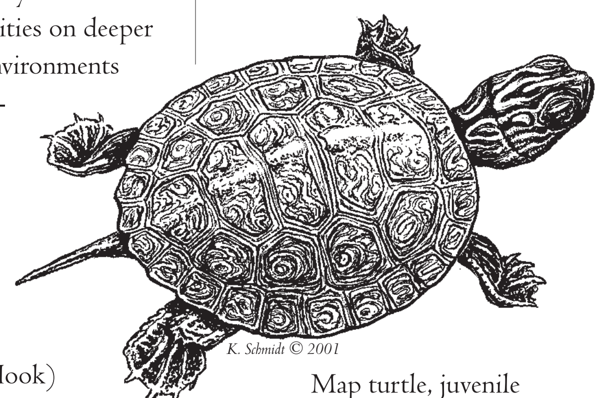
River birch occurs on a rocky peninsula in Dutchess Co. Clustered sedge has been found on a rocky island in Putnam Co. Regionally-rare vascular plants on islands include downy arrowwood, fragrant sumac, dwarf sumac, and wild lupine, all of which also occur on the mainland in our study area. Regionally-rare mosses include *Sphagnum compactum* in the Hudson Highlands. Two crustose lichens new to North America were reported from a Dutchess Co. island: *Caloplaca scotoplaca* and *Acarospora subfuscescens*; *C. scotoplaca* was also found on rocks along the mainland shore (Royte 1985, Royte et al. 1985). Some scarce vascular plant species seem to thrive where trampling and grazing are reduced; Dutchman's-breeches, for example, is abundant on Magdalen Island (Town of Red Hook). Rare species of rocky Crests (Sects. 7.33, 7.34) could occur on rocky islands.

Harbor seal uses rocks and islands as well as docks and wreckage for hauling-out (Kiviat and Hartwig 1994). Osprey and bald eagle use snags or large live trees on islands for hunting perches and apparently nocturnal roosts. Mearns (1878-1881) described a historic winter bald eagle roost on Constitution Island. American black duck nests on Hudson River islands, often concealed by shrubs in niches on rocky ledges. An active turkey vulture nest was reported on a ledge on one island. Black duck and mallard also nest on the railroad causeways, in duck blinds, on rocks in streams, and on the mainland, but the black duck seems to be more common on islands. Map turtle basks and nests on rocks and small islands (Kiviat and Buso 1977; Kiviat, unpublished data). This species has not been seen basking on the mainland or railroad, but nests on the railroad in at least one area in Dutchess Co.. The regionally-rare swarthy skipper (butterfly) has been observed at Iona Island.

The plant communities of rocky islands resemble mainland crest communities on similar rock types. This habitat includes the "pitch pine-oak-heath rocky summit," and the "Appalachian oak-pine forest" communities of Reschke (1990). Some islands have small patches of Reschke's "rocky summit grassland" community, and Constitution Island has an area of "cliff community." Islands with limy bedrock could have Reschke's "limestone woodland" community. The shores of rocky islands may have any of the several rocky shoreline communities described by Reschke (1990); see the Estuarine Rocky Shore habitat profile (Sect. 7.2). Some islands also have "lowland" terrestrial communities on deeper soils. Areas with shell middens support a distinct calcicolous (thriving in environments rich in calcium carbonate) plant community including, e.g., basswood, hackberry, slippery elm, and round-leaf dogwood.

Substrates

Bedrock geology varies from graywacke (sandstone) and shale in the Mid-Hudson (e.g., Cruger, Magdalen, Esopus islands), to hard metamorphic and igneous rocks in the Highlands and Westchester, including gneiss and granitic gneiss. Soils are mostly till-based, but Astor Point (Town of Red Hook) is covered with glacial outwash sand, and Jones Island (Town of Rhinebeck) with clayey soil.



Map turtle, juvenile
(Graptemys geographica)
adult carapace to 27 cm (10.6 in)

Surface Waters

There are few nontidal streams on Hudson River islands due to their small size. Constitution Island has a small, probably intermittent, stream draining a large, partly dammed, woodland pool complex. Some of the bedrock islands have intermittent or permanent pools, many of which seem to have been human-altered; examples are on Magdalen, Cruger, Constitution, and Con Hook (Cons Hook). (See Habitat Profile for Supratidal Pool.)

Extent

Hudson River rocky islands range from a few square meters to approximately 69 ha (170 ac) (Constitution Island) in area above high tide level.

Distribution

Rocky islands are sparsely distributed through large reaches of the estuary, but most are between Saugerties and Peekskill. Islands range from sea level "reefs" to high crests. Iona Island at 30 m (100 ft), and Constitution Island at 43 m (140 ft), both in the Hudson Highlands, are the highest.

Quality

Greater isolation from the mainland, less disturbance and compaction of upland soils, less excavation of soils, less alteration (damming, dredging) of pools, fewer artificial structures (buildings, navigational lights, etc.), less recent clearing of vegetation, fewer exotic plants, and less historic dumping of spoil or other fill are probably indicators of better habitat quality on rocky islands. Presence of prehistoric shell midden material, however, may improve habitat quality for some rarities.

Human Uses

Hunting, fishing, camping, picnicking, nature study, archaeological excavation (mostly amateur and illegal), dumping. Some islands have houses, hunting-fishing cabins, duck blinds, and navigation lights. Islands with road access and islands visible from shore are often popular sites for birdwatching. Some islands are popular for other nature study because they support upland or wetland species less common on the mainland. One island has been much-used as a latrine by boaters, and has been extensively excavated by artifact collectors (Burns 1997).

Sensitivities, Impacts

Campfires can result in vegetation fires, but occasional natural fires may be a normal phenomenon for some Hudson River islands. Human use of islands often causes soil erosion and compaction, loss of sensitive flora through trampling, and visual and noise disturbance of sensitive wildlife.

Conservation and Management

Because of their relatively small size and harsh environmental conditions, rocky islands are especially sensitive to human use. If habitats are to be protected, the manner of use needs to be "lightened." Curtailment of certain human activities (e.g., camping and "pot-hunting"), and restricting other uses to established trails and picnic areas would help protect the soil and native vegetation (e.g., less erosion, compaction, digging, building). Human use can be steered away from sites where special values are identified (e.g., raptor and waterfowl nest sites, rare lichens).

Examples on Public Access Lands

Areas accessible on foot include Constitution Island (permission from U.S. Military Academy required), the knolls at Nutten Hook, Cruger Island, the north knoll at Iona Island, part of Croton Point, and Oscawana Island. Georges Island is accessible by car. Rogers Island, Magdalen Island, and Esopus Island are accessible only by boat.

References

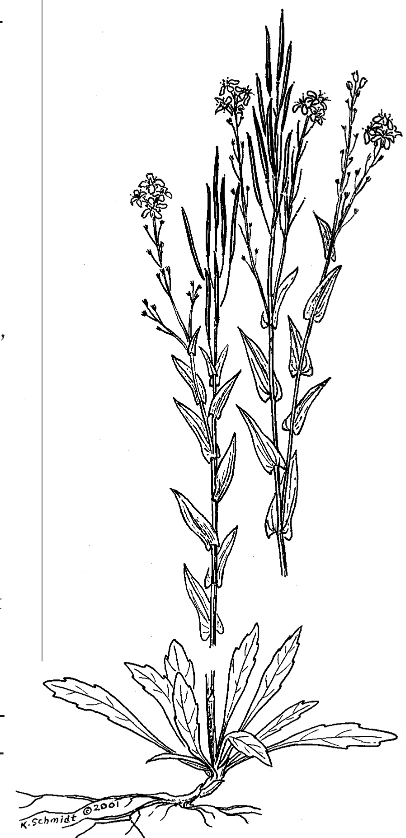
McVaugh (1958), Kiviat (1978b).

7.8 Supratidal Railroad and Road Causeway

THIS PROFILE PERTAINS TO SUPRATIDAL PORTIONS of the railroads that run along the east and west shores of the Hudson River, and to the raised roadways (causeways) crossing tidal wetlands and bays. These artificial structures have greatly damaged islands, and the estuarine shorelines and shallows, but they nonetheless have biological values worth noting.

Vegetation

Causeways range from nearly bare to herb-, shrub-, or tree-dominated. Narrow (approximately 3-6 m [10-20 ft]), linear, dense, tall shrub thickets are commonplace. The herbaceous vegetation and large areas of the woody vegetation are dominated by introduced species, some of which are rare away from the railroads (e.g., four-o'clock). Ninebark, a calcicolous shrub that, in the study area, is nearly restricted to the Hudson River shoreline, is uncommon to locally common along the railroads and road causeways. Many showy flowering herbs may be present (Kiviat 1978b).



Drummond's rock cress
(Arabis drummondii)
3–9 dm (12–35 in)

Fauna

The wildlife comprises mostly common animals of watercourse bank, roadside, field, oldfield, and hedgerow habitats, including white-tailed deer, meadow vole, white-footed mouse, Norway rat, eastern cottontail, raccoon, and many small birds. A few mallards nest in the herb communities; an occasional killdeer and probably spotted sandpiper nests on the service roads or ballast. Raptors, including bald eagle, perch on the utility poles; swallows, belted kingfisher, and other birds perch on the wires. Where shrub thickets are extensive, as at Tivoli Bays and Vanderburgh Cove-Suckley Cove, the railroads support an exceptionally high density of breeding birds of which the most numerous species are gray catbird, yellow warbler, and song sparrow (Stapleton and Kiviat 1979). A northern water snake has been observed overwintering in the railroad bed in Manitou Marsh (Robert E. Schmidt, personal communication). The railroads and some road causeways are used intensively for nesting by snapping turtle and eastern painted turtle (Kiviat 1980). Turtle nests attract predators such as raccoon and striped skunk.

Indicators and Identification

Presence of railroad tracks or abandoned ties or ballast, presence of roads, and weedy vegetation in the supratidal zone.

Biodiversity Values

SPECIES OF CONSERVATION CONCERN. See Sect. 2.0 and App. 3 for rarity ranks.

	State Lists	Regional Lists
Plants		
hair-rush		•
Drummond's rock-cress	•	
green-headed coneflower		•

(continued)

SPECIES OF CONSERVATION CONCERN (cont.)

	State Lists	Regional Lists
Plants (cont.)		
Canada lily		•
Frank's sedge	•	
Davis' sedge	•	
slender knotweed	•	
swamp lousewort	•	
kidneyleaf mud-plantain	•	
Invertebrates		
Baltimore (butterfly)		•
Amphibians and Reptiles		
spotted turtle	•	
wood turtle	•	
diamondback terrapin	•	
map turtle		•

Drummond's rock cress has been collected on the railroad in Dutchess Co. Hair-rush and slender knotweed occur on the railroad at Iona Island. The rare plants Frank's sedge and swamp lousewort have each been found on a road causeway in Ulster Co. Green-headed coneflower, Canada lily, and other scarce to regionally-rare herbs occur on the wet, partly shaded margins of road causeways.

In the freshwater reaches, map turtle nests locally on the causeways (Kiviat and Buso 1977; Kiviat, observations). Diamondback terrapin apparently nests on an old railroad causeway and pier in Rockland Co. (Simoes and Chambers 1999).

These habitats may include Reschke's (1990) "successional shrubland" and "successional old field" communities, and numerous cultural communities, such as "herbicide-sprayed roadside/pathway," "unpaved road/path," "riprap/erosion control roadside," and "brushy cleared land."

Substrates

At Tivoli, the railroad foundation is of large, carbonate blocks; the tracks rest on coarse (approximately 6 cm [2.4 in]) crushed carbonate rock; and the soil underlying the service roads and verges is principally coal cinder and diesel soot. Different materials may be used at other locations. Discarded railroad ties and a variety of other railroad-generated refuse litter large areas. The railroad soils are contaminated with toxic elements and organic compounds from coal and petroleum; the ties are treated with petroleum derivatives presumably rich in toxic polycyclic aromatic hydrocarbons (PAH). The railroads have been repeatedly sprayed with herbicides to prevent vegetation overgrowing the ballast, tracks, and utility lines. The Cruger Island Road causeway at Tivoli Bays rests on a foundation of blocks of rock and was apparently paved in the past with brick and gravel.

Surface Waters

The only surface waters are large, semi-permanent rain puddles on some roads, and those tidal (mostly) and nontidal waters adjoining the causeways and flowing beneath them through culverts and bridges.

Extent

Don Squires (unpublished data) estimated that the railroads alone account for 800 ha (2600 ac) of fill in the tidal Hudson River. Besides the north-south "East Shore" and "West Shore" railroads, the Piermont Pier is largely an abandoned railroad causeway, and old railroad spurs cross marshes and swamps elsewhere (e.g., Nutten Hook). Road causeways also cross marshes and swamps at many locations; e.g., Nutten Hook, Hudson North and South bays, Rams Horn, Inbocht Bay, Tivoli Bays (Cruger Island), Sleightsburg Spit, Georges Island, Manitou Marsh, Iona Island, and the Haverstraw Marshes.

Distribution

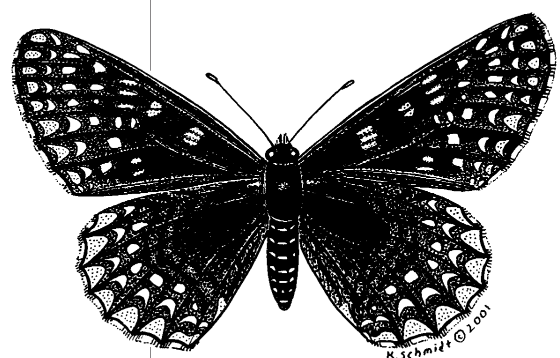
Found nearly throughout the study area, within a few meters (feet) of sea level.

Human Uses

Transportation, fishing, hunting, birdwatching, and miscellaneous recreational activities are the most prominent uses of railroads and causeways.

Quality

Our only measure of quality in these disturbed habitats is based on the occurrence of individual rare species.



Baltimore
(Euphydryas phaeton)
forewing 2.0–3.3 cm (0.8–1.3 in)

Sensitivities, Impacts

The railroad causeways are contaminated by toxicants from coal cinders, diesel smoke, herbicides, creosote or other preservatives in railroad ties, and possibly spilled freight; effects of these contaminants have not been studied. Herbicides, brush-hogging, and hand cutting have been used to prevent woody plants from growing up into the utility wires and to open views. Railroad causeway vegetation is prone to fires. Causeways reduce tidal circulation and contribute to the accumulation of wetland sediments. While this has helped to create some of the Hudson's most important wetlands, continued sedimentation in some areas appears to cause declines in marsh quality.

Conservation and Management

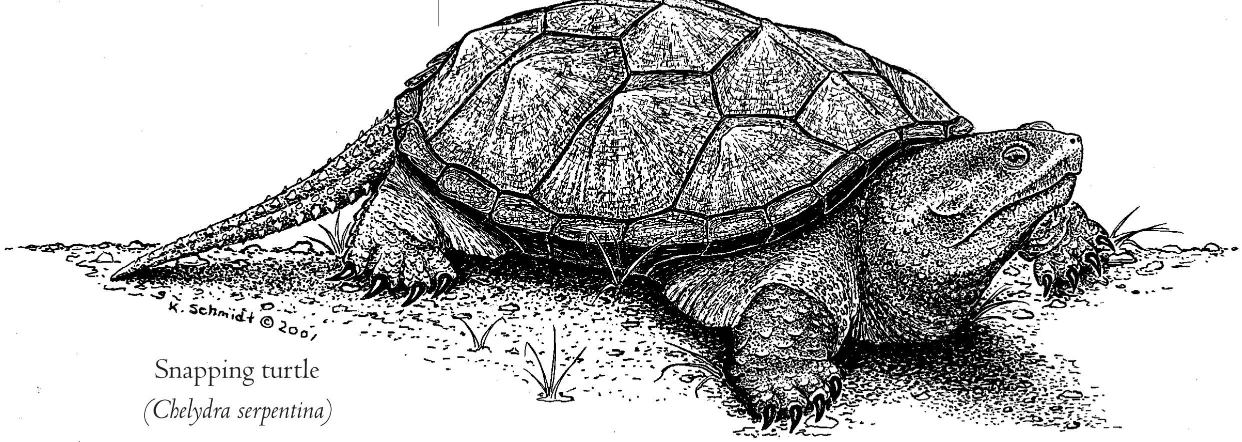
Alternatives to herbicides are needed for vegetation management on the railroads. Planting of aggressive, low-growing plants that outcompete taller species has been used effectively on powerline rights-of-way, and might be effective along railroads. On the side of the railroad away from the utility lines, vegetation should be left uncut, wherever possible, to act as a screen between wildlife and the trains. Discarded ties and other refuse should be removed from the railroads and their vicinities, and disposed of legally.

Examples on Public Access Lands

Although railroad causeways border the Hudson along most of the east side and portions of the west side, the causeways and their access roads are the property of the railroad companies and are closed to the public. They may be viewed from grade crossings, overpasses, and dead ends of public roads at many locations including the Iona, Tivoli, and Stockport components of the Hudson River National Estuarine Research Reserve (HRNERR), the Barrytown and Tivoli landings (Town of Red Hook), Denning Point (Town of Fishkill), and Little Stony Point (Town of Philipstown). Be cautious of high speed trains. The former railroad at Piermont Pier is now a road, and is open to the public. Some of the non-causeway portions of the east shore railroad can be seen from the Amtrak and Metro North railroad stations, but these segments tend to be farther from tidal habitats, more actively disturbed, and less interesting biologically. Road causeways crossing tidal habitats are accessible at the town park at Sleightsburg Spit (Town of Esopus); Brett Park (City of Beacon), Cruger Island Road at Tivoli Bays, the unnamed road at Iona Island, and Ferry Road at Nutten Hook.

References

McVaugh (1958), Kiviat (1978b), Stapleton and Kiviat (1979).



Snapping turtle
(Chelydra serpentina)
carapace 20–30 cm (8–12 in)

7.9 Hudson River Dredge Spoil Habitats

THIS PROFILE INCLUDES THE VARIOUS HABITATS on sandy substrates dredged from the Hudson River navigation channels: dredge spoil shore, dredge spoil shore meadow, dredge spoil tidal swamp, dredge spoil pools, dredge spoil forest, and dredge spoil dry meadow. Since the late 1800s, the U.S. Army Corps of Engineers has dredged the main navigation channel (and side channels) and deposited the dredged material, called spoil, on shallows, wetlands, islands, and shorelines. The spoil is mostly fine sand, and is reported to be low in PCB content. The spoil deposits were usually contained by timber bulkheads or sand (sometime rock) berms, but these structures have deteriorated at older deposits. Many of the sandy islands, peninsulas, and shoreland areas along the Hudson are dredge spoil deposition sites. A few sandy islands (e.g., Denning Point) are natural, however, as is the mostly sandy Croton Point peninsula. Most of the dredge spoil communities in the study area are 50–70 years old; a few are more recent.

Much of the biological information below is based on field studies conducted by Hudsonia biologists in 1998–99 on dredge spoils habitats in Columbia and Greene Counties (Stevens, in prep.).

Vegetation

We recognize several distinct dredge spoil habitats, distinguished by vegetation and hydrologic factors.

Dredge spoil shore is the tidal and supratidal portion of sparsely vegetated shores. The vegetation is entirely herbaceous, including grasses, sedges, and forbs.

Dredge spoil shore meadow is the tidal and supratidal portion of densely vegetated shores with tall, robust grasses and forbs such as Joe-Pye-weeds, purple loosestrife, common reed, sneezeweed, and shrubs such as stiff willow, silky willow, and meadowsweet.

Dredge spoil tidal swamp is a wooded or shrubby tidal wetland, with vegetation similar to that of tidal swamps on native substrates, including such species as silver maple, red ash, slippery elm, eastern cottonwood, white willow, crack willow, silky dogwood, gray dogwood, and alder.

Dredge spoil forest is an upland forest community, usually with eastern cottonwood, black locust, slippery elm, and black cherry in the overstory, and with Eurasian honeysuckle and Oriental bittersweet common in the understory.

Dredge spoil dry meadow is a predominantly herbaceous, open habitat, with sparse or dense vegetation, often enclosed by dredge spoil forest. Characteristic dry meadow species are lovegrass, wiry witchgrass, switchgrass, deer-tongue grass, blue wild-rye, hogweed, cypress spurge, and bouncing-bet. Eurasian honeysuckles, black locust, and other trees and shrubs may be sparsely distributed.

Fauna

The fauna differs according to the size and age of the spoil deposit and the degree of isolation from the mainland. On forested dredge spoil, white-tailed deer, eastern cottontail, wild turkey, coyote, gray squirrel, and meadow vole are common. A fairly diverse community of common songbirds inhabits the upland and wetland dredge spoil habitats.

Schweinitz's flatsedge
(Cyperus schweinitzii)
stems 1–10 cm (4–39 in)

Breeding bird density can be high (Stevens, in prep.). Although sandy soils are usually good reptile and amphibian habitats, there seems to be low abundance and low species richness on Hudson River spoil, due perhaps to lack of soil organic matter, lack of prey, and the generally impoverished reptile and amphibian fauna of the tidal habitats. American toad, spring peeper, wood frog, northern leopard frog, green frog, gray treefrog, bullfrog, spotted salamander, blue-spotted salamander, northern water snake, smooth green snake, eastern garter snake, snapping turtle, eastern painted turtle, and spotted turtle have been found in and adjacent to Hudson River dredge spoil habitats (Stevens, in prep.). Snapping turtle and painted turtle nest in areas above high tide.

Indicators and Identification

Sandy soils with shallow or no topsoil, adjoining or close to tidal waters. Microtopography may show elongated ridges or small mounds 1–3 m high. Nontidal surface water is restricted or absent.

Biodiversity Values

Bald eagle
(Haliaeetus leucocephalus)
75–108 cm (30–43 in)

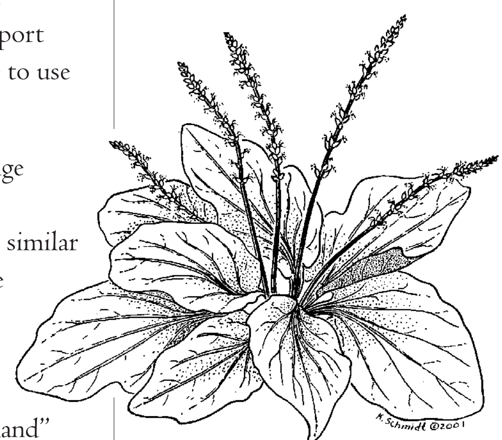
SPECIES OF CONSERVATION CONCERN. See Sect. 2.0 and App. 3 for rarity ranks.

	Federal Lists	State Lists	Regional Lists
Plants			
Fernald's sedge		•	
Schweinitz's flatsedge		•	
Long's bittercress		•	
kidneyleaf mud-plantain		•	
heartleaf plantain		•	
estuary beggar-ticks		•	
swamp lousewort		•	
wild lupine			•
Invertebrates			
russet-tipped clubtail (dragonfly)		•	
sand wasp			•
Amphibians and Reptiles			
northern leopard frog			•
wood frog			•
spotted salamander			•
blue-spotted salamander		•	
Birds			
bald eagle	•	•	
fish crow			•
bank swallow			•

Heartleaf plantain, Long's bittercress, kidneyleaf mud-plantain, and estuary beggar-ticks are found on dredge spoil shores. Swamp lousewort and Fernald's sedge have been found in dredge spoil tidal swamps. Schweinitz's flatsedge has been found in dredge spoil dry meadows. Rarities of natural sandplains should be watched for on dredge spoil shore meadows. The presence of a sandplain species, wild lupine, on disturbed natural sandy soil on a rocky peninsula in Dutchess County suggests the possibility of creating native sand-plain communities on sandy dredge spoil.

Northern leopard frog, wood frog, and spotted salamander breed in dredge spoil vernal pools. Bank swallow and belted kingfisher construct nest burrows in high, eroding banks (Kiviat et al. 1985, Stevens, in prep.). Bald eagle and osprey use large trees along dredge spoil shores for hunting perches. Bald eagle could use isolated dredge spoil forests for nesting. We have found probable fish crow nests in an upland dredge spoil forest. Map turtle could nest in areas above mean high water, but there are no such records to date. The only New York records for the russet-tipped clubtail (a dragonfly) in the last 70 years have been on the Hudson River, and larval emergence and exuviae (cast off skins) have been observed only on dredge spoil at Stockport Flats and at a site in Germantown (Ken Soltesz, personal communication). Early-developmental dredge spoil areas may support other regionally-rare insects such as the sand wasp *Bembix*. Harbor seals may be able to use sandy islands for hauling-out if deeper channels are nearby.

Dredge spoil shore supports a community similar to Reschke's (1990) "estuarine dredge spoil shore" community, but she does not describe the densely vegetated ***dredge spoil shore meadow*** community. The communities of the ***dredge spoil tidal swamp*** habitat are similar to Reschke's "freshwater tidal swamp." ***Dredge spoil forest*** communities resemble "late successional" examples of Reschke's "dredge spoils" community. Reschke does not specifically describe communities of the ***dredge spoil dry meadow*** habitat, but they resemble in some respects "early successional" examples of "dredge spoils" community. They also resemble her "successional old field" and "successional shrubland" communities but with coarser, drier soils and sparser vegetation than typical examples of those communities.



Heartleaf plantain
(*Plantago cordata*)
leaves 12–25 cm (5–10 in) long

Substrate

The spoil is generally composed of fine sand with minor admixtures of other materials such as shell, silt, and organic matter. The older spoil deposits that have developed mature forests have considerable leaf litter and humus in the surface soil. Flora indicates a circumneutral soil (pH 6.5–7.3); calcium carbonate from mollusk shells and carbonate rocks may be responsible.

Surface Waters

Some dredge spoil sites have tidal creeks and extensive areas of intertidal and supratidal swamps. The highly permeable substrates in upland areas, however, support little surface water. Supratidal pools, intermittent pools, and other low, moist to wet areas occur at some sites (e.g., Nutten Hook, Stuyvesant, Seward Island).

Extent

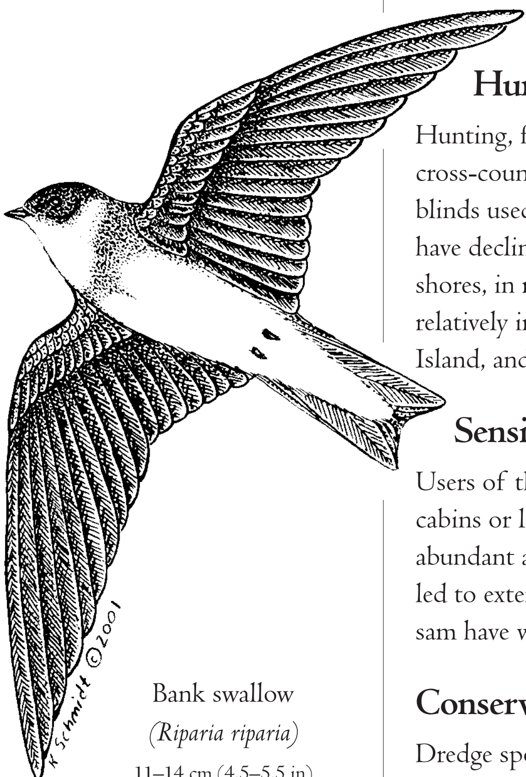
Variable; some areas are very small, but the Houghtaling-Schodack (Rensselaer, Columbia, and Greene cos.) spoil complex exceeds 400 ha (990 ac).

Distribution

Sandy dredge spoil islands and peninsulas are numerous from Saugerties north, and local southward where there has been less need for dredging.

Quality

The artificial nature of the habitat makes quality assessment difficult. Both early-developmental habitats (on recently deposited spoils) and mature habitats (such as cottonwood forests) can have important biodiversity values. Higher quality may be partially associated with lack of human disturbance.



Bank swallow
(Riparia riparia)
11–14 cm (4.5–5.5 in)

Human Uses

Hunting, fishing, trapping, All Terrain Vehicle (ATV) use, camping, picnicking, walking, cross-country skiing, and swimming. Some sites have cabins, lean-tos, campsites, and duck blinds used by hunters and fishers. Hunting and trapping uses of dredge spoil sites may have declined in recent years. ATV use, however, is still prominent at some sites along shores, in mudflats, in upland forests, and on bluffs (Stevens, in prep.). Interior areas with relatively impenetrable vegetation (e.g., common reed and Oriental bittersweet on Seward Island, and Eurasian honeysuckle at Mill Creek) seem to be avoided by humans.

Sensitivities, Impacts

Users of the fishing and hunting campsites have cleared patches of vegetation, constructed cabins or lean-tos and pit toilets, and dumped refuse. Trash from recreational users is abundant around popular picnicking and camping locations. ATV use and foot traffic has led to extensive slumping and erosion of high dredge spoil bluffs. Large amounts of jetsam have washed up in the low-elevation areas.

Conservation and Management

Dredge spoil habitat units supporting rare species should be identified and protected from any adverse recreational or other use. Use of ATVs should be restricted in areas known to have rare plants or animals. Prescribed fire, harvesting, and other techniques to encourage native plant replacement of introduced plants deserve scientific experimentation.

Examples on Public Lands

Spoil habitats accessible by boat include large areas of Rogers Island (Town of Greenport), Gays Point peninsula, Stockport Middle Ground (Town of Stockport), and many others. Portions of Nutten Hook (Town of Stuyvesant), the Saugerties lighthouse peninsula, and Sleightsburg Spit (Town of Esopus) have dredge spoil accessible on foot.

References

McVaugh (1947, 1957, 1958), Terrestrial Environmental Specialists (1997), Carr and Baumgartner (2000), Stevens, (in prep.).

7.10 Wet Clay Meadow

WET CLAY MEADOWS ARE WET MEADOW OR WET OLDFIELD HABITATS on clayey soil; most were formerly agricultural fields. Post-agricultural wet meadows may seem unexceptional on first inspection, but some are significant habitats for rare plants. Wet meadows are often overlooked in wetland delineations and biological surveys, because these habitats look like ordinary pastures and oldfields from a distance, and are difficult to identify as wetlands on maps and aerial photographs. Wet clay meadows have only recently been recognized as a distinct habitat type that is important for biodiversity (Kiviat et al. 1994).

Vegetation

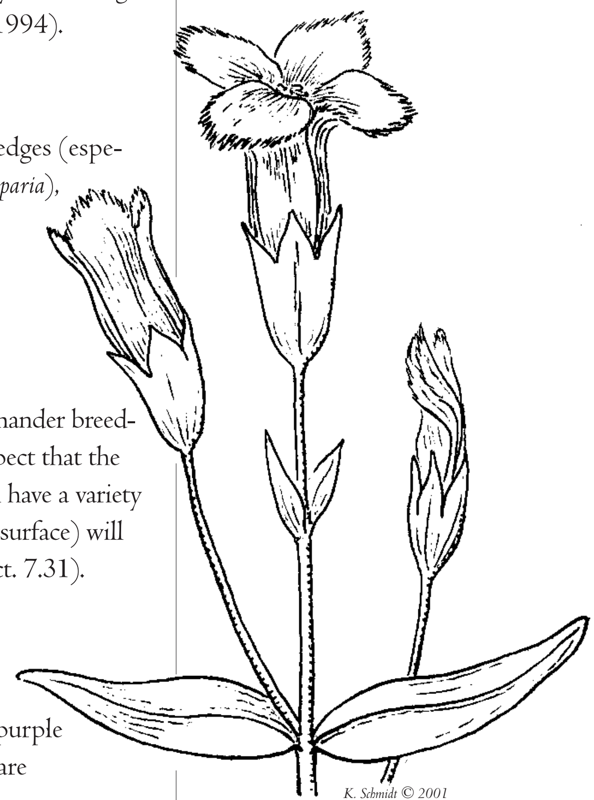
Goldenrods, purple loosestrife, false-foxglove, fox sedge, Bush's sedge, other sedges (especially *Carex lasiocarpa, C. granularis, C. annectens, C. cristatella, C. hirsutella,* and *C. scoparia*), grasses, oldfield and swamp shrubs (especially gray dogwood, silky dogwood, northern arrowwood, meadowsweet, alder), and trees of seedling or sapling size (e.g., elm, red ash) are present in variable combinations.

Fauna

The fauna is poorly known. In 1994, we found American toad and spotted salamander breeding abundantly in shallow, natural and artificial pools (Kiviat et al. 1994). We expect that the wetter sites (those that have sheets of water several centimeters/inches deep) will have a variety of marsh species, and the drier sites (where the water table rarely reaches the soil surface) will have wildlife typical of Shrubby Oldfields (Sect. 7.30) or Upland Meadows (Sect. 7.31).

Indicators and Identification

Seasonal or permanent wetness on any of the clayey soil types noted below, with wetland indicator flora (Reed 1988), especially false-foxglove, fox sedge, purple loosestrife and wetland goldenrods. Clay meadows often contain species that are also typical of fens; e.g., fringed gentian, *Carex cristatella, Carex flava, Carex granularis, Carex lasiocarpa* (Kiviat et al. 1994).



Fringed gentian
(*Gentianopsis crinita*)
2–8 dm (8–31 in)

Biodiversity Values

SPECIES OF CONSERVATION CONCERN. See Sect. 2.0 and App. 3 for rarity ranks.

	National Lists	State Lists	Regional Lists
Plants			
Frank's sedge		•	
Bush's sedge		•	
spiny coontail		•	
buttonbush dodder		•	
small-flowered agrimony		•	
downy ground-cherry		•	
winged monkey-flower		•	
small skullcap		•	

(continued)

SPECIES OF CONSERVATION CONCERN (cont.)	National Lists	State Lists	Regional Lists
Plants (cont.)			
slender lady's-tresses			•
nodding lady's-tresses			•
slender gerardia			•
ragged fringed orchid			•
winged loosestrife			•
fringed gentian			•
Invertebrates			
Baltimore (butterfly)			•
Amphibians and Reptiles			
spotted salamander			•
wood turtle		•	
Birds			
Virginia rail			•
American woodcock			•
alder flycatcher			•
sedge wren	•	•	
vesper sparrow		•	
grasshopper sparrow		•	
Henslow's sparrow	•	•	
orchard oriole			•

Winged monkey-flower occurs along streams and spiny coontail in permanent pools in wet clay meadows.

Baltimore (butterfly), wood turtle, spotted salamander, Virginia rail, and alder flycatcher are associated with some wet clay meadows or their edges. Orchard oriole may occur in wet clay meadows with scattered trees. American woodcock uses clay meadows and other meadows for displaying. Other rare butterflies, especially skippers, should be looked for, as should sedge wren, Henslow's sparrow, and other grassland birds. The dragonflies and other invertebrates also bear investigation.

The communities of this habitat resemble those of Reschke's (1990) "successional old field" and "successional shrubland" communities in some respects. Wet Clay Meadows are wetland habitats, however, and Reschke's descriptions do not include the characteristic clay meadow species.

Substrates

The soils are deep, more or less calcareous, silty clay loams, clay loams, and silt loams of glaciolacustrine (glacial lake) origin, as well as occasional clayey tills; includes the Hudson-Vergennes, Livingston, Kingsbury, and Rhinebeck soils. Wet meadows form where the clayey soils are nearly flat. Inclusions of sandy soils are often present, and may form mounds 30 cm or so higher than the surrounding clay. Underlying bedrock may be sandstone, shale, siltstone, or possibly carbonate.

Surface Waters

The soil surface may be no more than seasonally saturated, or may support standing surface water including shallow sheets, tiny pools in hollows (between plant tussocks, in old plow furrows or wheelruts, or associated with other microtopographic features), small perennial or intermittent streams, spring pools, beaver ponds, drainage ditches, and excavated artificial ponds.

Extent

Extremely variable; from less than 0.5 ha (1.2 ac) to hundreds of hectares (> 1000 ac). The most extensive wet clay meadows are in Greene Co.

Distribution

Elevations are 30–60 m (100–200 ft). This habitat should be expected wherever level, non-forested expanses of clayey soils occur in the study area.

Quality

Higher-quality units have greater abundance of sedges (other than tussock sedge).

Human Uses

Most or all of these meadows have been used for agriculture or ornamental landscape purposes in the past; these uses might be revived at some sites in the future.

Sensitivities, Impacts

Subject to resumption of agricultural activities including ditching, grazing, and mowing. Large areas have been drained for agricultural and ornamental purposes. Although some of the rare plants tolerate mowing (e.g., Bush's sedge), many presumably do not.

Conservation and Management

Without mowing or grazing, wet clay meadows are likely to be overgrown by purple loosestrife, shrubs, and trees. Common reed is a potential problem, and could outcompete rare plants and the sedge community in wetter areas. Some form of mowing or possibly grazing, rotated among portions of a meadow so that each portion is "set back" every few years, may be necessary to maintain the unusual community. Experimental light grazing and burning should also be tried. The management of wet clay meadows as native "wildflower" meadows for ornamental purposes should be considered on appropriate sites instead of mowing and drainage. Conservation easements on wet clay meadows could help insure that future uses are compatible with the special communities of these habitats.

Examples on Public Access Lands

The Greenport Conservation Area (Columbia Co.) has extensive wet clay meadows. A small but diverse clay meadow may be seen east of the Olin Building–visitors' parking lot at Bard College (Town of Red Hook).

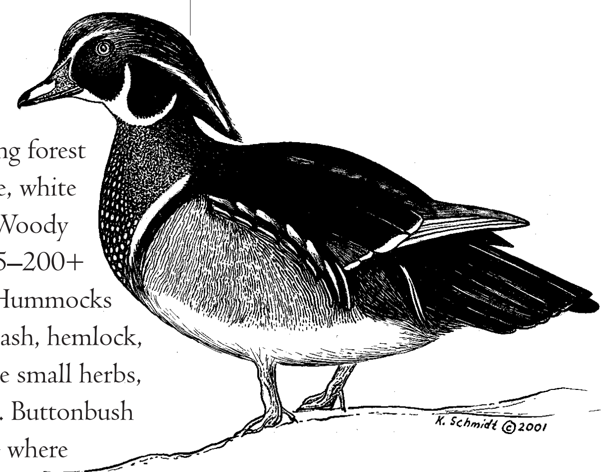
References

Kiviat et al. (1994), Groffman et al. (1996).

False-foxglove
(Penstemon digitalis)
stems to 1.5 m (3.4 ft)

7.11 Intermittent Woodland Pool

THIS IS A SHALLOW POOL, SURROUNDED by upland forest, usually retaining standing water during winter and spring but drying up by mid-summer of most years. A common but threatened habitat type, intermittent woodland pools (IWPs) look unassuming but are critical breeding places for several amphibian species. These small habitats are often damaged because their values are not appreciated by landowners, or because they are overlooked in the environmental reviews of development projects. Sometimes referred to as "intermittent flooding woodland pools," "vernal pools," or "ephemeral pools."



Wood duck *(Aix sponsa)*
43–51 cm (17–20.5 in)

Vegetation

There is usually a fringe of large trees at the pool edge, even if the surrounding forest is less mature. The bordering trees are most often hardwoods (e.g., red maple, white ash, red ash, tupelo, swamp white oak) but may be conifers (e.g., hemlock). Woody plant "hummocks" (raised root-pedestals) 15–60 cm (6–24 in) high and 15–200+ cm (6–80+ in) across are very often present at pool edges or in mid-pool. Hummocks support red maple and sometimes other trees (black birch, yellow birch, red ash, hemlock, elm), highbush blueberry, swamp azalea, chokeberry, sweet pepperbush, some small herbs, and often a profusion of mosses which may or may not include peat mosses. Buttonbush may be present, even dominant. Sedge tussocks (*Carex stricta*) may be present where shade is not too deep. Duckweeds (common duckweed, watermeal, sometimes greater duckweed, occasionally ivy-leaf duckweed) are usually present. The moss flora can be diverse, especially in pools with abundant rocks, woody hummocks, and down wood. Floating filamentous algae typically occur in small, ephemeral patches (a few square meters/yards) where there is more light penetration through the woody canopy; more extensive and long-lasting algal blooms probably indicate nutrient enrichment or other pollution, and could also be caused by logging in or adjacent to pools.

Fauna

Common resident animals include microcrustacea such as water-fleas and copepods, water sowbugs, fairy shrimp, caddisfly larvae, predaceous diving beetles (adults, larvae), water-striders, backswimmers, water boatmen, mosquito (larvae), water mites, fingernail clams, pouch snails, and pondsnails. Permeant ("commuting") animals include spotted salamander, Jefferson salamander, marbled salamander, four-toed salamander, red-spotted newt, spring peeper, wood frog, green frog, gray treefrog, spotted turtle, American black duck, mallard, wood duck, and raccoon. IWPs normally lack fish.

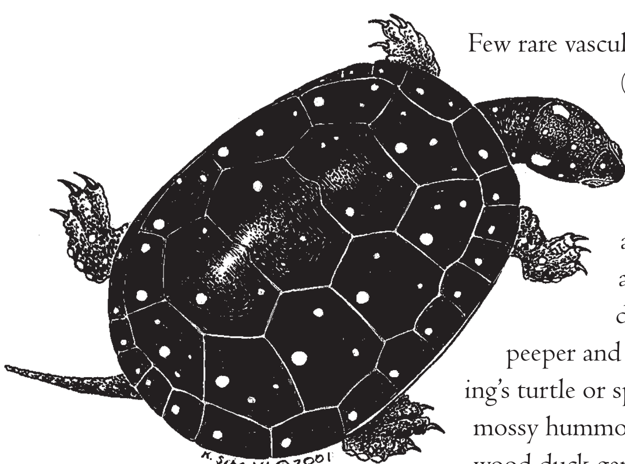
Indicators and Identification

At high water levels, water depths are normally 25–125 cm (10–50 in); small pools of deeper water do not detract from habitat quality provided they dry up in summer. Hydroperiod (duration of standing water) is 6-9 months in an average year. The presence of fairy shrimp is a good indicator that the standing water is temporary. For successful breeding of mole salamanders (*Ambystoma* spp.), the pool should not dry before July. Well-developed woody plant hummocks at the edge or in the interior of the pool are typical but not necessary for a high quality pool. The pool is moderately to heavily shaded when woody plants are in full leaf, and the perimeter is substantially wooded.

Biodiversity Values

SPECIES OF CONSERVATION CONCERN. See Sect. 2.0 and App. 3 for rarity ranks.

	National Lists	State Lists	Regional Lists
Plants			
featherfoil		•	
false hop sedge		•	
Invertebrates			
black dash (butterfly)			•
mulberry wing (butterfly)			•
springtime physa (snail)			•
Amphibians & Reptiles			
four-toed salamander			•
Jefferson salamander		•	
marbled salamander		•	
spotted salamander			•
wood frog			•
Blanding's turtle		•	
spotted turtle		•	
Birds			
wood duck			•
American black duck	•		•



Spotted turtle
(Clemmys guttata)
carapace up to 12 cm (4.7 in)

Few rare vascular plants have been reported from this habitat, but featherfoil (Ken Soltesz, personal communication) and false hop sedge (Spider Barbour, personal communication) have been found in intermittent woodland pools.

Intermittent woodland pools are best known as amphibian breeding and nursery habitats. They are virtually the only significant spawning areas for spotted salamander, Jefferson salamander, marbled salamander, and wood frog, and are also favorable spawning areas for spring peeper and certain other amphibians. Some woodland pools are used by Blanding's turtle or spotted turtle. Four-toed salamander may be present, associated with mossy hummocks, stone walls, rocks, and logs. Mallard, American black duck, and wood duck generally use these pools and may nest or rear broods there (mallard and black duck nest on hummocks in mid-pool; wood duck nests in tree cavities). An apparently rare pouch snail, the springtime physa (*Physa vernalis*), has been collected in this habitat and other natural and disturbed shallow-water habitats in New York and Connecticut. The mulberry wing and black dash butterflies may be present in woodland pools with tussock sedge. Other invertebrates bear investigation.

The communities of Intermittent Woodland Pools are similar to those of Reschke's (1990) "vernal pool."

Substrates

Vegetation usually suggests a neutral to moderately acidic water and soil pH, but some pools (in areas of calcareous bedrock) have alkaline water and subsoil even though the hummocks support acidicolous plants such as highbush blueberry. Some of the pools in the Hudson Highlands appear to be more acidic and have, for example, extensive peat moss (*Sphagnum*). Pool bottoms normally have a layer of decomposing woody plant leaves (leafpack) at least several centimeters deep.

Marbled salamander
(Ambystoma opacum)
7.7–12.7 cm (3–5 in)

Surface Waters

Standing water is about 25–125 cm (10–50 in) deep (at highest water levels and in the deeper parts of the pools) and is present from about November to June or longer. The hydroperiod (duration of standing water) varies from year to year depending on precipitation, soils, and other factors. Some IWPs are flooded through summer and fall in the wettest years, but dry up by early to mid-summer in a normal-precipitation year. Inlets and outlets are very small or absent, and surface water throughflow is generally absent or negligible. Surface water is usually neutral to moderately acidic, and usually moderately to heavily stained by organic substances from decaying leaves (the more calcareous pools are likely to have clearer water). The leafpack usually remains wet or damp during seasonal drawdowns.

Extent

These usually small (from well under 0.1 ha to perhaps 0.5 hectare [<0.2–1.2 ac]) wetlands are typically isolated from other wetlands and waters, but may also be part of larger swamps or wetland complexes.

Distribution

Throughout the study area, ranging from near 0 m (where IWPs grade into Supratidal Pools [see Habitat Profile]) to some of the highest elevations, such as the top of Breakneck Ridge (> 430 m [>1420 ft]). Most numerous where parallel bedrock (e.g., sandstone) ridges are separated by small depressions that hold water; rare on the Lake Albany clays (e.g., Hudson-Vergennes soil).

Quality

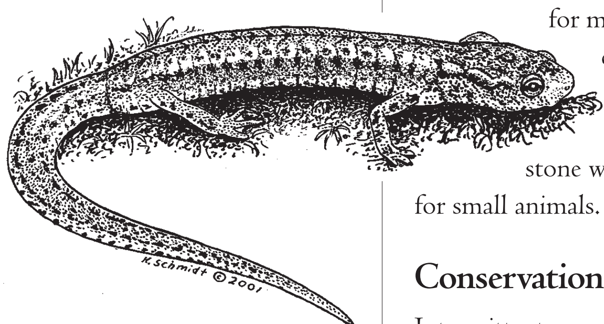
Higher quality is indicated by the vegetation, indicators, and surface water characteristics noted above, and the absence or insignificance of alterations and impacts (drainage, filling, dumping, dredging or impoundment, tree removal, pollution with nutrients or chemicals, pesticide application). The presence of intact mature forest habitat surrounding the pool is important to the habitat value for amphibians (deMaynadier and Hunter 1999). Because some of the amphibians, particularly the spotted salamander, have larvae that are sensitive to low pH, there has been concern over the impact of acidic precipitation on their populations. For this reason, the neutral-to-alkaline pools may have special value to amphibians due to their potential resistance to precipitation-induced acidification. Alkaline pools would also be more likely to support rare plant species.

Human Uses

Many pools have been partially or entirely filled or drained to accommodate development or agricultural uses; some have been used as dump sites for stumps, brush, construction and demolition debris, or household garbage.

Sensitivities, Impacts

Because intermittent woodland pools are usually small, they are often overlooked by wetland regulatory agencies, and are easily filled or drained. Although many meet the federal jurisdictional criteria for wetlands, IWPs are too small (<5 ha [12.4 ac]) to be protected under the New York State Freshwater Wetlands Act. Woodland pools are vulnerable to application of pesticides for mosquito control; these materials vary in their toxicity to woodland pool fauna. The presence of fish (e.g., by release of domestic fish) reduces or precludes the successful reproduction of mole salamanders (spotted, Jefferson, and blue-spotted). Destruction of the surrounding forests will eliminate the non-breeding habitat for mole salamanders. Excessive nutrient input, e.g., from fertilizer in runoff, could be harmful to the plants and animals of woodland pools. Pools are sometimes destroyed or damaged by fill, drainage or channelization, excavation or damming to create ponds, and other construction. Old stone walls crossing or adjoining pools are not harmful and may provide shelter for small animals.



Four-toed salamander
(*Hemidactylium scutatum*)
5.1–8.9 cm (2–3.5 in)

Conservation and Management

Intermittent woodland pools and the surrounding forests should be preserved in an unaltered state wherever possible. Negative impacts noted above should be prevented or removed. If mosquitoes prove to be a problem in a particular pool, least-toxic methods should be used for control of larval mosquitoes. The insect growth regulator methoprene or the bacterium *Bacillus thuringiensis israelensis* (*Bti*) are preferable alternatives to broad-spectrum insecticides; however, methoprene and *Bti* need further testing for impacts on amphibians and nontarget invertebrates (*Bti* does affect certain other Diptera and methoprene affects many other insects as well as crustaceans). Artificial construction of intermittent woodland pools may be possible, given appropriate hydrological conditions, if care is taken to prevent contamination with soil and nutrients.

Examples on Public Access Lands

Norrie State Park (Town of Hyde Park) has many IWPs near the trails in the northwestern portions of the park (Kiviat and Stevens 1993). Clermont State Historic Site (Town of Clermont) also contains IWPs. The Breakneck Ridge unit of Hudson Highlands State Park (towns of Fishkill and Philipstown) has a few IWPs at high elevations close to the Breakneck Trail. Blue Mountain Reservation (Town of Cortlandt) has IWPs near the trails. The Ramshorn-Livingston Sanctuary (Town of Catskill) contains IWPs (Barbour and Kiviat 1994). The Black Creek Forest Preserve (Town of Lloyd) has numerous IWPs (Barbour 1998). The Young-Morse Historic Site has IWPs southwest of the big house.

References

Kiviat and Stevens (1993), Kiviat et al. (1994), Barbour (1995a, b, 1998).

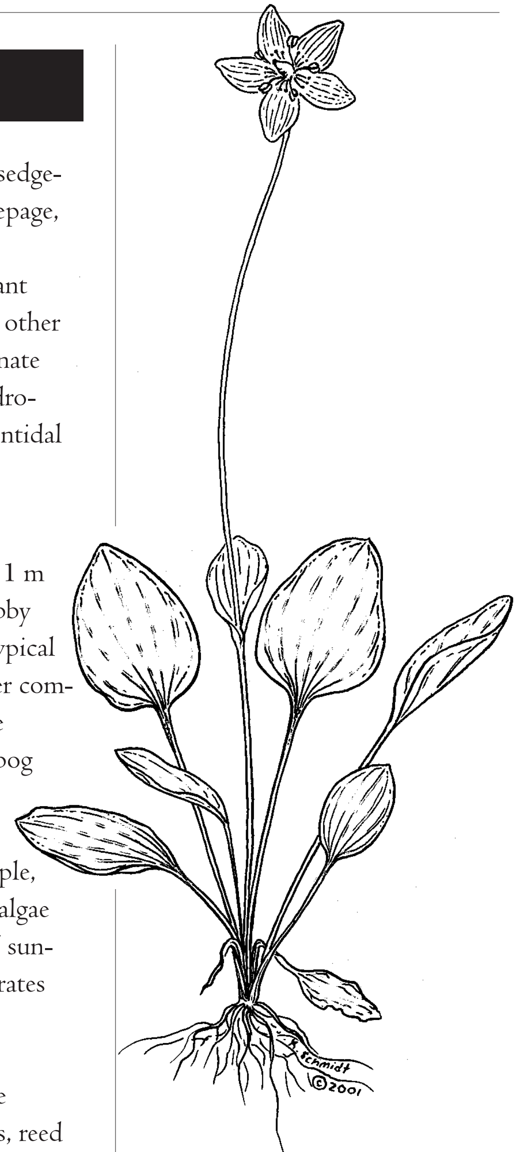
7.12 Fen and Calcareous Wet Meadow

THESE ARE OPEN (I.E., UNSHADED BY TREES), HERB-DOMINATED (usually sedge-dominated), calcareous, shallow wetlands. ***Fens*** are distinguished by groundwater seepage, and a "fen plant community" (see below), typically including shrubby cinquefoil. ***Calcareous wet meadows*** may have a variety of water sources, and a less specialized plant community. Fens and calcareous wet meadows occur where bedrock is limestone or other carbonate rock, or where the soils contain glacier-transported materials from carbonate rocks. These habitats support many rare plants and animals, and are sensitive to hydrological changes and pollution. Some wetlands are intermediate between fens and nontidal swamps or nontidal marshes.

Vegetation

Fens are characteristically dominated by low *Carex* sedges and shrubs (i.e., less than 1 m [3.3 ft], or even less than 0.5 m [1.6 ft] tall). The most characteristic shrub is shrubby cinquefoil; autumn willow and hoary willow are also typical of fens. Some of the typical sedges are sterile sedge, porcupine sedge, yellow sedge, and woolly-fruit sedge. Other commonly occurring fen plants include the cotton-grass *Eriophorum viridi-carinatum,* white beakrush, drooping bulrush, spike-muhly, creeping spikemoss, grass-of-Parnassus, bog goldenrod, Kalm's lobelia, swamp thistle, purple avens, red-osier dogwood, alder-leaf buckthorn, and tamarack. Peat mosses (*Sphagnum*) are often present but do not develop extensive cover. In addition, broadly tolerant wetland plants such as red maple, silky dogwood, alder, pussy willow, and poison sumac may be present. Charophyte algae (stoneworts) may be present in spring pools. Bog plants (e.g., leatherleaf, roundleaf sundew, pitcher-plant, snakemouth orchid) may occur sparingly in fens on raised substrates that presumably are out of contact with mineral-rich surface water.

Calcareous wet meadows are usually dominated by ordinary wet meadow plants (see Habitat Profile for Non-Calcareous Wet Meadow) such as tussock sedge, woolgrass, reed canary grass, or lakeside sedge, but also have some fen plants. Some lime-indicating (calcicolous) plants that are not, strictly speaking, fen plants may occur in calcareous wet meadows as well as fens (e.g., sweetflag, New York ironweed, spreading goldenrod, lakeside sedge, small-flowered agrimony).



Grass-of-Parnassus
(Parnassia glauca)
2–4 dm tall (8–16 in)

Fauna

Common wetland animals such as meadow vole, meadow jumping mouse, song sparrow, swamp sparrow, red-winged blackbird, green frog, pickerel frog, and many others occur in these habitats.

Indicators and Identification

Fens are identified by the groundwater seepage and abundance of characteristic fen plants (e.g., shrubby cinquefoil, yellow sedge, sterile sedge, porcupine sedge, grass-of-Parnassus). Calcareous wet meadows are identified by their wet meadow characteristics (see Habitat Profile for Non-calcareous Wet Meadow Habitat) and the presence (usually sparing) of plants such as shrubby cinquefoil, sweetflag, lakeside sedge, New York ironweed, spreading goldenrod, drooping bulrush, and yellow sedge.

Shrubby cinquefoil
(Potentilla fruticosa)
shrub to 1 m (3.3 ft) tall

Biodiversity Values

SPECIES OF CONSERVATION CONCERN. See Sect. 2.0 and App. 3 for rarity ranks.

	Federal Lists	National Lists	State Lists	Regional Lists
Plants				
slender lady's-tresses				•
nodding lady's-tresses				•
small flowered agrimony			•	
bog valerian			•	
Schweinitz's sedge			•	
handsome sedge			•	
ovate spikerush			•	
spreading globeflower			•	
swamp birch			•	
Indian paintbrush			•	
Kalm's lobelia				•
snakemouth orchid				•
grass-of-Parnassus				•
Invertebrates				
Gammarus pseudolimnaeus (amphipod)				•
Pomatiopsis lapidaria (snail)				•
eyed brown (butterfly)				•
two-spotted skipper (butterfly)				•
Dion skipper (butterfly)			•	
Baltimore (butterfly)				•
mulberry wing (butterfly)				•
black dash (butterfly)				•
Amphibians and Reptiles				
northern leopard frog				•
bog turtle	•		•	
spotted turtle			•	
ribbon snake				•
Birds				
sedge wren		•	•	

The most noteworthy rare species of fens and calcareous wet meadows is the bog turtle (see Species Profile). Sedge wren may nest in fens. Northern leopard frog occurs in fens east of the study area in New York and Massachusetts. Other regionally-rare species that use fens are spotted turtle, ribbon snake, and several butterflies (Dion skipper, two-spotted skipper, eyed brown). A rare snail, *Pomatiopsis lapidaria* (The Nature Conservancy, unpublished data) and a rare amphipod, *Gammarus pseudolimnaeus,* have been found in fens of western Massachusetts, and could occur in New York fens. Numerous rare insect species have been found in fens in western Massachusetts; the insect fauna of New York fens deserves further investigation.

Reschke (1990) recognized several fen communities; of those, only "rich sloping fen," "rich graminoid fen," and "rich shrub fen" are included in the habitats described in this profile. Calcareous examples of Reschke's "sedge meadow" would be included in the calcareous wet meadows of this profile. All fen communities are rare in the study area. Calcareous wet meadow communities are not necessarily rare, but information is scant.

Substrates

Fens occur on gentle slopes, in basins, or adjoining water bodies or other wetlands. Soils are hydric, and may be organic or mineral (but not clay), shallow or deep. Locally, small areas of these habitats occur on residual mineral materials such as calcareous gravel, probably where organic soils have been eroded or decomposed.

Surface Waters

Fens and some calcareous wet meadows have groundwater seepage or springs at their margins and sometimes in their interiors. Fens and calcareous wet meadows can also have pools or streams at the edges or in the interior, but these are generally small. The groundwater that feeds fens is "hard," (i.e., rich in calcium, magnesium, and iron), and the surface waters are cool. Fens typically have moderate to low nitrogen and phosphorus.

Extent

From a small fraction of a hectare to more than 50 hectares (0.02–125+ ac). Fens in the study area are few and small, although many fens occur not far outside the study area.

Distribution

Fens and probably most calcareous wet meadows are restricted to areas on or near calcareous bedrock, usually limestone, dolostone, and marble. These bedrock types are localized in the study area, e.g., just west of the Hudson River from Kingston north, in the Marlboro area (Ulster Co.), at Verplanck Point in Westchester Co., near Wappinger Creek in Dutchess Co., and southeast of the City of Hudson (Columbia Co.). Most fens and calcareous wet meadows are at low elevations. Fens are more widespread east and west of the study area in the Harlem Valley and in Orange Co.; many of the Orange Co. fens have been severely degraded by human land uses in recent decades.

Quality

Higher quality is associated with large extent, absence or rarity of invasive plants (e.g., purple loosestrife, common reed, reed canary grass), minimal cover of tall herbs, tall shrubs, or trees, an intact buffer zone with minimal impingement by intensive land uses, absence of landfills or dumps upstream or upgradient, and light or no livestock grazing.

Human Uses

Fens and calcareous wet meadows are sometimes used for hay production and livestock grazing. Calcareous wet meadows may sometimes be planted to other crops.

Sensitivities, Impacts

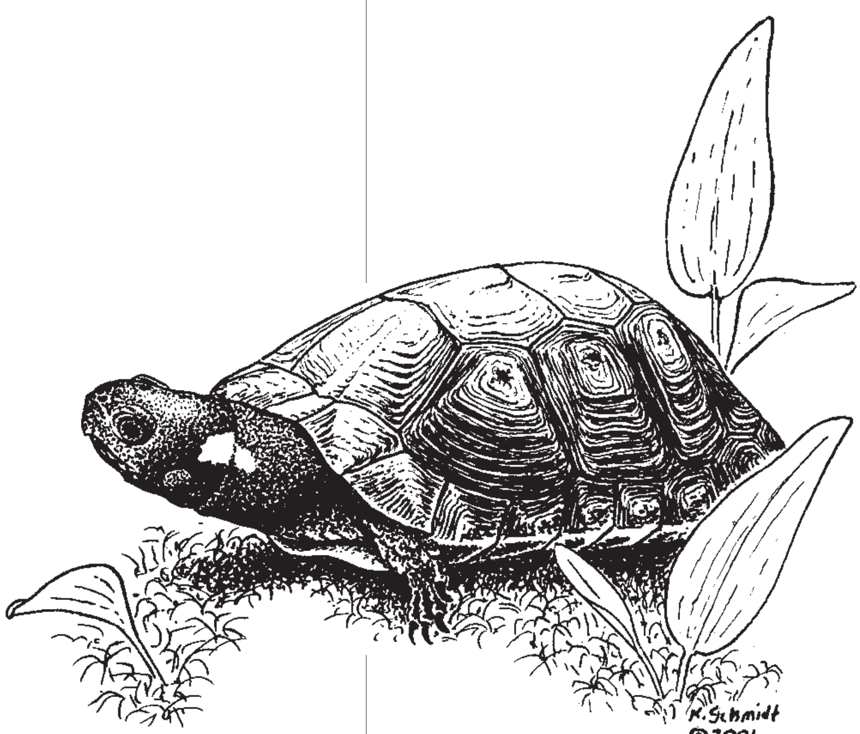
Fens are among the wetlands most sensitive to hydrological, physical, or chemical alteration. Any reduction of groundwater movement into fens (e.g., by altering topography or pumping groundwater upslope of the fen) can dry out the fen surface. Increasing surface water runoff into fens is likely to cause siltation and nutrient enrichment, and to alter the plant and animals communities that rely on the groundwater seepage regime. De-icing salts appear to favor purple loosestrife invasion in fens (Kiviat et al. 1998). Alteration of the fen surface (e.g., by road construction) also favors plant invasions. Calcareous wet meadows are less sensitive (depending on their biota) to environmental alterations. Fens can often tolerate light grazing (depending upon the biota), and calcareous wet meadows may tolerate light to moderate grazing. Mineral soil fens are more susceptible to invasive plants than organic soil fens (Kiviat et al. 1998).

Conservation and Management

Protection of water quality and quantity, and maintenance of buffer zones are most important to protection of high quality fen and calcareous wet meadow habitats. Establishment of conservation easements on lands surrounding fens may be an effective means of protecting fen habitats from a variety of offsite impacts.

Examples on Public Access Lands

We know of no fens on public access lands in the study area. A boardwalk crosses a small fen, surrounded by common reed stands, in Boyce Park (Town of Dover, Dutchess Co.) outside the study area.



Bog turtle
(Clemmys muhlenbergii)
carapace usually 7.6–8.9 cm (3–3.5 in)

7.13 Non-Calcareous Wet Meadow

THESE ARE WETLANDS WITH NON-CALCAREOUS SOILS AND GROUNDWATER, where the soil is saturated for part or all of the growing season, but only shallowly and briefly inundated, if at all, and which support predominantly herbaceous (non-woody) vegetation. Non-calcareous wet meadows are common in the study area. They occur where there is seepage, or accumulation of rainwater or runoff, on soils that are moderately to highly acidic. Wet meadows usually occur where there is (or was until recently) livestock grazing, mowing, hay cutting, recent abandonment of crops, or where woody vegetation has recently been cleared. Wet meadows also occur in beaver meadows (abandoned beaver ponds) and some partially drained marshes. Wet meadows are often associated with the margins of marshes or swamps. Small wet meadows also may occur on logging roads, on top of wetland fill, in openings such as treefall gaps in wooded swamps, and a variety of other settings.

The vegetation of non-calcareous wet meadows is often dominated by such species as reed canary grass, purple loosestrife, common reed, rice cutgrass, soft rush, woolgrass, Joe-Pye-weed, arrowleaf tearthumb, late goldenrod, tall hairy goldenrod, or some combination of these and other herbs. Sparse woody plants, such as red maple, red ash, silky dogwood, willows, or alder, may be present. Common animals of non-calcareous wet meadows include meadow vole, red-winged blackbird, American goldfinch, swamp sparrow, eastern garter snake, green frog, and pickerel frog.

Quality of non-calcareous wet meadows is generally better where invasive plants (purple loosestrife, common reed, reed canary grass, multiflora rose, etc.) are less abundant, although small amounts or mixed stands of these plants do not necessarily degrade the habitat. Low-intensity livestock grazing or hay cutting may be compatible with biodiversity conservation, depending on the kinds of rare or uncommon biota present (or potentially present).

Biodiversity values of non-calcareous wet meadows are poorly studied. In particular, we often do not know which species use non-calcareous compared to calcareous wet meadows. Therefore, our statements about rare species in non-calcareous wet meadows are tentative. Southern bog lemming, a secretive and puzzling small vole, may occur where there are certain rushes or sedges for food. More extensive non-calcareous wet meadows could be breeding habitat for grassland or wetland birds; Henslow's sparrow and sedge wren are possibilities. Wet meadows with marshy spots or pools may support Virginia rail at any time of year. American woodcock, a declining species, uses wet meadows for courtship display areas and possibly for foraging. Rare butterflies of wet meadows are associated with larval food plants such as blue flag, sedges, and grasses, or nectar plants such as swamp milkweed. Ribbon snake and spotted turtle are possibilities.

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American woodcock
(Philohela minor)
28 cm (11 in)

SPECIES OF CONSERVATION CONCERN. See Sect. 2.0 and App. 3 for rarity ranks.

	National Lists	State Lists	Regional Lists
Invertebrates			
mulberry wing (butterfly)			•
black dash (butterfly)			•
two-spotted skipper (butterfly)			•
meadow fritillary (butterfly)			•
Baltimore (butterfly)			•
Milbert's tortoiseshell (butterfly)			•
eyed brown (butterfly)			•
Amphibians and Reptiles			
ribbon snake			•
spotted turtle		•	
Birds			
Virginia rail			•
American woodcock			•
sedge wren	•	•	
Henslow's sparrow	•	•	
Mammals			
southern bog lemming			•

Reschke's (1990) "sedge meadow" and the driest examples of her "shallow emergent marsh" communities are included in this habitat.

Southern bog lemming
(Synaptomys cooperi)
head and body 8.6–11.2 cm (3–4 in)

7.14 Kettle Shrub Pool

Kettle shrub pools are deep-flooding, seasonal, shrub-dominated wetlands on glacial outwash, originally formed by the melting of stranded blocks of glacial ice. Kettle shrub pools are a subset of Nontidal Hardwood Swamps and also resemble Intermittent Woodland Pools (see Habitat Profiles). We accord them a separate profile because of their importance to the threatened Blanding's turtle in Dutchess Co.

Vegetation

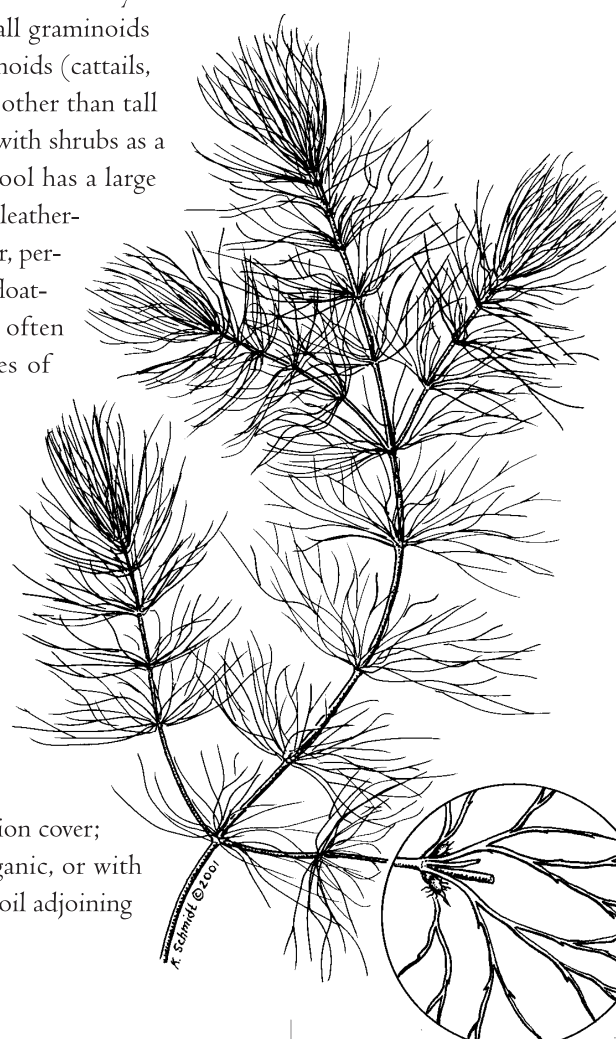
Usually dominated by tall swamp shrubs. Buttonbush strongly dominates many pools, but shrubby willows, highbush blueberry, red maple, purple loosestrife, and other species may co-dominate or be present as significant secondary species. Shrubs (and purple loosestrife) are usually 1.5-2.5 m (5-8 ft) tall. Small trees or sparse large trees (e.g., red maple, red ash) may be present in the wetland interior but rarely cast appreciable shade; often these trees are unhealthy or damaged. A few pools have substantial patches of swamp forest in addition to large areas of shrub thicket. Moderate to large size hardwood trees almost always form a fringe around the margin of the pool. Low forbs and a few small graminoids may be present, but tall forbs (e.g., Joe-Pye-weeds) and tall graminoids (cattails, tall sedges) are rare. Occasionally a pool is dominated by plants other than tall shrubs. One pool in the Town of La Grange is cattail-dominated with shrubs as a substantial minority component, and a Town of East Fishkill pool has a large patch of buttonbush and a large patch of mixed tussock sedge and leatherleaf. Spatterdock and submergent aquatic plants may occur in deeper, permanent or semipermanent water within the pools. Duckweeds and floating liverworts, along with other living or dead plant material, often abound on the water surface. Mosses are abundant on the bases of woody plants.

Fauna

Common animals include northern water snake, green frog, pickerel frog, spotted salamander, gray catbird, red-winged blackbird, American goldfinch, and muskrat. Eastern painted turtle and snapping turtle may be present at low or moderate densities. Fishes are usually absent but species such as grass pickerel may occur where kettle shrub pools are on floodplains of larger streams or are connected to other water bodies by small streams.

Indicators and Identification

Tall shrubs (especially buttonbush) comprising substantial vegetation cover; seasonal or permanent water 0.3-1+ m (1-3+ ft) deep; soil organic, or with a deep organic surface layer; and Hoosic or other glacial outwash soil adjoining or nearby.



Spiny coontail

(Ceratophyllum echinatum)

leaves 1–3 cm (0.4–1.2 in)

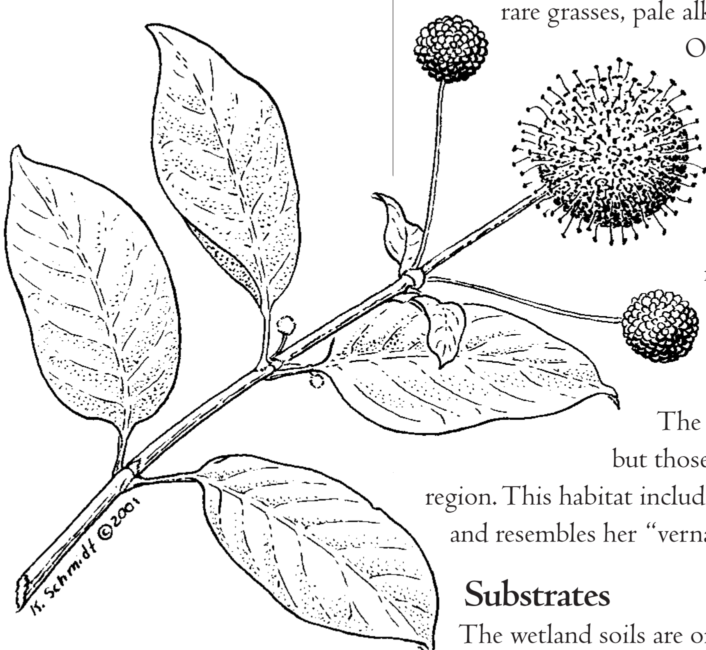
Biodiversity Values

SPECIES OF CONSERVATION CONCERN. See Sect. 2.0 and App. 3 for rarity ranks.	National Lists	State Lists	Regional Lists
Plants			
Helodium paludosum (moss)			•
pale alkali-grass			•
short-awn foxtail			•
spiny coontail		•	
buttonbush dodder		•	
Amphibians and Reptiles			
blue-spotted salamander		•	
Blanding's turtle		•	
spotted turtle		•	
ribbon snake			•
Birds			
wood duck			•
American black duck	•		•

Spiny coontail frequently occurs in kettle shrub pools. We have also found two regionally-rare grasses, pale alkali grass and short-awn foxtail, and the moss *Helodium paludosum*. One should look for buttonbush dodder.

Kettle shrub pools are part of the critical habitat for Blanding's turtle (see Species Profile). Spotted turtle is also common in these pools and ribbon snake may be a frequent user. Blue-spotted salamander probably breeds in a few pools. American black duck (declining) and wood duck (vulnerable) use kettle shrub pools for foraging and probably brood-rearing. Buttonbush is attractive to insects and could support rare species.

The communities of Kettle Shrub Pools do not appear to be rare, but those with hyper-dominant stands of buttonbush are scarce in the region. This habitat includes Reschke's (1990) more general "shrub swamp" community, and resembles her "vernal pool" community in some respects.



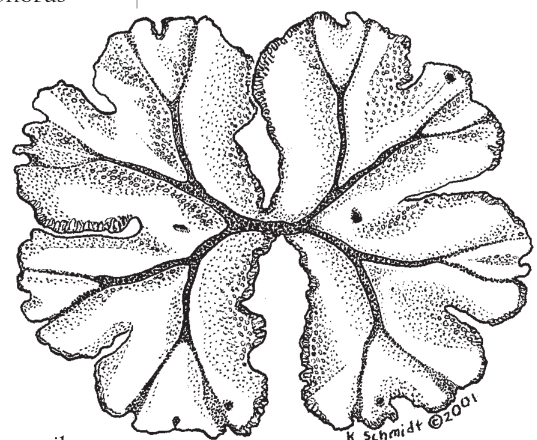
Buttonbush
(Cephalanthus occidentalis)
flower heads 3 cm (1.2 in)

Substrates

The wetland soils are organic (e.g., Palms muck) or silt loam soils with an organic surface layer (e.g., Sun or Wayland silt loams). Glacial outwash soils, e.g., Hoosic gravelly loam, are adjacent to the pools or nearby. Most or all of these pools have formed in glacial kettle holes; these are depressions remaining where blocks of ice were buried by water-deposited materials from the melting glacier. Some kettle shrub pools are underlain by marl (highly alkaline, biologically-precipitated calcium carbonate) beneath the organic layer.

Surface Waters

Inlet and outlet streams are small or absent; there is usually little throughflow. Hydroperiod (duration of standing water) ranges from about 5 to 12 months. The seasonal pools are flooded in winter and early spring. Maximum water depths are about 1 m (3.3 ft) in the deeper pools (occasionally there are deeper "holes"). Groundwater discharges into the periphery of typical pools; we do not know if this is a universal feature. Pools we have studied in the Town of La Grange appear to have abundant groundwater seepage or springs. The groundwater in these pools is alkaline and has moderately low phosphorus and nitrogen levels, but we do not know if these conditions pertain elsewhere.



Ricciocarpus natans
(a floating liverwort)
thalli 2–3 cm (0.8–1.2 in)

Extent

From approximately 0.04 to 7 ha (0.1 to 17 ac). Some of the larger pools are actually complexes of connected smaller pools. Most are less than 0.2 ha (0.5 ac).

Distribution

Widespread but uncommon at low elevations in Dutchess Co.. Distribution poorly known elsewhere in the study area (glacial outwash is generally less extensive in other counties).

Quality

Quality for Blanding's turtle is discussed in the Species Profile. Quality is not necessarily related to pool size, depth, or vegetation. It should be assessed in relation to the site-specific biota. Filling, dumping, siltation, and nutrient pollution degrade quality. Presence of fish reduces quality for amphibians. The impacts of purple loosestrife on these habitats is poorly understood.

Human Uses

Many kettle shrub pools have been partly or entirely filled, dumped in, partially drained, dammed to create ponds, or dredged (possibly as sources of peat for horticultural use).

Sensitivities, Impacts

Dumping, draining, and damming of kettles, and removal of the tree fringe can degrade the habitat for sensitive animal species such as the Blanding's turtle. Kettle shrub pools may produce mosquitoes; thus, pesticide use for mosquito control is a potential threat. Construction of buildings or infrastructure close to pools may have adverse impacts on habitat quality for Blanding's turtle or other species.

Conservation and Management

In the Hudson Valley, Blanding's turtle occurs only in the western 2/3 of Dutchess County. Kettle shrub pools and nearby wetlands and ponds in Dutchess Co. (except the eastern tier of towns) should be surveyed for Blanding's turtle before management decisions are made. If Blanding's turtles are known to use pools, expert advice should be sought. Wetlands used by Blanding's turtle will be considered Class I wetlands by NYSDEC. Within 1 km of a kettle used by Blanding's turtle, any wetlands and any non-forested uplands on Hoosic gravelly loam soils should be treated as potential Blanding's turtle habitat. Potential movement corridors between these habitats should be preserved, and special measures should be implemented to protect Blanding's turtles during their seasonal migrations between habitats.

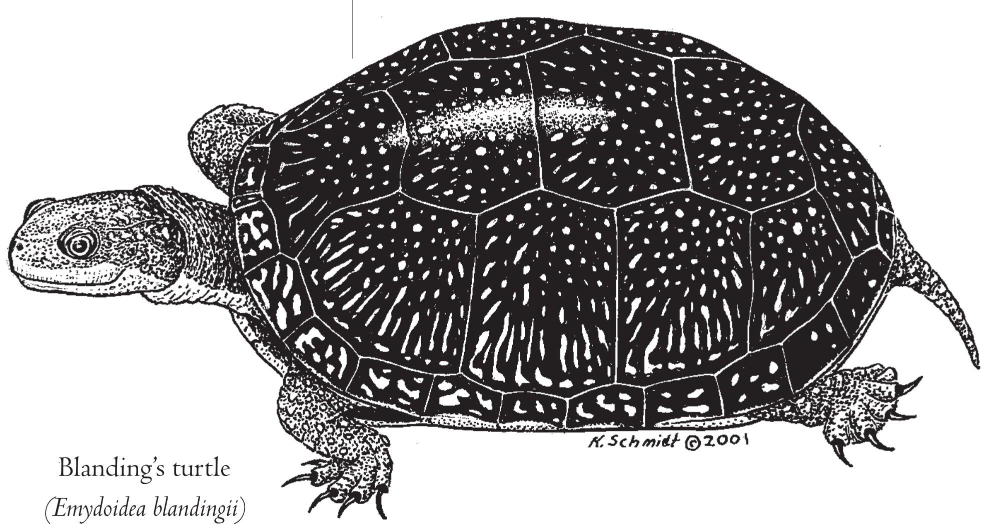
If Blanding's turtles are not detected using a particular kettle shrub pool (or nearby wetlands and ponds), the pool should be treated as potential future habitat for Blanding's turtles, and as habitat for the other biota mentioned above. Mosquito control should be implemented only when necessary, and should use least-toxic materials. Conservation easements may be an effective means of protecting not only the kettle shrub pools, but the entire wetland and upland complex that comprise the habitat for the local Blanding's turtle population.

Examples on Public Access Lands

There are small buttonbush pools in the Town of La Grange recreation area on Stringham Road (partly filled), in the Town of Wappinger Recreation Area on Robinson Lane, and next to the entrance road of Val Kill (Eleanor Roosevelt National Historic Site, Town of Hyde Park).

References

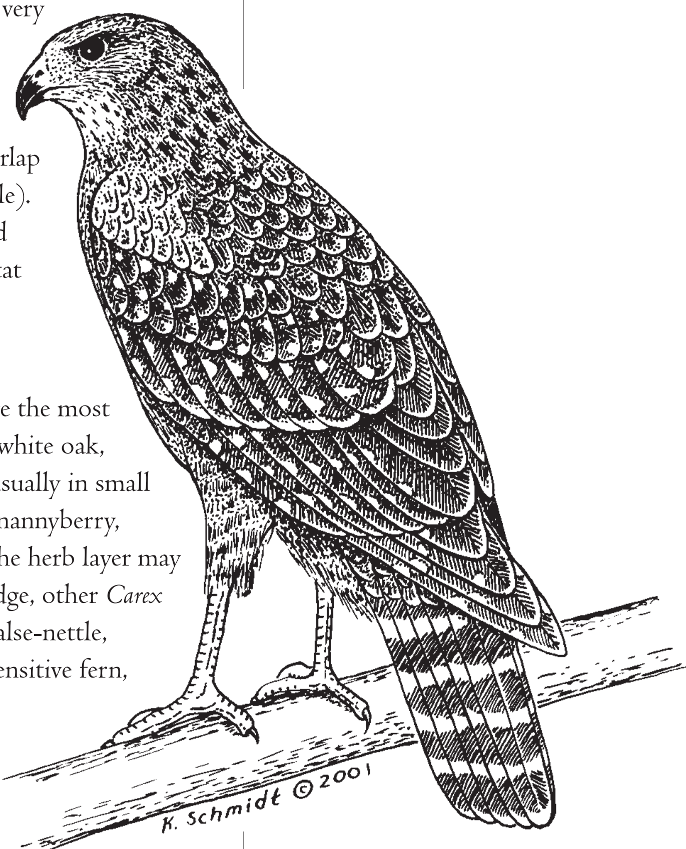
Kiviat (1993, 1997b).



Blanding's turtle
(Emydoidea blandingii)
carapace to 25 cm (10 in)

7.15 Nontidal Hardwood Swamp

IN PREVALENT NORTH AMERICAN USAGE, "swamp" is wetland dominated by trees or shrubs. Tree-dominated wetlands are also called "wooded" or "treed" wetlands, and shrub-dominated wetlands are sometimes called "scrub-shrub" wetland or "carr." Nontidal hardwood swamps are fairly common in the study area; conifer swamps are very rare, very different ecologically, and very important for biodiversity. This habitat profile covers hardwood and shrub-dominated nontidal wetlands except "Kettle Shrub Pool," which is covered by a separate profile because of its importance to Blanding's turtle. There is some overlap between Nontidal Swamps and certain Beaver Ponds (see Habitat Profile). Small nontidal swamps that flood deeply in winter and spring are called Intermittent Woodland Pools and are also treated separately (see Habitat Profile).



Red-shouldered hawk
(Buteo lineatus)
43–60 cm (17–24 in)

Vegetation

Tree or shrub canopy may be closed or open. Red maple and red ash are the most common dominant trees. American elm, slippery elm, pin oak, swamp white oak, white pine, hemlock, tupelo, black ash, or black birch may be present, usually in small numbers. Common tall swamp shrubs are silky dogwood, arrowwood, nannyberry, spicebush, highbush blueberry, winterberry, swamp azalea, and alder. The herb layer may be well-developed or sparse. Common swamp herbs include tussock sedge, other *Carex* sedges, fowl meadow grass, wood reedgrass, skunk-cabbage, blue flag, false-nettle, marsh-marigold, purple loosestrife, violets, bur-marigolds, royal fern, sensitive fern, and cinnamon fern.

Certain common plants (red maple, highbush blueberry, tussock sedge, purple loosestrife) form root crowns elevated 15-60+ cm (6-24+ in) above the substrate and 15-200+ cm (6-80+ in) in diameter. Formation of these pedestals (also called hummocks or tussocks) is more pronounced where water levels fluctuate and in wetter swamps. The tops of pedestals are generally near the springtime high water level. The pedestals apparently act as breathing organs, and also support many plants and animals on their tops, sides and within that cannot grow or persist directly on the swamp floor.

Fauna

Common animals of nontidal swamps include white-footed mouse, raccoon, red-winged blackbird, swamp sparrow, and green frog. Larger live or dead trees often contain cavities used by bats, owls, woodpeckers, eastern bluebird, gray treefrog, and other cavity-using animals.

Indicators and Identification

Wetland trees or shrubs are prominent, usually red maple, red ash, pin oak, swamp white oak, silky dogwood, nannyberry, northern arrowwood, alder, swamp azalea, spicebush, or winterberry, or some combination of these typical swamp plants. Soils are saturated or flooded for at least part of growing season.

Biodiversity Values

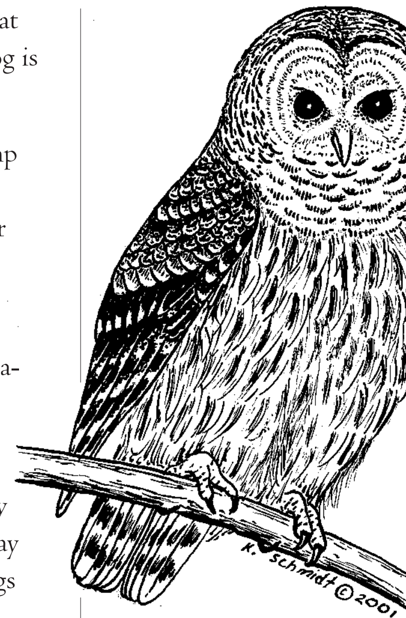
SPECIES OF CONSERVATION CONCERN. See Sect. 2.0 and App. 3 for rarity ranks.

	National Lists	State Lists	Regional Lists
Plants			
swamp cottonwood		•	
ostrich fern			•
Amphibians and Reptiles			
blue-spotted salamander		•	
four-toed salamander			•
northern leopard frog			•
spotted turtle		•	
wood turtle		•	
Birds			
great blue heron			•
wood duck			•
red-shouldered hawk	•	•	
American woodcock			•
barred owl			•
white-eyed vireo			•
eastern bluebird			•
prothonotary warbler	•	•	
Canada warbler	•		•

Swamp cottonwood is known from two hardwood swamps in the study area. Ostrich fern is occasionally found in hardwood swamps. Swamps with unusual species composition (e.g., an abundance of swamp azalea, maleberry, pin oak, swamp white oak, tupelo, beaked hazel or American hazel) may be especially worthy of conservation. Some calcareous swamps, especially where the canopy is open, may support rare fen plants or animals.

Red-shouldered hawk is quite rare as a breeding bird in our region, and requires extensive mature forest and swamp with areas of large trees. Barred owl also breeds in this habitat complex, especially if there are groves of mature or pole-size conifers. Great blue heron breeding colonies (breeding colonies are regionally-rare although the species *per se* is not) are usually in larger dead trees in nontidal swamps; extensive swamps afford these birds the isolation from humans required during the nesting season. Wood duck nests in cavities (or constructed boxes) in and near wooded swamps. American woodcock forages at swamp edges, where the soil is moist but not saturated. White-eyed vireo, Canada warbler, and prothonotary warbler are possibilities. Spotted turtle may occur, and wood turtle occasionally uses nontidal swamps. Lowland swamps with a small stream channel may support breeding populations of blue-spotted salamander. Four-toed salamander may be present in and at edges of swamps with mossy hummocks and mossy rotting logs. Northern leopard frog is a possibility, especially northward.

Reschke's (1990) "red maple–hardwood swamp," "silver maple–ash swamp," and swamp communities of the "floodplain forest" are included in this habitat type. "Red maple–tamarack peat swamp" would also be included, but may not occur in the Hudson River corridor.



Barred owl
(Strix varia)
43–60 cm (17–24 in)

Substrates
Soils are organic or mineral, shallow or deep. Surface soils range from permanent saturation or inundation, to short-duration saturation (usually winter and early spring)

Surface Waters
Swamps may be inundated throughout, may contain only small streams or pools, or may border larger streams, ponds, or lakes. The swamp floor (outside any stream channel) may flood with standing water seasonally, occasionally after heavy rains, or not at all. Springs or seeps (groundwater discharge) may be present within or at the edges of swamps.

Extent
From a small fraction of a hectare to more than 50 hectares (0.12 – >125 ac).

Distribution
Widespread longitudinally although more extensive in areas of lower human population density. Much more common and extensive at lower elevations.

Quality
Generally, better quality is indicated by greater extent, larger trees, more large downwood in swamp, and less intensive land use around swamp margins. Swamps not dominated by red maple, the most common swamp tree species in the study area, may be of better quality (other things equal). Large mats of floating filamentous algae that cover pools for long periods each year indicate overfertilization from external sources.

Human Uses
Agriculture, logging, dumping, creation of ponds. Historically, many of our nontidal swamps were drained and cleared for agriculture and for malaria control. Old drainage ditches are sometimes visible on aerial photographs or in the field.

Sensitivities, Impacts
As with other types of wetlands, swamps are often affected by filling, dumping, damming, or excavation (to create ponds), siltation, pollution (e.g., from road or agricultural runoff), and alteration of vegetation (e.g., logging), as well as drainage. Upstream changes in water quantity or quality, due to urbanization, agriculture, or other factors, can have important impacts. Despite federal, state, and (in some municipalities) local wetland laws, alteration of wetlands still occurs, albeit at a smaller scale than previously. A wetland permit is not required for selective logging of swamps, even though the ecological damage from logging may be great. Wetland protection laws often do not protect adequate ecological buffer zones around wetlands; the 30 m (100 ft) "adjacent area" mandated by the State Freshwater Wetlands Act is helpful but often insufficient to maintain wetland biodiversity. Whether a particular wetland has higher biodiversity values as an herb-dominated or woody plant-dominated wetland depends on the environmental setting and the species that use (or might use) the wetland.

Conservation and Management

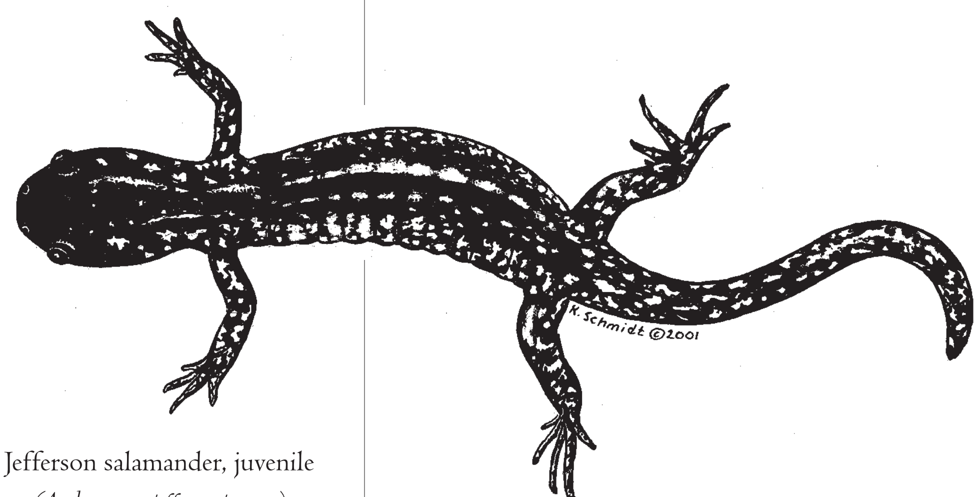
Logging or other intensive disturbance could be prohibited in nontidal swamps known to support rare plants or animals. Swamp management should consider the maintenance of water quality and quantity, and the hydropatterns (the patterns of water levels and water flows) upon which wetland organisms depend. Swamp extent and the adequacy of buffer zones should also be considered on a site-specific basis. Buffer zones should be large enough to include the upland non-breeding habitats of amphibians, the upland nesting areas of turtles, or other combinations of habitats used by animals. Buffer zones will also help to reduce noise, visual disturbance, pollution, siltation, invasive plants, and microclimatic alteration that may degrade habitat for rare and common biota.

Examples on Public Access Lands

The Great Swamp on the Stewart Airport Buffer Lands (Orange Co.) is visible on the south side of Interstate Highway 84. Snyder Swamp is part of Ferncliff Forest, a Town of Rhinebeck reserve. Jobsen Swamp (Town of Rhinebeck) is owned by the Nature Conservancy (access permission is required). A small swamp on the Burroughs Sanctuary, the "Celery Swamp," (Town of Esopus) was cultivated by John Burroughs and has reverted to natural vegetation. The Great Vly Wildlife Management Area (towns of Saugerties and Catskill) includes areas of calcareous shrub swamp. Several hardwood swamps occur in Bear Mountain and Harriman state parks. A spectacular, very extensive, swamp complex outside the study area is the Great Swamp of northeastern Putnam Co. and southeastern Dutchess Co.; information on public access is available from the Nature Conservancy in Pawling.

References

Golet et al. (1993), Kiviat et al. (1994).



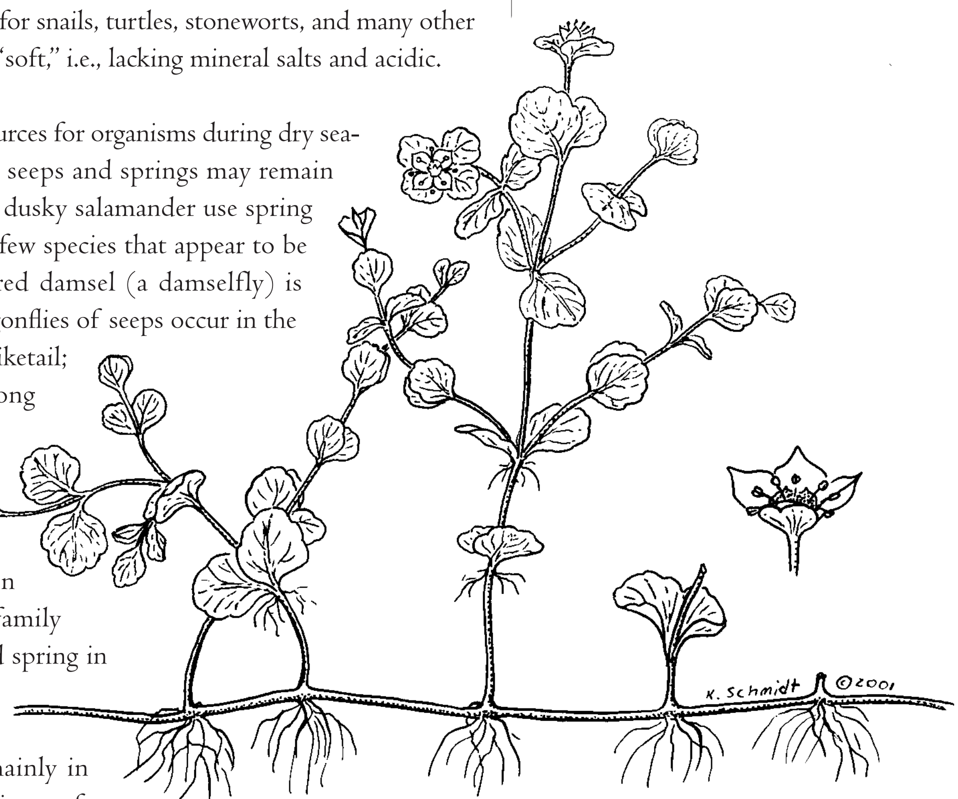
Jefferson salamander, juvenile
(Ambystoma jeffersonianum)
adult 11–18 cm (4.3–7 in)

7.16 Springs and Seeps

SEEPS AND SPRINGS ARE PLACES WHERE GROUNDWATER DISCHARGES to the ground surface. Springs are concentrated discharges and seeps are diffuse discharges. Springs and seeps may discharge inconspicuously at the bottom of a pond or pool, or they may discharge visibly from upland soil or bedrock. Springs and seeps often emerge at the base of a ledge or slope, or at the edge of a wetland, stream, or pond. Groundwater discharges at mean annual temperature of about 10–13° C (50–55° F) in our region, thus springs and seeps are warmer than their surroundings in winter and cooler in summer. In winter, springs and seeps can sometimes be spotted easily where they melt the surrounding snow or ice. Discharge of pond-bottom springs creates melted or black "stars" in the ice on the pond surface. Throughout the year, pond-bottom springs may create a slight current, causing submergent vegetation to trail away from the spring or to gently waft back and forth. Springs may also be detected in summer by cooler spots in a pond or a small cool area upland, e.g., at the base of a cliff.

Groundwater discharge points are much more important than their size suggests. Groundwater discharge helps keep streams cool in summer, and may prevent mortality of coldwater fishes, such as brook trout, in hot, dry spells. Groundwater is often rich in minerals, especially where it issues from carbonate bedrock or carbonate-rich glacial deposits. Such groundwater is "hard" because of dissolved calcium, magnesium, and iron salts. Inflow of hard groundwater is important for the maintenance of characteristic chemistry in Fens, Kettle Shrub Pools, and certain other wetlands and waters (see Habitat Profiles). Because some organisms have high requirements for, or tolerances of, calcium and other cations, groundwater discharge habitats are important for snails, turtles, stoneworts, and many other animals and plants. Spring water can also be "soft," i.e., lacking mineral salts and acidic.

Springs and seeps provide important water sources for organisms during dry seasons and droughts, and during winter when seeps and springs may remain free of ice. Spring salamander and northern dusky salamander use spring habitats as well as cold streams. There are a few species that appear to be restricted to spring habitats. The eastern red damsel (a damselfly) is restricted to open, grassy seeps. Two rare dragonflies of seeps occur in the study area: the gray petaltail and the tiger spiketail; the latter inhabits spring runs below strong perennial springs (Ken Soltesz, personal communication). The Piedmont groundwater amphipod, documented in Massachusetts (Smith 1988), could occur in the study area. An uncommon phantom midge, *Eucorethra underwoodi* (subfamily Chaoborinae), was reported from a very cold spring in the Northern Shawangunk Mountains (Smiley & Huth 1984). A small plant, golden saxifrage, is not rare but seems to occur mainly in spring pools or in groundwater-fed portions of swamps. Calcareous springs often have stoneworts (Characeae), but these have not been well-studied in the Hudson River corridor.



Golden saxifrage
(Chrysosplenium americanum)
stems 5–20 cm (2–8 in)

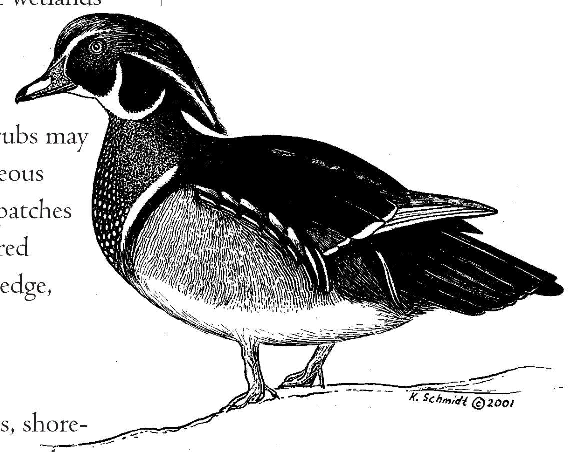
SPECIES OF CONSERVATION CONCERN. See Sect. 2.0 and App. 3 for rarity ranks.	State Lists	Regional Lists
Invertebrates		
Piedmont groundwater amphipod		•
gray petaltail (dragonfly)	•	
tiger spiketail (dragonfly)	•	
Amphibians and Reptiles		
mountain dusky salamander		•
northern dusky salamander		•
spring salamander		•

Many springs have been modified for water supply: small basins, excavated or masonry-built, with channelized runoff and covered with spring houses. In many areas, groundwater has been polluted, or drawn-down by pumping for water supply, affecting the quality or quantity of water issuing from seeps and springs.

Reschke (1990) does not describe these habitats, but mentions that springs are sometimes present in or adjoining "rocky headwater stream ," "marsh headwater stream," and the rich fen communities.

7.17 Beaver Pond

BEAVER PONDS ARE CREATED BY BEAVERS BUILDING DAMS across small to medium-size perennial streams. Beaver ponds flood portions of the riparian area for a few years or sometimes longer. During that time, the beavers cut trees near the water, build lodges of sticks and mud in the pond or on the banks, dig burrows in the banks, and often dig short canals through the shallows of the pond or back into the forest. The pond accumulates silt, organic matter, and nutrients. Eventually the beavers die or leave the pond, the dam deteriorates, and the water level of the pond draws down, leaving a beaver meadow—a silty marsh or wet meadow. Beaver ponds and beaver meadows are different from surrounding habitats and are used by many other animals and plants. This profile covers active and abandoned beaver ponds and beaver meadows in nontidal environments. Beaver activities in tidal environments of the Hudson River are excluded (see Tidal Swamp profile). Lakes or wetlands inhabited by beaver, but of origin other than beaver dams, are also excluded.



Wood duck (*Aix sponsa*)
43–51 cm (17–20.5 in)

Vegetation

Area surrounding pond is at least partly wooded, and live or dead trees and shrubs may stand in the pond itself. In addition, submerged, floating, and emergent herbaceous plants are present to a variable degree, often limited to pond margins or small patches within the pond. Common plants in and at the edges of beaver ponds include red maple, quaking aspen, alder, cattail, common reed, purple loosestrife, tussock sedge, woolgrass, bur-reeds, spatterdock, and fragrant pond-lily.

Fauna

Muskrat, mink, river otter, raccoon, tree swallow, water birds (waterfowl, herons, shorebirds, belted kingfisher), northern water snake, eastern painted turtle, snapping turtle, green frog, pickerel frog, bullfrog, a variety of common fishes, and many invertebrates use beaver ponds. Cavity-making and cavity-using birds and small mammals are attracted to dead and dying trees in beaver ponds and meadows.

Indicators and Identification

Defined and identified by the presence of an active or abandoned beaver dam on a stream. A beaver dam comprises sticks approximately 2-7 cm (0.8-2.8 in) in diameter and 0.5-2 m (1.6-6.6 ft) long, mud, small rocks, and other materials; most of the sticks have sharpened, conical ends with numerous 8 mm (0.3 in) wide teethmarks like little axe-marks.

Biodiversity Values

SPECIES OF CONSERVATION CONCERN. See Sect. 2.0 and App. 3 for rarity ranks.

	Federal Lists	National Lists	State Lists	Regional Lists
Plants				
spiny coontail			•	
Invertebrates				
phantom cranefly				•
beaverpond baskettail (dragonfly)				•
Amphibians and Reptiles				
Blanding's turtle			•	
bog turtle	•		•	
spotted turtle			•	
wood turtle			•	
ribbon snake				•
Birds				
great blue heron				•
wood duck				•
American black duck		•		•
osprey			•	
eastern bluebird				•
Mammals				
river otter				•

Little is known about rare plants in beaver ponds and meadows in our region. We have found spiny coontail in a calcareous beaver pond, and would expect to find various fen plants in calcareous beaver meadows where vegetation is not too tall and dense.

River otter may use beaver ponds and abandoned beaver lodges and burrows. Dead or dying trees in beaver ponds may support great blue heron nesting colonies. Beaver ponds are attractive to American black duck and wood duck, both in breeding and nonbreeding seasons. Osprey may forage in beaver ponds. Drawn-down (abandoned) beaver ponds may be excellent foraging habitat for migrant shorebirds of several species. Eastern bluebird may nest over water in beaver ponds (Kiviat 1982). Wood turtle and spotted turtle probably use beaver ponds extensively. Blanding's turtle may use beaver ponds, but probably not as a primary habitat. Bog turtle may use calcareous beaver meadows, but the high fertility of this habitat would tend to cause rapid overgrowth by tall vegetation unfavorable to bog turtle. We expect ribbon snake to occur at beaver ponds and meadows in calcareous areas. The beaverpond baskettail (dragonfly) is scarce, especially in the southern portions of the corridor where beaver ponds are scarce (Ken Soltesz, personal communication). Phantom cranefly (Sect. 9.4) probably occurs in beaver meadows, at least in calcareous areas. A variety of fen biota would be expected to occur in calcareous beaver meadows during early stages of vegetation development when low sedges and other low-growing plants (< 1 m [3.3 ft] tall) predominate.

Beaver ponds and beaver meadows may include Reschke's (1990) "shallow emergent marsh," "deep emergent marsh," "shrub swamp," "marsh headwater stream," "oligotrophic pond," and "eutrophic pond." Fen communities may occur in calcareous beaver meadows.

Substrates

The pond bottom is most often silty. Organic soils may be present from pre-existing wetlands.

Surface Waters

Beaver ponds are built on perennial streams. Water is impounded to depths of 1–2 m (3–6 ft) while beaver dams are intact. After dams are breached, surface water is reduced to a perennial stream, often with small, braided tributaries.

Extent

From less than 0.1 ha to 2 or more ha (0.2–5+ ac). Often a series of small ponds is impounded by multiple dams within 100 m (330 ft) or so of each other along a stream.

Distribution

Widespread in the study area, except in areas of high human population density where beaver ponds are usually drained to prevent damage to roads, yards, and ornamental trees.

Quality

Beaver ponds and meadows that are larger, farther from intensive human land uses, and on streams with better water quality would be expected to be more important to biodiversity, but smaller ponds and urban-fringe ponds may be locally important where other water bodies are scarce or damaged. Beaver meadows sometimes become colonized rapidly by dense stands of common reed, which may lower the biodiversity value of the meadows.

Human Uses

Beaver ponds figure prominently in waterfowl hunting, fur trapping, fishing, bird watching, and non-motorized boating.

Sensitivities, Impacts

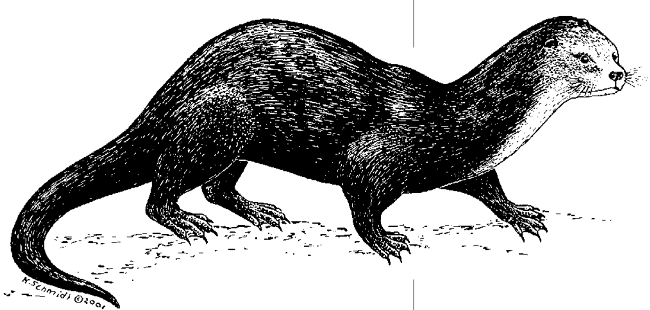
Highway departments and land owners often remove beaver dams or kill beaver to lower water levels in beaver ponds where damage is occurring to highways, ornamental plants, specimen trees, timber trees, or agricultural lands.

Conservation and Management

We recommend protection of beaver habitats for their natural duration wherever possible, because they support a great variety of native animal species, and have long been integral to the development of the northeastern ecological landscape. Beaver are protected by law in New York with open and closed seasons and prescribed methods of take; landowners may apply to NYSDEC to control nuisance beaver. Occasionally it may be desirable to remove beaver to protect unusual habitats such as bog turtle fens or old growth riparian forests. Various devices and techniques have been developed to prevent beaver colonization of stream segments, or to allow lowering of water levels in beaver ponds: exclusion devices around culverts and drains, drainpipes through dams, artificial scent mounds, trapping and removal of beaver (Hammerson 1994). The success of these devices is variable, and much experimentation may be needed to solve flooding problems due to beaver. Successful use of certain devices may allow adequate regulation of beaver pond water levels without removing the beaver.

Examples on Public Access Lands

Beaver ponds and meadows may be seen in Bear Mountain and Harriman State Parks and probably many other public areas.



River otter *(Lutra canadensis)*
total length 1–1.2 m (3.3–3.9 in)

7.18 Circumneutral Bog Lake

THESE ARE CALCAREOUS SPRING-FED WATER BODIES with deep, organic substrates, and supporting vegetation of both acidic bogs and calcareous marshes. Floating peat mats and rafts are often present. These lakes are often aesthetically attractive because of their clear water, interspersion of water and emergent vegetation, and abundance of pond-lilies. Circumneutral bog lakes contain a variety of habitats for rare and uncommon species.

Vegetation

Deeper open water may be dominated by pondweeds and common coontail. Shallower open water typically has large expanses of pond-lily beds (*Nymphaea odorata, Nuphar advena*). Still shallower water may have softstem bulrush and hardstem bulrush. Floating mats often dominated by water-willow or cattails; purple loosestrife, water-willow, alder, leatherleaf, or peat mosses (*Sphagnum*) may dominate shoreline areas. A moat between the floating mat and the shore often has little vegetation. Hummocky red maple swamps may occur along the shores or in shallow coves. Vegetation of a Circumneutral Bog Lake outside the corridor was described by Kiviat and Zeising (1976).

Fauna

Typical animals include muskrat, beaver, red-winged blackbird, swamp sparrow, eastern painted turtle, pickerel frog, largemouth bass, chain pickerel. The game fish and pan fish community may have low biomass, probably due to a sparse benthic macroinvertebrate food base (R.E. Schmidt, personal communication).

Indicators and Identification

Oval, circular, or complex pond or lake in calcareous bedrock terrain, with clear water, pond-lily beds, and usually with floating mats and peat rafting in summer. Multiple lakes may be interconnected.

Biodiversity Values

SPECIES OF CONSERVATION CONCERN. See Sect. 2.0 and App. 3 for rarity ranks.

	Federal Lists	National Lists	State Lists	Regional Lists
Plants				
ovate spikerush			•	
floating bladderwort			•	
hidden-fruit bladderwort			•	
inflated bladderwort			•	
spotted pondweed			•	
water-thread pondweed			•	
prairie sedge				•
twig-rush				•
pipewort				•
water-marigold			•	
southern dodder			•	

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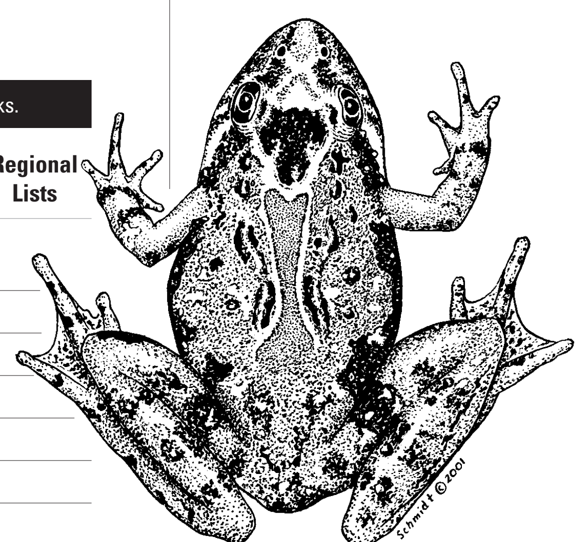


Northern cricket frog

(Acris crepitans)

1.6–3.5 cm (0.5–1.4 in)

SPECIES OF CONSERVATION CONCERN (cont.)

	Federal Lists	National Lists	State Lists	Regional Lists
Amphibians and Reptiles				
blue-spotted salamander			•	
four-toed salamander				•
northern cricket frog			•	
Blanding's turtle			•	
bog turtle	•		•	
spotted turtle			•	
Birds				
American bittern		•	•	
least bittern		•	•	
king rail			•	
marsh wren				•
Mammals				
river otter				•

Blanding's turtle uses at least two bog lakes outside the corridor. Bog turtle could occur in adjoining fens (see Habitat Profile). Northern cricket frog occurs at some lakes outside the corridor in Ulster, Orange, and Dutchess. State-listed and regionally-rare birds (American bittern, least bittern, king rail, marsh wren) may breed in circumneutral bog lakes. Blue-spotted salamander is reported to breed in a moat at one lake outside the corridor. Spotted turtle and four-toed salamander are likely. River otter may be present. The lakes have diverse communities of mollusks and odonates (dragonflies, damselflies); rare species of these groups are expected.

Circumneutral Bog Lakes may have bogs, fens, calcareous wet meadows, shrub swamps, or wooded swamps at their margins. Reschke's (1990) "oligotrophic pond" or "eutrophic pond" communities may be present in some of these habitats.

Substrates

Peat, which may comprise a "soupy" false bottom beneath open water. There are floating peat mats which form from peat "rafts" buoyed out of the fragrant pond-lily (*Nymphaea*) beds by gases of decomposition; where water-willow occurs, the mats may also grow laterally. Adjoining uplands are typically gravelly glacial outwash or till underlain by carbonate or calcareous sandstone bedrock. Many of the bog lakes in the region are in geologic fault basins or glacial kettles.

Surface Waters

Clear, shallow (usually < 2 m [6.5 ft]), with pH ca 6.5–8.0 (Dickinson 1993). Maintained in part by springs; also by surface runoff. Inlet and outlet stream channels absent, small, or sluggish.

Extent

Extremely variable; may be smaller than 3 ha (7.5 ac) to over 160 ha (>400 ac).

Distribution

Probably widespread in the corridor although many (and the best known) examples occur farther inland. This profile is partly based on Thompson Pond, a Dutchess Co. bog lake outside the corridor (Busch 1976). However, this description applies to bog lakes in the corridor such as Esopus Lake, Mirror Lake, and probably Van Leuven Lake (Ulster and Greene counties).

Quality

Quality is inversely proportional to numbers of buildings on shores, boat use, presence of roads, or runoff from developed areas. In summer, "healthier," less eutrophic (lower nutrient level) lakes have clearer water and less conspicuous floating algae. Purple loosestrife or common reed on floating mats may represent degradation caused by nutrient pollution or physical alteration.

Human Uses

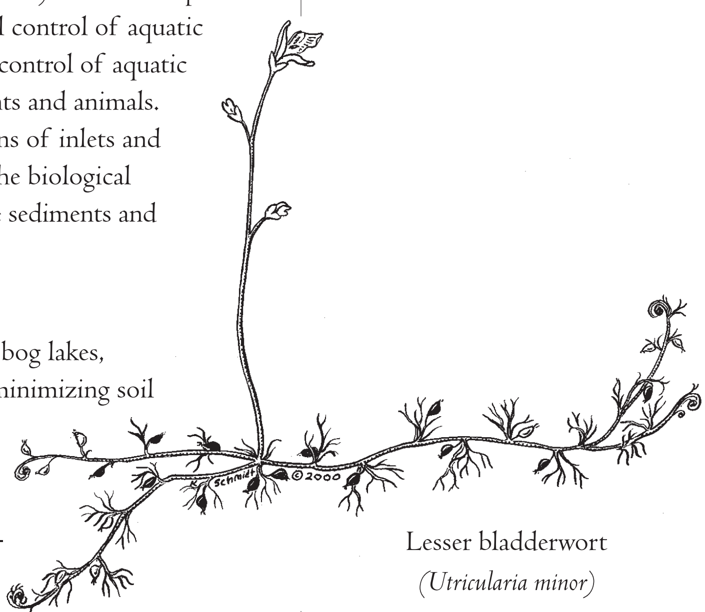
Some of the circumneutral bog lakes in the study area are used for fishing (ice and ice-free), boating, swimming, skating, picnicking, and hiking around the perimeter. Some have adjoining agricultural uses or residential developments at the perimeter.

Sensitivities, Impacts

Any of the recreational uses can be sources of garbage. Docks can introduce toxins such as chromated copper arsenate (CCA), used to treat wood for decay-resistance, which readily leach into the water and sediments, and are taken up by algae, snails, bivalves, benthic worms, fishes, and other aquatic organisms (Weis 1998). Nutrients and pesticide runoff from lawns and agricultural areas adjoining shorelines can degrade water quality and alter the biological communities of these lakes. Septic leachate from human residences can similarly introduce nutrients and toxins. Highly permeable outwash soils may not "filter" septic leachate or other pollutants adequately. Motorized craft can introduce hydrocarbon pollution that degrades water quality, and noise pollution that disturbs aquatic and terrestrial animal life associated with these lakes (Mele 1993, Nisbet 1997). Power boat propellers can destroy floating mats and other vegetation. Mechanical control of aquatic weeds can destroy submerged and emergent rare plants. Chemical control of aquatic weeds can degrade water quality and harm non-target aquatic plants and animals. Water withdrawals for agricultural or other purposes, or alterations of inlets and outlets, can change the hydrologic regime and substantially alter the biological communities of the lake. Mining on adjoining areas can introduce sediments and toxic leachates to the lake.

Conservation and Management

Upgrading septic systems around the perimeter of circumneutral bog lakes, reducing or eliminating the use of fertilizers and pesticides, and minimizing soil disturbance in the lake watershed would improve water quality and help to reduce aquatic "weed" problems. If management of aquatic weeds is warranted, selective harvesting should be used instead of chemical treatments, exotic fish introductions, or drawdowns. Selective harvesting permits close targeting of the nuisance plants, while the other treatments would affect a broad spectrum of non-target organisms, including rare species if present. Reduction of



Lesser bladderwort

(Utricularia minor)

leaves usually 3–10 mm (0.1–0.4 in)

motorized craft use, or restriction to certain parts of the lake, could help to protect the most sensitive habitats. Maintaining or restoring forested buffer zones at the lake perimeter would help to protect water quality and shield the lake wildlife from human disturbance. Maintenance of water levels and water movement would help to preserve the special habitats of circumneutral bog lakes. Establishment of conservation easements or other permanent protective measures on lands surrounding circumneutral bog lakes could help to prevent future land uses that would pose hazards to lake habitats and biota.

Examples on Public Access Lands

Louisa Pond at Shaupeneak Ridge (Town of Esopus) (Kiviat 1995). The Great Vly Wildlife Management Area (towns of Saugerties and Catskill), partly owned by NYS DEC. Sutherland Pond in Black Rock Forest (towns of Cornwall and Highlands). Lake Tiorati in Harriman State Park retains a remnant of a much larger bog mat present before the lake was flooded by the Civilian Conservation Corps (CCC) in the 1930s. Outside the corridor, Thompson Pond on the Thompson Pond Preserve of the Nature Conservancy (Town of Pine Plains, Dutchess Co.), and several lakes in Sterling Forest and at West Point.

References

Busch (1976), Dickinson (1993), Kiviat (1995).

7.19 Acidic Bog

ACIDIC BOGS ARE PERENNIALLY WET, VERY LOW-NUTRIENT WETLANDS dominated by low shrubs and peat mosses, with acidic, organic soils. Bogs are rare in the study area, are strikingly different from other wetlands, and support many uncommon and rare plants.

Vegetation

Acidic bogs are typically dominated by low shrubs (≤ 1 m tall) of the heath family (Ericaceae), and have very extensive carpets or floating mats of peat mosses (*Sphagnum*). Leatherleaf and cranberries are the most characteristic bog shrubs; other low shrubs include chokeberries, huckleberries, bog-rosemary, and sheep laurel. Tall, acid-tolerant shrubs such as highbush blueberry, poison sumac, and swamp azalea are often present. The insectivorous plants pitcher-plant and sundews are also characteristic; roundleaf sundew is the most common sundew in the Hudson Valley. Sedges (e.g., three-seed sedge, tussock cottongrass, and beak-rush) may be present. Virginia chain fern may be abundant, for example, between the true bog and the moat. Red maple, white pine, pitch pine, elm, and other trees may occur, usually at low densities.

Fauna

Common animal species include white-tailed deer, white-footed mouse, pileated woodpecker, eastern towhee, spring peeper, and gray treefrog.

Indicators and Identification

The unusual vegetation dominated by low heath shrubs and peat mosses is distinctive.

Biodiversity Values

SPECIES OF CONSERVATION CONCERN. See Sect. 2.0 and App. 3 for rarity ranks.

	National Lists	State Lists	Regional Lists
Plants			
pod-grass		•	
tussock cottongrass			•
pitcher-plant			•
roundleaf sundew			•
narrow-leaf sundew			•
snakemouth orchid			•
Virginia chain fern			•
small cranberry			•
large cranberry			•
Amphibians and Reptiles			
four-toed salamander			•

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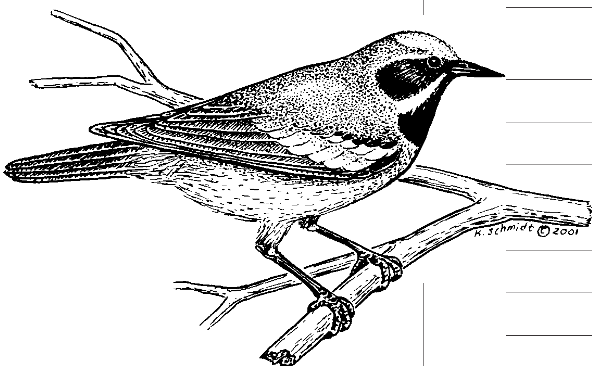


Golden-winged warbler
(Vermivora chrysoptera)
13–14 cm (5–5.5 in)

SPECIES OF CONSERVATION CONCERN (cont.)	National Lists	State Lists	Regional Lists
Birds			
eastern bluebird			•
golden-winged warbler	•	•	
Nashville warbler			•
northern waterthrush	•		•
Mammals			
southern bog lemming			•

Because acidic bogs are themselves rare in the Hudson River corridor, many of the indicator species of bogs are also rare or scarce in the region, including pitcher-plant, sundews, and cranberries.

Breeding birds include Nashville warbler, golden-winged warbler, northern waterthrush, and eastern bluebird. Four-toed salamander is likely. Southern bog lemming is possible where sedges (*Carex*), peat mosses, and shrubs are present, and in woods adjacent to the bog (Paul F. Connor, personal communication).

Reschke's (1990) "highbush blueberry bog thicket," "perched bog," "medium fen," "inland poor fen," and acidic examples of "dwarf shrub bog" are included in this habitat type. Acidic bog communities are rare in the Hudson River corridor.

Substrates

Organic soils (peats and mucks); especially Palms muck and Carlisle muck in bogs east of the Hudson River.

Surface Waters

Acidic bogs usually have a moat or lagg (mineral-rich standing water, sedgy fen, or shrubland) positioned between the main bog community and the surrounding upland; the moat resembles an intermittent woodland pool, flooding in winter and spring, and supporting swamp shrubs and trees on well-developed root pedestals. The moat is evidently subject to groundwater discharge from outside the bog, and may be too rich in minerals to support bog vegetation. There may also be an interior pool in a bog. If present, this pool would have acidic stained water (i.e., discolored by organic matter). The best developed bogs do not have streams flowing through them. Small acidic bogs, however, may occur in portions of other wetlands or at lake edges. Acidic bogs are fed primarily by rainwater.

Extent

Most acidic bogs in the study area probably range from a small fraction of a hectare to several hectares (200 ft^2 to 7+ ac).

Distribution

In the study area, characteristic acidic bogs on deep organic soils are apparently confined to low elevations (≤150 m [500 f]); acidic pools occur at higher elevations but do not support a complex flora of bog plants. This elevation restriction does not apply outside the study area. The longitudinal distribution of bogs is probably extensive. Acidic bogs apparently occur in microclimatically cool spots and represent a relict (remnant) system usually associated with more northerly regions. The peat moss blanket also insulates underlying ice into late spring or early summer, maintaining a cool microclimate that supports boreal relict plant species.

Quality

Better quality bogs tend to be those with greater extent, a forested buffer zone, and fewer direct human impacts.

Human Uses

Peat mining has occurred in the past, and may still occur on some bogs in the region. In other regions, acidic bogs have been important sites for archaeological, paleobotanical, and climate studies, because of the preservative qualities of the organic substrates.

Sensitivities, Impacts

Acidic bogs are probably very sensitive to removal of the surrounding forests (which results in microclimatic warming, siltation, and surface waters flooding the bog). Repeated walking on the bog surface readily damages the vegetation and soil.

Conservation and Management

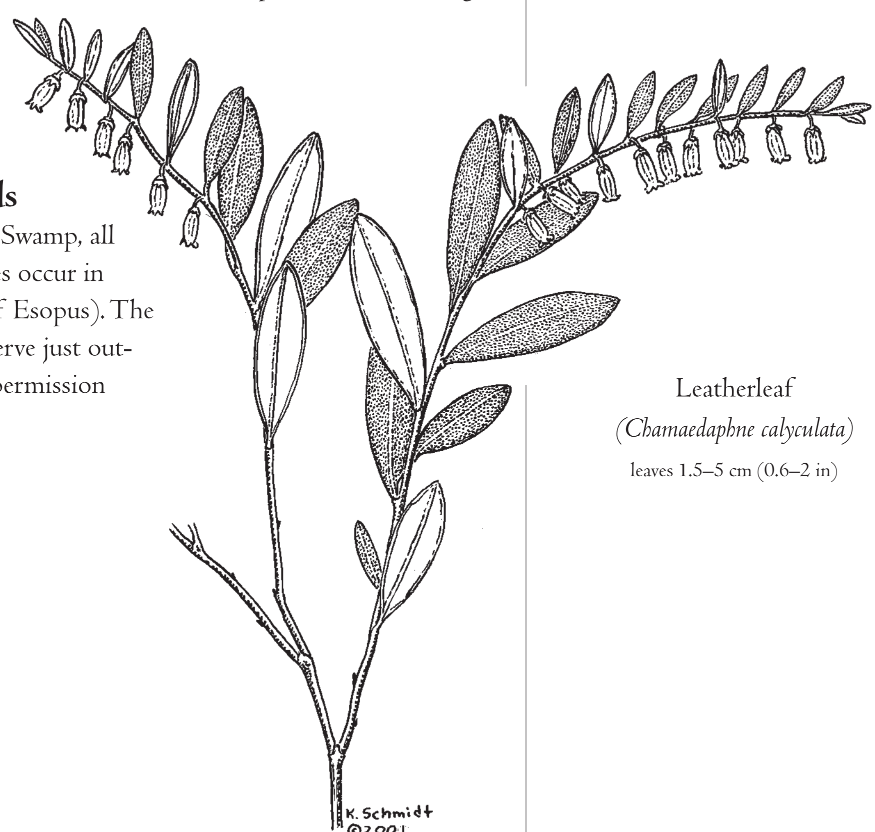
Forested buffer zones should be preserved wherever possible to help protect bog water quality, and to shield the bog habitat from human disturbance. For any bogs that are to be visited more than occasionally, boardwalks should be constructed to protect soils and vegetation. Establishment of conservation easements could help to preserve the bog and buffer zones from disturbance in the long term.

Examples on Public Access Lands

Pine Swamp, Surebridge Swamp, and Green Swamp, all in Harriman State Park. Small boggy patches occur in Louisa Pond at Shaupeneak Ridge (Town of Esopus). The Zipfelberg Bog is a Nature Conservancy reserve just outside the study area in Dutchess Co. (access permission needed).

References

Larsen (1982), Crum (1988).



Leatherleaf
(Chamaedaphne calyculata)
leaves 1.5–5 cm (0.6–2 in)

7.20 Nontidal Marsh

Marshes are wetlands dominated by herbaceous (non-woody) plants, and with standing water through all or much of the growing season. Dominant plants tend to be taller in marshes than in wet meadows, although some tall species (notably purple loosestrife and common reed) occur in both habitats. Marshes are very important habitats for many species of birds. There is some overlap between Nontidal Marshes and Circumneutral Bog Lakes (see Habitat Profiles); the latter often contain marshy areas. Many other lakes and ponds have marsh fringes of variable widths. Also, there are nontidal wetlands that are ecologically intermediate between types, e.g., marsh and wet meadow, marsh and fen, or even marsh and swamp. Large nontidal marshes are uncommon in the study area.

Vegetation

Plants typically dominant or abundant in nontidal marshes are tussock sedge, common reed, reed canary grass, rice cutgrass, cattail (narrow-leaf cattail, broadleaf cattail, or hybrid cattail), bur-reed, occasionally softstem bulrush, sweetflag, purple loosestrife, and smartweeds. Many of the same plants occur in both nontidal marshes and non-calcareous wet meadows; the differences are primarily in the water depths, and extent and duration of flooding. Cattail and bur-reed require longer hydroperiods (duration of flooding) than the other plants listed, so are more likely to occur, and to form extensive stands, in marshes than in wet meadows. Wet meadow is often present around the margin of, or in patches within, a nontidal marsh. A few trees or tall shrubs are often present among the herbaceous vegetation. Deeper pools (more or less permanent water) may support floating or submerged aquatic plants such as yellow pond-lily, fragrant pond-lily, pondweeds, or bladderworts. Water-willow occurs locally.

Fauna

Common animals include muskrat, raccoon, white-tailed deer, mallard, red-winged blackbird, swamp sparrow, snapping turtle, eastern painted turtle, northern water snake, eastern garter snake, spring peeper, green frog, bullfrog, and pickerel frog. Meadow jumping mouse and other small animals are likely. Muskrat population density varies greatly from year to year and place to place, but the lodges and burrows muskrats build, and the clearings in the vegetation around lodges, are important resources for the smaller plant species and for other animals.

Indicators and Identification

Dominance of one or more of the plants listed above, plus standing water through most or all of the growing season (i.e., into July or later during a normal precipitation year).

Biodiversity Values

SPECIES OF CONSERVATION CONCERN. See Sect. 2.0 and App. 3 for rarity ranks.

	National Lists	State Lists	Regional Lists
Plants			
winged monkey-flower		•	
buttonbush dodder		•	
spiny coontail		•	

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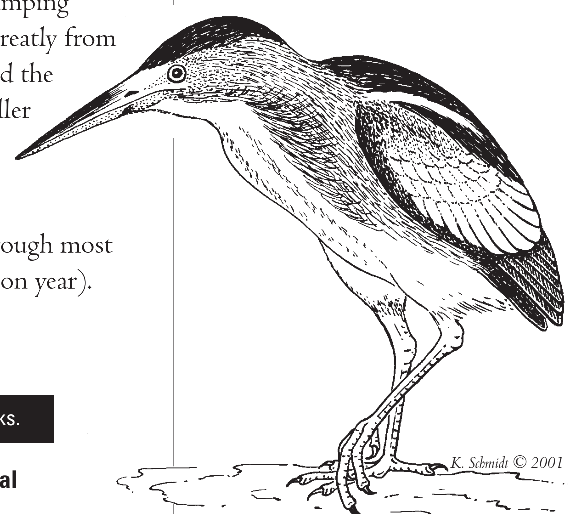


Least bittern
(Ixobrychus exilis)
28–36 cm (11–14 in)

SPECIES OF CONSERVATION CONCERN (cont.)

	National Lists	State Lists	Regional Lists
Amphibians and Reptiles			
northern cricket frog		•	
northern leopard frog			•
southern leopard frog		•	
Blanding's turtle		•	
spotted turtle		•	
Birds			
American bittern	•	•	
least bittern	•	•	
wood duck			•
American black duck	•		•
northern harrier	•	•	
king rail		•	
Virginia rail			•
sora			•
common moorhen			•
marsh wren			•

Streamside (floodplain) marshes may support winged monkey-flower. Buttonbush dodder (*Cuscuta cephalanthi*), a small parasitic vine similar to the common dodder (*C. gronovii*), may grow on buttonbush, purple loosestrife, or other host plants in marshes. We also find the submerged aquatic plant spiny coontail in calcareous marshes and ponds.

Nontidal marshes are important habitat for several uncommon or rare marsh and water birds: least bittern, American bittern, common moorhen, king rail, Virginia rail, sora, and marsh wren. These species tend to breed in extensive marshes dominated by cattail, other robust graminoid species, or a mixture of cattail with other plants (e.g., cattail - purple loosestrife). Northern harrier may breed in marshes, wet meadows, or shrubby habitats (wet or dry). Marshes are important habitat for migrant ducks and geese, and are also used for foraging and brood-rearing by locally breeding American black duck (a declining species) and wood duck (a common but vulnerable species). Marshes, especially those with exposed mudflats, are important foraging habitats for several species of migrant shorebirds. Spotted turtle may occur in marshes, and Blanding's turtle may use marshes near their "core" habitats in Kettle Shrub Pools (see Habitat Profile). Nontidal marshes are important frog habitats; northern leopard frog is more common east of the Hudson River and southern leopard frog west of the Hudson. Northern cricket frog is more typically an inhabitant of circumneutral bog lakes in our region, but may also occur in nontidal marshes.

Although softstem bulrush is not a rare plant, nontidal marshes where this species is prominent are unusual in the study area. Nontidal marsh includes Reschke's (1990) "deep emergent marsh," and "shallow emergent marsh" communities.

Substrates
Hydric soil, mineral or organic, shallow or deep.

Surface Waters
A marsh may be isolated from other surface waters, may adjoin a pond or stream, or may have a stream flowing through it.

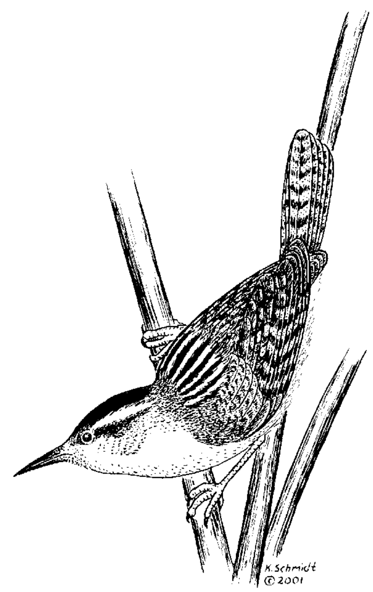
Extent
From a small fraction of a hectare to more than 50 hectares (200 ft^2 – 125+ ac).

Distribution
Nontidal marshes are longitudinally widespread, occurring more or less throughout the study area, but are mostly at low elevations where more water and nutrients collect.

Quality
Quality is better where invasive plants (purple loosestrife, common reed, reed canary grass, water-chestnut, multiflora rose) are less abundant, although the presence of these species *per se* is not necessarily detrimental. Impacts of surrounding land use on quality must be evaluated on a site-specific basis. Nearby residential, commercial, or industrial developments are likely to degrade a marsh. Presence of non-invasive woody plants is not necessarily detrimental, depending on which biota are of conservation concern and on the behavior of the woody species.

Human Uses
Hunting, fur trapping, birdwatching, and nature study are prominent uses of non-tidal marshes. Some marshes are partially grazed by livestock.

Sensitivities, Impacts
Many impacts originate upstream or upgradient from marshes: siltation, pollution, changes in hydrology. Channelized runoff from roadways often discharges into marshes, carrying sediments that may smother marsh plants and animals, and roadway pollutants. Changes in patterns of water quantity and quality will change the marsh and alter the biological community. Human activity in or near marshes can discourage breeding of rare animal species. Generally, livestock activities, unless very light, are likely to damage marsh soils and vegetation, although livestock (especially horse) feeding may keep common reed under control, and horses, cattle, or sheep often reduce the density of purple loosestrife substantially.



Marsh wren
(Cistothorus palustris)
10–14 cm (4–5.5 in)

Conservation and Management
Marsh management should consider the maintenance of water quality and quantity, and the hydropatterns (the patterns of water levels and water flows) upon which wetland organisms depend. Marsh extent and the adequacy of buffer zones should also be considered on a site-specific basis. Buffer zones should be maintained that are large enough to include the upland habitats used by marsh animals, and to effectively reduce noise, visual disturbance, pollution, siltation, invasive plants, and microclimatic alteration that may degrade habitat for rare and common biota. Buffer zone widths must be designed on a site-by-site basis, to serve the particular plant and animal communities of concern in and near the marsh.

Examples on Public Access Lands
There is a small common reed marsh in a pond at Ferncliff Forest (Town of Rhinebeck). There are areas of nontidal marsh in the Black Creek Forest Preserve (Town of Lloyd), Great Vly Wildlife Management Area (towns of Saugerties and Catskill), and nontidal marsh can be viewed from NY Route 9 at Green Fly Swamp (towns of Wappingers and Fishkill). Outside the study area, an extensive purple loosestrife–tussock sedge marsh is accessible by boardwalk at the Seward T. Highley Wetlands Sanctuary at the Millbrook Prep School (Town of Washington, Dutchess Co.) (access permission required).

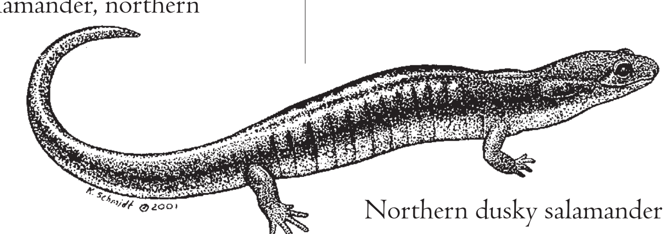
7.21 Intermittent Stream

INTERMITTENT STREAMS ARE STREAMS THAT FLOW only during part of the year—seasonally (fall, winter, and spring) or after rains. Many intermittent streams flow directly into the Hudson River while many others flow into perennial streams that drain into the Hudson. This habitat type is found more or less throughout the study area, at all but the highest elevations. Intermittent streams are small, with channels often only a meter or two wide, but they may be a kilometer or more (0.6+ mi) long. Because the streambeds are dry much of the growing season, but also carry scouring flows for short periods, intermittent streambeds tend to be poor in macroscopic plant and animal life. Substrates vary greatly, and include clay, cobbles, and bedrock. The substrate strongly influences the form of the stream and its biological character. Often, intermittent streams have small pools that hold water at least part of the time when the stream is not flowing. These pools can be refuges for aquatic invertebrates and small fishes. Terrestrial animals and plants may invade intermittent streambeds during dry periods. Snails, insects, and a few small fishes such as blacknose dace and creek chub are common aquatic animals of intermittent streams.

Some intermittent streams are shown on USGS topographic maps as dot-dash (instead of solid) blue lines. Many others are not shown explicitly on USGS maps, but can be inferred from the shapes of the contour lines (see Sect. 5.1). Small perennial streams are sometimes shown as intermittent streams. The only way to tell for certain is to check the stream for flow during a normal dry season (late summer and early fall). Any aquatic invertebrate, moss, or lichen indicators of intermittency are unknown to us.

Quality of intermittent streams is mainly related to degree of alteration and pollution. Intermittent streams, due to their small size, are especially vulnerable to damage from unfortified vehicle crossings, livestock activities, dumping, channelization, stormwater scouring, siltation, and other impacts. Alteration and pollution of intermittent streams also affect the watercourses or wetlands into which the intermittent streams flow.

The biodiversity values of intermittent streams are poorly known. Goldenseal, a very rare plant, has been found on the banks of an intermittent stream in the Town of Red Hook. Gremaud (1977) found rich aquatic invertebrate communities in clay bed intermittent streams flowing into the Tivoli Bays. At least one regionally-rare snail species (*Marstonia decepta*) has been found there, and a fingernail clam (*Pisidium adamsi*) which may also be regionally-rare (Gremaud 1977, Strayer 1987). Adults of two state-rare dragonfly species, arrowhead spiketail and mocha emerald, patrol nearly-dry intermittent stream beds, and females lay their eggs in the few remaining pools (Ken Soltesz, personal communication). The arrowhead spiketail is unusually abundant in the Hudson Highlands. Red-backed salamander is common under rocks in the dry channels of intermittent streams. Intermittent streams may provide habitat for stream salamanders, especially if associated with seeps or springs. These could include northern two-lined salamander, northern dusky salamander, and, west of the Hudson, mountain dusky salamander, spring salamander, and red salamander.



Northern dusky salamander
(Desmognathus fuscus)
6–14 cm (2.5–5.5 in)

Biodiversity Values

SPECIES OF CONSERVATION CONCERN. See Sect. 2.0 and App. 3 for rarity ranks.

	State Lists	Regional Lists
Plants		
goldenseal	•	
Invertebrates		
arrowhead spiketail (dragonfly)	•	
mocha emerald (dragonfly)	•	
Marstonia decepta (snail)		•
Pisidium adamsi (fingernail clam)		•
Amphibians and Reptiles		
mountain dusky salamander		•
northern dusky salamander		•
red salamander		•
spring salamander		•

The communities of this habitat are similar to Reschke's (1990) "intermittent stream" community.

Intermittent streams may be seen in many public areas throughout the corridor. The biodiversity of intermittent streams can best be protected by preventing damage to the stream channel, banks, and watershed.

7.22 Perennial Stream

PERENNIAL STREAMS FLOW CONTINUOUSLY throughout years with normal precipitation. Some of the smaller perennial streams may dry up during severe droughts. This profile covers the channels of perennial streams above the influence of the Hudson's tides. Riparian areas (i.e., the tops of the banks, the floodplain, and non-floodplain areas adjoining the stream) are covered in a separate profile (Riparian Corridor).

Vegetation

Pools and slow runs may support submerged vegetation with species such as water starwort, Eurasian watermilfoil, wild-celery, pondweeds, waterweeds, water-purslane, and coontails. Bars, backwaters, and low portions of banks may support plants such as willows, alder, silky dogwood, purple loosestrife, spotted jewelweed, stinging nettle, wood-nettle, amaranths, teal lovegrass, toad rush, and whitegrass.

Fauna

Fish and aquatic macroinvertebrate communities may be diverse (see Schmidt et al. 1986, Strayer 1987, Stevens et al. 1994). Stream salamanders (see Species Profile), green frog, snapping turtle, eastern painted turtle, wood turtle (see Species Profile), and northern water snake are common reptiles and amphibians of streams. Many bird species use streams, notably great blue heron (see Species Profile), green heron, mallard, American black duck, wood duck, spotted sandpiper, belted kingfisher, tree swallow, bank swallow (see Species Profile), barn swallow, and Louisiana waterthrush.

Indicators and Identification

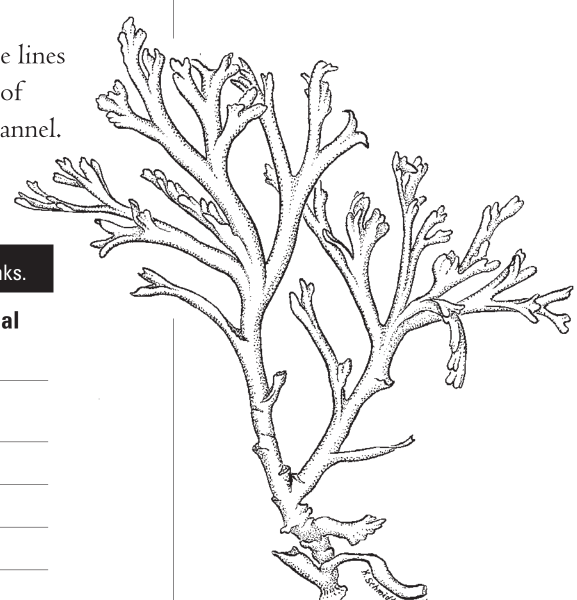
Perennial stream channels are shown on USGS topographic maps as solid blue lines or, in the case of wider channels, solid blue linear areas. In the field, presence of flowing water during non-drought dry seasons indicates a perennial stream channel.

Biodiversity Values

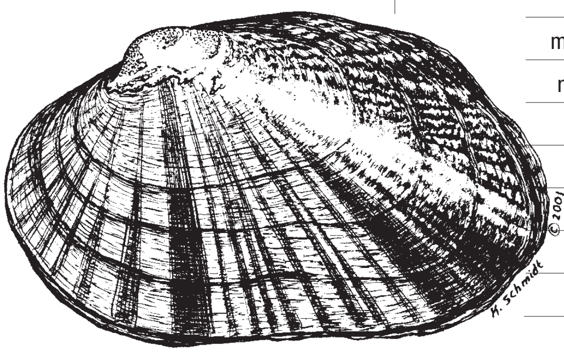
SPECIES OF CONSERVATION CONCERN See Sect. 2.0 and App. 3 for rarity ranks.

	National Lists	State Lists	Regional Lists
Plants			
winged monkey-flower		•	
riverweed		•	
spiny coontail		•	
Invertebrates			
sable clubtail (dragonfly)		•	
brook floater (mussel)		•	
Fishes			
tadpole madtom		•	

(continued)



Riverweed
(Podostemum ceratophyllum)
2–10 cm (0.8–4 in)



Brook floater
(Alasmidonta varicosa)
adult 40–60 mm (2 in)

SPECIES OF CONSERVATION CONCERN (cont.)

Fishes	National Lists	State Lists	Regional Lists
creek chubsucker			•
longnose sucker		•	
bridle shiner			•
brook trout			•
eastern mudminnow		•	
mud sunfish		•	
slimy sculpin			•
Amphibians and Reptiles			
long-tailed salamander		•	
mountain dusky salamander			•
northern dusky salamander			•
red salamander			•
spring salamander			•
wood turtle		•	
Birds			
wood duck			•
American black duck	•		•
bank swallow			•
Louisiana waterthrush	•		

Winged monkey-flower occurs along banks and backwaters of low-gradient perennial streams (e.g., towns of Red Hook and Clarkstown). Spiny coontail occurs in sluggish reaches of circumneutral streams (Town of Rhinebeck) (Stevens and Kiviat 1991b). Riverweed is known from one swift, rocky perennial stream in the study area in Orange Co. (Spider Barbour, personal communication), and another such stream just outside the study area (Kiviat 1991a).

Several rare native fishes have been found in study area streams, including eastern mudminnow, mud sunfish, longnose sucker, creek chubsucker, tadpole madtom, bridle shiner, slimy sculpin, and native populations of brook trout. The sable clubtail (dragonfly) is known from one cold stream in the Town of Highlands (Ken Soltesz, personal communication). A variety of rare mollusks could occur in clean perennial streams in the corridor. Brook floater (mussel) is known from a stream just outside the corridor.

Reschke's (1990) "rocky headwater stream," "marsh headwater stream," and "midreach stream" communities are included in this habitat type.

Substrates

Variable: bedrock, rock rubble, cobbles, gravel, sand, silt, clay. Rock types vary, and include limestone, sandstone, shale, and gneiss.

Surface Waters

Variable in many water quality characteristics. In the study area, perennial streams are generally well-buffered with neutral or mildly acidic pH; headwater streams on hard metamorphic or igneous rocks may be more acidic. Nutrient levels tend to be moderate to high, possibly excepting smaller streams in forested areas. Water quality of some study area streams has been described by Schmidt and Kiviat (1986), Schmidt et al. (1986), Kiviat (1991b), Parsons and Lovett (1992), Stevens et al. (1994), and Nieder (1997).

Extent

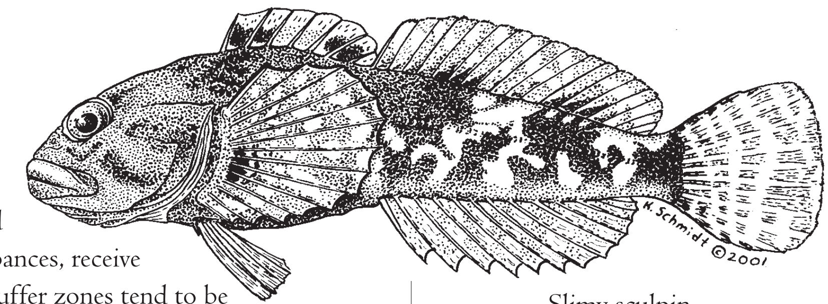
Perennial stream segments in the study area may be many kilometers (miles) long. Channels may be 1–30+ m (3–100+ ft) wide.

Distribution

Throughout study area except at highest elevations.

Quality

Quality of perennial streams is related to pollution and alteration. Streams that are remote from human disturbances, receive relatively clean runoff, and have substantial vegetated buffer zones tend to be of higher quality.



Slimy sculpin
(Cottus cognatus)
to 12.7 cm (5 in)

Human Uses

Fishing, canoeing, kayaking, swimming, nature study, drinking water supply, irrigation withdrawals, wastewater discharge. Almost all medium and large perennial stream reaches in the study area have old dams built for waterpower and other purposes.

Sensitivities, Impacts

Dams interfere with movements of fishes and other organisms. Dams also turn riffles and runs into ponds, thus eliminating habitats for many mollusks, insects, crustaceans, and fishes that require fast-moving and well-oxygenated water. Water withdrawals reduce low flows and may raise temperatures and reduce dissolved oxygen during hot weather. The timing and duration of water temperature fluctuations are important to the growth and development of fishes and invertebrates (Ward and Stanford 1979). Siltation and nutrient loading (fertilization) affect most perennial streams and tend to degrade habitat for rarer plants and animals, thereby reducing biological diversity. De-icing salts, petroleum compounds, and other contamination from road runoff can adversely affect sensitive aquatic organisms. We found that modest levels of phosphate, sulphate, or chloride (for example, from sewage, agricultural runoff, and de-icing salts) were correlated with substantial reductions in the integrity of benthic macroinvertebrate communities in three Hudson River tributaries (Stevens et al. 1994). Finally, many introduced fishes (e.g., brown trout, common carp, largemouth bass, smallmouth bass, several sunfishes) may be affecting native biological diversity in streams; however, introduced fishes are so widespread that it is difficult to understand their impacts and probably impossible to change this situation, even if it were desirable.

Conservation and Management

Water quality and habitat quality of perennial streams may be protected or restored by protecting buffer zones of natural or semi-natural vegetation and soil adjoining streams; by reducing or eliminating pollution and siltation; by removal of artificial streambank structures (e.g., riprap, gabions, concrete), and by restoring free-flowing stream segments where removal of disused dams is practical (McCormick 1978, Morton 1985).

Examples on Public Access Lands

There are many locations where perennial streams may be seen on public lands, for example: Doodletown Brook in Bear Mountain State Park (Town of Stony Point), Indian Kill in Norrie State Park (Town of Hyde Park), Black Creek in Black Creek Forest Preserve (Town of Esopus), and Stony Creek in Tivoli Bays (Town of Red Hook).

References

McCormick (1978), Morton (1985), Schmidt and Kiviat (1986), Schmidt et al. (1986), Kiviat (1991a, b), Parsons and Lovett (1992), Stevens et al. (1994), and Nieder (1997).

7.23 Riparian Corridor

THE RIPARIAN CORRIDOR INCLUDES THE STREAMBANKS, the floodplain, and higher areas directly adjoining the stream. Not only do riparian corridors contain important habitats, but they are also closely tied to the ecological integrity of the stream itself. Riparian zones are characterized by high species diversity and biological productivity (McCormick 1978). Most fish and wildlife depend upon riparian habitats in one way or another for their survival (Hubbard 1977), and loss of riparian habitat has been associated with dramatic declines of fish and wildlife populations. This profile pertains mainly to habitats along perennial streams; intermittent streams are small and flood little.

The floodplain is the low-lying land that is flooded by a stream at statistical intervals. The 100-year floodplain, for example, is predicted to be flooded once per century, and the annual floodplain is expected to flood each year. Because hydrological records span only a century, the extent of the 100-year flood is poorly understood. Furthermore, removal of vegetation, soil compaction, and increased area of impervious surfaces (pavement, roofs) in the watersheds of streams decrease the flood recurrence intervals. Thus "100-year floods" may be expected to occur more often than once per century in streams with watersheds that have been subject to intensive land development in recent decades. In this profile, "floodplain" means approximately the 100-year floodplain. Floodplains may contain a variety of habitats, including but not limited to upland meadows, wet meadows, swamps, marshes, and lowland forests.

Vegetation

Streambanks and floodplains are often dominated by plants tolerant of flooding and ice damage, such as sycamore, silver maple, red maple, boxelder, elms, red ash, American hornbeam, alder, silky dogwood, multiflora rose, common buckthorn, and purple loosestrife. Higher banks or natural levees may support hackberry and oaks. The flora of the ground layer can be extremely diverse, and the plant growth luxuriant.

Fauna

A few of the typical riparian and floodplain species are green frog, wood turtle, northern water snake, eastern garter snake, Canada goose, wood duck, wild turkey, American woodcock, pileated woodpecker, red-bellied woodpecker, gray catbird, Carolina wren, yellow warbler, common yellowthroat, muskrat, mink, and white-tailed deer.

Indicators and Identification

Federal Emergency Management Agency (FEMA) floodplain maps may be used to identify the approximate extent of the 100-year floodplains of larger streams; however, the accuracy of this mapping is uneven. Nearly-level areas near the same elevation as perennial stream channels are commonly floodplains. Soils described in soil surveys as "recent alluvium," such as Linlithgo and Occum soils in Columbia Co., are floodplain soils. Natural (non-planted) occurrence of numerous sycamore or silver maple normally indicates riparian corridor or floodplain.

Ostrich fern
(Matteuccia struthiopteris)
fronds usually 0.5–1 m (1.7–3.3 ft)

Biodiversity Values

American woodcock
(Philohela minor)
28 cm (11 in)

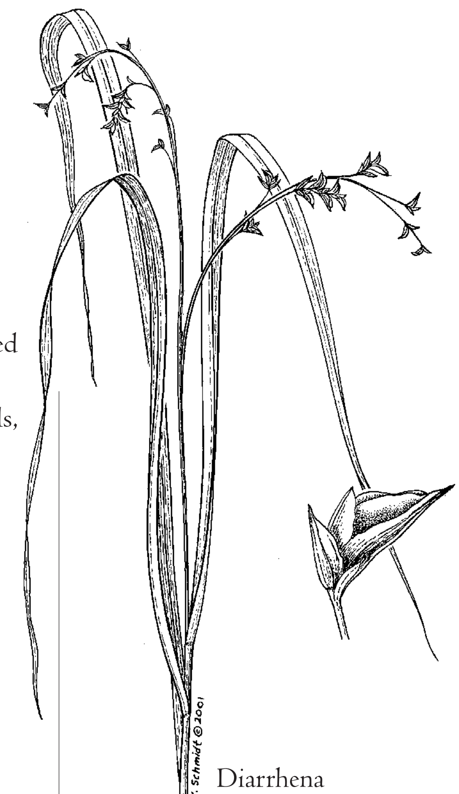
SPECIES OF CONSERVATION CONCERN See Sect. 2.0 and App. 3 for rarity ranks.

	National Lists	State Lists	Regional Lists
Plants			
cattail sedge		•	
diarrhena		•	
Davis' sedge		•	
wingstem		•	
river birch		•	
small-flowered agrimony		•	
winged monkey-flower		•	
goldenseal		•	
false-mermaid			•
swamp rose-mallow			•
Amphibians and Reptiles			
wood turtle		•	
Birds			
wood duck			•
red-shouldered hawk	•	•	
American woodcock			•
cerulean warbler	•	•	
Mammals			
river otter			•

Riparian habitats are known to support numerous rare plant species. Wingstem is known from riparian habitats outside the Hudson River corridor, and could occur here (Spider Barbour, personal communication). Swamp rose-mallow, although fairly common in brackish tidal marshes of the Hudson River, is rare along nontidal tributaries (e.g., Saw Mill River, Crum Elbow Creek). Davis' sedge, diarrhena, and cattail sedge have been found on stream terraces outside the study area in Orange County, and could occur here.

Rare or significant animals of riparian habitats include wood turtle, red-shouldered hawk, cerulean warbler, river otter, and any of our rare bat species, which may use these habitats for foraging. Wood turtles require a combination of stream pools, undercut banks (or muskrat or beaver burrows), and riparian or floodplain meadows and woods. Cerulean warbler breeds in large hardwood trees near water or wetlands. Red-shouldered hawk is associated with extensive closed-canopy mature forest, often with large trees, and generally including swamps or riparian areas. American woodcock is a declining species that uses riparian habitats as well as wetlands and wet woods.

High quality riparian or floodplain forests with large trees are scarce and significant in the study area. Some types of meadows, thickets, and wetlands that occur on floodplains are also significant. For example, fens (see Habitat Profile) or other seepage wetlands may occur at the upland margins where groundwater discharges onto the floodplain. Oxbow lakes and other types of floodplain ponds and pools may be biologically different from non-floodplain wetlands. Reschke's (1990) "floodplain forest" and "oxbow lake" communities are included in this habitat.



Diarrhena
(Diarrhena obovata)
stems 5–12 dm (20–47 in)

Substrates
Riparian areas have variable substrates. Streambanks may have a slightly raised "natural levee" built of coarser sediments that settle quickly as floodwaters overtop the banks. Floodplains generally have silty or locally sandy, flood-deposited soils (alluvium). Many streambanks have been altered with rip-rap (artificially placed rock armor) or other stabilizing materials.

Surface Waters
Some floodplains contain wetlands with water near or above the soil surface for prolonged periods. Other floodplain areas are normally without standing water except during flood events. Floodwaters tend to carry coarse woody debris, other live and dead plant materials, and heavy loads of sediment.

Extent
The 100-year floodplain may extend hundreds of meters (1000 ft or more) from the stream channel in low lying areas, or may be narrow or entirely absent if the stream is bordered by steep slopes.

Distribution
Throughout the study area except at the highest elevations.

Quality
Higher quality is associated with less hydrological alteration; e.g., less riprap or channelization, and fewer drainage ditches. Generally higher quality for biodiversity is associated with smaller numbers of buildings and other development or alteration (roads, croplands) in riparian and floodplain habitats. Higher quality may also be associated with larger trees, more "brush" (shrub thicket), and a wider buffer zone of natural or semi-natural soil and vegetation adjoining the stream channel. Rare species can still occur, however, in cleared or otherwise human-altered riparian areas.

Human Uses
Hunting, fishing, fur trapping, nature study, canoeing, and walking are important recreational uses in riparian zones. Many floodplains are used for cropland, livestock grazing, and logging. Water supply and waste treatment are also important uses. Many regulatory agencies discourage development on streambanks or within the 100-year floodplain. Much development nonetheless continues to occur in these riparian zones in certain towns in the study area.

Sensitivities, Impacts
Riparian and floodplain habitats are sensitive to all forms of alteration, development, and pollution. Human structural development in floodplains is not only harmful to stream quality and biodiversity in general, but is economically risky due to flooding and unstable soils.

Conservation and Management

Minimizing pollution of the riparian corridor and minimizing hydrological alteration of the stream system and its watershed (including intermittent tributaries and wetlands) will help protect stream habitat quality, and biodiversity of the watershed and the riparian zone in general (McCormick 1978, Morton 1985, Crance 1988). Activities in the watershed of the stream, including removal of vegetation, and construction of impervious surfaces (e.g., paving and roofs) will affect stream water quality, stream flows, and water interchange with the riparian corridor. All environmental reviews of development activities in the watershed should carefully consider those impacts and the cumulative impacts of all such developments.

We recommend that the 100-year floodplain be protected from development or alteration, and that broad buffer zones of natural or seminatural soil and vegetation upgradient of the floodplain also be preserved. The width of the buffer zone will depend on the conservation goals. If a goal is also to protect the habitats of animals of the riparian corridor, then those habitats need to be delineated for each species of concern, and the buffer zone configured accordingly. For example, certain bird species will nest successfully in a narrow vegetated zone along a stream, while others, such as red-shouldered hawk, may need several hundred hectares (acres) of undisturbed contiguous forest (Bednarz and Dinsmore 1982, Croonquist and Brooks 1993, Hafner and Brittingham 1993). Conservation easements could help to achieve these protections.

Examples on Public Access Lands

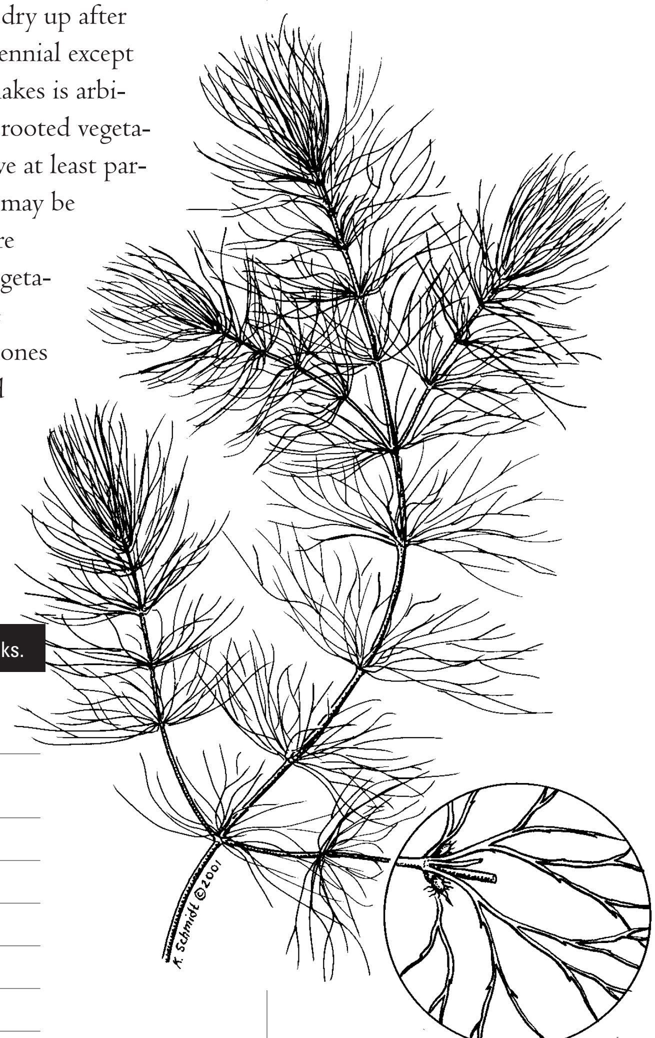
See Perennial Stream profile.

References

McCormick (1978) and Morton (1985) discussed the importance of riparian zones, and ways to protect them.

7.24 Constructed Ponds and Lakes

THE STUDY AREA CONTAINS NUMEROUS CONSTRUCTED PONDS and lakes of all sizes. Some have been excavated or dammed in existing wetlands or stream beds and others excavated in upland soils. Ponds and lakes have been deliberately created for aesthetic purposes, fishing, watering livestock, irrigation, emergency or regular water supply, ice harvest, water power, detention of stormwater and removal of suspended sediments, and other forms of wastewater treatment. They have also been created during mining, and by construction of roads and building lots. Constructed water bodies are extremely variable in size, ranging up to many hectares (acres). Some dry up after stormwater subsides or during the summer and fall, but most are perennial except perhaps during severe droughts. The distinction between ponds and lakes is arbitrary and many definitions have been proposed based on depth, size, rooted vegetation, and other characteristics. Most constructed ponds and lakes have at least partial cover of submerged and emergent vegetation, although the latter may be localized. Many old mill ponds, built on streams of moderate size, are silted in and may be partly or largely covered by emergent (marsh) vegetation such as purple loosestrife, cattail, or common reed. Many of the smaller water bodies are in house yards or farm fields, whereas larger ones often have houses or other buildings on their shorelines. Constructed ponds and lakes generally should be considered an increasing habitat type. They are often substituted for natural wetlands and other low-lying habitats that may be more valuable for biological diversity.



Spiny coontail
(Ceratophyllum echinatum)
leaves 1–3 cm (0.4–1.2 in)

SPECIES OF CONSERVATION CONCERN. See Sect. 2.0 and App. 3 for rarity ranks.

	National Lists	State Lists
Plants		
spiny coontail		•
Amphibians and Reptiles		
spotted turtle		•
Blanding's turtle		•
wood turtle		•
northern cricket frog		•
Birds		
American bittern	•	•
osprey		•

Nonetheless, constructed ponds and lakes that are not intensively disturbed by human activities can be important habitats for common biota (e.g., frogs, turtles, fishes, water birds, muskrat, bats). Rare species such as American bittern and osprey may forage at constructed ponds and lakes, especially outside the breeding season. Other rarities such as Blanding's turtle and spotted turtle use constructed ponds and lakes during summer and droughts. Wood turtle may overwinter and mate in constructed ponds. Northern cricket frog is a possibility in circumneutral constructed ponds. Spiny coontail is known from several constructed ponds in and near the study area. The occurrence of rarities is enhanced if better quality or "core" habitats are nearby, or if the water and soil are especially acidic or alkaline.

Reschke's (1990) "farm pond/artificial pond," "reservoir/artificial impoundment," "quarry pond," "artificial pool," and "sewage treatment pond" communities are included in this habitat type.

The quality of constructed ponds and lakes for biodiversity is generally related to water quality, presence of springs or marginal seeps, presence of submerged, floating, and emergent vegetation, natural or seminatural vegetation (especially trees) on the banks, and the distance from buildings, roads, and intensive agricultural activities. Nonetheless, as in many types of habitats, important elements of biodiversity may occasionally be found where pond or lake quality is apparently low. Water quality of ponds and lakes with residential lots, agricultural lands, or golf courses at the perimeter may be impaired by septic leachate, fertilizer, and pesticides in runoff.

7.25 Cool Ravine

A COOL RAVINE HAS STEEP, HIGH, ROCKY WALLS flanking a rocky perennial or intermittent stream at the ravine bottom. The ravine walls are commonly forested with a mixture of hardwoods and conifers, usually including hemlock. Steep rocky ravines occur at many locations just above the mouths of Hudson River tributaries, because many tributaries drop steeply in the lowest 30–45+ m (100–150+ ft) of elevation before reaching the river. Other cool ravines occur farther inland; many are located inland beyond the boundaries of the study area, where climates are slightly cooler and the terrain is more rugged. Cool ravines support some plants and animals of more northern affinities. Due to their steep, rocky slopes, some ravines have not been logged or built on. The rushing water, waterfalls, and rocky, wild slopes, are aesthetically inviting, especially in hot weather. The habitat is sometimes called a "hemlock gorge" or a "hemlock ravine."

Vegetation

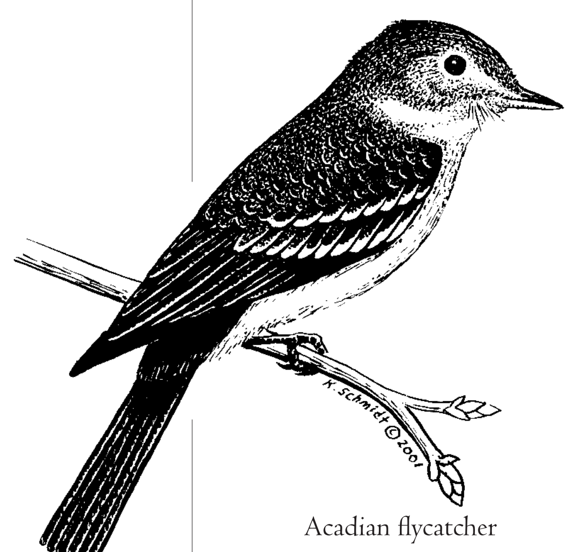
Hemlock–northern hardwood forests are common in ravines, but some ravine walls are without well-developed forest cover. Striped maple, mountain maple, and fly honeysuckle may be present, and heaths (e.g., low blueberries, mountain laurel) are sometimes prominent. Lichens, mosses, or ferns may be extensive, especially in moister areas. Fragile fern, bulblet fern, and ebony spleenwort may be present if soils or bedrock are somewhat limy.

Fauna

Ravines are used by many common animals species, and also by uncommon or rare species, often of northern affinities. Breeding birds may include Louisiana waterthrush, winter wren, and ruby-throated hummingbird. Mammals may include woodland jumping mouse (Paul F. Connor, personal communication).

Indicators and Identification

Steep-walled, ledgy ravine flanking a steep-gradient stream. Eastern hemlock, striped maple, American yew, yellow birch and red-berried elder may be present. Bryophyte cover (mosses and liverworts) is often extensive.

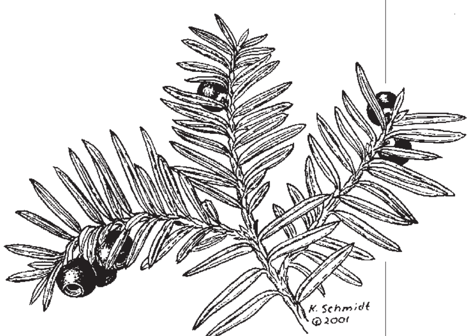


Acadian flycatcher
(Empidonax virescens)
14 cm (5.5 in)

Biodiversity Values

SPECIES OF CONSERVATION CONCERN. See Sect. 2.0 and App. 3 for rarity ranks.

	National Lists	State Lists	Regional Lists
Plants			
purple cliffbrake			•
walking fern			•
plantain sedge			•
fly honeysuckle			•
spikenard			•
American ginseng			•
leatherwood			•
American yew			•
Birds			
Acadian flycatcher	•	•	
blue-headed vireo	•		•
winter wren			•
black-throated green warbler	•		•
Blackburnian warbler	•		•
Louisiana waterthrush	•		•
dark-eyed junco			•



American yew
(Taxus canadensis)
leaves 1–2 cm (0.4–0.8 in)

Plantain sedge is very rare in the study area, but occurs in a cool ravine in Orange Co. Other rare and uncommon species include leatherwood, American yew, fly honeysuckle, American ginseng, and spikenard. Purple cliffbrake may be present if the bedrock is limy.

The fauna of cool ravine habitats is not well known. In Turkey Hollow–Deep Hollow (outside corridor), rare and uncommon breeding birds include Acadian flycatcher, dark-eyed junco, Blackburnian warbler, and black-throated green warbler.

Reschke's (1990) "hemlock-northern hardwood forest" community is similar to the communities of cool ravines of the study area. The streams at the ravine bottoms often resemble her "rocky headwater stream" community.

Substrates

Exposed bedrock, usually moderately to highly resistant (sandstone, schist, etc.). Soils often highly erodible. Stream beds and banks of bedrock, boulders, rock rubble, cobbles, sometimes finer materials.

Surface Waters

Perennial (usually) or intermittent stream at ravine bottom; size variable. Small natural or dammed pools are often present.

Extent
Varies greatly.

Distribution
Widespread in the Hudson River corridor at various elevations.

Quality
Higher quality to be expected with larger size, steeper and higher slopes, more exposed rock, fewer signs of logging, walls less eroded and trampled by climbers, generally less regular or permanent human presence, and an undisturbed forested buffer. Water pollution from upstream sources, or soil erosion from upgradient sources may degrade this habitat.

Human Uses
Swimming, picnicking, hiking. Some ravines have been the sites of private water supply reservoirs, mills, and millponds.

Sensitivities, Impacts
Recreation can result in trampling, littering (e.g., broken bottles in the stream), and serious soil erosion. Any clearing of trees and shrubs could alter the shade-tolerant plant community, cause soil erosion, and lead to elevated temperatures in the stream and ravine bank habitats. Creation of reservoirs will alter the habitats for aquatic and riparian biota.

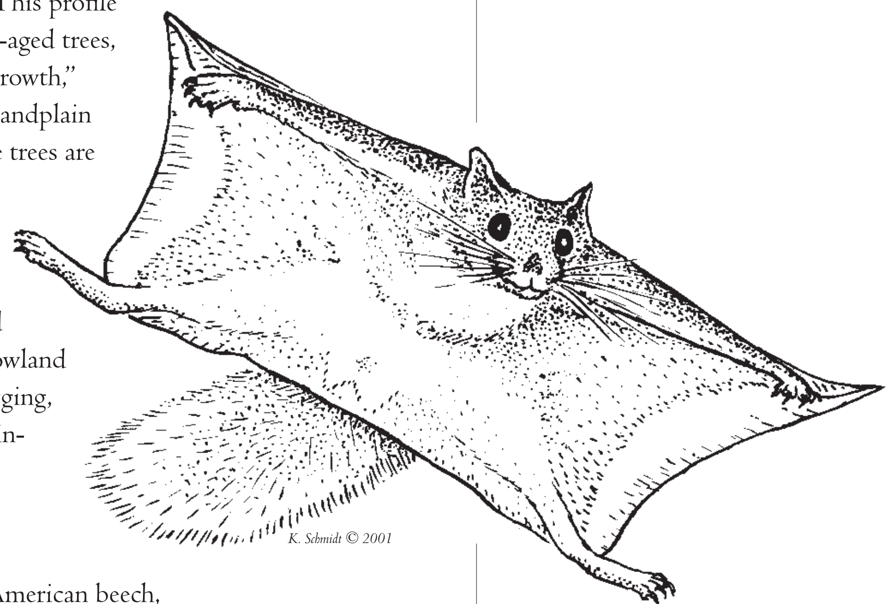
Conservation and Management
Uncontrolled use of rocky ravines may be dangerous to participants and harmful to habitats. Access points and trails should be designed and constructed carefully to protect streams, streams pools, and sensitive soils and vegetation of the ravine walls. Pollution or diversion of upstream waters can be harmful to this habitat.

Examples on Public Access Lands
Doodletown Brook at Bear Mountain State Park (Town of Stony Point); Black Creek Forest Preserve (Town of Esopus); the Saw Kill at Bard College and the Montgomery Place Historic Site (Town of Red Hook); Stony Creek in the Tivoli Bays (Town of Red Hook).

7.26 Mature Mesophytic Lowland Forest

WE DEFINE "MATURE" FORESTS as forests in which many trees exceed 30 cm (12 in) dbh. "Mesophytic" refers to vegetation of medium-moisture soils, differentiating these forests from swamp forests and dry forests of crests or sandplains. Forests of lowland (elevations ≤ 250 m (800 ft), usually deep, soils (as opposed to shallow soils of, e.g., mountainous sites) tend to produce larger trees. This profile includes forests of moderate-sized and moderate-aged trees, as well as those that are also referred to as "old growth," "ancient," or "large tree" forests. Rocky crest or sandplain forests may have trees that are equally old but the trees are generally stunted and diameters usually remain under 30 cm (12 in) dbh.

Mature forests are important habitats for common as well as rare species and communities, and are aesthetically important to humans. Because lowland areas are the most attractive for development, logging, and agriculture, the study area has very few remaining extensive mature forests.



Southern flying squirrel
(Glaucomys volans)
head and body 14 cm (5.5 in)

Vegetation

Sugar maple, oaks (black, red, chestnut, white), American beech, or hemlock are generally important. Shagbark hickory, white ash, basswood, tulip tree, and black birch may be present. Understory trees may include flowering dogwood and hop-hornbeam. Shrubs include spicebush, mapleleaf viburnum, witch-hazel, and serviceberries. Forest wildflowers, sedges, and ferns may be diverse; e.g., bellworts, hepatica, rue-anemone, baneberries, black snakeroot, starflower, wood lily, blue cohosh, may-apple, and twin-leaf. The lichen and bryophyte flora may be especially abundant and diverse in mature and old growth forests, particularly in regions with relatively unpolluted air (Lesica et al. 1991).

Fauna

Red-shouldered hawk, barred owl, pileated woodpecker, ovenbird, wood thrush, cerulean warbler, and Acadian flycatcher are among many vertebrates that thrive in (but are not limited to) this habitat type. A diverse small mammal community, including hairy-tailed mole, shrews (Soricidae), eastern chipmunk, southern flying squirrel, white-footed mouse, and pine vole. Harvestmen (daddy longlegs), long-horned beetles, and underwing moths seem especially diverse in lowland mature forests, but this remains to be investigated. Where soils are calcareous, land snails may be diverse and abundant (Garlinghouse 1976).

Indicators and Identification

Many trees exceeding 30 cm (12 in) dbh on a forested, low-elevation (generally ≤ 250 m [800 ft]) site identifies a mature mesophytic lowland forest.

Biodiversity Values

SPECIES OF CONSERVATION CONCERN. See Sect. 2.0 and App. 3 for rarity ranks.

	National Lists	State Lists	Regional Lists
Plants			
silvery spleenwort			•
American ginseng			•
red baneberry			•
blue cohosh			•
leatherwood			•
Birds			
northern goshawk		•	
red-shouldered hawk	•	•	
barred owl			•
eastern wood-pewee	•		
Acadian flycatcher	•	•	
wood thrush	•		
cerulean warbler	•	•	
black-throated blue warbler	•		•
black-throated green warbler	•		•
ovenbird	•		•
Mammals			
southern bog lemming			•

Rare fungi, lichens and bryophytes (mosses and liverworts) are associated with lowland old-growth forests elsewhere and probably occur in this habitat type in the study area.

Breeding cerulean warbler, black-throated blue warbler, black-throated green warbler, Acadian flycatcher, red-shouldered hawk, northern goshawk and barred owl. Several species of common, Neotropical-migrant, insect-feeding songbirds — especially vireos, warblers, tanagers, thrushes, and flycatchers — may depend on the interior areas of mature forests as habitats with lower rates of predation and brood-parasitism. Southern bog lemming may be present where there is a ground layer of sedges and other herbs (Paul F. Connor, personal communication). Probably many rare invertebrates occur in these habitats, but information is lacking.

Diverse, native, spring-blooming wildflowers, sedges, and ferns (and presumably invertebrates), and well-developed corticolous (bark-inhabiting) assemblages of lichens, bryophytes, and arthropods may be present. Complex communities of fungi are associated with live and dead trees of mature mesophytic forests. Mature examples of Reschke's (1990) "oak-tulip tree forest," "beech-maple mesic forest," "maple-basswood rich mesic forest," and "hemlock – northern hardwood forest" communities are included in this habitat type.

Substrates

Usually deep soils of variable texture (clayey, sandy, loamy). Locally on rocky lowland soils. Other soil characteristics also vary. Forests with minimal recent disturbance (e.g., off-trail pedestrians and vehicles, logging) may have strikingly spongy-feeling, uncompacted, topsoil and leaf litter layers. Coarse woody debris (i.e., dead logs and branches on the forest floor) are abundant in older forests. "Pit-and-mound" (or "pillow-and-cradle") features, formed from tip-up of tree root systems decomposing and leaving mounds and hollows, indicate long periods with minimal human disturbance and no plowing.

Surface Waters

Intermittent or perennial streams and woodland pools may occur within, or border, mature forests.

Extent

Ranges from natural (non-planted) groves of a few mature trees to stands exceeding 50 ha (125 ac).

Distribution

Mature forests are widely distributed in the study area, but extensive mature forests and large tree forests are very spotty in distribution.

Quality

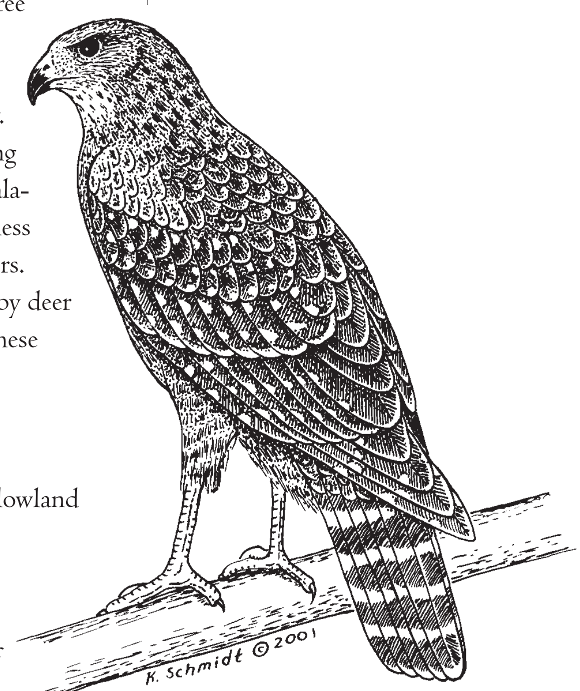
High quality is related to extent, size of trees, scarcity of direct human disturbance (trails, roads, off-road vehicles and pedestrians, logging and salvage of dead wood, etc.), scarcity of introduced plant species (e.g., ailanthus, Eurasian honeysuckles, Japanese honeysuckle, Oriental bittersweet), lack of soil compaction or erosion, and abundance of coarse woody debris, especially in larger diameters and a wide range of states of decay. Native tree species composition, diversity, or crown integrity, *per se*, are not quality indicators, although widespread serious tree disease might be. "Natural" disturbances (e.g., blowdown, fire, insect damage) are also not necessarily indicators of lower quality. High diversity of fungi, lichens, mosses, liverworts, native shrubs, spring-blooming wildflowers, sedges, ferns, native small mammals, forest-interior breeding birds, salamanders, land snails, and forest-interior arthropods may be indicators of forests less disturbed by humans. These communities also vary with soil type and other factors. Overbrowsing of low foliage or overconsumption of acorns and other tree seeds by deer and other overabundant animals are pervasive in the study area; a forest lacking these problems could be considered of higher quality.

Human Uses

Nature study, birdwatching, hunting, and logging are prominent uses in mature lowland forests.

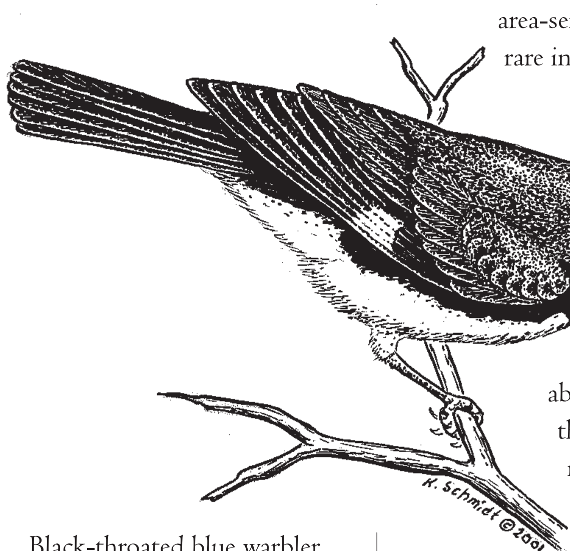
Sensitivities, Impacts

Clearing for development has significantly fragmented and reduced the extent of mature lowland forests in the Hudson River corridor. Fragmentation of forests by roads and other land development has been implicated in the declines of numerous species of migratory songbirds in the Northeast (Hill and Hagan 1991). Highly



Red-shouldered hawk
(Buteo lineatus)
40–61 cm (16–24 in)

area-sensitive species such as red-shouldered hawk (see Species Profile) may be rare in part due to fragmentation of this habitat type in the study area. The adverse ecological effects of roads on forest bird species, on amphibians and reptiles, on macroinvertebrate soil fauna, on plant communities, and on stream water quality are well documented. Some of these road effects include restricted movements between populations, increased mortality, increased predation and nest parasitism, invasions by exotic plants, increased human access, and habitat pollution from road runoff (Trombulak and Frissell 2000). Reduced abundance and diversity of soil macrofauna may extend up to 100 m from the road (Haskell 2000). The various effects of roads on biological communities and surface water quality have been found to extend 600 m and more from the road edge (Forman and Deblinger 2000).



Black-throated blue warbler
(Dendroica caerulescens)
13–14 cm (5–5.5 in)

Hemlock woolly adelgid, an introduced insect, has killed large numbers of hemlocks in forests in the middle and southern portions of the study area. Other diseases or insect outbreaks have killed beech, oaks, flowering dogwood, and other species. Salvage of dead standing wood eliminates important habitat for insects and cavity-using birds, mammals, and amphibians. Vehicle or pedestrian traffic can readily damage the shallow roots of trees. Lichens are extremely sensitive to air pollution (Brodo 1966, Thomas et al. 1973). Corticolous (bark-inhabiting) lichen communities in Dutchess Co. have lower diversity near the Hudson River, and lichen diversity has been severely reduced in Westchester Co., presumably due to air pollution in both cases (Feeley-Connor 1978, Prince 1978).

Conservation and Management

To conserve the biodiversity of mature mesophytic lowland forests, extensive stands of forest will need protection. Likewise, younger stands must be allowed to reach maturity. Enough examples of extensive, mature forest should be conserved to protect viable populations of area-sensitive species. However, estimates of stand extent, tree size (or basal area), and number of stands required for conservation of the more vulnerable elements are not currently available for our region. Representative stands on sites with different soils and physiography should be protected soon to allow the long-term development of mature stands and old growth stands. Conservation easements could help to achieve these protections.

Examples on Public Access Lands

South Woods and North Woods at the Montgomery Place Historic Site (Town of Red Hook). Forest at foot of slope on uphill side of Mt. Repose Cemetery (Town of Haverstraw, Rockland Co.).

7.27 Rich Rocky Woodland

By Spider Barbour

THIS IS A WOODED HABITAT ON ROCKY, CALCAREOUS SOILS, underlain by granitic bedrock and other hard rock substrates such as amphibolite and pegmatite. This habitat is known primarily from the Hudson Highlands. Most examples are on upper east- or south-facing slopes of rocky ridges, rather than on summits. Several rare plants and at least one rare invertebrate are known from this habitat.

Vegetation

Tree canopy has 30–60% closure and is composed of any of the following: pignut hickory, white oak, red oak, chestnut oak, white ash, black cherry, hop-hornbeam and basswood. Eastern red cedar may be present in low numbers. Typical tall shrubs are black-haw, downy arrowwood, and choke cherry. Early low blueberry may be present, and may indicate slightly higher soil acidity.

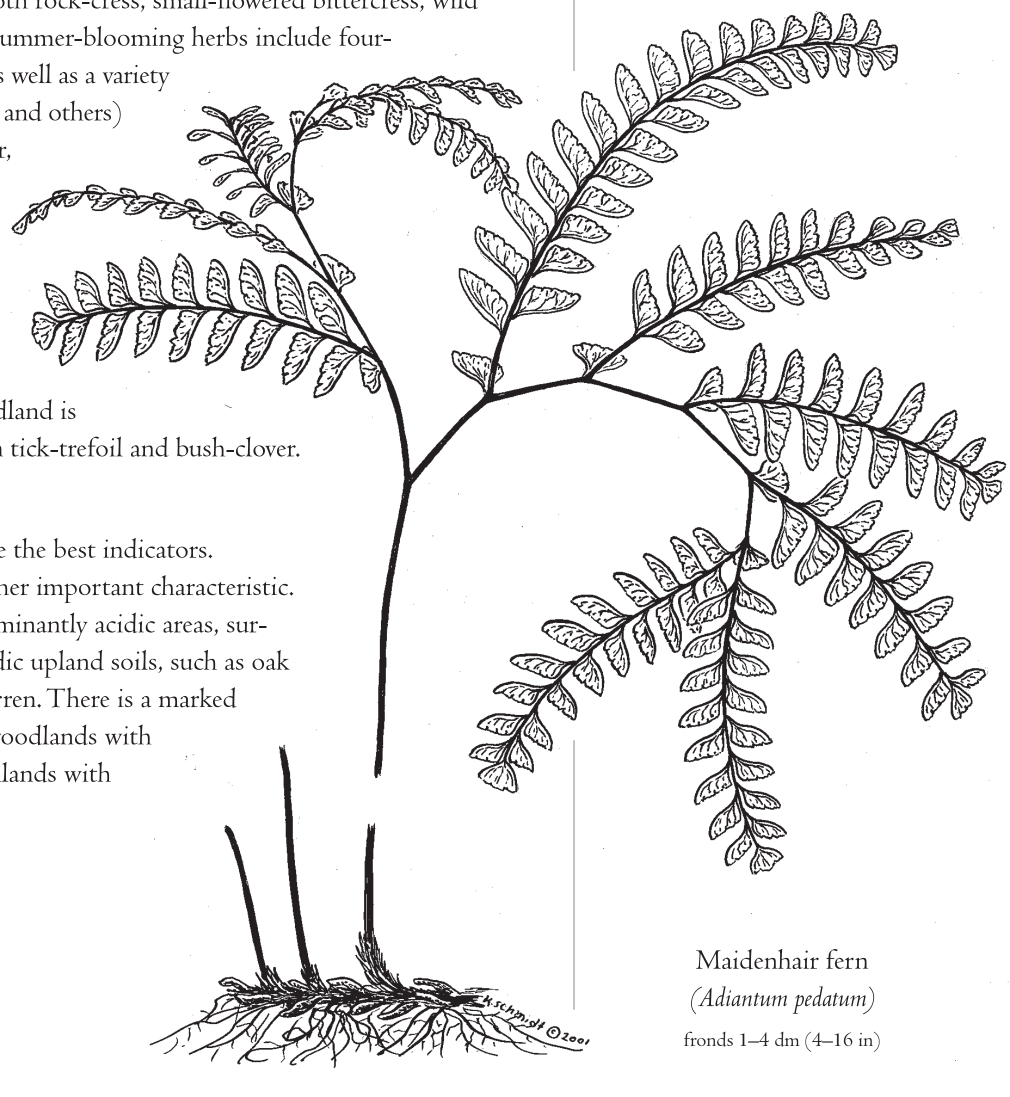
A major distinction between rich (calcareous) rocky woodlands and acidic rocky woodlands is the greater diversity of broad-leaved herbs in the richer communities. The Rich Rocky Woodland herb community usually contains two or more of the following spring ephemerals: lyre-leaved rock-cress, smooth rock-cress, small-flowered bittercress, wild columbine, and two-flowered cynthia. Summer-blooming herbs include four-leaved milkweed, and stiff-leaved aster, as well as a variety of tick-trefoils (round-leaved tick-trefoil and others) and bush-clovers (e.g., violet bush-clover, hairy bush-clover, and wand-leaf bush-clover).

Fauna

Common reptiles include northern black racer and eastern milk snake. A common butterfly of Rich Rocky Woodland is eastern tailed blue, whose larvae feed on tick-trefoil and bush-clover.

Indicators and Identification

Vegetation and flora described above are the best indicators. Persistent soils on steep slopes are another important characteristic. Rich Rocky Woodlands occur in predominantly acidic areas, surrounded by communities typical of acidic upland soils, such as oak forest, oak-pine forest, or oak-heath barren. There is a marked contrast between the prevailing acidic woodlands with shrubby understories and the rich woodlands with their diverse herb layers.



Maidenhair fern
(Adiantum pedatum)
fronds 1–4 dm (4–16 in)

Biodiversity Values

SPECIES OF CONSERVATION CONCERN. See Sect. 2.0 and App. 3 for rarity ranks.

	State Lists	Regional Lists
Plants		
Virginia snakeroot	•	
yellow harlequin	•	
small-flowered crowfoot	•	
Emmons' sedge	•	
violet bush-clover	•	
sweet pignut		•
downy arrowwood		•
Invertebrates		
falcate orange tip		•
cobweb skipper		•
olive hairstreak		•
Reptiles and Amphibians		
black rat snake		•

Virginia snakeroot has been found in rich, rocky woodlands of the Hudson Highlands. Other rare plants include yellow harlequin, small-flowered crowfoot, violet bush-clover, Emmons' sedge, and sweet pignut. Woodland areas with unshaded, droughty soils should be examined for rare grasses and lichens.

In the Hudson Highlands west of the river, Rich Rocky Woodlands are the typical natural habitat of falcate orange tip butterfly, which flies only in April and May, and lays its eggs on rock cresses and bittercress. Where red cedar is present, there may also be olive hairstreak. Cobweb skipper occurs in woodlands with scattered patches of its larval host plant, little bluestem.

The communities of closed-canopy woodlands approach the "Appalachian oak-hickory forest" communities of Reschke (1990). Open-canopy variants with red cedar are similar to Reschke's "red cedar rocky summit." Neither serves to describe the species-rich woodland communities found in the Hudson Highlands. Reschke's "limestone woodland" which occurs on other kinds of rock has a similar flora, but some important species are not shared.

Substrates

Soils of Rich Rocky Woodlands have not been studied. Those we have observed resembled rich bottomland soils or clay meadow soils. Some are reddish, fine-grained, cohesive when wet, and unexpectedly resistant to erosion, even on extremely steep slopes (e.g., Crow's Nest, West Point Military Reservation). These soils overlie various types of bedrock, mostly siliceous and acidic (e.g., granite or gneiss). Yet the soils appear calcareous, as they support rich floras including many calcicoles (rock cresses, legumes, woody species such as white ash, basswood and downy arrowwood). An important question is whether the rich soils are derived from glacial deposits or whether they have developed in place. Some granites and gneisses contain calcium-rich minerals such as apatite, titanite, amphibole, or pyroxene (McCrone 1967), and, if present, these may contribute to local calcareous environments. (See discussion of substrate in profile for Non-Carbonate Crest, Ledge, and Talus.)

Surface Waters

Small perennial or intermittent streams may drain some rich slopes, but typically there is very little water present. The soil may provide carbonate buffering, but often streams have cut to bedrock, and are presumed to have acidic waters.

Extent

This community exists only in small patches in the Hudson Highlands. Occurrences range from less than 0.5 ha to perhaps 20 ha (<1 ac to 50 ac) (e.g., Cascade Ridge, West Point Military Reservation).

Distribution

Distribution is restricted to the Hudson Highlands. Elevations tend to be between 80 and 320 m (260–1050 ft) on the upper slopes of ridges and hills. West of the Hudson River, most known occurrences are on east- or south-facing slopes, possibly because these aspects are warmer. There are instances of abrupt transitions from the rich woodland type on the east of a ridge to an acidicolous woodland type on the west (including a 1–2 m [3–6.5 ft] broad transition zone on a ridge at West Point).

Quality

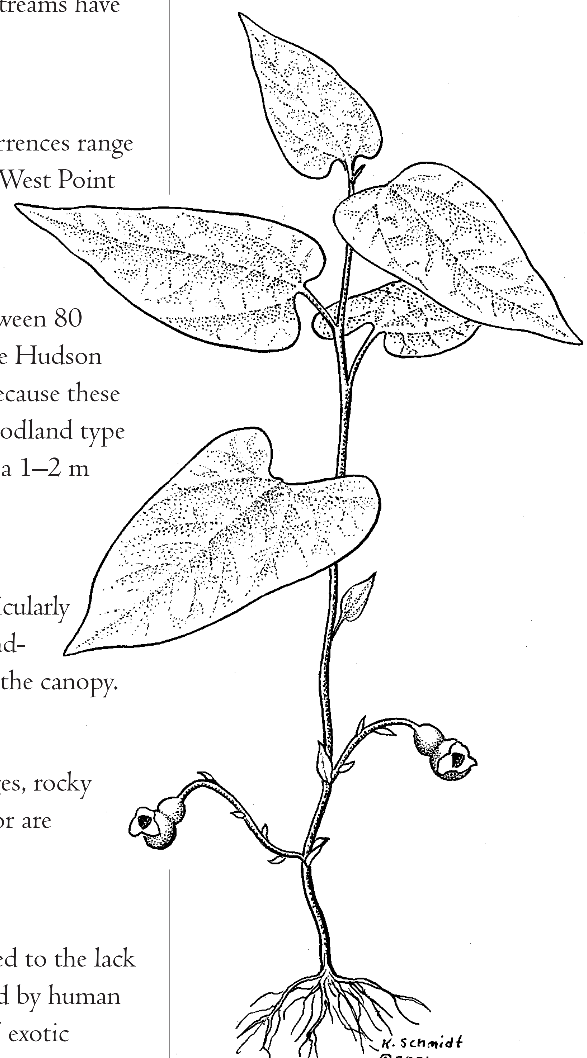
Since few occurrences are large, quality should be measured by biodiversity, particularly the number of calcicolous plant species. As a general rule, the number of broad-leaved herbs is a good indicator, as well as the presence of ash or basswood in the canopy.

Human Uses

Due to their relatively inaccessible positions on the steep, upper slopes of ridges, rocky woodlands are little used by humans. Some Hudson Highlands sites are near or are crossed by hiking trails.

Sensitivities, Impacts

The scarcity of hiking trails crossing these woodlands has probably contributed to the lack of attention from ecologists. Although these areas are substantially undamaged by human activity, they may be sensitive to soil erosion from foot traffic, introduction of exotic plants, damage to fragile ground plants, and disruption of the activities of sensitive fauna.



Virginia snake-root
(Aristolochia serpentaria)
stem to 6 dm (24 in)

Conservation and Management

Trails should be located away from Rich Rocky Woodlands, and other human uses of these sensitive areas should be avoided as much as possible. Fire may be an important force in maintaining the biological communities of rich woodlands. The role of fire is unknown and deserves study.

Examples on Public Access Lands

Harriman State Park has several good examples: Blauveldt Mountain, east slope of "Almost Perpendicular," Brooks Mountain and Tuxedo Ridge.

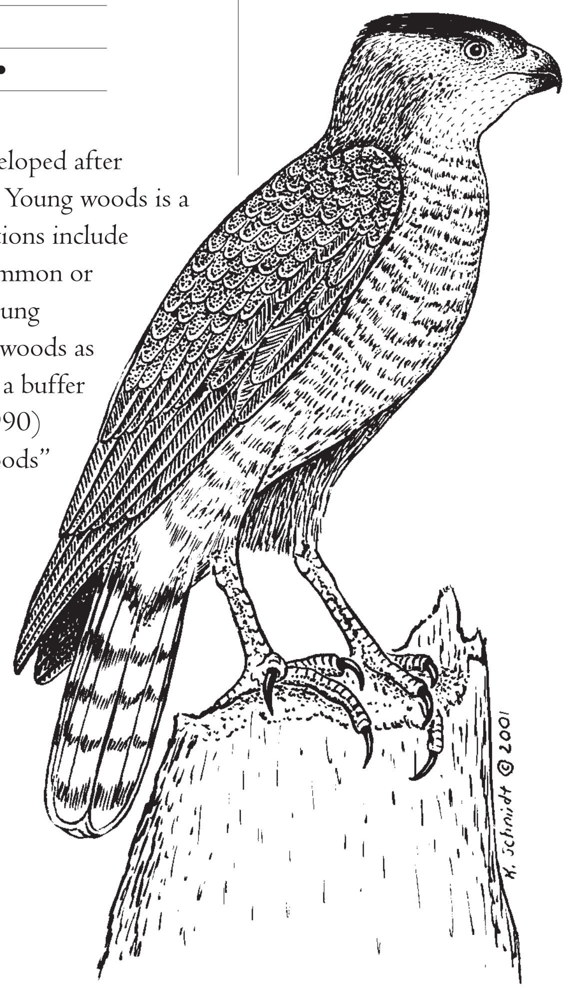
7.28 "Young Woods"

"YOUNG WOODS" IS DEFINED MORE BY THE SIZE OF TREES than their age, which is often unknown, hence the quotation marks. Young woods are forest stands of trees almost all less than 30 cm (12 in) dbh. Young woods comprise what foresters call "pole" and "sapling" size trees. Species composition is highly variable, and may be dominated by hardwoods, conifers, or a mixture of both. Sugar maple, black birch, and red oak are frequent dominants.

SPECIES OF CONSERVATION CONCERN. See Sect. 2.0 and App. 3 for rarity ranks.

	State Lists	Regional Lists
Plants		
hackberry		•
sweet-gum		•
Birds		
Cooper's hawk	•	
American woodcock		•

Most young woods were formerly agricultural fields, but some have developed after clearcut logging, or catastrophic events such as hurricanes or tornadoes. Young woods is a very common habitat, and usually does not support rare species. Exceptions include those with an unusual species composition, e.g., dominance by an uncommon or rare tree such as hackberry or sweet-gum. Cooper's hawk may nest in young woods, even close to a public road. American woodcock will use young woods as summer habitat. Young woods may also be important where it serves as a buffer zone for a wetland or stream, or another sensitive habitat. Reschke's (1990) "successional northern hardwoods," and "successional southern hardwoods" are included in this habitat.



Cooper's hawk
(Accipiter cooperii)
35–50 cm (14–20 in)

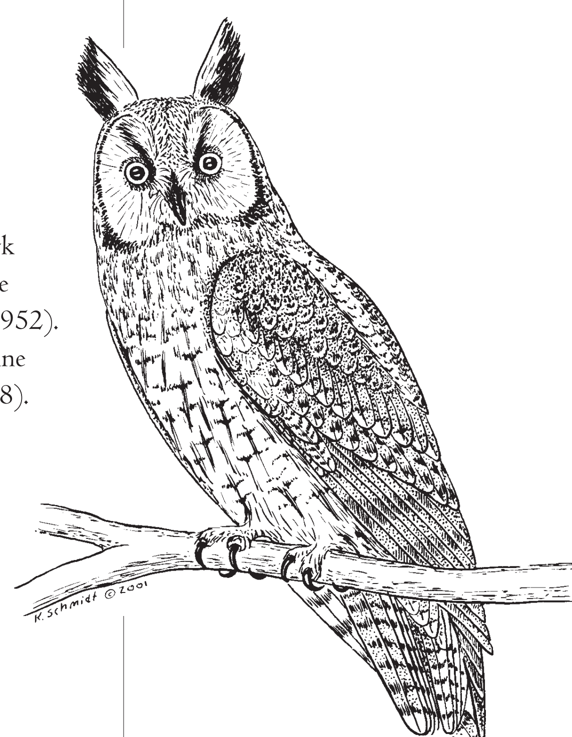
7.29 Conifer Plantation

CONIFEROUS TREES, INCLUDING RED PINE, SCOTCH PINE, Norway spruce, and European larch, are often planted in a grid pattern in single-species stands for Christmas tree production, for sheltering farm fields from wind, or for reforestation. Such habitats are easily recognized by the even spacing and the generally non-native species of the trees (red pine is native to the region but rare outside plantations). Some spontaneous stands of white pine may resemble plantations in having even-aged trees; however, the rectilinear spacing is absent. Older plantations usually have an admixture of volunteer hardwood trees of various species, and often a scattering of volunteer shrubs and herbs; however, species diversity tends to be low. Plantation trees vary from < 1 m (<3.3 ft) tall to 40+ cm (16+ in) dbh. Except in very young plantations, the ground is generally covered with conifer litter. Reschke's (1990) "pine plantation," "spruce/fir plantation," and "conifer plantation" are included in this habitat.

SPECIES OF CONSERVATION CONCERN. See Sect. 2.0 and App. 3 for rarity ranks.

	National Lists	State Lists	Regional Lists
Birds			
Cooper's hawk		•	
American woodcock			•
barred owl			•
long-eared owl		•	
short-eared owl	•	•	
red-breasted nuthatch			•
pine siskin			•

Conifer plantations often attract roosting owls (barred, great horned, long-eared, short-eared owls); long-eared owl occasionally breeds in this habitat. Cooper's hawk may also nest in an older conifer plantation. Young conifer plantations may provide breeding habitat and summer foraging habitat for American woodcock (Sheldon 1952). Small birds, usually associated with natural conifer forests farther north, such as pine siskin and evening grosbeak, may also nest in this habitat (Andrle and Carroll 1988). Even single rows or small clusters of planted conifers may be used for nesting by red-breasted nuthatch.



Long-eared owl
(Asio otus)
33–40 cm (13–16 in)

7.30 Shrubby Oldfield

OLDFIELDS ARE FIELDS ABANDONED FROM CROPS, livestock grazing, mowing for ornamental purposes, or other management. Oldfields become covered by grasses, forbs, shrubs, and saplings or root sprouts of trees. At some intermediate stage of development, oldfields often support diverse vegetation with a variety of plant species and a variety of patches of herbs, shrubs, or small trees. Eventually oldfields become young forests. Oldfields, especially larger ones, may provide habitat for rare birds and rare butterflies. Sometimes rare plants are present, especially on calcareous soils. We limit the use of "oldfield" to habitats on upland (i.e., non-wetland) soils. This profile focuses on shrub-dominated oldfields.

Vegetation

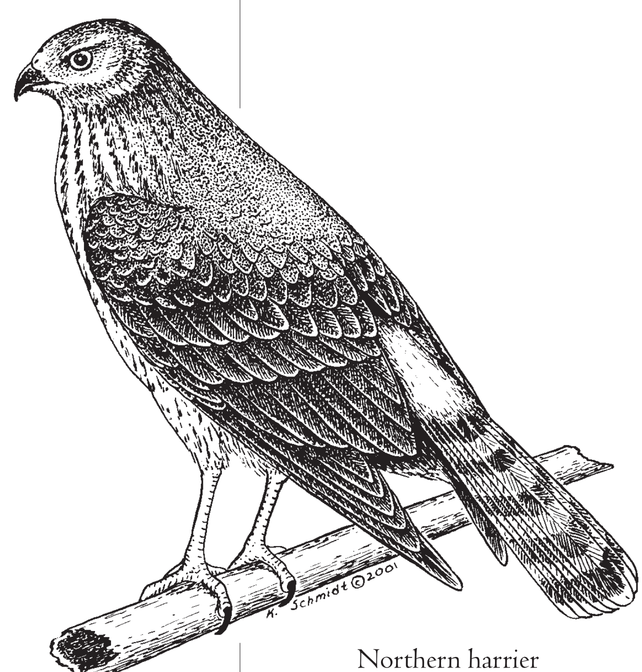
Species that are frequently prominent in our oldfields include goldenrods, asters, Kentucky bluegrass, orchard grass, little bluestem, gray dogwood, multiflora rose, prickly dewberry, bristly dewberry, northern blackberry, black raspberry, hawthorns, staghorn sumac, smooth sumac, eastern red cedar, gray birch, red maple, black locust, oaks, quaking aspen, and white pine. Any list of common oldfield species would be very long. Occasional, large, open-grown trees (e.g., American sycamore, black oak), left as shade for livestock, may be present.

Fauna

Meadow vole in herb-dominated areas; white-footed mouse in areas dominated by woody plants. Breeding birds include gray catbird, northern mockingbird, brown thrasher, American robin, willow flycatcher, blue-winged warbler, prairie warbler, American goldfinch, song sparrow. Eastern box turtle, northern black racer. Many butterflies, depending on presence of particular larval food plants and nectar plants.

Indicators and Identification

Identified by height of dominant plants (e.g., 0.2–2 m [0.7–6.5 ft]) and absence of many larger trees. Old fences or stone walls, or rows of mature trees along old fence lines, indicate former farm use. Species tolerant of livestock grazing or distasteful to livestock, such as eastern red cedar, black locust, and multiflora rose, are often common in formerly grazed fields.



Northern harrier
(Circus cyaneus)
48–61 cm (19–24 in)

Biodiversity Values

SPECIES OF CONSERVATION CONCERN. See Sect. 2.0 and App. 3 for rarity ranks.

	National Lists	State Lists	Regional Lists
Plants			
stiff-leaf goldenrod		•	
small-flowered agrimony		•	
shrubby St. Johnswort		•	
devil's-bit		•	
butterflyweed			•
Invertebrates			
aphrodite fritillary			•
dusted skipper		•	
Leonard's skipper			•
cobweb skipper			•
Birds			
northern harrier	•	•	
short-eared owl	•	•	
northern saw-whet owl		•	
loggerhead shrike	•	•	
blue-winged warbler	•		
golden-winged warbler	•	•	
prairie warbler	•		
yellow-breasted chat		•	
clay-colored sparrow	•	•	
vesper sparrow		•	
grasshopper sparrow		•	
Henslow's sparrow	•	•	

In dry, calcareous oldfields, watch for the rare plants otherwise associated with carbonate crests (see Habitat Profile for Carbonate Crest, Ledge, and Talus). Butterflyweed and yellow bedstraw (non-native) may be indicators of dry calcareous soils. Shrubby cinquefoil may occur on dry calcareous soils, although wet calcareous soils are its more typical habitat. Where calcareous springs or seeps occur, devil's-bit is possible. Wet or moist areas may support small-flowered agrimony. Shrubby St. Johnswort may occur in moist or dry oldfields (Town of Greenport). Stiff-leaf goldenrod has been found in a shrubby oldfield near the City of Hudson (Spider Barbour, personal communication).

Northern harrier, golden-winged warbler, yellow-breasted chat, clay-colored sparrow, grasshopper sparrow, Henslow's sparrow, and vesper sparrow are rare breeding birds that (at least in part) are associated with oldfields and that do or could occur in the study area. Northern shrike has been observed in an oldfield in winter, just outside the Hudson River corridor (Joseph T. Bridges, personal communication). Loggerhead shrike is a very rare breeder in shrubby fields with thorny shrubs or trees such as hawthorns. Dense groups of large red cedars may attract winter-roosting birds of prey (e.g., northern harrier, short-eared owl); northern saw-whet owl may nest in such groves. Aphrodite fritillary, a rare butterfly of dry fields, could occur in our region. Dry fields with little bluestem could have the bluestem-feeding skippers—dusted skipper and Leonard's skipper. Cobweb skipper occurs in high-elevation dry oldfields.

Reschke's (1990) "successional shrubland," and, in part, "successional old field" communities are included in this habitat type.

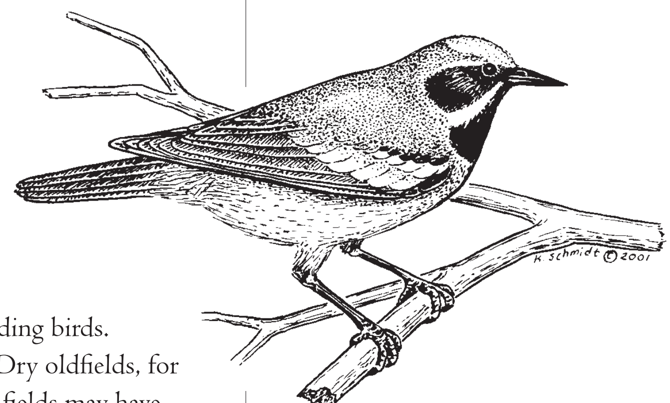
Substrates
Practically any upland substrate except bare rock.

Surface Waters
Oldfields may adjoin watercourses or wetlands, and may contain wet meadows, or intermittent or permanent pools in depressions.

Extent
Highly variable.

Distribution
Widespread at low and middle elevations.

Quality
More extensive fields often represent higher quality for shrubland-breeding birds. Otherwise, quality depends on the affinities of particular rare species. Dry oldfields, for example, may support any of several rare butterflies. Shrub-dominated fields may have rare shrubland-nesting birds.



Golden-winged warbler
(Vermivora chrysoptera)
13–14 cm (5–5.5 in)

Human Uses
Shrubby oldfields are used extensively for walking, birdwatching, other passive recreation, and All Terrain Vehicle (ATV) use.

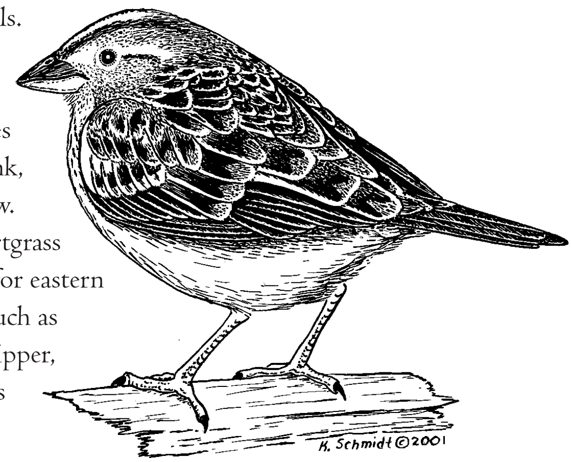
Sensitivities, Impacts
Oldfields are relatively tolerant of human disturbance. ATV use can destroy rare plant habitats, disturb nesting birds, and cause soil loss. Normal vegetation change (e.g., from shrubby oldfield to young woods) may be unfavorable for some rare species.

Conservation and Management
Although oldfields are generally tolerant of human use, areas known to support rare plants, rare breeding birds, or rare butterflies should be protected from human disturbance. Habitat of rare species may require management (e.g., infrequent mowing, selective removal of trees, prescribed fire) to retard development of tree cover. Transition of grassland to shrubland to young forest to mature forest to old growth forest presents a conundrum for management, as each type of habitat supports different elements of biodiversity.

Examples on Public Access Lands
Probably widespread on public access lands. Stewart Airport Buffer Lands (Town of New Windsor) . Small oldfields at Nutten Hook (Town of Stuyvesant), and north of the library at Bard College (Town of Red Hook).

7.31 Upland Meadow

THIS PROFILE INCLUDES HAYFIELD, PASTURE, CROP FIELD, fallow crop field, herbaceous oldfield, and mowed grassland, all on upland (non-wetland) soils. The most important types of field for rare species are the extensive grass or grass-and-forb dominated hayfields, pastures, mowed grassland, or herbaceous oldfield that serve as critical habitat for grassland-breeding birds. The bird species of particular interest are northern harrier, upland sandpiper, sedge wren, bobolink, eastern meadowlark, grasshopper sparrow, Henslow's sparrow, and vesper sparrow. Upland sandpiper and grasshopper sparrow have bred, for example, in mowed shortgrass habitat in Orange County. Fields and field edges are important feeding habitats for eastern bluebird. Dry herbaceous oldfield may be important habitat for rare butterflies such as aphrodite fritillary. Dry oldfields with lots of little bluestem may have dusted skipper, Leonard's skipper, or (at high elevations) cobweb skipper. Calcareous, herbaceous oldfield may support rare plants.



Grasshopper sparrow
(Ammodramus savannarum)
11–13 cm (4.3–5 in)

Biodiversity Values

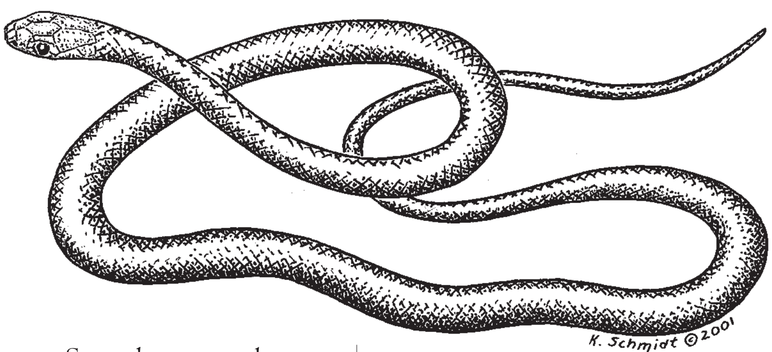
SPECIES OF CONSERVATION CONCERN. See Sect. 2.0 and App. 3 for rarity ranks.

	National Lists	State Lists	Regional Lists
Plants			
Bush's sedge		•	
Invertebrates			
aphrodite fritillary			•
dusted skipper		•	
Leonard's skipper			•
swarthy skipper			•
Birds			
northern harrier	•	•	
upland sandpiper	•	•	
sedge wren	•	•	
eastern bluebird			•
vesper sparrow		•	
grasshopper sparrow		•	
Henslow's sparrow	•	•	
bobolink	•		•
eastern meadowlark			•

Reschke's "cropland/row crops," "cropland/field crops," "pastureland," and (in part) "successional old field" communities are included in this habitat type.

Continued or modified management may be necessary to maintain field conditions for rare species. Mowing in late summer, for example, prevents dominance by woody species while allowing successful breeding by ground-nesting birds. Prescribed fire may be useful for management of some fields. Mowing or burning in rotation (every 2–3 years, or in alternating strips or patches) may promote conditions suitable for certain birds and butterflies. Experts should be consulted for advice on management of particular sites.

Upland meadows are widespread in the study area, and can be seen on many public-access sites; for example, at Nutten Hook (Town of Stuyvesant), Tivoli Bays (Town of Red Hook), Vassar Farm (Town of Poughkeepsie), and Iona Island (Town of Stony Point).



Smooth green snake
(Opheodrys vernalis)
36–51 cm (14–20 in)

7.32 Clay Bluff and Ravine

THIS HABITAT, WHICH OCCURS ON CLAYEY SOILS close to the Hudson River, is characterized by narrow ridges, steep-sided ravines cut by small streams, and steep bluffs fronting on the river. The clayey soils formed in prehistoric Lake Albany during the melting of the glaciers. Clay bluffs and ravines may support some of the habitat types profiled elsewhere in the *Manual* (e.g., Mature Mesophytic Lowland Forest, Shrubby Oldfield, Intermittent Stream); however, we describe Clay Bluff and Ravine separately because of unusual characteristics. Wet Clay Meadow (Sect. 7.10) habitats are not included here.

Vegetation

Steep areas near the river are typically forested. Common trees include sugar maple, American beech, chestnut oak, black oak, and flowering dogwood. Hemlock groves or stands develop on local areas of sandy soils, in ravines, and at stream mouths.

Fauna

These habitats are used by a variety of common and rare animals of forests and meadows. Breeding birds of forested clay bluffs and ravines include eastern screech-owl, American kestrel, Carolina wren, pileated woodpecker, and several rarer species listed below. Eastern box turtle is found in clay bluff habitats, but clayey soils are poor for small burrowing animals (e.g., moles and salamanders).

Indicators and Identification

Steep ravines with knife-edge ridges, and high bluffs facing the Hudson River, on Hudson or Hudson–Vergennes complex soils (see county soil survey). Heavy clay soils in fields below the 150 ft contour. Subsoil displays characteristic "varves" — layers of sediment indicating seasonal deposits of soil material.

Hackberry
(Celtis occidentalis)
leaves 6–12 cm (2.4–4.7 in)

Biodiversity Values

SPECIES OF CONSERVATION CONCERN. See Sect. 2.0 and App. 3 for rarity ranks.

	Federal Lists	National Lists	State Lists	Regional Lists
Plants				
goldenseal			•	
leatherwood				•
closed gentian				•
stiff gentian				•
northern white cedar				•
Amphibians and Reptiles				
eastern box turtle			•	
Birds				
osprey			•	
bald eagle	•		•	
Cooper's hawk			•	
barred owl				•
fish crow				•
winter wren				•
black-throated blue warbler		•		•
black-throated green warbler		•		•
cerulean warbler		•	•	
vesper sparrow			•	
grasshopper sparrow			•	
Henslow's sparrow		•	•	

Leatherwood has been found in clay ravines in Dutchess Co. A rare herb, goldenseal, has been found in a clay ravine at one Mid-Hudson location. The regionally-rare wildflowers, closed gentian (*Gentiana andrewsii*) and stiff gentian (*Gentianella quinquefolia*) have been found on clays near the river in Dutchess and Columbia Counties. Closed gentian is usually within a few meters of mean high water (MHW), and stiff gentian was found on the rim of an abandoned clay pit, but both species could occur elsewhere on the Hudson–Vergennes soil complex. Northern white cedar is not rare *per se* in our region, but it is virtually restricted to the bluffs and wetlands of the Hudson River, and, due to deer browsing, is not thriving.

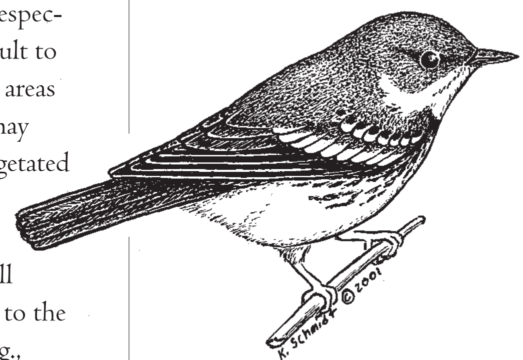
Rare and uncommon breeding birds of this habitat complex include Cooper's hawk, barred owl, fish crow, and cerulean warbler (see Species Profiles). Bald eagle, osprey, and fish crow use trees of clay bluffs on the Hudson River for hunting perches, and we know of one historic record of osprey nesting on a clay bluff. Breeding birds of clay bluff forests include black-throated green warbler, black-throated blue warbler, and winter wren.

Breeding grasshopper, Henslow's, and vesper sparrows were recorded by the late ornithologist Joseph Hickey on a Dutchess Co. clay bluff oldfield in the 1930s.

No rare communities are known. The steep, actively slumping and eroding clay bluffs on the river are unusual in our region, and may support uncommon plant species restricted to the river edge. Otherwise, these habitats are vegetated principally with common forest species. Reschke (1990) does not describe this community.

Substrates

Silty clay subsoils in which thin (several mm [≤ 0.25 in]) layers of clay and silt alternate. These are called "varved clays" and were deposited as winter and summer layers, respectively, in Lake Albany. The soils are deep, somewhat calcareous, "heavy" and difficult to farm, with thin topsoils. Steep, eroded, and often unstable (slumping and sliding) areas occur closer to the river, and gentle or level areas occur farther inland. Slumping may produce step- or terrace-like features, and sliding may produce smooth, sparsely vegetated scars with soil accumulations at their bases. Water collects in winter and spring on the level areas (see profile for Wet Clay Meadow), but all areas tend to be very dry in summer and early fall. Characteristic steep, V-shaped ravines eroded by small streams are separated by knife-like ridges which may run perpendicular or parallel to the river. Sands were deposited locally on top of the clays, and areas of sandy soils (e.g., Knickerbocker) of variable size persist, interspersed with clayey soils in complex patterns (Kiviat 1978b). The sandy areas, usually small, are included here with the clay bluff and ravine landscape, although the tree species composition and some of the fauna differ.



Cerulean warbler
(Dendroica cerulea)
11 cm (4.5 in)

Surface Waters

Small perennial or intermittent streams with clayey beds and, near the river, local areas of exposed bedrock; also widely spaced larger perennial streams with more extensive exposed bedrock. Small, ephemeral, shallow pools may form on level areas.

Extent

Very extensive (thousands of hectares/acres) in some regions.

Distribution

Coincident with the distribution of the Hudson–Vergennes soil complex derived from the sediments of postglacial Lake Albany. Occurring in and north of Ulster and Dutchess counties. From sea level at the Hudson River to the 150 ft (46 m) elevation contour.

Quality

Undeveloped forested areas of clay bluffs and ravines appear to have higher quality for biodiversity. Soil erosion from off-trail walking or vehicle use degrades quality.

Human Uses

Formerly much used for livestock grazing, brick production (with associated clay and sand mining), and other local industry and transportation infrastructure, as well as for ornamental landscaping purposes. The clay bluff and ravine complex in the Hudson River corridor is now mostly forested. There are still some non-forested areas on working farms, e.g., in Columbia County and Dutchess County. Many areas are on institutional properties (schools and religious institutions) and on other large private tracts. During the 1800s and early 1900s, where steep bluffs fronting on the river were forested, land owners kept "vistas" or "viewways" open between mansions and the river. Since the 1970s, many private and institutional land owners have re-cleared historic vistas in conjunction with other historic landscape restoration activities.

Sensitivities, Impacts

Cleared areas on the clay bluffs are very prone to erosion, slumping, and sometimes sliding. The cleared vistas are also highly vulnerable to dominance by invasive plants, particularly ailanthus. Some clay bluff and ravine areas are subject to erosion along foot and bicycle trails. Construction of new buildings in some areas has resulted in removal of patches of forest or large trees, as well as noise and visual disturbance to forest wildlife and siltation into the ravines and their streams.

Conservation and Management

We encourage the conservation of extensive forested areas on the clay bluffs and ravines. Forests will continue to support the rare species and protect the sensitive soils from accelerated erosion and slumping. Any new construction should be sited on level, dry, open areas, avoiding forests and wet meadows associated with clay bluffs and ravines. Control of soil erosion and sedimentation is critical. Trail design and maintenance requires special consideration of the sensitive soils; log steps, bridges over streams, and design on the contour (e.g., with switchbacks) are often necessary. Measures are needed to keep pedestrians, bicycles, and All Terrain Vehicles (ATVs) on trails. It may be necessary to close the more sensitive trails to wheeled vehicles because clay soils, when wet, do not tolerate tires well. Similarly, use of trails as bridle paths must be planned on a site-by-site basis with regard to the erosion potential. Because clay ravines and their streams are affected by upstream land use as well as by activities on the ravine walls and the ridges, stormwater management and non-point source pollution management in these small watersheds are important.

Examples on Public Access Lands

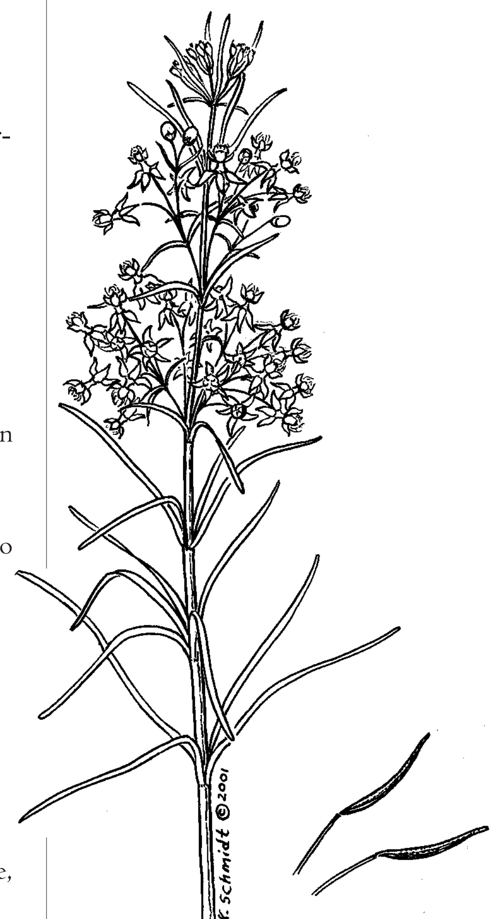
An extensive clay bluff and ravine landscape may be seen at the Tivoli Bays (Town of Red Hook). Clay bluff and ravine may also be seen at Poet's Walk (Town of Red Hook), Montgomery Place (Town of Red Hook), Wilderstein (Town of Rhinebeck), and Greenport Conservation Area (Town of Greenport).

7.33 Non-Carbonate Crest, Ledge, and Talus

THIS PROFILE COVERS ROCKY AREAS ON KNOLLS, hillsides, and hilltops, with exposed non-carbonate bedrock, shallow soils, and sparse vegetation, and includes ledges, cliffs, scree, and talus. Scree is an accumulation of small rock fragments or gravel on a steep slope or at the base of a cliff or slope; talus is an accumulation of large rock fragments, blocks, or boulders on a steep slope or at the base of a slope or cliff.

Bedrock types other than carbonates predominate in the study area, including diabase, granite, gneiss, schist, quartzite, sandstone, slate, and shale, approximately in order from harder to softer rocks. Crest habitats are "harsher" (i.e., more extreme in dryness and infertility) on the harder rocks. Habitats on non-carbonate bedrock, or on shallow soils over non-carbonate bedrock are widespread in the study area, with concentrations near the Hudson River (including on bedrock islands) and in mountainous areas, particularly the Hudson Highlands and the New York Palisades.

Non-carbonate crest habitats are important for rare plants and rare animals (mammals, birds, reptiles, and invertebrates), as well as for recreation and scenery. Abandoned quarry habitats in the same rock types resemble these crests but tend to be more extensively barren and less likely to support rarities. Some of the flora is common to unconsolidated waste ground habitats such as railroad verges and fill, but, unlike crests, waste grounds tend to be conspicuously dominated by introduced weeds. Sandstone and shale crests grade into the Estuarine Rocky Shores and Rocky Islands of the Hudson River (Sects. 7.2 and 7.7), where microclimates are generally more humid.



Whorled milkweed
(Asclepias verticillata)
2–5 dm (8–20 in)

Vegetation

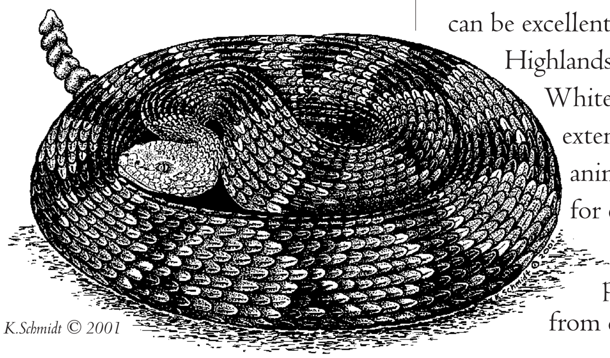
Vegetation may be dominated by trees, shrubs, or herbs; often crest vegetation is a patchwork of all three, somewhat like oldfields. The trees are generally stunted although medium-size (e.g., 6 m [20 ft] tall) trees occur on pockets of deeper soil between ridges. Trees are normally under 30 cm (12 in) dbh. Many dead or damaged trees are often present. Among the most typical trees on harder bedrock are red oak, chestnut oak, red maple, and pitch pine. Other trees include paper birch, mountain paper birch, black birch, gray birch, pignut hickory, white ash, hop-hornbeam, serviceberry (shadbush), pin cherry, striped maple, mountain maple, American mountain-ash, white pine, and eastern red cedar. Typical trees on softer bedrock (e.g., sandstone and shale) are basswood, sugar maple, white ash, hackberry, chestnut oak, and American beech.

Low or tall shrubs often form patches or thickets; shrubs are taller on deeper soil in more sheltered locations. Common shrubs are scrub oak, low blueberries, huckleberries, chokeberries; bearberry is occasional.

Herbaceous communities are often dominated by Pennsylvania sedge or by grasses, especially little bluestem, hairgrass, or poverty grass. Common forbs include downy and other goldenrods, bristly sarsaparilla, rock-cresses and rock polypody. Foliose and crustose lichens may be abundant. Mosses are usually present in small patches.

Fauna

Crevice-using animals (e.g., winter wren, porcupine, small mammals, several species of snakes) are associated with ledge-and-talus formations. Smaller species of cavity-using animals are associated with damaged or dead trees, especially oaks. Sedimentary rock crests can be excellent habitat for mole salamanders. Non-carbonate crests (e.g., Hudson Highlands, Palisades) constitute many of the important pathways for migrating hawks. White-tailed deer may "yard" in winter on south-facing wooded slopes. The very extensive forests of crests in the Hudson Highlands may act as a reservoir for animals that do poorly in forest fragments; migratory forest-interior songbirds, for example, would use the extensive forested crests with larger trees and less extreme conditions. Animals requiring deep soils, large or deep wetlands, permanent water, well-developed forests, or large trees are generally absent from crests.



Timber rattlesnake
(Crotalus horridus)
91–137 cm (36–54 in)

Indicators and Identification

Rugged topography supporting crests, ledge, or talus is readily identified on topographic maps; local relief exceeding 10–20 m (35–65 ft) almost always indicates rock-dominated terrain, whereas local relief under 20 m (65 ft) may be rock-dominated or soil-dominated (e.g., clay bluffs). Extensive, rugged, forested areas with few or no streams and few small ponds or wetlands are usually crest terrains. Surface soil pH (as reported in soil surveys) less than 6.6 indicates non-carbonate bedrock. Bedrock geology maps show carbonates and non-carbonates in general (see Table 18), but some gneisses, schists, and granites and other non-carbonates may have calcareous components (McCrone 1967).

In the field, crest habitats show abundant exposed rock (bedrock or fragments) and shallow soil. Vegetation is generally sparse with the tree canopy open or absent. Xerophytic (dry-adapted) herbaceous species, such as rock spikemoss, hairgrass, and low blueberries are typical. Non-carbonate rocks tend to have less cover of mosses and lichens (if moisture is equal) than carbonate rocks.

Biodiversity Values

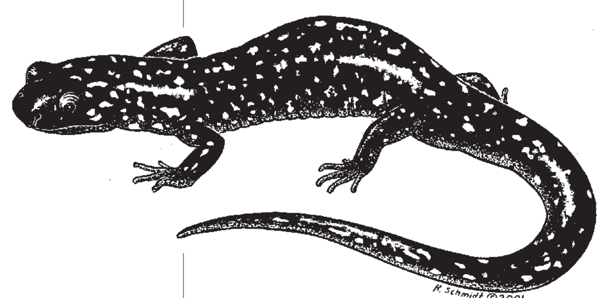
SPECIES OF CONSERVATION CONCERN. See Sect. 2.0 and App. 3 for rarity ranks.

	National Lists	State Lists	Regional Lists
Plants			
mountain spleenwort		•	
walking fern			•
rock spikemoss			•
Bicknell's sedge		•	
bronze sedge			•
clustered sedge		•	
reflexed sedge		•	
whorled milkweed			•
blunt-leaf milkweed			•
eastern prickly-pear			•

(continued)

SPECIES OF CONSERVATION CONCERN (cont.)	National Lists	State Lists	Regional Lists
whorled milkwort			•
rock sandwort			•
downy arrowwood			•
goat's-rue			•
slender knotweed		•	
dittany		•	
Torrey's mountain-mint		•	
Allegheny-vine			•
bearberry			•
three-toothed cinquefoil			•
stiff-leaf aster			•
Invertebrates			
Edward's hairstreak		•	
falcate orange tip			•
striped hairstreak			•
brown elfin			•
olive hairstreak			•
northern hairstreak		•	
gray hairstreak			•
Horace's duskywing			•
swarthy skipper			•
Leonard's skipper			•
cobweb skipper			•
dusted skipper		•	
Amphibians and Reptiles			
eastern box turtle		•	
five-lined skink		•	
eastern fence lizard		•	
black rat snake			•
northern copperhead		•	
eastern hognose snake		•	
timber rattlesnake		•	
worm snake		•	
slimy salamander			•
marbled salamander		•	
Fowler's toad			•

(continued)



Slimy salamander
(Plethodon glutinosus)
12–17 cm (4.7–6.7 in)

Slender knotweed
(Polygonum tenue)
1–4 dm (4–16 in)

SPECIES OF CONSERVATION CONCERN (cont.)

	National Lists	State Lists	Regional Lists
Birds			
turkey vulture (nesting)			•
golden eagle		•	
peregrine falcon		•	
whip-poor-will	•	•	
common raven			•
winter wren			•
eastern bluebird			•
hermit thrush			•
Nashville warbler			•
Blackburnian warbler	•		•
cerulean warbler	•	•	
worm-eating warbler	•		•
Mammals			
small-footed bat		•	
eastern woodrat		•	
boreal redback vole			•
longtail shrew			•
porcupine			•
fisher			•
bobcat			•

Numerous rare plants occur on non-carbonate crests (see table above). Mountain spleenwort occurs outside the study area on both sides of the river, and could occur in similar habitats in the Hudson Highlands or, for example, Schunemunk Mountain. Eastern prickly-pear occurs on 30–40 non-carbonate crests in or just outside the study area.

Whorled milkweed, blunt-leaf milkweed, rock sandwort, stiff-leaved aster, harebell, and downy arrowwood occur on sandstone and shale crests. Three-toothed cinquefoil may occur on the most exposed summits of non-carbonate crests.

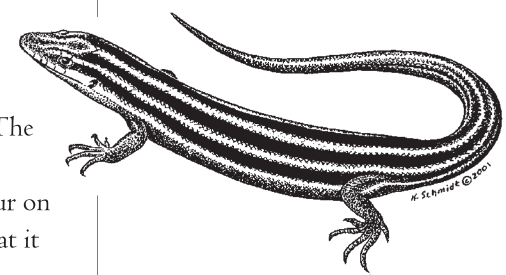
Non-carbonate crests are very important to rare and uncommon mammals, such as bobcat, fisher, porcupine, and boreal redback vole. Small-footed bat has been reported in rocky terrain and could occur on crests and talus in the study area. Longtail shrew occurs on talus slopes of the Northern Shawangunks and could be in similar habitats in the Hudson Highlands or Palisades. Eastern woodrat, believed extirpated from New York, formerly occurred in the Hudson Highlands, Taconics, and Northern Shawangunks. It still persists in the New Jersey Palisades, and could reappear in New York in the future.

Breeding birds include Blackburnian warbler, cerulean warbler, worm-eating warbler, eastern bluebird, hermit thrush, winter wren, common raven, peregrine falcon, and turkey vulture. Golden eagle regularly winters near the study area, and may have nested in the Hudson Highlands in the past (Mearns 1881). Black vulture has nested in the Shawangunks, just outside the study area (Joseph T. Bridges, personal communication).

Reptiles and amphibians include timber rattlesnake, northern copperhead, eastern hognose snake, black rat snake, worm snake, eastern fence lizard, five-lined skink, eastern box turtle, slimy salamander, and marbled salamander. Fowler's toad could occur in this habitat in the study area.

West of the Hudson, the falcate orange tip butterfly occurs where rock-cresses are abundant.

Communities of non-carbonate crests include Reschke's (1990) "acidic talus slope woodland," "shale talus slope woodland," "shale cliff and talus community," "rocky summit grassland," and "cliff community." Reschke does not describe the sandstone crest communities that are included here.



Five-lined skink
(Eumeces fasciatus)
13–20.5 cm (5–8 in)

Substrates

Bedrock, talus (accumulations of broken rock), or shallow glacial tills over bedrock. The "harshest" habitats occur on the hardest, most resistant bedrock types with the most rugged topography: diabase, granite, gneiss, schist, quartzite. Less harsh habitats occur on sandstone, and locally on siltstone, mudstone, argillite, and shale. Shale is so weak that it rarely forms extensive outcrops, and shale crest habitats are relatively "mild."

Carbonate erratics are sometimes located near non-carbonate crests, supporting localized communities of calcicolous (limy soil inhabiting) plants. Also, non-carbonate rocks may contain significant amounts of calcium carbonate or other calcium salts. Many graywackes (carbonaceous sandstones), for example, appear to be somewhat calcareous, and some of the rocks in the Hudson Highlands (e.g., calcsilicate, amphibolite) seem to be "sweeter" (less acidic) than other rocks. Thus, non-carbonate bedrock types and the crests that form there actually grade into carbonates with respect to soil pH and other ecological characteristics. This phenomenon is not clearly understood in our region. Some of the rare species of non-carbonate crests could actually be associated with mildly calcareous soils in those situations. Soils in recently burned areas also appear to favor some calcicolous plants (Spider Barbour, personal communication).

Soils may be derived from weathering of the bedrock *in situ*, or from glacial till or outwash. Some of the crests are small enough or narrow enough that they have been omitted from soil and geologic maps. Shallow soils on steep slopes and summits are usually highly erodible.

Surface Waters

Some crests border the Hudson River, lakes, or ponds, but surface waters and wetlands are scarce on the crests themselves. If present at all, waters include small ephemeral or intermittent pools and intermittent streams. Rarely are there larger streams or ponds. Surface waters are expected to be acidic.

Extent

Crest habitats may be patchy or extensive, from a few square meters to more than 100 ha (e.g., 200 ft^2 to >250 ac). Crests often occur as linear features or clusters of linear features.

Distribution

Very widespread in study area; range from sea level (Hudson River) to 430 m (1420) elevation at Bull Hill, and other high summits of the Hudson Highlands.

Quality

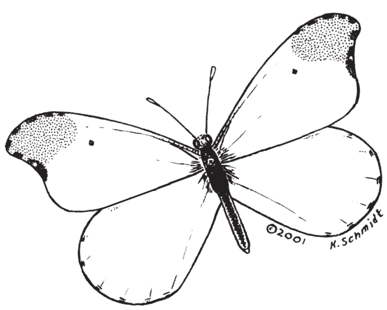
Higher quality of non-carbonate crests is often related to extent (i.e., larger areas are better quality for biodiversity), moderate to low levels of vegetation cover, and absence of major development (buildings, transportation and communications infrastructure, reservoirs, etc.). Less trail erosion or other human-caused soil loss may indicate better quality. Signs of vegetation fires (charred wood) may also indicate better quality. Quality is not to be confounded with environmental "harshness" as rare species inhabit very harsh as well as moderately harsh crest habitats.

Human Uses

Non-carbonate crests are used for recreation (hiking, cycling, motorized All Terrain Vehicle use, skiing, birdwatching, hunting, climbing), timber harvest, mining, water storage, residential structures, and communications towers.

Sensitivities, Impacts

Erosion along foot trails, logging skid trails, and dirt roads has severe impacts on fragile, shallow soils which are difficult or impossible to repair or restore. Off-road vehicles, motorized and not, often cause more erosion than hikers, although heavily used hiking trails in our region commonly show areas of significant soil erosion. Recreation often results in vegetation fires during dry periods (whether fires have a detrimental or beneficial impact varies locally.) Construction of homes and other facilities causes fragmentation of habitats. Because many animal and plant populations are at low densities in crest habitats with infertile soils and low ecological productivity, the extent and connectivity of habitats may be more important than on deeper soils at lower elevations. Human activity above the nest ledges of peregrine falcon may cause nest abandonment (Hickey 1969). Human developments near snake winter den sites often causes conflicts between snakes and humans (which results in death of, or collecting of, snakes). Lighted communications towers attract and kill nocturnally migrating birds. Crest habitats may be especially sensitive to acidic precipitation, and may be susceptible to harm from local air pollution.



Falcate orange tip
(Anthocharis midea)
forewing 1.6–2.1 cm (0.6–0.8 in)

Conservation and Management

Recreational, extractive, and other land uses should be designed to minimize habitat fragmentation, soil erosion, direct and indirect disturbance to wildlife, and other ecological damage to crest, ledge, and talus habitats. Existing eroded areas, abandoned buildings, and other derelict or damaged areas need ecological restoration. In some cases, vegetation management may be advisable to prevent eventual overgrowth and shading of rare plants by tall woody vegetation. Prescribed burning of crests needs investigation.

Examples on Public Access Lands

Mountain areas have been foremost in open space preservation in our region, thus many non-carbonate crests are in public or public-access ownership. Among these parks and reserves are Tallman Mountain State Park, and Rockland Beach State Park (Rockland Co.), Blue Mountain Reservation (Westchester Co.), Hudson Highlands State Park (Putnam, Orange, and Dutchess counties), Bear Mountain State Park and Harriman State Park (Orange and Rockland counties), Black Rock Forest Preserve and Schunemunk Mountain (Orange Co.), Breakneck Ridge (Dutchess and Putnam counties), Fishkill Ridge Conservation Area (Dutchess Co.), Shaupeneak Ridge (Ulster Co.). Public lands at Cruger Island and Magdalen Island (Tivoli Bays, Dutchess Co.), Nutten Hook Reserve (Columbia Co.), and Iona Island (Rockland Co.) have crests near sea level.

References

McVaugh (1958), Wyckoff (1971), Kiviat (1978, 1994a, 1997a), Mitchell and Tucker (1993), Barbour (1995a,b, c, 1996, 1997), Mitchell et al. (1995).

7.34 Carbonate Crest, Ledge, and Talus

THIS HABITAT TYPE REFERS TO ROCKY HILLS OR RIDGES of all sizes that are underlain by "carbonate" rock, that is, limestone, marble, and similar types of rock composed mainly of calcium carbonate (or magnesium carbonate and calcium carbonate together in dolostone).

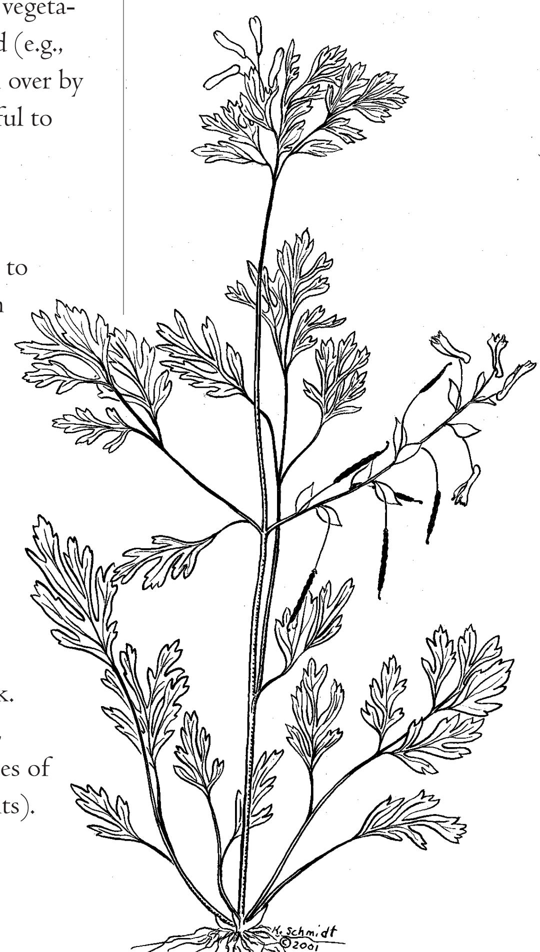
Carbonate crests include small and large bedrock outcrops, knolls, hills, ridges, cliffs, ledges, talus (slide rock), rock houses (rock shelters), and erratics (isolated boulders or blocks). Carbonate crests tend to be more densely vegetated than non-carbonate crests, and have less bare rock exposed. Some sandstone bedrock contains enough calcium carbonate to support some of the rare species that occur on carbonate bedrock. Some metamorphic and igneous rocks (e.g., calcsilicate, amphibolite) in the Hudson Highlands contain calcium compounds other than calcium carbonate; ecological similarities to carbonate rocks are unclear.

Like non-carbonate crests, carbonate crests have shallow, droughty soils, are exposed to the brunt of winter and summer weather, and generally are difficult places for plants to grow. Vegetation may be sparse with large areas of bare rock exposed. If not too rugged, however, some carbonate crests are overgrown by dense tall red cedars or other tall vegetation, shading out some of the rare plants that occur on carbonates. Once disturbed (e.g., by clearing of vegetation or removal of soil), carbonate crests are likely to be taken over by weedy plants such as garlic-mustard or Japanese barberry, which may also be harmful to rare native plants.

Vegetation
Ranges from bare rock, to lichen or moss-covered rock, to grass or forb dominance, to (occasionally) shrub thickets, to tree groves or forest. Common trees include eastern red cedar (very important), hackberry, basswood, white ash, maples, oaks, and others. Common shrubs are Japanese barberry, bladdernut, prickly-ash, roundleaf dogwood, and black-haw (especially southwards).

Fauna
Many common animals occur indiscriminately on carbonate and non-carbonate crests, and other areas with dry soils.

Indicators and Identification
Using geology maps and soil maps in combination with topographic maps, identify carbonate crests as hills or knolls with shallow soils and carbonate bedrock. In the field, look for abundance of calcicolous plants such as hackberry, basswood, prickly-ash, bladdernut, ebony spleenwort, maidenhair spleenwort, and other species of dry calcareous soils (see Appendix 5 for plant indicators of calcareous environments).



Yellow harlequin
(Corydalis flavula)
1–3 dm (4–12 in)

Biodiversity Values

SPECIES OF CONSERVATION CONCERN. See Sect. 2.0 and App. 3 for rarity ranks.

	State Lists	Regional Lists
Plants and Fungi		
Geastrum pectinatus (fungus)		•
walking fern		•
purple cliffbrake		•
side-oats grama	•	
Emmons' sedge	•	
yellow wild flax	•	
Carolina whitlow-grass	•	
devil's-bit	•	
hairy rock-cress		•
yellow harlequin	•	
Dutchman's-breeches		•
pellitory		•
blazing-star	•	
small-flowered crowfoot	•	
roundleaf dogwood		•
Invertebrates		
anise millipede		•
falcate orange tip	•	
olive hairstreak		•
Amphibians and Reptiles		
five-lined skink	•	
eastern hognose snake	•	
northern black racer		•
black rat snake		•
northern copperhead	•	
timber rattlesnake	•	
long-tailed salamander	•	

An extremely rare earthstar fungus, *Geastrum pectinatus* has been found on a limestone boulder just outside the study area, and could be found here also. Some of the plant species listed above have been documented on "marble knolls" in the Harlem Valley and not yet in the study area, but could occur here as well.

The "anise millipede" (*Apheloria virginiensis*) may be regionally significant. Calcareous talus provides overwintering habitat for northern black racer, black rat snake, eastern hognose snake, and northern copperhead. The extent to which timber rattlesnake and five-lined skink use carbonate crests is unknown. On the west side of the Hudson River, long-tailed salamander could occur in moist areas (as it does in Sussex Co., New Jersey). Clusters of dense, tall red cedars are likely to attract birds of prey (see Habitat Profile for Shrubby Oldfield).

Reschke's (1990) "calcareous cliff," "calcareous talus slope woodland," "red cedar rocky summit," and "calcareous shoreline outcrop" communities are included in this habitat type.

Substrates

Limestone (sedimentary rock composed of calcium carbonate), dolostone (sedimentary rock composed of calcium and magnesium carbonates), and marble (metamorphosed calcium carbonate). Dolostone may be harder, and seems less attractive to calcicolous (lime-associated) species than limestone.

Surface Waters

Generally lacking in surface waters due to small size, rugged topography, and abundance of crevices and joints in many areas.

Extent

Variable. Generally less extensive than non-carbonate crests in the region.

Distribution

Carbonate crests are restricted to areas of carbonate bedrock. Among the larger areas are Verplanck Point (Westchester Co.), Soap Hill and vicinity (Ulster Co.), Becraft Mountain (Columbia Co.), and portions of the "Kalkberg" or lime belt (cement belt) from East Kingston in Ulster Co. north into Greene Co.

Quality

Areas with interspersed bare rock or herbaceous cover and groves of trees (especially red cedar) or shrub thickets seem to be of higher quality for biodiversity. Areas recently disturbed by removal of vegetation or soil, or invaded by weedy introduced plants, are of lower quality. Fire or light grazing by livestock may not be harmful.

Human Uses

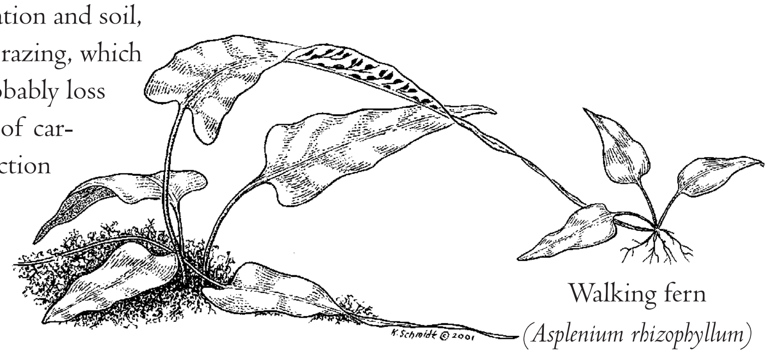
Carbonate crests are used for recreation (hiking, cycling, All Terrain Vehicle use, skiing, hunting, birdwatching, and climbing), timber harvest, mining, water storage, residential structures, and communications towers. Livestock grazing, once a prominent use of crests, is now declining.

Sensitivities, Impacts

Carbonate crests are especially sensitive to removal of vegetation and soil, or soil damage from ATVs, heavy pedestrian use, or heavy grazing, which lead to invasion by weedy exotic (non-native) plants and probably loss of rare native species. Construction activities in the vicinity of carbonate crests are likely to cause impacts beyond the construction footprint.

Conservation and Management

Recreation, extractive uses, and other land uses should be



Walking fern
(Asplenium rhizophyllum)
leaves 5–30 cm (2–12 in)

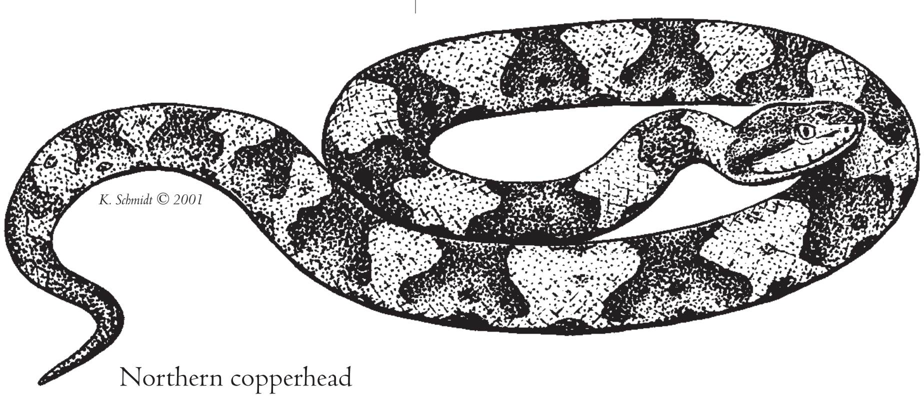
designed to minimize habitat fragmentation, soil erosion, direct and indirect disturbance to wildlife, and other ecological damage to crest, ledge, and talus habitats. Existing eroded areas, abandoned buildings, and other derelict or damaged areas need ecological restoration. In some cases, vegetation management may be advisable to prevent eventual overgrowth and shading of rare plants by tall woody vegetation. Fire ecology of carbonate crests needs investigation. Because soils of carbonate crests are highly erodible, and many of the rare plants are probably sensitive to treading and soil damage, any trail design should carefully avoid vulnerable areas.

Examples on Public Access Lands

Extensive carbonate crests occur around the Great Vly Wildlife Management Area in towns of Saugerties and Catskill, in part on state lands.

References

Barbour (1987).

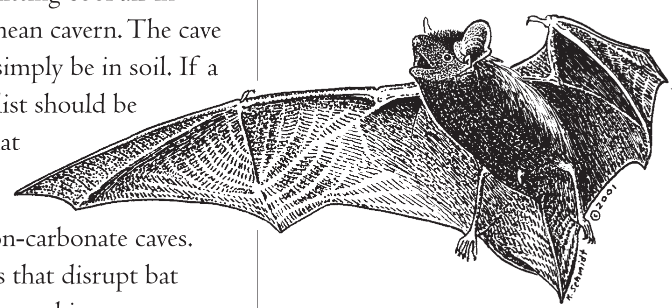


Northern copperhead
(Agkistrodon contortrix)
average length 0.6–0.9 m (2–3 ft)

7.35 Caves and Mineshafts

CARBONATE CAVES (LIMESTONE CAVERNS) IN THE STUDY AREA are rare and small, and very little is known about their biology. The carbonate beds in this region are too thin to allow extensive formation of caverns. Also, dolostones and marbles (more extensive here than limestones) do not form caverns as readily as limestone. Caves may provide roosting or hibernating sites for bats, and may also support rare invertebrates. The federally endangered Indiana bat, for example, hibernates in limestone caves in the Hudson Valley. Bats will also use abandoned mineshafts in non-carbonate bedrock. Mineshafts are scarce in the study area; most are relics of iron mining in the Hudson Highlands in the 1800s. We have no information on comparative habitat values for invertebrates, and assume that mine shafts are important for invertebrate species different from those in carbonate caves.

All carbonate formations should be inspected for caves. Cave entrances may be recognized as a hole in the ground, or a cleft in a ledge, often small, and often emitting cool air in summer. A disappearing stream may signal the presence of a subterranean cavern. The cave entrance may be in or adjoining an obvious bedrock outcrop, or may simply be in soil. If a cave is located, assistance from an amateur or professional cave specialist should be sought. Specialists may be able to locate and explore cave entrances that would be obscure or dangerous for inexperienced persons.



Silver-haired bat
(Lasionycteris noctivagans)
forearm 42 mm (1.7 in)

Conservation and management issues are similar for carbonate and non-carbonate caves. Mining activities close to cave habitats can cause physical disturbances that disrupt bat communities. Spelunking can also be disruptive, and should be discouraged in caves known to be used by bats. Structural and groundwater characteristics of carbonate and non-carbonate bedrock are different, so there may be differing susceptibilities to groundwater pollution.

These habitats include Reschke's (1990) "mine/artificial cave" and "terrestrial cave" communities.

SPECIES OF CONSERVATION CONCERN. See Sect. 2.0 and App. 3 for rarity ranks.

	Federal Lists	State Lists	Regional Lists
eastern pipistrelle			•
Indiana bat	•	•	
Keen's bat			•
silver-haired bat			•
small-footed bat		•	
eastern (Allegheny) woodrat		•	

7.36 Sand Plains and Barrens

By Spider Barbour

THESE ARE WOODY-DOMINATED HABITATS on deep, glacial sands (usually derived from the bottoms of drained glacial lakes), typically with open-canopy, oak-pine forests or dwarf, oak-heath shrubland with scattered trees (oaks and pitch pine). The sandy soils are generally nutrient-poor and moderately well drained to somewhat excessively drained, creating poor growing conditions for most plant species. Sand plains, more than other habitats, are periodically swept by fires, which may kill the tops of woody plants, but not the root crowns from which new shoots rapidly grow. Topography may be flat or hilly, the result of former moving dunes now stabilized by the overlying vegetation. Barrens may contain streams, wetlands, vernal pools and patches of mesophytic forest (in moist places such as stream valleys), grassland, or bare sand with only mosses and lichens. Herbs are few, but include species not found in other habitats. Sand barrens wetlands tend to be acidic, and range from red maple–highbush blueberry swamp to open sphagnum bogs. These habitats support many rare plants and animals, and are sensitive to invasion by exotic plants, particularly in the absence of fire. Fire suppression in sand barrens near residential areas (e.g., Albany Pine Bush) has resulted in replacement of native species by exotics.

Vegetation

Pitch pine is the most common conifer, and may grow in dense thickets of small trees (dwarf pine plains), in forests with oak trees, or as sparse, emergent trees over dense scrub oak thicket. Dwarf chestnut oak occurs in interdunal basins where frost often kills off the earlier-emerging leaves of scrub oak. Heaths, especially blueberries and black huckleberry, are another frequent component of the shrub layer. Edges, recent disturbances, and active dunes often have grasses, especially little bluestem, and forbs such as wild lupine, dotted horsemint, silverweed and jointweed. Gray birch and bracken are common. The most common oaks in sand plain habitats are scarlet oak and chestnut oak, with white oak, black oak and red oak less frequent. Sand plain swamps in New York are nearly always red maple swamps, sometimes with tupelo or sassafras, the understory consisting primarily of highbush blueberry. Peat moss is common in swamps and open bogs. The latter habitat is likely also to have cottongrass, sundews, pitcher-plant and *Carex* sedges, 70 species of which have been reported from the Albany Pine Bush.

Fauna

Characteristic vertebrates of dry sands include prairie warbler, eastern towhee, Fowler's toad, eastern spadefoot toad, eastern hognose snake, eastern worm snake, and numerous small mammals. Spring azure, eastern tailed blue, pine elfin, brown elfin, tiger beetles, cicada-killer (wasp), digger bees, cicadas, pygmy grasshoppers, and yellow-winged short-horned grasshoppers are characteristic invertebrates. Pine barrens bogs are homes for common frogs (green frog, bullfrog, wood frog) and many species of dragonflies and damselflies.

Inland barrens buck moth
(Hemileuca maia ssp.3)

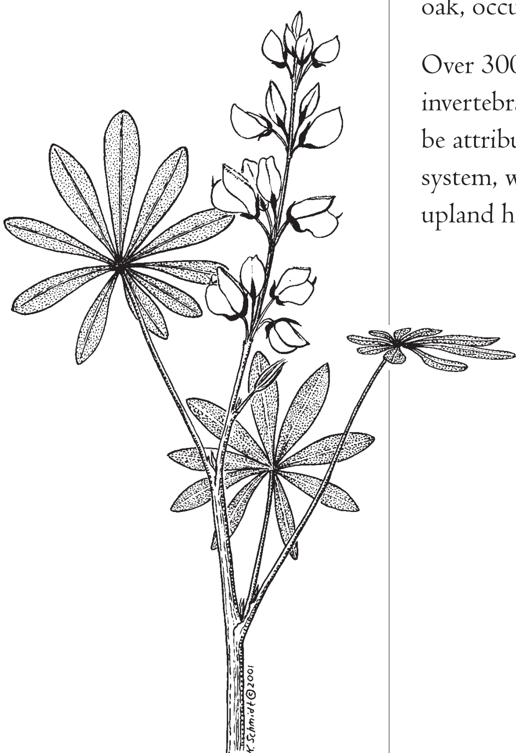
Indicators and Identification

The sandy soils are usually exposed and visible. Vegetation is characteristically fire-stunted, the mixture of oaks and pines and the shrub thicket understory visually distinctive. Nearly identical communities occur on some rocky summits in the study area, but the substrate, topographic context, and shallow soils distinguish the rocky summits from sand plains.

Biodiversity Values

Sand plain communities are in themselves rare and specialized. Most of the dominant plants can be found, at least in low numbers, in other habitats (e.g., acidic crests), but the deep, sandy soils support greater biodiversity of non-woody plants and other groups of organisms. Herbs such as wild lupine, sandspur, purple boneset, eyebane, stiff gentian, dotted horsemint and blunt-leaf milkweed do not occur naturally on rock substrates. Insects that depend on these plants are absent from barrens habitats lacking these essential plants. In the Northeast, even buck moth, which in the larval stage feeds on leaves of scrub oak, occurs almost exclusively in sand barrens and rarely in rocky barrens.

Over 300 species of vertebrates, over 1,500 species of plants, and over 10,000 species of invertebrates have been reported from the Albany sand plains area. This high diversity may be attributed to the variety of habitats contained within the general realm of the dunes system, which includes stream ravines, frost pocket basins and wetlands, as well as dry upland habitats.



Wild lupine
(Lupinus perennis)
2–6 dm (8–24 in)

SPECIES OF CONSERVATION CONCERN. See Sect. 2.0 and App. 3 for rarity ranks.

	National Lists	State Lists	Regional Lists
Plants			
giant pine-drops		•	
false gromwell		•	
clustered sedge		•	
pink wintergreen		•	
wild lupine			•
Invertebrates			
Karner blue (butterfly)	•	•	
dusted skipper (butterfly)		•	
inland barrens buck moth		•	
Amphibians and Reptiles			
eastern spadefoot toad		•	
Fowler's toad			•
wood frog			•
eastern hognose snake		•	

Giant pine-drops is recorded in New York only from the Albany Pine Bush. False gromwell, clustered sedge, and pink wintergreen are found in sand barrens and other dry habitats. All are reported from the Albany Pine Bush.

The most noteworthy rare animal species of sand barrens are the Karner blue (butterfly), inland barrens buck moth, eastern hognose snake, and eastern spadefoot toad.

Reschke (1990) describes four sand barrens communities, three of which occur in the Hudson Valley. The three types—pitch pine-scrub oak barrens, pitch pine-oak-heath woodland and pitch pine-heath barrens—occur in the Albany Pine Bush as parts of the larger mosaic, while smaller sand barrens areas may be of a single type. The distinctions are not great, consisting primarily of variations in vegetational structure.

Substrates

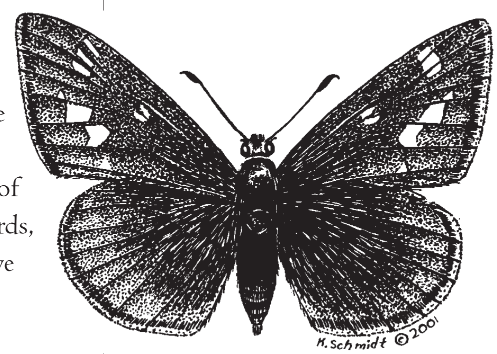
Sand or a mixture of sand and gravel (stream outwash plains) comprises the entire soil profile in most sand plain areas. Wetland basins may have deep organic soils (such as Adrian muck), or mineral soils (such as Granby loamy fine sand). The predominant upland soils are mapped as Colonie loamy fine sand, and Elnora loamy fine sand in the county soil survey.

Surface Waters

Wetlands, ponds, and small perennial or intermittent streams may be present. One perennial stream, the Hunger Kill, runs through the Albany Pine Bush. Wetlands and pools of sand barrens tend to have acidic waters due to the lack of carbonate buffering, and to the accumulation of tannin-rich plant debris, especially from heaths and pines.

Extent

The only major sand barren in the study area is the Albany Pine Bush just west of the City of Albany, with 1600 ha (4000 ac) of its original 16,200 ha (40,000 ac) remaining in preserves and undeveloped parcels. Outside the study area, little is left of the Rosendale Sand Plains (Ulster Co.) except for a few pitch pines in residential yards, and there is almost no documentation of the original natural habitat, which may have covered 200 ha (500 ac) or more.



Dusted skipper
(Atrytonopsis hianna)
forewing 1.5–1.8 cm (0.6–0.7 in)

Distribution

The geographic range of sand barrens habitats is from New Hampshire and Rome, New York, south to northern Florida and west to the Great Lakes (with different regional plant species assemblages, but similar vegetational structure). In New York, and most other areas, sand plains are restricted to broad valleys (30–200 m [100–650 ft] elevation) where glacial lake sands accumulated during the late Pleistocene era. Albany County contains the only extant sand barrens in the study area.

Quality

Higher quality is indicated by large extent; absence or rarity of invasive plants (such as black locust, black cherry, quaking aspen, Eurasian honeysuckles, switchgrass, purple lovegrass, Hungarian brome, common mullein, white sweet clover, common ragweed and other roadside weeds); presence of characteristic herbs such as wild lupine, pink ladyslipper, birdsfoot violet, and goat's-rue; presence of characteristic rare Lepidoptera (inland barrens buck moth, Karner blue, and dusted skipper). A substantial buffer zone facilitates prescribed burns, which may be essential to maintain characteristic native flora and fauna.

Human Uses

The scarcity of other natural resources with commercial value in sand barrens habitats has made them targets for high-intensity land use. Typically regarded as waste areas, their loose, sandy soils and short, loosely-rooted plants make sand plains easy to clear and grade for commercial, industrial and residential development.

Sensitivities, Impacts

Never extensive compared to other habitats, the study area's sand plains have been reduced to less than 10% of their former total land area, and many small examples have been entirely eliminated. Reduction and fragmentation of habitat, and elimination of vegetation fires threatens the sustainability of functioning sand plains ecosystems.

Conservation and Management

The most important conservation measures are 1) preventing fragmentation by conserving large, contiguous parcels of sand barrens habitat, 2) permitting or facilitating the occurrence of natural or prescribed fires, and 3) restoring degraded habitats wherever possible.

Fragmentation (especially division by road systems) facilitates invasion by opportunistic plant species by providing a larger ratio of edge to interior area. Control of invasive and exotic plants often involves prescribed burns, which are more safely carried out on larger parcels with buffers of more fire-resistant vegetation between the barrens area and nearby residences. Fire also stimulates reproduction of pitch pine and certain other plants of the barrens, and reinvigorates sand plains shrubs, which otherwise cannot obtain enough nutrients from the poor soils to sustain large tops. Fire ash may help buffer soil acidity, providing better conditions for acid-intolerant plants such as wild lupine (John Cryan, personal communication).

Planners and managers should seek opportunities to restore degraded or destroyed pine barrens (e.g., on post-industrial sites) to expand habitat areas into more of their former range. Control of invasives combined with reintroduction of native species should allow for rapid restoration of degraded sand plains adjacent to existing high-quality habitat. Establishment of conservation easements could help to insure long term protection.

Examples on Public Access Lands

The Albany Pine Bush Preserve (The Nature Conservancy) is located between Albany and Schenectady in three municipalities—Albany, Guilderland, and Colonie.

A few degraded slivers of the original Pine Bush are visible along Interstate 87 north of Exit 23, all "preserved" by the highway construction and consisting of pitch pines and shrubs (scrub oak and exotics such as Eurasian honeysuckles), or pitch pines over mowed highway verge.

References

Rittner (1976), Kerlinger and Doremus (1981), Mattox (1994).

7.37 Waste Ground

"WASTE GROUND" IS A BOTANICAL TERM FOR A HIGHLY ALTERED HABITAT with mineral soil lacking topsoil or with soil compromised in some other way. Vegetation is usually sparse and dominated by weedy herbs and woody species that are often non-natives. Examples of waste ground habitats are urban vacant lots, areas that have been stripped of vegetation and topsoil pending construction, post-industrial "brownfields," highway or railroad verges (away from the tides of the Hudson River), road cuts, abandoned parking lots, abandoned playing fields, closed landfills that have not been reclaimed, dry wetland fill, dry banks of some constructed wetlands and ponds, sand traps and soil storage piles at abandoned golf courses, "infield" areas of horse or automobile race tracks, some recently clearcut and eroded vista swaths that overlook the Hudson River (some topsoil may remain), timber harvest staging areas (may have some topsoil), and unreclaimed surface mines (soil mines or rock quarries) including piles of tailings. Abandoned topsoil storage piles in surface mines and other situations, and abandoned livestock feedlots or paddocks, are included here although they are richer in nutrients and organic matter than other waste ground substrates. Hudson River dredge spoil deposits are treated separately (Sect. 7.9).

Vegetation

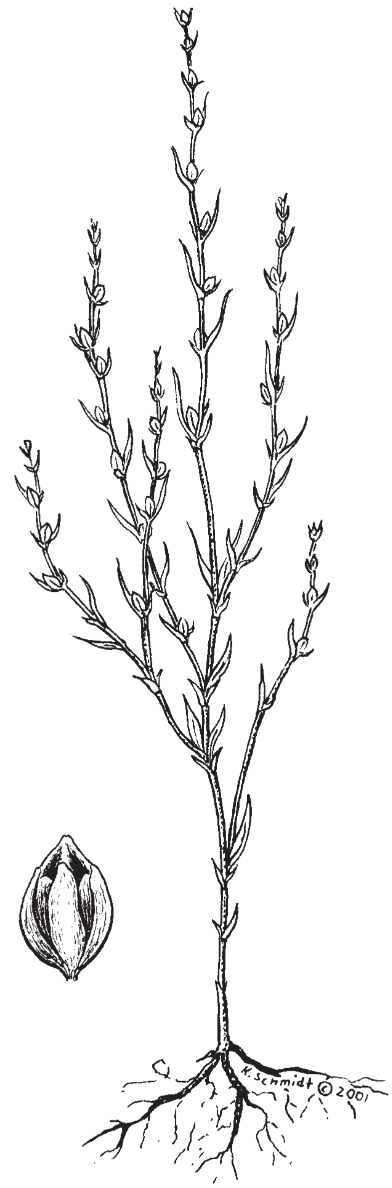
Many species of weedy, often introduced, herbs, shrubs, and trees occur on waste ground. Some of the common trees or shrubs are ailanthus, black locust, quaking aspen, black birch, Eurasian honeysuckles, common buckthorn, brambles (*Rubus*), staghorn sumac, and smooth sumac. Herbs include common mullein, knapweeds, white sweet clover, bladder-campion, bouncing-bet, evening-primrose, butter-and-eggs, blue-curls, common reed, purple loosestrife, and path rush. Topsoil piles or dredged organic soil piles may support weeds such as pokeweed and jimsonweed. Mosses and lichens may develop on moister or older habitats. Occasional large trees or logs have important values to animals and epiphytes.

Fauna

Mostly common species that are typically associated with bare soil or rock, or other habitat features characteristic of waste grounds. Examples are woodchuck, which burrows in loose soil, killdeer, which nests on bare gravel or rubble, and American toad, which forages in areas of sparse vegetation and breeds in shallow, sunny, often intermittent pools. Burrowing insects, including velvet-ants (Mutillidae), bee-wolves (*Phyllanthus*), and sand wasps (*Bembix*), use waste ground habitats with coarse-textured soil.

Indicators and Identification

Bare, often equipment-scarred rock with different colors and harder surfaces than nearby unweathered rocks indicate bedrock exposed by mining or by removal of soil materials. Bare, homogeneous-looking soil with contours reflecting excavation or stockpiling, and often signs of slumping, settling, or gullying indicates soil mining or other cut-and-fill activities. Generally the best indicators are the signs of human activities such as pavement, construction and demolition (C & D) debris, garbage, other foreign materials in soils, parked or abandoned equipment, stockpiled or dumped construction materials, buildings, and abundance of plants that are characteristically associated with infertile, altered or disturbed soils. Also, historical information, and map symbols (e.g., mines, buildings, purple revision overprint on USGS topographic maps) can help with remote identification of waste grounds.



Slender knotweed
(Polygonum tenue)
1–4 dm (4–16 in)

Biodiversity Values

SPECIES OF CONSERVATION CONCERN. See Sect. 2.0 and App. 3 for rarity ranks.	National Lists	State Lists	Regional Lists
Plants			
hair-rush			•
toad rush			•
orangeweed			•
field dodder		•	
slender pinweed		•	
rattlebox		•	
blunt mountain-mint		•	
slender knotweed		•	
river birch		•	
Amphibians and Reptiles			
Fowler's toad			•
timber rattlesnake		•	
northern copperhead		•	
eastern hognose snake		•	
Birds			
peregrine falcon		•	
American black duck	•		•
common raven			•
grasshopper sparrow		•	
Henslow's sparrow	•	•	

Rare plants normally associated with rock outcrops, talus, sand plains, and other infertile, natural habitats may occur in waste areas.

Rare animals of waste grounds are poorly documented in our region. The character of surrounding habitats may be important to the use of waste grounds by most vertebrate species. We would expect nesting American black duck, some of the rare grassland birds (grasshopper sparrow, Henslow's sparrow), reptiles with affinities for rocky or sandy areas (eastern hognose snake, northern copperhead, timber rattlesnake), and, where there are breeding ponds within 500 m (1650 ft), Fowler's toad. High or elevated faces of abandoned quarries with little or no human presence could support nesting peregrine falcon and common raven. Probably many rare invertebrate species could be found on waste grounds; the burrowing insects mentioned above (Fauna) could include rare species.

Little information is available on rare communities on waste grounds. We have seen fen-like communities on small patches of seepage-influenced, coarse-textured, presumably calcareous soil on the downstream sides of dams of constructed ponds and wetlands. Some waste grounds resemble sites of natural disturbances such as landslides and high banks undercut by streams or by the Hudson River. Some waste ground develops Oldfield or Young Forest vegetation if left undisturbed (Sections 7.28 and 7.30).

Many of Reschke's (1990) "cultural" communities are included in our general "waste ground" habitat; for example, "roadcut cliff/slope," "rock quarry," "gravel mine," "sand mine," "brushy cleared land," "construction/road maintenance spoils," "mine spoils," "urban vacant lot," "closed landfills and dumps," "riprap/erosion control roadside," "artificial beach," "riprap/artificial lakeshore," and "unpaved trail/path" communities.

Substrates

Virtually any natural subsoil or bedrock type in the study area; also a variety of soils brought in as fill (mapped as Udorthents in county soil surveys). Substrates are often dominated by coarse particles such as sand, gravel, or rock rubble. Organic matter and macronutrients (nitrogen, phosphorus) are often at very low concentrations, and water-holding capacity is often poor, making soil drought an important constraint on vegetation. Unusual substrates (e.g., bare gravel) may attract rarities.

Surface Waters

Scarce. Rain puddles may accumulate on finer-textured (e.g., silty) soil materials. Occasionally there are intermittent or permanent pools that have formed in, e.g., abandoned mine pits. Some pits at slate quarries or limestone quarries contain substantial permanent lakes. Seeps may occur, for example, on road verges, road cuts, or quarry walls.

Extent

From a few square meters to more than 50 hectares (200 ft^2 to >120 ac).

Distribution

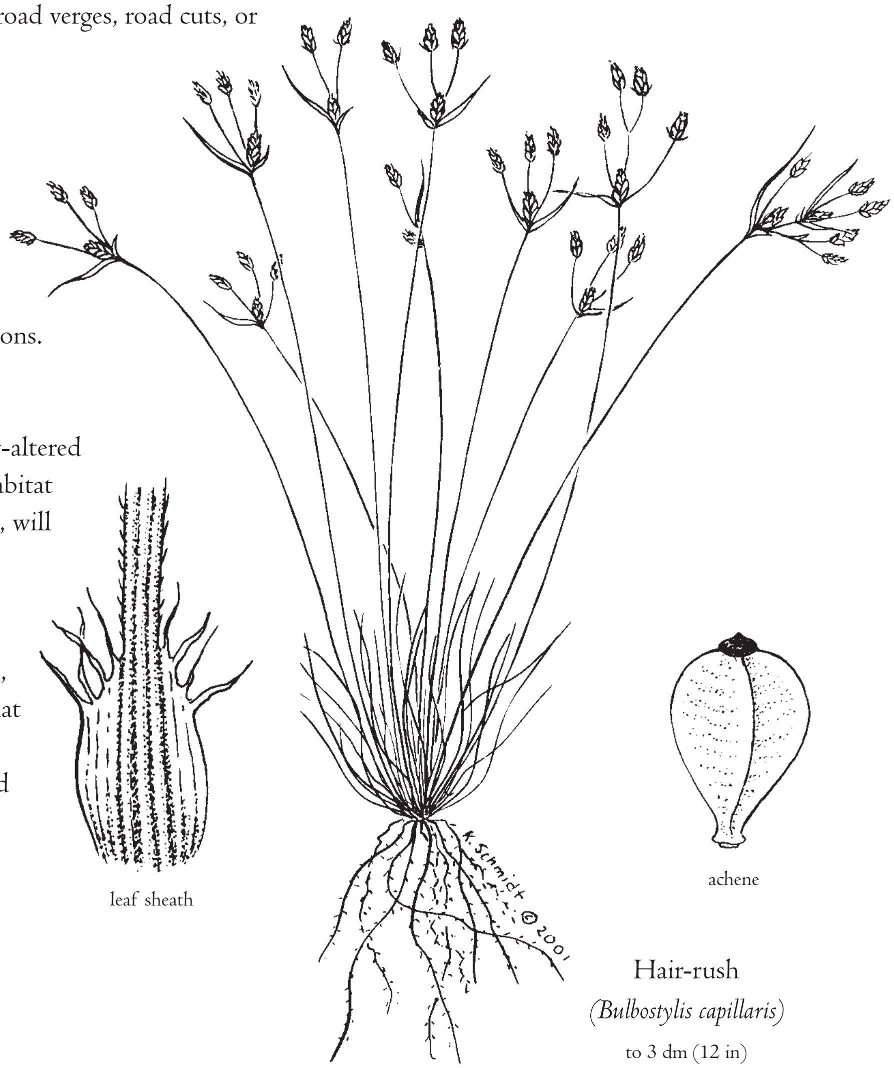
Throughout study area, but rare at higher elevations.

Quality

There really is no measure of "quality" in highly-altered habitats. The presence of rare species, and the habitat characteristics that help to support those species, will help to define quality on particular sites.

Human Uses

Many waste grounds are sites of illegal dumping, off-road vehicle use, or other human activities that may affect rare biota. Some areas are being reclaimed for agriculture or parks, or redeveloped for industry.



Hair-rush
(Bulbostylis capillaris)
to 3 dm (12 in)

Sensitivities, Impacts

Some areas may be exposed to toxic substances from illegal dumping of construction and demolition debris, household garbage, and motor vehicles and other equipment. Most waste grounds are highly disturbed and not especially sensitive to further disturbance. Many such areas gradually become dominated by tall vegetation which shades out some of the small biota. Sensitivities are related to those of particular rare species using the waste grounds; see Conservation and Management, below.

Conservation and Management

Because most waste ground areas are not significant for rare species conservation, it is not practical or desirable to conserve waste grounds *per se.* Therefore, the waste ground habitats where rare species occur must be identified and managed on a local, site-specific basis. It is then important to determine what conditions favor the persistence of rare species (e.g., unstable, bare, or dry soils; calcareous bedrock; calcareous seepage), and maintain these conditions with tilling, mowing, fire, regulation of vehicle or pedestrian disturbance, or other means.

Examples on Public Access Lands

The walking trail of the Old Croton Aqueduct State Historic Park from at least Hastings to Yonkers near the Hudson River in Westchester Co. Abandoned diabase quarries on the river side of the New York Palisades at Hook Mountain in Nyack Beach State Park (Rockland Co.). The "Almost Perpendicular" east slope of Blauveldt Mt. in Harriman State Park (Orange and Rockland counties). A large abandoned parking lot on the Iona Island component of the Hudson River National Estuarine Research Reserve (Rockland Co.). Abandoned quarry on the west side of Bull Hill (Mt. Taurus) in Hudson Highlands State Park (Putnam Co.). Abandoned shale pits on the western portion of the Stewart Airport Buffer Lands (Orange Co.). Riverfront Park (City of Beacon) is on a closed landfill. Dry areas above most flooding on the Hudson River waterfront in the Corning Preserve, Albany. Carbonate road cuts on both sides of Route 199 just west of the Kingston-Rhinecliff Bridge, and shale road cuts on the north side of Route 199 farther west between Old Sawkill Road and Route 28 (Ulster Co.). Abandoned sections of New York-New Haven-Hartford Railroad from Town of Poughkeepsie to Hopewell Junction, owned by Dutchess County. Rail trails in many localities. Closed municipal landfills in many towns. Roadside geology guides (e.g., Fisher and Warthin 1976) often list roadcuts and other artificial bedrock exposures accessible to the public.

Use caution investigating waste grounds where there may be unstable substrates, crevasses, debris, disintegrating structures, hazardous materials, or other dangers.

7.38 Catskill Mountains Eastern Escarpment

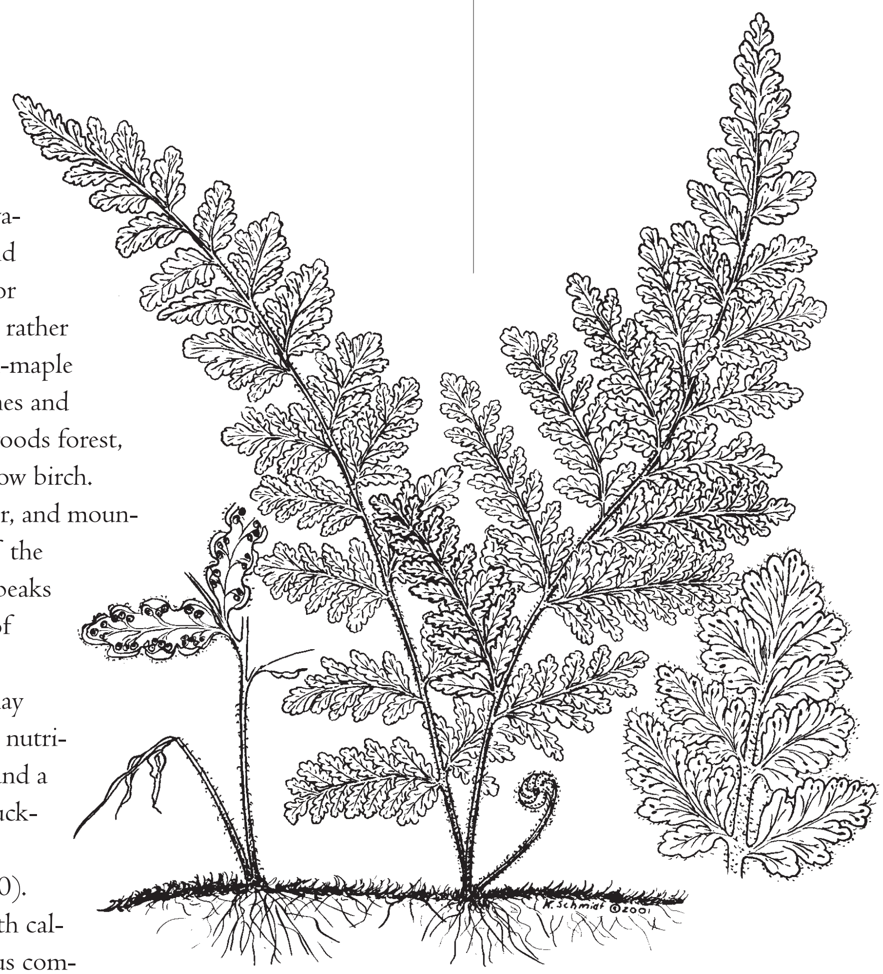
By Spider Barbour

THE EASTERN ESCARPMENT (or "mural front") of the Catskills is a glacially steepened, generally east-facing system of slopes and the intervening ravines of streams flowing east into the Hudson Valley.

The land is very rugged, with numerous rock exposures, areas of talus, and numerous boulders, mostly of local origin. Soils are formed in glacial till, and most are rocky. Most of the land is forested, with the exception of open ledgetops with extensive bare rock and scattered, stunted trees and shrubs. Upper stream courses are very steep, often with vertical waterfalls over ledges, and rapids tumbling down steep, rocky slopes. Erosion along the stream courses is intense, especially after snowmelt or heavy rains. Runoff may create new intermittent streams within just a few years, especially on steep roads or trails. In contrast, protruding landforms (ledges, knolls and spurs) are typically very dry, with water running off or evaporating within a day or two, except in winter, when ice may build up to form thick walls on ledge faces. Backsloping terraces retain water, and some support swamps or woodland pools. A number of state- and regionally-rare plants and animals occur along the Catskills Eastern Escarpment.

Vegetation

Forests cover most of the Eastern Escarpment, except for rim ledges, cliff faces and some wetlands. Forest species composition varies with elevation, aspect, soil depth, moisture regime, and wind exposure. The escarpment differs from the interior Catskills in having mostly oak-dominated forests rather than beech- and maple- dominated forests. Beech-maple forest increases with elevation and latitude. Ravines and some moist slopes have hemlock-northern hardwoods forest, usually with American beech, red maple, and yellow birch. Boreal spruce-fir forest with red spruce, balsam fir, and mountain paper birch occurs on the high peaks west of the escarpment. Red spruce occurs outside the high peaks forest, at least on the upper north-facing slopes of the major ravines, but its distribution below the high summits is poorly known. Dry rim ledges may have chestnut oak forest, usually on well-drained, nutrient-poor mineral soils, with small, stunted oaks and a dense low shrub layer of blueberries and black huckleberry, or may have pitch pine-oak-heath rocky summit communities described by Reschke (1990). Smaller, mid-elevation ledges, especially those with calcareous siltstone or shale, have a varied herbaceous community, with any of the following: wild columbine, early saxifrage, lyre-leaved rock-cress, smooth rock-cress, white wood aster, whorled wood aster, and silver-rod.



Woolly lip fern
(Cheilanthes lanosa)
fronds to 5 dm (20 in)

Native stands of red pine occur at numerous sites on parts of the Eastern Escarpment outside the study area. Within the study area, there is a native red pine stand on a spur north of Kaaterskill Clove. Red spruce, a dominant element of boreal spruce-fir forests on summits west of the Eastern Escarpment, occurs only as an element of cold cove forest on north-facing slopes. This is not a true spruce-fir forest, but contains elements of several other forest types. The dominant trees are yellow birch, red maple, paper birch and red spruce, with striped maple, mountain maple, American yew, and hobblebush in the shrub layer. There may be American mountain-ash and sour-top blueberry at higher elevations, beech and sugar maple and hemlock at lower elevations. Characteristic herb layer species are fancy fern, rose twisted-stalk, common wood-sorrel, bunchberry, purple trillium, and painted trillium. This spruce-hardwood forest occurs on steep, rocky slopes of the Catskills, especially north-facing slopes.

Fauna

Birds, reptiles, and mammals of Hudson Valley forests, ravines, and rocky streams are also typical of the Eastern Escarpment. Turkey vulture is a ledge-nesting bird that also soars on thermals rising up the Eastern Escarpment. Black rat snake is a characteristic reptile.

Indicators and Identification

The steep, eastern slopes of the Catskill Mountains in the towns of Catskill, Saugerties, and Ulster.

Biodiversity Values

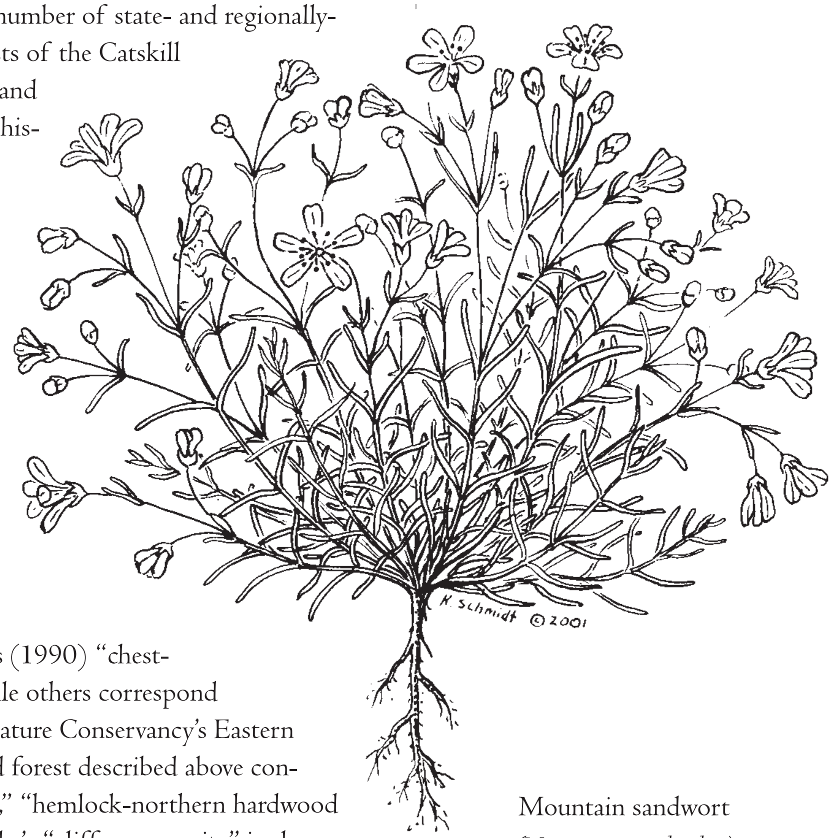
SPECIES OF CONSERVATION CONCERN. See Sect. 2.0 and App. 3 for rarity ranks.

	National Bird Lists	State Lists	Regional Lists
Plants			
woolly lip fern		•	
mountain sandwort		•	
three-toothed cinquefoil			•
Invertebrates			
falcate orange tip			•
Amphibians and Reptiles			
timber rattlesnake		•	
Birds			
common raven			•
blue-headed vireo	•		•
Mammals			
bobcat			•
black bear			•

Cliffs, ledgetops, swamps, and vernal pools support a number of state- and regionally-rare plants and animals. The upper ledges of some crests of the Catskill Eastern Escarpment support three-toothed cinquefoil and mountain sandwort; woolly lip fern has been reported historically from similar locations.

Difficult to reach due to rugged terrain and lack of road access, the Catskill Eastern Escarpment is a haven for large, secretive mammals such as black bear and bobcat, which range westward into the deeper reaches of the mountains (but are rare in the study area). Other rare animals include timber rattlesnake and falcate orange tip butterfly. Blue-headed vireo nests in cool ravines, and hemlock-hardwood forests. Common raven and turkey vulture are reported to have nested along the Escarpment (Andrle and Carroll 1988).

Some oak forests here correspond roughly to Reschke's (1990) "chestnut oak forest" and "Appalachian oak-pine forest," while others correspond well with the "oak-maple forest" recognized by The Nature Conservancy's Eastern Matrix Forest Inventory Project. The spruce-hardwood forest described above contains elements of Reschke's "beech-maple-mesic forest," "hemlock-northern hardwood forest," and "spruce-northern hardwood forest." Reschke's "cliff community" is also present in the study area. Dry rim ledges may have "pitch pine-oak-heath rocky summit" communities.



Mountain sandwort
(Minuartia groenlandica)
2–15 cm (0.8–6 in)

Substrates

Rock and shallow soils derived from glacial till are the major substrates. Bedrock exposures, boulders, and fragments of all sizes are abundant. Soil depth is extremely variable, from no soil on rock ledges to several meters deep in the lower portions of hollows or coves (called "cloves" locally) or the bases of slopes. Transport of materials occurs frequently and voluminously along stream courses, and to a lesser and slower extent on seeping slopes. On dry slopes and near-level terraces away from streams, soil movement may be negligible.

Surface Waters

These include streams, swamps and woodland pools. Surface water chemistry is variable, but probably mildly acidic to circumneutral, depending on local bedrock chemistry.

Distribution

The Escarpment runs from North Mountain in the Town of Catskill south to Overlook Mountain in the Town of Woodstock (outside the study area). The steep mountain wall is dissected by two major streams, Kaaterskill Creek at Palenville, and Plattekill Creek at West Saugerties. The valley walls of both streams are precipitous and spectacular, almost canyon-like, with extremely steep lateral tributaries. Elevations range from 60–760 m (200–2500 ft) at the rims of the upper cliffs to 210–275 m (700–900 ft) at the bases of the steep slopes that meet the moderately-steep foothills of the Mount Marion formation.

Quality

Quality may be most strongly associated with 1) extent of habitats unfragmented by roads and other human developments, and 2) isolation from human activities.

Human Uses

Hiking, birdwatching, hunting, ATV use. Residential developments are present on the lower elevations of the Eastern Escarpment.

Sensitivities, Impacts

Poorly designed hiking and ATV trails are often subject to erosion. Noise and physical disturbance from ATVs can be harmful to breeding birds and other sensitive fauna. Residential development often causes fragmentation of forested habitats. When trails and human residences are near timber rattlesnake habitat, the snakes often suffer from loss of foraging habitat and direct loss of individuals from road kills, and deliberate killings by human residents and recreationists who fear snakes.

Conservation and Management

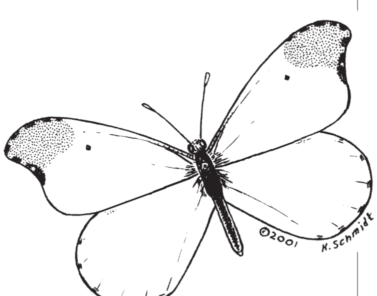
Prohibition of development on steep, highly erodible slopes would help to protect stream habitats and water quality of the Eastern Escarpment. Protection of large undisturbed areas contiguous with other unfragmented areas to the west would help to protect habitats for area- and disturbance-sensitive species (bobcat, bear, nesting turkey vulture, and common raven). Restrictions on development in the vicinity of known and potential rattlesnake dens, including known and potential foraging habitats and travel corridors to water sources, would help to protect rattlesnakes and minimize undesired encounters between snakes and humans. For the same reason, hiking trails should be designed to avoid such areas. Establishment of conservation easements could help to protect some of the most important tracts from future disturbance.

Examples on Public Access Lands

Catskill State Forest Preserve lands in Plattekill Clove, Kaaterskill Clove and Overlook Mountain are not readily accessible from roads along the base of the Eastern Escarpment, from which the state lands are nearly completely landlocked. Legal access to these lands is primarily from points west over the crest of the escarpment, or laterally from one of the cloves.

References

Barbour (1991), Kudish (2000).



Falcate orange tip
(Anthocharis midea)
forewing 1.6–2.1 cm (0.6–0.8 in)

8.0

Habitat Photographs

We apologize for the poor reproduction of the photographs in this file. We will have a file of higher quality available on Hudsonia's website later in 2009.

www.hudsonia.org
-Hudsonia Ltd., February 2009-

PHOTO BY ERIK KIVIAT

Estuarine Rocky Shore Section 7.2

PHOTO BY ERIK KIVIAT

Brackish Tidal Marsh (1) Section 7.3

PHOTO BY ERIK KIVIAT

Brackish Tidal Marsh (2) Section 7.3

PHOTO BY ERIK KIVIAT

Freshwater Tidal Marsh Section 7.3

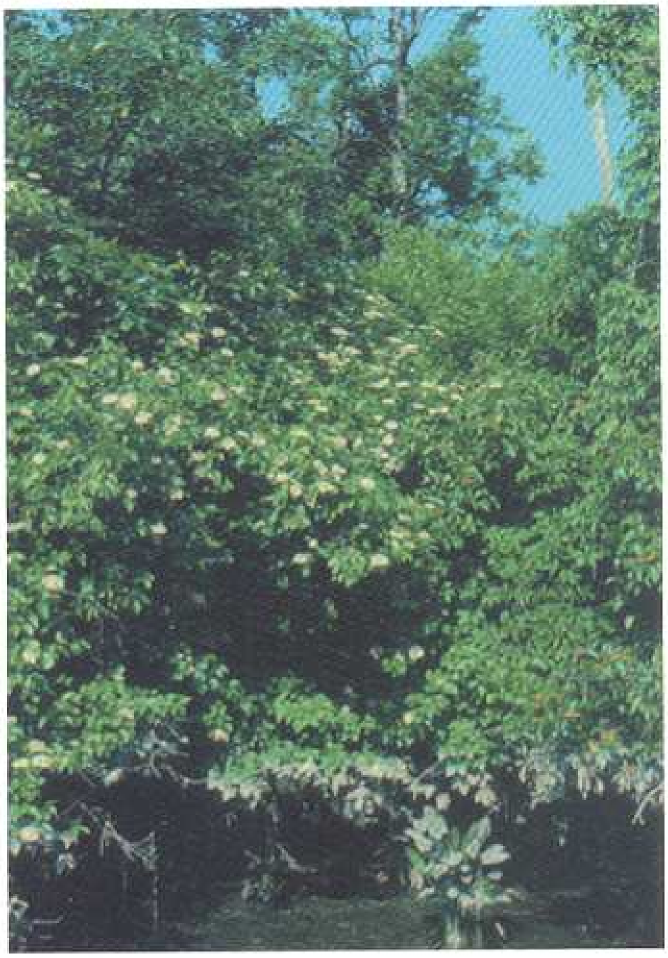


PHOTO BY ERIK KIVIAT

Intertidal Swamp Section 7.4

PHOTO BY ERIK KIVIAT

Supratidal Swamp Section 7.4

PHOTO BY ERIK KIVIAT

Supratidal Pool Section 7.5

PHOTO BY ERIK KIVIAT

Tidal Tributary Mouth Section 7.6

PHOTO BY JERRY C. JENKINS

Hudson River Rocky Island Section 7.7

PHOTO BY ERIK KIVIAT

Supratidal Railroad Causeway Section 7.8

PHOTO BY ERIK KIVIAT

Hudson River Dredge Spoil Meadow Section 7.9

PHOTO BY SPIDER BARBOUR

Hudson River Dredge Spoil Forest Section 7.9

PHOTO BY ERIK KIVIAT

Wet Clay Meadow Section 7.10

PHOTO BY ERIK KIVIAT

Intermittent Woodland Pool Section 7.11

PHOTO BY ERIK KIVIAT

Fen (1) Section 7.12

PHOTO BY ERIK KIVIAT

Fen (2) Section 7.12

PHOTO BY ERIK KIVIAT

Non-Calcareous Wet Meadow Section 7.13

PHOTO BY ERIK KIVIAT

Kettle Shrub Pool Section 7.14

PHOTO BY ERIK KIVIAT

Nontidal Hardwood Swamp Section 7.15

PHOTO BY ANTIA F. BARBOUR

Spring Section 7.16

PHOTO BY ANITA F. BARBOUR

Beaver Pond Section 7.17

PHOTO BY ERIK KIVIAT

Circumneutral Bog Lake Section 7.18

PHOTO BY ERIK KIVIAT

Acidic Bog Section 7.19

PHOTO BY ERIK KIVIAT

Nontidal Marsh Section 7.20

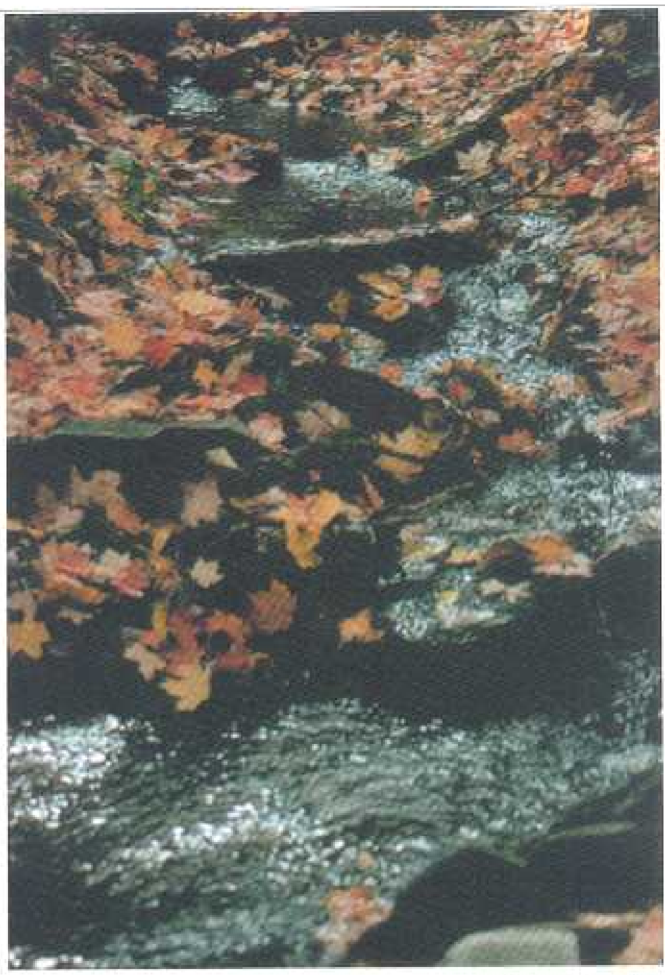


PHOTO BY ANITA F. BARBOUR

Intermittent Stream Section 7.21

PHOTO BY ERIK KIVIAT

Perennial Stream Section 7.22

PHOTO BY ERIK KIVIAT

Riparian Corridor Section 7.23

PHOTO BY ERIK KIVIAT

Mature Mesophytic Lowland Forest Section 7.26

PHOTO BY SPIDER BARBOUR

Rich Rocky Woods Section 7.27

PHOTO BY ANITA F. BARBOUR

Shrubby Oldfield Section 7.30

PHOTO BY ERIK KIVIAT

Upland Meadow Section 7.31

PHOTO BY ERIK KIVIAT

Clay Bluff Section 7.32

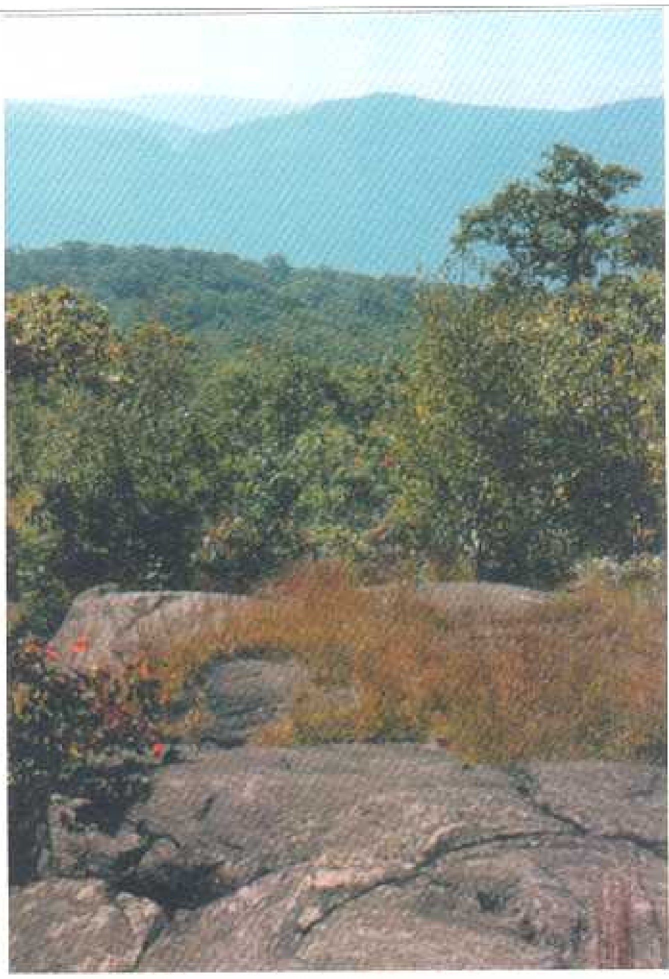


PHOTO BY ERIK KIVIAT

Non-Carbonate Crest (1) Section 7.33

PHOTO BY ERIK KIVIAT

Non-Carbonate Crest (2) Section 7.33

PHOTO BY ERIK KIVIAT

Carbonate Ledge Section 7.34

PHOTO BY ERIK KIVIAT

Sand Barrens Section 7.36

PHOTO BY ERIK KIVIAT

Waste Ground Section 7.37

PHOTO BY ANITA F. BARBOUR

Catskill Eastern Escarpment Section 7.38

Appendices

Contents of Appendices

Appendix 1

Glossary

Glossary

acidic Having a low pH (<6.6); compare with “alkaline,” “neutral,” and “circumneutral.”

acidicolous Describing organisms that inhabit acidic environments.

acidicole A species that thrives in acidic environments.

algal bloom Rapid growth of algae. Often visible as soupy-looking greenish water or widespread floating “pond scum.”

alkaline Having a high pH (>7.0); compare with “acidic,” “neutral,” and “circumneutral.”

alluvium Soil materials deposited by flowing water; usually silt, sand, and gravel.

alternate leaves Leaves arranged along stem with one leaf at each node; compare with “opposite leaves.”

ambient Present in the background or surrounding environment.

ammocoete A fish larva.

amphipod Member of the order Amphipoda, a group of small to medium-sized crustaceans that reside predominantly in substrates of aquatic or marine environments.

annelid Member of the phylum Annelida, which includes segmented worms such as leeches, earthworms, and various other aquatic and marine forms.

area-sensitive species Animals that require large areas of suitable habitat to meet their life history needs and support viable populations.

arthropod Member of the phylum Arthropoda, which includes insects, crustaceans, millipedes, centipedes, spiders, mites, ticks, and their relatives.

axil In plants, the angle where the leaf joins the stem.

benthic Describing the processes, organisms, or materials at the bottom of a water body such as a lake, a stream, or the ocean.

biota The total of the flora and fauna of a habitat or region.

brackish Having a salinity level (0.5–17 parts per thousand) between that of fresh water and sea water.

brood parasitism The use of a host species to brood the young of another species (the parasite) (Lincoln et al. 1982).

bryophyte Member of the phylum Bryophyta, a division of nonvascular plants including mosses (class Musci), liverworts (class Hepaticae), and hornworts (class Anthocerotae).

buffer zone Zone of soils and vegetation left undisturbed, or intentionally planted, to screen an adjacent area from an adverse effect.

buffer A substance that prevents rapid change in pH.

calcareous Containing high concentrations of calcium salts.

calcicole A species that thrives in calcium-rich environments.

calcicolous Describing organisms that inhabit calcium-rich environments.

capsule In plants, a dry, many-seeded fruit that splits open in predetermined segments.

carapace In turtles, the upper shell.

carbonate rock Limestone, marble, dolostone, and similar types of rock composed largely of calcium carbonate, magnesium carbonate, or both.

cation An atom or group of atoms with a positive charge.

channery soil A soil containing, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist.

circumboreal Distributed around the high latitudes of the northern hemisphere.

circumneutral Having a pH at or near 7.0 (approximately 6.6–7.3); compare with “acidic,” “neutral,” and “alkaline.”

cohesiveness In soils, the degree to which soil particles hold together.

colluviation Downslope movement of soil materials due to gravity.

community A group of organisms sharing a common habitat or area, and interacting with one another.

contour Line on a topographic map connecting points of equal elevation.

copepod Member of the order Copepoda, a group of small crustaceans.

corticolous Bark-inhabiting.

costal groove In salamanders, vertical groove on side of body between front and hind legs.

critical habitat Component of the landscape that provides essentials for the survival of a population.

(continued)

crustacean Member of the class Crustacea, a group of mostly aquatic arthropods typically having a hard shell, such as crabs, shrimps, and barnacles.

crustose Crust-like, referring to the form of lichens or algae that form a thin, crust-like layer on a substrate.

cultural Describing a feature of, an artifact of, or an impact of human activity. In the *Manual*, the term often refers to such features and artifacts as roads, trails, ditches, fields, noise, or pollution deriving from human sources, or the impacts of those features.

cryptic coloration Protective coloration or patterning that camouflages an animal (Art 1993).

diabase A dark, medium-grained igneous rock composed mostly of feldspar and pyroxene with small quantities of other minerals (Wyckoff 1971).

deltoid Triangular.

Diptera The order of invertebrates known as the "true flies," including mosquitoes, midges, craneflies, bee flies, and others.

dissolved oxygen Oxygen gas in water; used as a measure of the ability of water to support aquatic organisms (Art 1993).

disturbance Natural or anthropogenic event that changes a local environment by disrupting, removing, or adding organisms, soil, or rock, or by subjecting the environment to other disruptions such as pollution by substances, noise, or light.

dormant Describing a condition of plants or animals with reduced or suspended activity, often to survive a period of harsh environmental conditions, such as drought or extreme temperatures.

drawdown Lowered water levels due to management practices or natural causes such as drought.

emergent plant Rooted plant in shallow water, having a substantial portion growing above the water surface.

endemic Native to a particular area or a particular kind of habitat, and found only there.

ephemeral pool Temporary pool that forms after a rainstorm or snowmelt.

epiphyte A plant (such as a moss or lichen) lacking roots in the soil, supported by another plant or object, and obtaining nutrients from air, rain water, and organic debris.

escarpment Cliff, steep hillside, or embankment at the edge of an area of relatively flat land; formed by faulting or erosional processes (Art 1993).

estivation (aestivation) Summer dormancy.

estuary The tidal reach at the mouth of a river where the freshwater of the river meets the saline water of the ocean.

eutrophic Pertaining to surface waters, nutrient-rich (and often oxygen depleted), usually with excessive growth of algae or weedy vascular plants.

excrescence Outgrowth.

extant Still in existence.

extirpate Destroy locally; eradicate.

fauna The animal species of a region or a habitat.

fishway Fish ladder; a structure enabling fish to move upstream past dams or natural barriers.

floodplain Low-lying land along a watercourse, flooded at statistical intervals.

flora The plant species of a region or a habitat.

foliose Bearing leaf-like structures, as in leafy lichens and leafy liverworts.

forb Broad-leaved (non-graminoid), herbaceous (non-woody) vascular plant.

freshet Sudden increase in stream flow due to heavy rain or thaw.

geomorphology The description and interpretation of land forms (Whitten and Brooks 1971).

glacial kettle hole (or glacial kettle) Depression remaining where a block of ice was buried by water-deposited materials from a melting glacier.

glacial outwash Stratified mineral materials, usually rich in sands and gravels, deposited by meltwaters near glaciers.

glacial till Unstratified and unsorted glacial debris consisting of clay, silt, sand, gravel, cobbles, and boulders transported and deposited directly by a glacier.

glaciolacustrine Describing material deposited in glacial lakes mainly by glacial meltwater, ranging from fine clay to sand, often interbedded silt and clay.

gneiss Banded, generally coarse-grained, metamorphic rocks of various origins. The bands may include alternations of such components as schists, quartz, and feldspar.

gradient Slope or inclination of land surface. Also, a pattern of change in any environmental factor, such as moisture or disturbance.

graminoid Any grass-like plant, especially grasses (family Poaceae), sedges (family Cyperaceae), rushes (family Juncaceae), and cattails (*Typha*).

gravid Carrying developing young or eggs.

hardwood Deciduous, broad-leaved tree (such as an oak or maple) usually characterized by dense, closely grained wood.

(continued)

herbaceous Describing a plant that does not produce woody tissue.

hibernaculum The sheltered place in which an animal hibernates or overwinters.

host plant A plant that provides food, support, or shelter to another plant or an animal.

Hudson Highlands An area of rugged, hilly terrain running southwest-northeast through southeastern New York, intersecting the Hudson River between approximately Newburgh-Beacon and Jones Point-Peekskill, and reaching elevations of 1300–1450 ft. The bedrock is a complex of fractured, faulted, and contorted metamorphic and igneous rocks, mainly gneisses and granites.

hummock A raised woody pedestal (root crown) of a plant.

humus Partially decayed plant and animal remains at the soil surface, eventually forming the organic component of soil.

hydric soil Wetland soil, or soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions near the surface. In general, soils described in the county soil surveys as "poorly drained" and "very poorly drained" are hydric. Soils described as "somewhat poorly drained" may also be hydric, or may have hydric inclusions.

hydrology Water levels and water movement, or the science of water levels and water movement.

hydropattern The temporal and spatial pattern of water levels and water flows.

hydroperiod Duration of flooding or standing water.

ice scouring Clearing of vegetation and sediments from the banks and bottom of watercourses by the abrasive action of ice.

impoundment Body of water that is held back or impounded by a natural or artificial dam.

infraspecific Pertaining to a taxonomic category within a species, such as a "form," or a "variety," or a "subspecies."

intermittent stream Stream that flows only during part of the year—seasonally (e.g., fall, winter, and spring) or after rains or thaws.

intertidal In coastal or estuarine environments, describing the zone between mean high tide and mean low tide water levels.

introduced species Organism brought to an area where it was not previously found; introduction may be inadvertent (e.g., by seeds on vehicle tires), or on purpose (e.g., horticultural plantings), by humans, by animals, or by natural forces.

invasive species Species that rapidly populates an area it had not previously inhabited, and becomes dominant numerically or in terms of cover, resource use, or other ecological impacts (adapted from the definition developed by the Invasive Plant Council of New York State). The term is sometimes restricted to species that penetrate "natural" habitats and alter their biota or ecological function.

invertebrate Animal without a backbone or bony internal skeleton, such as an insect, mollusk, or crustacean.

jetsam Human refuse washed on shore.

kettle (See "glacial kettle hole.")

lacustrine deposit Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised (Case 1989). Often used in the sense of "glaciolacustrine," referring to material ranging from fine clay to sand, derived from glaciers and deposited in glacial lakes.

lagg Mineral-rich drainage area surrounding a bog, containing standing or sometimes moving water, a sedgy fen, or a shrub swamp (Crum 1988).

larva (plural: larvae) Immature form of an organism that undergoes metamorphosis, such as a tadpole or a caterpillar.

leafpack Wet, decomposing woody plant leaves comprising a layer on the soil or sediment surface.

life history The significant features of the life cycle of an organism, particularly those related to survival and reproduction (Lincoln et al. 1982).

macroscopic Sufficiently large in size to be observed with the naked eye or with the aid of a hand lens.

marl Unconsolidated, highly alkaline sediment composed mostly of calcium carbonate, usually mixed with clay or other impurities.

mesic Describing an environment of medium moisture.

mesophytic Describing vegetation of medium-moisture soils.

metamorphosis Significant change in shape, structure, and habits of an animal during a fairly short period, between the embryonic and adult stages (Art 1993).

microclimate Climate of a very limited area, dependent on extremely localized influences of topography, soil, vegetation, and physical structure.

microcrustacea Microscopic (or nearly microscopic) crustaceans.

microtopographic, microtopography Describing topography of a very limited area or on a very small scale; microrelief.

midden Refuse pile left by an animal from feeding repeatedly in the same location; e.g., seed hulls, cones, shells, and bones.

(continued)

mineral soil Any soil consisting primarily of mineral (gravel, sand, silt, or clay) material, rather than organic material.

mollusk Member of the phylum Mollusca, including bivalves, snails, and slugs.

muck Well-decomposed organic soil material.

mudflat Portion of the intertidal zone where fine-grained mineral sediments are deposited, and where vegetation is sparse or absent for all or part of the year. The "mudflat" habitats of the Hudson River also include the intertidal sand flats (with coarse-grained sandy sediments) that have formed adjacent to dredge spoil deposits.

native As applied to organisms, those taxa that are growing within their natural geographic range and dispersal potential; that is, within the range they could have or would have occupied without direct or indirect introduction or care by humans (adapted from the definition developed by the Invasive Plant Council of New York State).

nest parasitism A form of parasitism in which one species lays eggs in the nest of another (host) species. The host species then rears the young of the parasite as one of its own, often to the detriment of its own young (Art 1993).

neutral Having a pH of approximately 7.0; compare with "acidic," "circumneutral," and "alkaline."

non-point source pollution Pollution originating from diffuse sources; e.g., sheet runoff carrying fertilizer and pesticides from lawns, agricultural fields, and golf courses.

nutrient loading Over-enrichment of aquatic ecosystems with plant nutrients such as phosphorus or nitrogen compounds, which can cause rapid increase in plant growth (Art 1993).

opposite leaves Leaves arranged along stem in pairs at each node (compare to "alternate leaves").

organic Pertaining to or deriving from living organisms.

outfall Point where a stream or artificial drainage discharges into a body of water.

outwash (See "glacial outwash.")

palimpsest A parchment or other material from which writing has been erased and then written over with later text.

Palisades (In New York and New Jersey) columnar cliffs of predominantly diabase rock, running along the west side of the Hudson River from west of Haverstraw south to Staten Island.

parasitic plant Plant that obtains nutrients from a host plant.

parent material The organic and mineral material in which soil forms.

peat Partially decomposed organic matter that accumulates under conditions of extreme moisture.

pedestal (See "hummock" or "tussock.")

pedon The smallest volume of material that can be called "a soil," and large enough to permit study and identification of all layers; usually ranging from one to 10 square meters (10–100 square feet).

permeable Allowing fluids such as water to pass through.

permeant Describing animals that inhabit an area part-time ("commuting").

pH The hydrogen ion concentration; used as a measure of the acidity or alkalinity of a substance.

physiographic Pertaining to physical and geographical features of the earth's surface.

plant invasions (See "invasive species.")

plastron In turtles, the under shell.

polygynous Describing a mating system in which a single male mates with multiple females during a breeding season.

polyploid hybrid Having two or more sets of homologous (having common ancestry) chromosomes.

postglacial Referring to the time period following the retreat of the continental glaciers.

pupa Stage in the development of many insects when the organism undergoes metamorphosis within a protective case (Art 1993).

range-margin phenomenon An element of the ecology of a species at the limits of its geographical distribution (range margin).

restoration The practice of restoring degraded or altered lands to a state of higher natural functioning or other desired condition.

riffle Shallow area in a stream where water flows with gentle turbulence over a gravelly substrate (Art 1993).

riparian Pertaining to the area and features along a river or stream, including but not limited to the floodplain.

rip-rap Large stones or concrete blocks artificially placed on a riverbank or shoreline to stabilize the soils and prevent erosion.

runoff The portion of precipitation or snowmelt waters that does not infiltrate the soil, but flows freely away, usually along the soil surface.

sandy lens Local layer of sand enclosed within another substrate type.

scree Accumulation of gravel or other small rock fragments on a steep slope, or at the base of a cliff or steep slope (compare to talus).

sea level Mean elevation of the ocean or estuarine water level between high and low tides.

(continued)

seepage Gradual release of groundwater at the ground surface.

seep Diffuse groundwater discharge; compare with "spring."

shingle Gravel or cobbles accumulated on beaches or off-shore bars.

siltation Accumulation of silt-sized particles in a body of water.

snag To ornithologists, an upright tree stump, trunk, or dead tree. To aquatic biologists, a fallen tree or log in a stream.

spawning Egg-laying directly in water by aquatic or amphibious animals.

species Group of organisms able to interbreed, and reproductively isolated from other similarly distinct groups.

spoil Waste material from excavation, dredging, or mining activities.

spring Concentrated groundwater discharge; compare with "seep."

spring tide A tide of maximum range occurring at the times of the new and full moons.

submergent plant Plant growing entirely or substantially underwater.

subsoil Soil layer below the surface soil (plow depth) and above the bedrock.

subtidal Tidal environment below the mean low water level.

subtidal shallows Zone between mean low water (MLW) and approximately 2 m (6 ft) below MLW.

subtidal pool Pool that holds water all the time below mean low water in a tidal environment.

supratidal On the Hudson River, the zone along a tidal shoreline within 1 m elevation above the mean high water level; this zone receives tidal flooding from the highest tides (spring tides and storm tides).

talus Accumulation of large rock fragments, blocks, and boulders at base of cliff or steep slope (compare to scree).

taxon (plural: taxa) Any grouping of organisms given a formal taxonomic name (e.g., a species, genus, family, order, or class).

terrestrial Pertaining to organisms that grow or live on land, or to land-based phenomena, as distinct from aquatic.

thallus (plural: thalli) A plant body that is not differentiated into true leaves, stems, and roots.

till (See "glacial till.")

tolerant Describing an organism's ability to withstand specific environmental conditions (Art 1993).

toxic Poisonous.

toxicant Poisonous substance.

trammel net Vertically set fishing net of three layers with a fine-meshed net between two coarser-meshed nets.

tributary River or stream that discharges into a larger river or stream.

turbidity Lack of clarity in water due to large quantities of suspended particles.

tussock Raised herbaceous root-pedestal.

unthrifty Unhealthy or damaged.

varve Layer(s) of sediment (usually silt or clay) deposited in a single year, usually in a glacial melt-water lake.

vascular plant Any plant with an organized system of vessels or other conducting tissue for transporting water and nutrients. Ferns, grasses, sedges, wildflowers, shrubs, and trees are all vascular plants. Mosses, liverworts, and algae are nonvascular plants.

vegetation gradient Distribution of plants along a changing environmental factor.

vernal pool Intermittent pool flooded more or less from late fall to late spring or summer.

xeric Describing habitats with very little moisture.

Appendix 2

Explanation of Statewide Rarity Ranks and Data Request Procedures

A. EXPLANATION OF STATEWIDE RARITY RANKS AND CODES

EXPLANATION OF RANKS and CODES, NEW YORK
EXPLANATION OF RANKS and CODES
New York Natural Heritage Program

NATURAL HERITAGE PROGRAM GLOBAL AND STATE RANKS: Each element has a global and state rank as determined by the NY Natural Heritage Program. These ranks carry no legal weight. The global rank reflects the rarity of the element throughout the world and the state rank reflects the rarity within New York State. Infraspecific taxa are also assigned a taxon rank to reflect the infraspecific taxon's rank throughout the world.

GLOBAL RANK:
G1 Critically imperiled globally because of extreme rarity (5 or fewer occurrences), or very few remaining acres, or miles of stream) or especially vulnerable to extinction because of some factor of its biology.

G2 Imperiled globally because of rarity (6 - 20 occurrences, or few remaining acres, or miles of stream) or very vulnerable to extinction throughout its range because of other factors.

G3 Either rare and local throughout its range (21 to 100 occurrences), or found locally (even abundantly at some of its locations) in a restricted range (e.g. a physiographic region), or vulnerable to extinction throughout its range because of other factors.

G4 Apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery.

G5 Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.

GH Historically known, with the expectation that it might be rediscovered.

GX Species believed to be extinct.

GU Status unknown.

STATE RANK:
S1 Extremely rare; typically 5 or fewer occurrences, very few remaining individuals, acres, or miles of stream, or some factor of its biology making it especially vulnerable in New York.

S2 Very rare; typically 6 to 20 occurrences, few remaining individuals, acres, or miles of stream, or factors demonstrably making it very vulnerable in New York.

S3 Rare to uncommon; typically 21 to 100 occurrences, limited acreage, or miles of stream in New York. May have fewer occurrences, but with a large number of individuals in some populations.

(continued)

A. EXPLANATION OF STATEWIDE RARITY RANKS AND CODES (cont.)

S4 Common, apparently secure in New York State; typically 100 or more estimated occurrences. May be fewer occurrences with many large populations.

S5 Very common, demonstrably secure in New York.

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

SX Apparently extirpated from New York.

SA Accidental or casual in New York.

SE Exotic, not native to New York.

SN see SZ.

SP Element potentially occurs in New York but there are no occurrences reported.

SR Reported in New York but without persuasive documentation.

SU Status uncertain, often because of low search effort; uncertainty spans a range of 4 or 5 ranks between S1 through S5. There are three possible ranges:
S1-S5, S1-S4 or S2-S5.

SZ (formerly SN) = This rank applies to long-distance migratory animal species which occur in an irregular, dispersed or transitory manner; not of conservation concern in New York for a reason other than being exotic or accidental.

B and N QUALIFIERS: Species which are long distance migrants will normally receive two ranks, one for the breeding season (B) and one for the non-breeding season (N). Example: S2B,SZN

TAXON (T) RANK: The T-ranks (T1 - T5) are defined the same way the Global ranks (G1 - G5) are but the T-rank only refers to the rarity of the subspecific taxon of the species as a whole.

T1 - T5 See Global Rank definitions above.

Q Indicates a question exists whether or not the taxon is a good taxonomic entity.

? Indicates a question exists about the rank.

(continued)

A. EXPLANATION OF STATEWIDE RARITY RANKS AND CODES (cont.)

NEW YORK STATE LEGAL STATUS - PLANTS: 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: listed species are those with:
1) 5 or fewer extant sites, or
2) fewer than 1,000 individuals, or
3) restricted to fewer than 4 U.S.G.S. 7.5 minute topographical maps, or
4) species listed as endangered by U.S. Department of Interior, as enumerated in Code of Federal Regulations 50 CFR 17.11.

T Threatened: listed species are those with:
1) 6 to fewer than 20 extant sites, or
2) 1,000 to fewer than 3,000 individuals, or
3) restricted to not less than 4 or more than 7 U.S.G.S. 7.5 minute topographical maps, or
4) listed as threatened by U.S. Department of Interior, as enumerated in Code of Federal Regulations 50 CFR 17.11.

R Rare: listed species have:
1) 20 to 35 extant sites, or
2) 3,000 to 5,000 individuals statewide.

U Unprotected (defined in Environmental Conservation Law section 11-0103): the species may be taken at any time without limit; however a license to take may be required.

V Exploitably vulnerable: listed species are likely to become threatened in the near future throughout all or a significant portion of their range within the state if causal factors continue unchecked.

blank No state status assigned.

(continued)

A. EXPLANATION OF STATEWIDE RARITY RANKS AND CODES (cont.)

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

E Endangered Species: any species which meet one of the following criteria:
1) Any native species in imminent danger of extirpation or extinction in New York.
2) Any species listed as endangered by the United States Department of the Interior, as enumerated in the Code of Fed. Regulations 50 CFR 17.11.

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

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

P Protected Wildlife (defined in Environmental Conservation Law section 11-0103): wild game, protected wild birds, and endangered species of wildlife.

U Unprotected (defined in Environmental Conservation Law section 11-0103): the species may be taken at any time without limit; however a license to take may be required.

G Game (defined in Environmental Conservation Law section 11-0103): any of a variety of big game or small game species as stated in the Environmental Conservation Law; many normally have an open season for at least part of the year, and are protected at other times.

blank No state status assigned.

B. DATA REQUEST PROCEDURES

HOW TO REQUEST DATA
from the New York Natural Heritage Program

Requests should be submitted in writing. Please fill out and send in a Data Request Form, or send a request letter which provides all of the following information.

Requests for data from the New York Natural Heritage Program are handled in the order in which they are received. Faxed requests are discouraged due to the poor quality of faxed maps. Since our office receives many requests each day, we strongly encourage you to contact us during the early stages of a project. You will receive the official response in writing.

NECESSARY INFORMATION. In order for us to determine what data you are requesting and respond to your request more quickly, the following information should be included on the Data Request Form or in your request letter. If your request lacks this information, our response will be delayed, or we may not be able to respond at all.

1. Write a brief description of the proposed project or activity (e.g., residential development, landfill siting, bridge repair, cellular communication tower). Include the current use of the project site.

2. Tell us why you need the data (e.g., environmental assessment under SEQR, wetland permit, management plan, town planning). Include any documents which are expected to include the data (e.g., EAF, DEIS, Phase I Assessment), and, if applicable, the Lead Agency for SEQR review.

3. Include the name of all counties and towns where the proposed project is located.

4. Include the name of all 7 ½ minute U.S.G.S. topographical maps where the proposed project is located.

5. Include a photocopy of the appropriate 7 ½ minute (1:24,000 or 1:25,000 scale) U.S.G.S. topographical map(s). Tax maps, architectural drawings or road maps are generally not useful.

7. Clearly mark the boundary of the proposed project with a colored pen or highlighter.

EXAMPLE OF A COMPLETE DATA REQUEST:

"A 250 unit housing development is proposed for 400 acres in the Town of Red Hook, Dutchess County. The site is currently undeveloped, and mostly wooded with some former agricultural fields. We have been contracted to review the environmental impacts of the project and prepare the Environmental Assessment Form under SEQR, to be reviewed by the Town of Red Hook acting as Lead Agency. In order to complete the EAF, we will need to know whether the proposed project would likely impact any ecologically significant areas or rare species of plants or animals. Enclosed is a photocopy of the Saugerties USGS quadrangle showing the location of the proposed development in red."

WHERE TO SEND YOUR DATA REQUEST:

Information Services
New York Natural Heritage Program
New York State Department of Environmental Conservation
700 Troy-Schenectady Road
Latham, New York 12110 - 2400

Data from the Natural Heritage Program databases pertaining to a specific Department of Environmental Conservation Region is also available from that Region's Fish and Wildlife Office.

(continued)

B. DATA REQUEST PROCEDURES (cont.)

The Department of Environmental Conservation (DEC) adopted a new policy regarding the release of information compiled by the New York Natural Heritage Program in February, 1997. The following guidelines are used by the New York Natural Heritage Program in implementing the data release policy when providing element occurrence data.

Entity Making Information Request	Level of Information Provided
DEC, and Federal natural resource agencies	All element occurrences, full set of fields
Public & private landowners (regarding their property)	All element occurrences on their property, full set of fields
Anyone* requesting information regarding a site that is subject to a specific project or development proposal requiring a permit, SEQR review, subdivision approval, etc., and where full set of fields are needed for sound decision-making	All element occurrences potentially impacted by the project, full set of fields
Anyone* requesting information regarding a site or area where there is no specific project proposed yet, and the site is being reviewed for the presence of elements (as in a Phase I review for a land purchase)	Non-sensitive element occurrences at the site: full set of fields Sensitive** element occurrences at the site: coded set of fields (general locations, but no element names)
Anyone* requesting information regarding potential sites of a project which is still in its intial planning stages, and where the location is still to be chosen	Non-sensitive element occurrences at the site: full set of fields Sensitive** element occurrences at the site: coded set of fields (general locations, but no element names)
Local governments, regional planning agencies, land preservation organizations and elected state officials requesting "area-wide" locational data for their town, county, region, or area	Non-sensitive element occurrences in the town or area: full set of fields Sensitive** element occurrences in the town or area: coded set of fields (general locations, but no element names)
Anyone* requesting list of species for their town, county, region, or area	Species list of all elements in the town or area, no locational fields
Researchers and academics	Heritage (with the approval of DEC for listed species) will decide what data, and at what level, is approprpriate, including whether to provide full set of fields, or coded set of fields

*The term "anyone" includes consultants, developers, prospective land purchasers, environmental groups, the media, private organizations, individual citizens.

** "Sensitive" elements are those species and communities that are highly vulnerable to collection or disturbance (for example, bog turtles, timber rattlesnakes, bald eagle nesting sites, rare orchids).

(continued)

B. DATA REQUEST PROCEDURES (cont.)

New York State Department of Environmental Conservation
Division of Fish, Wildlife & Marine Resources
Wildlife Resources Center – New York Natural Heritage Program
700 Troy-Schenectady Road, Latham, New York 12110-2400
Phone: (518) 783-3932 FAX: (518) 783-3916

John P. Cahill
Commissioner

DATA REQUEST FORM: Please complete one form per project or activity.

Requestor: ____________________

Organization: ____________________

Address: ____________________

City: ____________________ State: __________ Zip: __________

Phone: (____)____________________ Fax: (____)____________________

Signature of Requestor: ____________________

1. Title of Project: ____________________

2. Site Location:
   Town(s): __________, __________, __________

   County(ies): __________, __________, __________

   USGS Topographic 7 ½ ' Quad Name(s): __________, __________

3. Describe the current and past use of the site (e.g. commercial, agricultural land, forest, roadway, etc.):
   ____
   ____

4. Is this project subject to SEQR review? ____Yes ____No

   If yes, who is the Lead Agency? ____________________

   Address of Lead Agency: ____________________

5. Proposed Project or Activity. **Please check one.** If you want to give additional details, you may do so on the lines below or in an accompanying letter.
   ____Residential Development ____Commercial Development ____Industrial Development
   ____Municipal or County Planning/Zoning ____Utility (electric, water, sewer)
   ____Assessment for Conservation ____Cellular/Communications Tower
   ____Potential Land Purchase (to be used for: ____________________)
   ____Other: ____________________
   ____

(OVER)

(continued)

B. DATA REQUEST PROCEDURES (cont.)

6. Size in acres: ______________ or hectares: ________________ or Length in miles:__________

7. In which of the following documents do you expect to use Heritage data:
   - ____Environmental Impact Statement
   - ____Environmental Assessment Form
   - ____Conservation Plan
   - ____Research Report
   - ____Other: ____
   - ____Phase I Assessment
   - ____State Wetlands Permit Application
   - ____Management Plan
   - ____Remedial Site Investigation

Please check below which data you are requesting:

______Standard Rare Species/Natural Communities Report **______Breeding Bird Atlas Data**

Be sure to enclose a copy of a 7 ½ minute USGS topographical map with the project site clearly marked.

The "User's Guide to New York Natural Heritage Data" and "NYS Department of Environmental Conservation Division of Environmental Permits Regional Offices" will be sent with each request. Frequent requestors: Check here if you DO NOT need a copy of these: ______

****Heritage Office Use Only****

Date Processed: ____________ **Processed By:** ________

Export File Name(s): ____

Quadname/Quadcode: ______________________ Dot #s: ______________________

______________________ ______________________

BBA Blocks: ______________________________SigHab: ______________________

Report: _____IR1_____IR2_____IR1Area_____IR2Area_____IRHAZWASTE_____Other______________

Data_______ **No Data**_______

Coastal Management Program? _____ **(Check if yes.)**

Copy:

____________Regional Wildlife Manager(s)
____________Regional Fisheries Manager(s)
____________Regional Bureau of Habitat(s)

____Peter Nye (Endangered Species Unit)
____Pat Festa (Bureau of Fisheries)
____Lead Agency

Other: ____

Appendix 3

Ranks of Rare Species and other Species of Conservation Concern

PUBLISHED BY THE NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

TABLE 9. RARE PLANT STATUS (statewide)

Ranks of NYS- and NYNHP-listed rare plant species mentioned in the Manual.

See Table 10 for regionally-rare species, and Appendix 2 for explanation of statewide ranks.

Scientific nomenclature for vascular plants follows Mitchell and Tucker (1997).

Common Name	Scientific Name	NHP-Global[1]	NHP-NY[2]	NYS[3]
agrimony, small-flowered	*Agrimonia parviflora*	G5	S3 (W)[4]	U
arrowhead, spongy	*Sagittaria calycina* var. *spongiosa*	G5T4	S2	T
arrowhead, strapleaf	*Sagittaria subulata*	G4	S3 (W)	U
beggar-ticks, estuary	*Bidens bidentoides*	G3	S3	R
birch, river	*Betula nigra*	G5	S3 (W)	U
birch, swamp	*Betula pumila*	G5	S2	T
bittercress, Long's	*Cardamine longii*	G3Q	S2	T
bladderwort, floating	*Utricularia radiata*	G4	S2	T
bladderwort, hidden-fruit	*Utricularia geminiscapa*	G4G5	S3 (W)	U
bladderwort, inflated	*Utricularia inflata*	G5	S1	E
blazing-star	*Liatris scariosa* var. *novae-angliae*	G3	S2	T
bur-marigold, smooth	*Bidens laevis*	G5	S2	T
bush-clover, violet	*Lespedeza violacea*	G5	S3 (W)	R
cliffbrake, smooth	*Pellaea glabella*	G5	S2	T
coontail, spiny	*Ceratophyllum echinatum*	G4?	S2S3	T
cottonwood, swamp	*Populus heterophylla*	G5	S2	T
crabgrass, slender	*Digitaria filiformis*	G5	S2	T
crowfoot, small-flowered	*Ranunculus micranthus*	G5	S2	T
devil's-bit	*Chamaelirium luteum*	G5	S2	T
diarrhena	*Diarrhena obovata*	G4G5	S1	E
dittany	*Cunila origanoides*	G5	S3 (W)	U
dodder, buttonbush	*Cuscuta cephalanthi*	G5	S1	E
dodder, field	*Cuscuta pentagona*	G5	S3 (W)	U
dodder, smartweed	*Cuscuta polygonorum*	G5	S1	E
dodder, southern	*Cuscuta obtusiflora* var. *glandulosa*	G5T?	S1	E
featherfoil	*Hottonia inflata*	G4	S2	T
fern, woolly lip	*Cheilanthes lanosa*	G5	SH	E
flatsedge, Schweinitz's	*Cyperus schweinitzii*	G5	S3	R
flax, yellow wild	*Linum sulcatum*	G5	S2	T
globeflower, spreading	*Trollius laxus*	G3Q	S3	V
goldenclub	*Orontium aquaticum*	G5	S2	T
goldenrod, stiff-leaf	*Solidago rigida*	G5	S2	T
goldenseal	*Hydrastis canadensis*	G4	S2	T
grama, side-oats	*Bouteloua curtipendula*	G5	S1	E
gromwell, false	*Onosmodium virginianum*	G4	S1	E
ground-cherry, downy	*Physalis pubescens* var. *integrifolia*	G5T?Q	S1	E
harlequin, yellow	*Corydalis flavula*	G5	S3 (W)	U
hatpins, estuary	*Eriocaulon parkeri*	G3	SX	U
knotweed, slender	*Polygonum tenue*	G5	S3 (W)	R
lousewort, swamp	*Pedicularis lanceolata*	G5	S2	T
micranthemum, Nuttall's	*Micranthemum micranthemoides*	GH	SX	U
monkeyflower, winged	*Mimulus alatus*	G5	S3 (W)	R
(moss)	*Brachythecium turgidum*	G3G5	S1	U
(moss)	*Desmatodon obtusifolius*	G5	S2	U
(moss)	*Fissidens fontanus*	G5	S3?	U
(moss)	*Lindbergia brachyptera*	G5	SH	U
(moss)	*Orthotrichum ohioense*	G4	SH	U

(continued)

TABLE 9. RARE PLANT STATUS (statewide) (cont.)

Common Name	Scientific Name	NHP-Global[1]	NHP-NY[2]	NYS[3]
(moss)	*Orthotrichum sordidum*	G5	SH	U
(moss)	*Orthotrichum stellatum*	G5	SH	U
(moss)	*Philonotis muhlenbergii*	G3G4	SH	U
(moss)	*Taxiphyllum taxirameum*	G4G5	SH	U
mountain-mint, blunt	*Pycnanthemum muticum*	G5	S2S3	T
mountain-mint, Torrey's	*Pycnanthemum torrei*	G2	S1	E
mud-plantain, kidneyleaf	*Heteranthera reniformis*	G5	S3 (W)	U
mudwort	*Limosella australis*	G4G5	S3 (W)	R
paintbrush, Indian	*Castilleja coccinea*	G5	S1	E
pine-drops, giant	*Pterospora andromedea*	G5	S1	E
pinweed, racemed	*Lechea racemulosa*	G5	S3 (W)	R
pinweed, slender	*Lechea tenuifolia*	G5	S2	T
plantain, heartleaf	*Plantago cordata*	G4	S3	T
pod-grass	*Scheuchzeria palustris*	G5	S3	R
pondweed, spotted	*Potamogeton pulcher*	G5	S2	T
pondweed, water-thread	*Potamogeton diversifolius*	G5	S1	E
quillwort, river	*Isoetes riparia*	G5?	S1	E
rattlebox	*Crotalaria sagittalis*	G5	S1	E
riverweed	*Podostemum ceratophyllum*	G5	S2	T
rock-cress, Drummond's	*Arabis drummondii*	G5	S1S2	E
sandwort, mountain	*Minuartia groenlandica*	G5	S3 (W)	U
sedge, Bicknell's	*Carex bicknellii*	G5	S2S3	T
sedge, Bush's	*Carex bushii*	G4	S3 (W)	U
sedge, cattail	*Carex typhina*	G5	S2	T
sedge, clustered	*Carex cumulata*	G4?	S2S3	T
sedge, Emmons'	*Carex albicans* var. *emmonsii*	G5T5	S3 (W)	U
sedge, false hop	*Carex lupulifomis*	G3G4	S3	R
sedge, Fernald's	*Carex merritt-fernaldii*	G5	S2S3	T
sedge, Frank's	*Carex frankii*	G5	S1	E
sedge, handsome	*Carex formosa*	G4	S2S3	T
sedge, reflexed	*Carex retroflexa*	G5	S1	E
sedge, Schweinitz's	*Carex schweinitzii*	G3	S2	T
skullcap, small	*Scutellaria parvula* var. *parvula*	G4T?	S3 (W)	U
snakeroot, Virginia	*Aristolochia serpentaria*	G5	S1	E
spikerush, ovate	*Eleocharis obtusa* var. *ovata*	G5T4Q	S1S2	E
spleenwort, mountain	*Asplenium montanum*	G5	S2S3	T
St. Johnswort, shrubby	*Hypericum prolificum*	G5	S2	T
starwort, terrestrial	*Callitriche terrestris*	G5	S2S3	T
twin-leaf	*Jeffersonia diphylla*	G5	S2	T
valerian, bog	*Valeriana uliginosa*	G4Q	S1S2	E
water-marigold	*Megalodonta beckii*	G4G5T4	S2S3	T
water-nymph, Hudson River	*Najas guadalupensis* var. *muenscheri*	G5T2?	SH	E
waterwort, American	*Elatine americana*	G4	S1	E
whitlow-grass, Carolina	*Draba reptans*	G5	S2	T
wingstem	*Verbesina alternifolia*	G5	S2	T
wintergreen, pink	*Pyrola asarifolia*	G5	S2	T
wood-sorrel, violet	*Oxalis violacea*	G5	S1S2	T

[1] NHP-Global = New York Natural Heritage Program global rank as of July 2000 (see Appendix 2).

[2] NHP-NY = New York Natural Heritage Program state rank as of July 2000 (see Appendix 2).

[3] NYS =New York State Protected Native Plant rank effective 30 August 2000: E = endangered; R = rare; T = threatened; V = exploitably vulnerable (see Appendix 2).

[4] (W) after the NHP-NY rank indicates a listing on the NYNHP rare plant Watch List as of July 2000 (see Sect. 2).

TABLE 10. REGIONALLY-RARE PLANTS

Preliminary list of regionally-rare (R) and regionally-scarce (S) plant species of the Hudson Valley, compiled by Hudsonia Ltd.

This list excludes species included on NYS or NYNHP rare species lists. Scientific nomenclature for vascular plants follows Mitchell and Tucker (1997).

Common Name	Scientific Name	Regional Rank[1]
adder's tongue	*Ophioglossum vulgatum*	R
alkali-grass, pale	*Torreyochloa pallida* var. *pallida*	R
Allegheny-vine	*Adlumia fungosa*	R
alum-root	*Heuchera americana*	R
arbutus, trailing	*Epigaea repens*	S
arrowwood, downy	*Viburnum rafinesquianum*	S
aster, stiff-leaf	*Aster linariifolius*	R?
azalea, early	*Rhododendron prinophyllum*	R?
baneberry, red	*Actaea rubra*	S
bearberry	*Arctostaphylos uva-ursi*	R?
beauty, spring	*Claytonia virginica*	S?
bedstraw, northern	*Galium boreale*	R?
bellwort, large-flowered	*Uvularia grandiflora*	S?
birch, mountain paper	*Betula cordifolia*	R?
bittercress, small-flowered	*Cardamine parviflora*	S
bittersweet, American	*Celastrus scandens*	S?
bladderwort, common	*Utricularia macrorhiza*	R?
bladderwort, horned	*Utricularia cornuta*	R?
bog-rosemary	*Andromeda glaucophylla*	R
boneset, climbing	*Mikania scandens*	S
boneset, upland	*Eupatorium sessilifolium*	R
brome, Kalm's	*Bromus kalmii*	R?
buckbean	*Menyanthes trifoliata* var. *minor*	R
buckthorn, alder-leaf	*Rhamnus alnifolia*	R
bulrush, leafy	*Scirpus polyphyllus*	R? S?
burning-bush	*Euonymus atropurpurea*	R
butterfly-weed	*Asclepias tuberosa*	S
calla, wild	*Calla palustris*	R
campion, starry	*Silene stellata*	R
cancer-root, one-flowered	*Orobanche uniflora*	R
cedar, northern white	*Thuja occidentalis*	S
cinquefoil, three-toothed	*Potentilla tridentata*	R
clematis, purple	*Clematis occidentalis*	R?
cliffbrake, purple	*Pellaea atropurpurea*	R
clubmoss, bog	*Lycopodiella inundata*	R
cohosh, blue	*Caulophyllum thalictroides*	S
coneflower, green-headed	*Rudbeckia laciniata*	S
coralroot, spotted	*Corallorhiza maculata*	S?
cottongrass, tussock	*Eriophorum vaginatum* ssp. *spissum*	R
crab, American	*Malus coronaria*	R?
cranberry-bush	*Viburnum opulus*	R
cranberry, large	*Vaccinium macrocarpon*	S

(continued)

TABLE 10. REGIONALLY-RARE PLANTS (cont.)

Common Name	Scientific Name	Regional Rank[1]
cranberry, small	*Vaccinium oxycoccos*	R?
cress, spring	*Cardamine bulbosa*	S
cuckoo-flower	*Cardamine pratensis*	S
cuphea, clammy	*Cuphea viscosissima*	R?
current, swamp red	*Ribes triste*	R?
dandelion, dwarf	*Krigia virginica*	S
dangleberry	*Gaylussacia frondosa*	R?
dogwood, alternate-leaf	*Cornus alternifolia*	S?
dogwood, round-leaf	*Cornus rugosa*	R?
dragon, green	*Arisaema dracontium*	R
duckweed, ivy-leaf	*Lemna trisulca*	S
Dutchman's-breeches	*Dicentra cucullaria*	S?
false-mermaid	*Floerkea proserpinacoides*	R
fern, Braun's holly	*Polystichum braunii*	R?
fern, broad beech	*Phegopteris hexagonoptera*	S
fern, long beech	*Phegopteris connectilis*	R
fern, oak	*Gymnocarpium dryopteris*	R?
fern, ostrich	*Matteuccia struthiopteris*	S?
fern, Virginia chain	*Woodwardia virginica*	R
fern, walking	*Asplenium rhizophyllum*	S
fetterbush	*Leucothoe racemosa*	R
flax, Virginia wild	*Linum virginianum*	R
foxtail, short-awn	*Alopecurus aequalis*	R
fumitory, climbing	*Fumaria officinalis*	R
gallberry	*Ilex glabra*	R
gentian, closed	*Gentiana clausa*	R
gentian, closed	*Gentiana andrewsii*	S
gentian, closed	*Gentiana linearis*	R
gentian, fringed	*Gentianopsis crinita*	S
gentian, stiff	*Gentianella quinquefolia*	R
gerardia, slender	*Agalinis tenuifolia*	R
giant-hyssop, purple	*Agastache scrophulariifolia*	R
ginseng, American	*Panax quinquefolius*	R
goat's-rue	*Tephrosia virginica*	R?
goldenrod, showy	*Solidago speciosa*	R?
goldenrod, sweet	*Solidago odora*	R?
gooseberry, common	*Ribes rotundifolium*	R?
gooseberry, northern	*Ribes hirtellum*	S
grapefern, cut-leaf	*Botrychium dissectum*	R?
grass-of-Parnassus	*Parnassia glauca*	S
grass, great manna	*Glyceria grandis*	R
grass, Indian	*Sorghastrum nutans*	S?
grass, panic	*Panicum oligosanthes* var. *scribnerianum*	R?
grass, yellow-eyed	*Xyris difformis*	R?
greenbrier, bristly	*Smilax hispida*	R

(continued)

TABLE 10. REGIONALLY-RARE PLANTS (cont.)

Common Name	Scientific Name	Regional Rank[1]
hackberry (natural stands only)	*Celtis occidentalis*	S
hair-rush	*Bulbostylis capillaris*	S
Hercules'-club	*Aralia spinosa*	R[2]
hobblebush	*Viburnum lantanoides*	R?
holly, American	*Ilex opaca*	S[2]
honeysuckle, fly	*Lonicera canadensis*	R
honeysuckle, mountain	*Lonicera dioica*	S?
honeysuckle, trumpet	*Lonicera sempervirens*	R?
horsetail, wood	*Equisetum sylvaticum*	S
Joe-Pye-weed, hollow-stemmed	*Eupatorium fistulosum*	S?
ladyslipper, yellow	*Cypripedium parviflorum*	R?
lady's-tresses, slender	*Spiranthes lacera*	R
larch, American	*Larix laricina*	S
laurel, bog	*Kalmia polifolia*	R
laurel, great	*Rhododendron maximum*	R
leatherwood	*Dirca palustris*	R
(lichen)	*Acarospora subfuscescens*	R
(lichen)	*Caloplaca scotoplaca*	R
lily, Canada	*Lilium canadense*	S
lily, turk's cap	*Lilium superbum*	S?
(liverwort)	*Aneura pinguis*	R
(liverwort)	*Trichocolea tomentella*	R
lizard's-tail	*Saururus cernuus*	R
lobelia, Kalm's	*Lobelia kalmii*	S
loosestrife, winged	*Lythrum alatum*	R
lopseed	*Phryma leptostachya*	R
lupine, wild	*Lupinus perennis*	R
maple, mountain	*Acer spicatum*	S
may-apple	*Podophyllum peltatum*	S
meadow-beauty, Virginia	*Rhexia virginica*	R?
milkweed, blunt-leaf	*Asclepias amplexicaulis*	R?
milkweed, four-leaf	*Asclepias quadrifolia*	R?
milkweed, poke	*Asclepias exaltata*	R?
milkweed, whorled	*Asclepias verticillata*	R
milkwort, field	*Polygala sanguinea*	S?
milkwort, whorled	*Polygala verticillata*	S?
moonseed	*Menispermum canadense*	S
(moss)	*Helodium paludosum*	R
(moss, peat)	*Sphagnum compactum*	R
mountain-holly	*Nemopanthus mucronatus*	S
mud-hyssop	*Gratiola neglecta*	S?
mulberry, red	*Morus rubra*	R? S?
oak, chinquapin	*Quercus muhlenbergii*	R?
oak, dwarf chestnut	*Quercus prinoides*	R?

(continued)

TABLE 10. REGIONALLY-RARE PLANTS (cont.)

Common Name	Scientific Name	Regional Rank[1]
oak, mossy-cup	*Quercus macrocarpa*	R
oak, post	*Quercus stellata*	S[2]
orangeweed	*Hypericum gentianoides*	S?
orchid, ragged fringed	*Platanthera lacera*	R?
orchid, small purple-fringed	*Plantanthera psycodes*	R
orchid, snakemouth	*Pogonia ophioglossoides*	R
orchid, tubercled	*Platanthera flava*	R?
orchis, snowy	*Galearis spectabilis*	R?
pellitory	*Parietaria pensylvanica*	R
pignut, sweet	*Carya ovalis*	R?
pink, grass	*Calopogon tuberosus*	R
pinkster-flower	*Rhododendron periclymenoides*	S[2]
pipewort	*Eriocaulon septangulare*	S
pipsissewa	*Chimaphila umbellata*	S
pitcher-plant	*Sarracenia purpurea*	S?
pondweed, blunt-leaf	*Potamogeton obtusifolius*	R?
pondweed, horned	*Zannichellia palustris*	S?
pondweed, Vasey's	*Potamogeton vaseyi*	R
prickly-pear, eastern	*Opuntia humifusa*	S
ragweed, giant	*Ambrosia trifida*	S
rattlesnake-plantain, downy	*Goodyera pubescens*	S?
rock-cress, hairy	*Arabis hirsuta* var. *pycnocarpa*	S
rose-mallow, swamp	*Hibiscus moscheutos*	S?
rose, pasture	*Rosa virginiana*	R?
rose, prairie	*Rosa setigera*	R?
rush, toad	*Juncus bufonius*	R?
rush, Torrey's	*Juncus torreyi*	R
sandwort, rock	*Minuartia michauxii*	S?
sedge	*Carex rugosperma*	O?
sedge, bronze	*Carex aenea*	R
sedge, Fernald's	*Carex merritt-fernaldii*	R
sedge, golden-fruit	*Carex aurea*	R
sedge, Gray's	*Carex grayi*	S?
sedge, hairy-fruit	*Carex trichocarpa*	O?
sedge, Muhlenberg	*Carex muhlenbergii*	R?
sedge, plantain	*Carex plantaginea*	R
sedge, prairie	*Carex prairea*	R
sedge, retrorse	*Carex retrorsa*	O?
sedge, rigid	*Carex tetanica*	R
sedge, Sprengel's	*Carex sprengelii*	R?
sedge, squarrose	*Carex squarrosa*	S
sedge, sterile	*Carex sterilis*	S?
seedbox	*Ludwigia alternifolia*	S?
senna, wild	*Cassia hebecarpa*	R

(continued)

TABLE 10. REGIONALLY-RARE PLANTS (cont.)

Common Name	Scientific Name	Regional Rank[1]
shadbush, dwarf	*Amelanchier stolonifera*	R
snowberry	*Symphoricarpos albus*	R?
snowberry, creeping	*Gaultheria hispidula*	R
Solomon's seal, great	*Polygonatum commutatum*	S
spikemoss, creeping	*Selaginella apoda*	S?
spikemoss, rock	*Selaginella rupestris*	R
spikenard	*Aralia racemosa*	R
spikerush, olivaceous	*Eleocharis flavescens*	R
spleenwort, silvery	*Deparia acrostichoides*	R
spruce, black	*Picea mariana*	S[2]
staggerbush	*Lyonia mariana*	R
stargrass, yellow	*Hypoxis hirsuta*	S
sumac, dwarf	*Rhus copallinum*	S[2]
sumac, fragrant	*Rhus aromatica*	R
sundew, roundleaf	*Drosera rotundifolia*	S
sundew, spatulate-leaf	*Drosera intermedia*	R
Susan, brown-eyed	*Rudbeckia triloba*	O?
sweet-gum	*Liquidambar styraciflua*	R[2]
tea, Labrador	*Rhododendron groenlandicum*	R?
tea, New Jersey	*Ceanothus americanus*	R
tearthumb, arrowleaf	*Polygonum arifolium*	S
tree, cucumber	*Magnolia acuminata*	R?
twig-rush	*Cladium mariscoides*	S
vervain, narrow-leaved	*Verbena simplex*	R
vetchling	*Lathyrus palustris*	R
violet, roundleaf	*Viola rotundifolia*	R?
water-crowfoot, white	*Ranunculus triphyllus*	O?
water-crowfoot, yellow	*Ranunculus flabellaris*	S?
watermilfoil, slender	*Myriophyllum tenellum*	R?
widgeon-grass	*Ruppia maritima*	R
wild-raisin, northern	*Viburnum nudum* var. *cassinoides*	S?
willow, autumn	*Salix serissima*	S
willow, hoary	*Salix candida*	S
willow, prairie	*Salix humilis*	S
willow, silky	*Salix sericea*	S
winterberry, mountain	*Ilex montana*	R?
winterberry, smooth	*Ilex laevigata*	R
woodrush, small-flowered	*Luzula parviflora*	R
woodsia, blunt-lobed	*Woodsia obtusa*	R?
woodsia, rusty	*Woodsia ilvensis*	R?
yew, American	*Taxus canadensis*	S

[1] R = regionally-rare in the Hudson Valley (20 or fewer occurrences); S = regionally-scarce in the Hudson Valley (21–100 occurrences); R?, S? = regional status uncertain; O? = occurrence in region uncertain. (See Sect. 2.)

[2] Common in one or several locales, but rare or scarce elsewhere in Hudson Valley.

TABLE 11. RARE ANIMAL STATUS (excluding birds)

Rarity ranks of invertebrates, fishes, reptiles, amphibians, and mammals mentioned in the Manual.

Common Name	Scientific Name	Federal[1]	NHP-Global[2]	NHP-NY[3,4]	NYS[5]	Regional[6]
INVERTEBRATES						
CRUSTACEANS	**CLASS CRUSTACEA**					
Amphipods	**Order Amphipoda**					
(amphipod)	*Gammarus pseudolimnaeus*				U	O?
Piedmont groundwater amphipod	*Stygobromus tenuis tenuis*				U	O?
MILLIPEDES	**CLASS DIPLOPODA**					
anise millipede	*Apheloria virginiensis*				U	S?
INSECTS	**CLASS INSECTA**					
Dragonflies & Damselflies	**Order Odonata**					
tiger spiketail	*Cordulegaster erronea*		G4	S1	U	
arrowhead spiketail	*Cordulegaster obliqua*		G4	S2S3	U	
sable clubtail	*Gomphus rogersi*		G4	S1	U	
mocha emerald	*Somatochlora linearis*		G5	S2S3	U	
russet-tipped clubtail	*Stylurus plagiatus*		G5	S1	U	
gray petaltail	*Tachopteryx thoreyi*		G4	S2	U SC	
beaverpond baskettail	*Tetragoneuria canis*		G5	S5	U	S
Stoneflies	**Order Plecoptera**					
(stonefly)	*Pteronarcys*				U	R
Butterflies & Moths	**Order Lepidoptera**					
Horace's duskywing	*Erynnis horatius*		G5	S4	U	R
swarthy skipper	*Nastra lherminier*		G5	S4	U	R
Leonard's skipper	*Hesperia leonardus*		G4	S5	U	R
cobweb skipper	*Hesperia metea*		G4G5	S4	U	R
mulberry wing	*Poanes massasoit*		G4	S4	U	S?
coastal broad-winged skipper	*Poanes viator zizaniae*		G5T5	S4	U	S?
Dion skipper (sedge skipper)	*Euphyes dion*		G4	S3 (W)	U	
black dash	*Euphyes conspicua*		G4	S3S4 (i)	U	R
two-spotted skipper	*Euphyes bimacula*		G4	S4	U	R
dusted skipper	*Atrytonopsis hianna*		G4G5	S3	U	
black swallowtail	*Papilio polyxenes*		G5	S?	U	S, D
falcate orange tip	*Anthocharis midea*		G5	S3S4 (W)	U	
little yellow	*Eurema lisa*		G5	S?N	U	R
bronze copper	*Lycaena hyllus*		G5	S4	U	R
Edward's hairstreak	*Satyrium edwardsii*		G4	S3S4	U	
striped hairstreak	*Satyrium liparops*		G5	S?	U	S
northern hairstreak	*Fixsenia favonius ontario*		G4T4	S1S3	U	
olive hairstreak	*Callophrys gryneus*		G5	S4	U	S
pine elfin	*Callophrys niphon*		G5	S5	U	R
brown elfin	*Callophrys augustinus*		G5	S5	U	R
gray hairstreak	*Strymon melinus*		G5	S5	U	S
Karner blue	*Lycaeides melissa samuelis*	LE	G5T2	S1S2	E	
aphrodite fritillary	*Speyeria aphrodite*		G5	S5	U	R?
silver-bordered fritillary	*Boloria selene*		G5	S?	U	R
meadow fritillary	*Boloria bellona*		G5	S5	U	R, D
Harris' checkerspot	*Chlosyne harrisii*		G4	S4	U	S
Baltimore (Baltimore checkerspot)	*Euphydryas phaeton*		G4	S4	U	S
Compton's tortoiseshell	*Nymphalis vaualbum*		G5	S5	U	S
Milbert's tortoiseshell	*Nymphalis milberti*		G5	S5	U	R

(continued)

TABLE 11. RARE ANIMAL STATUS (excluding birds) (cont.)

Common Name	Scientific Name	Federal[1]	NHP-Global[2]	NHP-NY[3,4]	NYS[5]	Regional[6]
Butterflies & Moths (cont.)						
hackberry butterfly	*Asterocampa celtis*		G5	S3S4 (W)	U	
eyed brown	*Satyrodes eurydice*		G5	S4	U	S
inland barrens buckmoth	*Hemileuca maia* ssp. 3		G4T1T2	S1	U SC	
phantom cranefly	*Bittacomorpha clavipes*				U	S?
Wasps, Bees, & Ants	**Order Hymenoptera**					
sand wasp	*Bembix*				U	R?
SNAILS & SLUGS	**CLASS GASTROPODA**					
(snail)	*Marstonia decepta*				U	R
(snail)	*Pomatiopsis lapidaria*				U	R
springtime physa	*Physa vernalis*				U	R
BIVALVES	**CLASS BIVALVIA**					
alewife floater	*Anodonta implicata*		G5	S1S2	U	
brook floater	*Alasmidonta varicosa*		G3	S1	T	
yellow lampmussel	*Lampsilis cariosa*		G3G4	S3	U	
tidewater mucket	*Leptodea ochracea*		G4	S1	U	
(fingernail clam)	*Pisidium adamsi*					R
FISHES	**[SUPERCLASS PISCES]**					
American brook lamprey	*Lampetra appendix*		G4	S3 (W)	U	
shortnose sturgeon	*Acipenser brevirostrum*	LE	G3	S1	E	
creek chubsucker	*Erimyzon oblongus*		G5	S4	U	R
northern hog sucker	*Hypentelium nigricans*		G5	S5	U	R
longnose sucker	*Catostomus catostomus*		G5	S3 (W)	U	
bridle shiner	*Notropis bifrenatus*		G5	S5	U	R
tadpole madtom	*Noturus gyrinus*		G5	S3 (W)	U	
eastern silvery minnow	*Hybognathus regius*		G5	S4	U	R
brook trout	*Salvelinus fontinalis*		G5	S5	P	S
rainbow smelt	*Osmerus mordax*		G5	S5	U	V
eastern mudminnow	*Umbra pygmaea*		G5	S3 (W)	U	
slimy sculpin	*Cottus cognatus*		G5	S4	U	S
mud sunfish	*Acantharchus pomotis*		G5	S1	T	
AMPHIBIANS	**CLASS AMPHIBIA**					
marbled salamander	*Ambystoma opacum*		G5	S4	U SC	
Jefferson salamander	*Ambystoma jeffersonianum*		G5	S4? (W)	U SC	
blue-spotted salamander	*Ambystoma laterale*		G5	S4 (W)	U SC	
spotted salamander	*Ambystoma maculatum*		G5	S5	U	V
northern dusky salamander	*Desmognathus fuscus*		G5	S5	U	D, V
mountain dusky salamander	*Desmognathus ochrophaeus*		G5	S5	U	R
slimy salamander	*Plethodon glutinosus*		G5	S5	U	S?
four-toed salamander	*Hemidactylium scutatum*		G5	S5	U	S?
spring salamander	*Gyrinophilus porphyriticus*		G5	S5	U	R
red salamander	*Pseudotriton ruber*		G5	S4	U	R
long-tailed salamander	*Eurycea longicauda*		G5	S2S3	U SC	
eastern spadefoot toad	*Scaphiopus holbrookii*		G5	S3 (W)	U SC	
Fowler's toad	*Bufo fowleri*		G5	S4	U	R
northern cricket frog	*Acris crepitans*		G5	S1	E	
wood frog	*Rana sylvatica*		G5	S5	G	V
northern leopard frog	*Rana pipiens*		G5	S5	G	R?
southern leopard frog	*Rana utricularis sphenocephalis*		G5	S2S3	G SC	

(continued)

TABLE 11. RARE ANIMAL STATUS (excluding birds) (cont.)

Common Name	Scientific Name	Federal[1]	NHP-Global[2]	NHP-NY[3,4]	NYS[5]	Regional[6]
REPTILES	**CLASS REPTILIA**					
spotted turtle	*Clemmys guttata*		G5	S4 (W)	U SC	
bog turtle	*Clemmys muhlenbergii*	LT-T	G3	S2	E	
wood turtle	*Clemmys insculpta*		G4	S4 (W)	G SC	
eastern box turtle	*Terrapene carolina*		G5	S4	G SC	
map turtle	*Graptemys geographica*		G5	S4	U	R
diamondback terrapin	*Malaclemys terrapin*		G4	S3 (W)	G	
Blanding's turtle	*Emydoidea blandingii*		G4	S2S3	T	
eastern fence lizard	*Sceloporus undulatus*		G5	S1	T	
five-lined skink	*Eumeces fasciatus*		G5	S3 (W)	U	
ribbon snake	*Thamnophis sauritus*		G5	S5	U	R?S?
eastern hognose snake	*Heterodon platirhinos*		G5	S3S4 (W)	U SC	
worm snake	*Carphophis amoenus*		G5	S3S4 (W)	U SC	
black rat snake	*Elaphe obsoleta*		G5	S5	U	S?
northern copperhead	*Agkistrodon contortrix*		G5	S3 (W)	U	
timber rattlesnake	*Crotalus horridus*		G4	S3	T	
northern black racer	*Coluber constrictor*		G5	S5	U	D?
smooth green snake	*Liochlorophis vernalis*		G5	S5	U	D?
MAMMALS	**CLASS MAMMALIA**					
longtail shrew	*Sorex dispar*		G4	S4	U	R
Keen's bat	*Myotis keeni*				U	O?
Indiana bat	*Myotis sodalis*	LE	G2	S1	E	
small-footed bat	*Myotis leibii*		G3	S2	U SC	
silver-haired bat	*Lasionycteris noctivagans*		G5	S4B, SZN	U	Rm
eastern pipistrelle	*Pipistrellus subflavus*		G5	S3 (i)	U	R
red bat	*Lasiurus borealis*		G5	S5B, SZN	U	Rm?
hoary bat	*Lasiurus cinereus*		G5	S4B, SZN	U	Rm
black bear	*Ursus americanus*		G5	S5	G	S
fisher	*Martes pennanti*		G5	S4	G	S
river otter	*Lutra canadensis*		G5	S5	G	S
bobcat	*Lynx rufus*		G5	S4	G	V
harbor seal	*Phoca vitulina*		G5	S3	P	
eastern woodrat (Allegheny woodrat)	*Neotoma magister*		G3G4	SH	E	
southern bog lemming	*Synaptomys cooperi*		G5	S4	U	R
boreal redback vole	*Clethrionomys gapperi*		G5	S5	U	R?S?
woodland jumping mouse	*Napaeozapus insignis*		G5	S5	U	R
porcupine	*Erethizon dorsatum*		G5	S5	U	R
New England cottontail	*Sylvilagus transitionalis*		G4	SH	G SC	

[1] Federal = Federal Endangered Species Act: LE = formally listed as endangered; LT = formally listed as threatened.

[2] NHP-Global = Natural Heritage Program global rank, as of August 2000; see Appendix 2 for explanation of ranks.

[3] NHP-NY = Natural Heritage Program New York State rank as of November 2000; see Sect. 2 and Appendix 2 for explanation of ranks.

[4] Species with NHP-NY ranks S1, S2, S3, S3S4, or SH are in "active" NYNHP inventory, unless marked (W) for Watch List or (i) for inactive list. Those with NHP-NY ranks S4 and S5 are on inactive list. See Appendix 2 for further explanation.

[5] NYS = Endangered (E), Threatened (T) and Special Concern (SC) Fish and Wildlife Species of New York State effective December 1999; P = protected; G = regulated as a game species. See Appendix 2 for explanation of ranks.

[6] Regional = Hudson Valley regional status: R = regionally-rare; Rm = regionally-rare migrant; S = regionally-scarce; R? or S? = status uncertain; D = declining; V = vulnerable; O? = occurrence in region is uncertain. See Section 2 for explanation of ranks.

TABLE 12. RARE BIRD STATUS

Rarity ranks of bird species mentioned in the Manual. See Section 2 and Appendix 3 for explanations of rarity ranks.

Common Name	Scientific Name	Federal[1]	NHP-Global[2]	NHP- NY[3]	NYS[4]	MIJ[5]	MIG[6]	PIF-Watch[7]	Regional[8]
Cormorants	**Phalacrocoracidae**								
double-crested cormorant	*Phalacrocorax auritus*		G5	S3 (W)	P				
Bitterns, Herons, and Allies	**Ardeidae**								
American bittern	*Botaurus lentiginosus*		G4	S4 (W)	P SC		•		
least bittern	*Ixobrychus exilis*		G5	S3B, S1N	T		•		
great blue heron	*Ardea herodias*		G5	S5	P				Rb
New World Vultures	**Cathartidae**								
black vulture	*Coragyps atratus*		G5	S?N	P				Rb
turkey vulture	*Cathartes aura*		G5	S4	P				Rb
Geese, Swans, and Ducks	**Anatidae**								
wood duck	*Aix sponsa*		G5	S5	G				V
American black duck	*Anas rubripes*		G5	S4	G			M	D
blue-winged teal	*Anas discors*		G5	S5	G				Rb
redhead	*Aythya americana*		G5	SE	G				
oldsquaw	*Clangula hyemalis*		G5	S?N	G				
ruddy duck	*Oxyura jamaicensis*		G5	S1	G				
red-breasted merganser	*Mergus serrator*		G5	S1S2	G				
Kites, Eagles, Hawks, and Allies	**Accipitridae**								
osprey	*Pandion haliaetus*		G5	S4B, SZN (W)	P SC				
bald eagle	*Haliaeetus leucocephalus*	T	G4	S2S3B,S	T				
northern harrier	*Circus cyaneus*		G5	S3B, S3N	T		•		
sharp-shinned hawk	*Accipiter striatus*		G5	S4	P SC				
Cooper's hawk	*Accipiter cooperii*		G5	S4 (W)	P SC				
northern goshawk	*Accipiter gentilis*		G5	S4B, S3N	P SC				
red-shouldered hawk	*Buteo lineatus*		G5	S4B, SZN (W)	P SC		•		
broad-winged hawk	*Buteo platypterus*		G5	S5	P	•			S
golden eagle	*Aquila chrysaetos*		G5	SHB,S1N	E				
Caracaras and Falcons	**Falconidae**								
American kestrel	*Falco sparverius*		G5	S5	P				D
peregrine falcon	*Falco peregrinus*		G4	S3B, S2N	E				
New World Quails	**Odontophoridae**								
northern bobwhite	*Colinus virginianus*		G5	S4	G				R

(continued)

TABLE 12. RARE BIRD STATUS (cont.)									
Common Name	**Scientific Name**	**Federal[1]**	**NHP-Global[2]**	**NHP- NY[3]**	**NYS[4]**	**MIJ[5]**	**MIG[6]**	**PIF-Watch[7]**	**Regional[8]**
Rails, Gallinules, and Coots	**Rallidae**								O?
black rail	*Laterallus jamaicensis*		G4	S1B, SZN	E		•	H	
clapper rail	*Rallus longirostris*		G5	S3 (W)	P				
king rail	*Rallus elegans*		G4G5	S1B, SZN	T				
Virginia rail	*Rallus limicola*		G5	S5	G				Sb
sora	*Porzana carolina*		G5	S4	G				Rb
common moorhen	*Gallinula chloropus*		G5	S4	P				Rb
American coot	*Fulica americana*		G5	S3	G				
Sandpipers, Phalaropes, and Allies	**Scolopacidae**								
upland sandpiper	*Bartramia longicauda*		G5	S3B	T		•		
common snipe	*Gallinago gallinago*		G5	S5	P				Rb
American woodcock	*Scolopax minor*		G5	S5	G				D
Cuckoos, Roadrunners, and Anis	**Cuculidae**								
black-billed cuckoo	*Coccyzus erythropthalmus*		G5	S5	P	•			
yellow-billed cuckoo	*Coccyzus americanus*		G5	S5	P	•			
Typical Owls	**Strigidae**								
barred owl	*Strix varia*		G5	S5	P				Sb
long-eared owl	*Asio otus*		G5	S3 (W)	P				
short-eared owl	*Asio flammeus*		G5	S2	E		•	M	
northern saw-whet owl	*Aegolius acadicus*		G5	S3 (W)	P				
Goatsuckers	**Caprimulgidae**								
common nighthawk	*Chordeiles minor*		G5	S4 (W)	P SC				
whip-poor-will	*Caprimulgus vociferus*		G5	S4	P SC	•			
Woodpeckers and Allies	**Picidae**								
red-headed woodpecker	*Melanerpes erythrocephalus*		G5	S4	P SC			M	
yellow-bellied sapsucker	*Sphyrapicus varius*		G5	S5	P	•			Rb
Tyrant Flycatchers	**Tyrannidae**								
eastern wood-pewee	*Contopus virens*		G5	S5	P	•			V
Acadian flycatcher	*Empidonax virescens*		G5	S3 (W)	P	•			
alder flycatcher	*Empidonax alnorum*		G5	S5	P				Rb
Shrikes	**Laniidae**								
loggerhead shrike	*Lanius ludovicianus*		G5	S1B,SZN	E		•		

(continued)

TABLE 12. RARE BIRD STATUS (cont.)

Common Name	Scientific Name	Federal[1]	NHP-Global[2]	NHP- NY[3]	NYS[4]	MIJ[5]	MIG[6]	PIF-Watch[7]	Regional[8]
Vireos	**Vireonidae**								
white-eyed vireo	*Vireo griseus*		G5	S4	P				Rb
blue-headed vireo	*Vireo solitarius*		G5	S5	P	•			Rb
red-eyed vireo	*Vireo olivaceus*		G5	S5	P	•			
Jays, Magpies and Crows	**Corvidae**								
fish crow	*Corvus ossifragus*		G5	S4	P				Sb
common raven	*Corvus corax*		G5	S4	P				Rb
Swallows	**Hirundinidae**								
purple martin	*Progne subis*		G5	S5	P				Rb?
bank swallow	*Riparia riparia*		G5	S5	P				Sb
Nuthatches	**Sittidae**								
red-breasted nuthatch	*Sitta canadensis*		G5	S5	P				Rb
Wrens	**Troglodytidae**								
Carolina wren	*Thryothorus ludovicianus*		G5	S5	P				Rb
winter wren	*Troglodytes troglodytes*		G5	S5	P				Rb
sedge wren	*Cistothorus platensis*		G5	S3B, SAN	T		•		
marsh wren	*Cistothorus palustris*		G5	S5	P				Sb
Kinglets	**Regulidae**								
golden-crowned kinglet	*Regulus satrapa*		G5	S5	P				Rb
Thrushes	**Turdidae**								
eastern bluebird	*Sialia sialis*		G5	S5	P				V
veery	*Catharus fuscescens*		G5	S5	P	•			
Bicknell's thrush	*Catharus bicknelli*		G4	S2S3B	P SC			M	
Swainson's thrush	*Catharus ustulatus*		G5	S5	P	•			Rb
hermit thrush	*Catharus guttatus*		G5	S5	P				Sb
wood thrush	*Hylocichla mustelina*		G5	S5	P	•		M	V
Wood Warblers	**Parulidae**								
blue-winged warbler	*Vermivora pinus*		G5	S5	P	•			
golden-winged warbler	*Vermivora chrysoptera*		G4	S4 (W)	P SC	•	•	H	
Nashville warbler	*Vermivora ruficapilla*		G5	S5	P				Rb
chestnut-sided warbler	*Dendroica pensylvanica*		G5	S5	P	•			
magnolia warbler	*Dendroica magnolia*		G5	S5	P	•			Rb
black-throated blue warbler	*Dendroica caerulescens*		G5	S5	P			M	Rb

TABLE 12. RARE BIRD STATUS (cont.)									
Common Name	**Scientific Name**	**Federal[1]**	**NHP-Global[2]**	**NHP- NY[3]**	**NYS[4]**	**MIJ[5]**	**MIG[6]**	**PIF-Watch[7]**	**Regional[8]**
black-throated green warbler	*Dendroica virens*		G5	S5	P	•			Sb
Blackburnian warbler	*Dendroica fusca*		G5	S5	P	•			Rb
pine warbler	*Dendroica pinus*		G5	S5	P				Rb
prairie warbler	*Dendroica discolor*		G5	S5	P			M	
cerulean warbler	*Dendroica cerulea*		G4	S4 B	P SC	•	•	H	
American redstart	*Setophaga ruticilla*		G5	S5	P	•			
prothonotary warbler	*Protonotaria citrea*		G5	S2	P	•		M	
worm-eating warbler	*Helmitheros vermivorus*		G5	S4	P	•		M	Sb
ovenbird	*Seiurus aurocapillus*		G5	S5	P	•			V
northern waterthrush	*Seiurus noveboracensis*		G5	S5	P	•			Rb
Louisiana waterthrush	*Seiurus motacilla*		G5	S5	P	•			
Kentucky warbler	*Oporornis formosus*		G5	S2	P	•		M	
hooded warbler	*Wilsonia citrina*		G5	S5	P	•			Rb
Canada warbler	*Wilsonia canadensis*		G5	S5	P	•			Sb
yellow-breasted chat	*Icteria virens*		G5	S3	P SC				
Tanagers	**Thraupidae**								
scarlet tanager	*Piranga olivacea*		G5	S5	P	•			V
New World Sparrows	**Emberizidae**								
clay-colored sparrow	*Spizella pallida*		G5	S2	P			M	
vesper sparrow	*Pooecetes gramineus*		G5	S5	P SC				
savannah sparrow	*Passerculus sandwichensis*		G5	S5	P				Sb?
grasshopper sparrow	*Ammodramus savannarum*		G5	S4 (W)	P SC				
Henslow's sparrow	*Ammodramus henslowii*		G4	S3B,SAN	T		•	H	
saltmarsh sharp-tailed sparrow	*Ammodramus caudacutus*		G4	S3 (W)	P			H	
seaside sparrow	*Ammodramus maritimus*		G4	S2S3	P SC		•	M	
dark-eyed junco	*Junco hyemalis*		G5	S5	P				Sb
Blackbirds	**Icteridae**								
bobolink	*Dolichonyx oryzivorus*		G5	S5	P			M	V
eastern meadowlark	*Sturnella magna*		G5	S5	P				D
orchard oriole	*Icterus spurius*		G5	S4	P				Sb
Fringilline and Cardueline Finches	**Fringillidae**								
pine siskin	*Carduelis pinus*		G5	S5	P				Rb
evening grosbeak	*Coccothraustes vespertinus*		G5	S5	P				Rb

[1] Federal = Federal Endangered Species Act: E = endangered; T = threatened.
[2] NHP-Global = Natural Heritage Program global rank, as of August 2000; see Appendix 2 for explanation of ranks.
[3] NHP-NY = Natural Heritage Program New York State rank as of August 2000; see Sect. 2 and Appendix 2 for explanation of ranks.
[4] NYS = Endangered (E), Threatened (T) and Special Concern (SC) Fish and Wildlife Species of New York State effective December 1999: P = protected; G = regulated as a game species. See Appendix 2 for explanation of ranks.
[5] MIJ = Migrants in Jeopardy (Ehrlich et al. 1988). See Section 2 and Table 13 for description of this list.
[6] MIG = Migratory Nongame Birds of Management Concern in the Northeast (Schneider and Pence 1992). See Section 2 and Table 13 for description of this list.
[7] PIF-Watch = priority rank in Partners in Flight WatchList (online version, fall 2000): H = high priority; M = moderate priority. See Section 2 and Table 13 for description of this list.
[8] Regional = Hudson Valley regional status: Rb = regionally-rare breeder; Sb = regionally-scarce breeder; D = declining; V = vulnerable; O? = occurrence in region is uncertain. See Section 2 for explanation of regional rarity ranks.

TABLE 13. NATIONAL BIRD LISTS

Three national lists of birds of conservation concern

A. Migrants in Jeopardy.

North American migratory bird species at particular risk due to loss of wintering habitat in mature neotropical forests. This list was modified from Terborgh (1980) by David Wilcove, and published in Ehrlich et al. (1988). An asterisk (*) denotes species that breed in New York State.

Common Name	Scientific Name	Common Name	Scientific Name
kite, Mississippi	*Ictinia mississippiensis*	warbler, chestnut-sided*	*Dendroica pensylvanica*
kite, American swallow-tailed	*Elanoides forficatus*	warbler, magnolia*	*Dendroica magnolia*
hawk, broad-winged*	*Buteo platypterus*	warbler, Cape May*	*Dendroica tigrina*
Chuck-will's-widow*	*Caprimulgus carolinensis*	warbler, black-throated gray	*Dendroica nigrescens*
whip-poor-will*	*Caprimulgus vociferous*	warbler, golden-cheeked	*Dendroica chrysoparia*
cuckoo, black-billed*	*Coccyzus erythropthalmus*	warbler, Townsend's	*Dendroica townsendi*
cuckoo, yellow-billed*	*Coccyzus americanus*	warbler, black-throated green*	*Dendroica virens*
sapsucker, yellow-bellied*	*Sphyrapicus varius*	warbler, Blackburnian*	*Dendroica fusca*
wood-pewee, western	*Contopus sordidulus*	warbler, yellow-throated*	*Dendroica dominica*
wood-pewee, eastern*	*Contopus virens*	warbler, Grace's	*Dendroica graciae*
flycatcher, yellow-bellied*	*Empidonax flaviventris*	warbler, bay-breasted*	*Dendroica castanea*
flycatcher, Acadian*	*Empidonax virescens*	warbler, blackpoll*	*Dendroica striata*
flycatcher, great-crested*	*Myiarchus crinitus*	warbler, cerulean*	*Dendroica cerulea*
vireo, black-capped	*Vireo atricapillus*	warbler, black-and-white*	*Mniotilta varia*
vireo, yellow-throated*	*Vireo flavifrons*	redstart, American*	*Setophaga ruticilla*
vireo, blue-headed*	*Vireo solitarius*	warbler, prothonotary*	*Protonotaria citrea*
vireo, Philadelphia*	*Vireo philadelphicus*	warbler, worm-eating*	*Helmitheros vermivorus*
vireo, red-eyed*	*Vireo olivaceus*	warbler, Swainson's	*Limnothlypis swainsonii*
gnatcatcher, blue-gray*	*Polioptila caerulea*	ovenbird*	*Seiurus aurocapillus*
veery*	*Catharus fuscescens*	waterthrush, northern*	*Seiurus noveboracensis*
thrush, gray-cheeked	*Catharus minimus*	waterthrush, Louisiana*	*Seiurus motacilla*
thrush, Swainson's*	*Catharus ustulatus*	warbler, Kentucky*	*Oporornis formosus*
thrush, wood*	*Hylocichla mustelina*	warbler, hooded*	*Wilsonia citrina*
warbler, Bachman's	*Vermivora bachmanii*	warbler, Canada*	*Wilsonia canadensis*
warbler, blue-winged*	*Vermivora pinus*	tanager, hepatic	*Piranga flava*
warbler, golden-winged*	*Vermivora chrysoptera*	tanager, scarlet*	*Piranga olivacea*
warbler, Tennessee*	*Vermivora peregrina*	grosbeak, black-headed	*Pheucticus melanocephalus*
parula, northern*	*Parula americana*	oriole, Bullock's	*Icterus bullockii*

(continued)

TABLE 13. NATIONAL BIRD LISTS (cont.)

B. Partners in Flight WatchList.

Bird species of the continental U.S., not listed as federally endangered, that are at particular risk due to low population size, small range, declining population, loss of habitat, nest parasitism, and other factors. Compiled by the Colorado Bird Observatory, American Bird Conservancy, Partners in Flight, and the U.S. Fish and Wildlife Service, updated in 1999; future updates available at www.audubon.org/bird/watch. An asterisk (*) denotes species that breed in New York State.

Common Name	Scientific Name
HIGH PRIORITY	
petrel, black-capped	*Pterodroma hasitata*
goose, emperor	*Chen canagica*
kite, snail	*Rostrhamus sociabilis*
rail, black*	*Laterallus jamaicensis*
plover, mountain	*Charadrius montanus*
oystercatcher, black	*Haematopus bachmani*
curlew, bristle-thighed	*Numenius tahitiensis*
vireo, Bell's	*Vireo bellii*
scrub-jay, island	*Aphelocoma insularis*
thrasher, Bendire's	*Toxostoma bendirei*
thrasher, Le Conte's	*Toxostoma lecontei*
warbler, golden-winged*	*Vermivora chrysoptera*
warbler, colima	*Vermivora crissalis*
warbler, hermit	*Dendroica occidentalis*
warbler, cerulean*	*Dendroica cerulea*
warbler, Swainson's	*Limnothlypis swainsonii*
warbler, red-faced	*Cardellina rubrifrons*
sparrow, rufous-winged	*Aimophila carpalis*
sparrow, Bachman's	*Aimophila aestivalis*
sparrow, Baird's	*Ammodramus bairdii*
sparrow, Henslow's*	*Ammodramus henslowii*
sparrow, saltmarsh sharp-tailed*	*Ammodramus caudacutus*
sparrow, Nelson's sharp-tailed	*Ammodramus nelsoni*
longspur, McCown's	*Calcarius mccownii*
longspur, Smith's	*Calcarius pictus*
oriole, Audubon's	*Icterus graduacauda*
goldfinch, Lawrence's	*Carduelis lawrencei*
MODERATE PRIORITY	
shearwater, black-vented	*Puffinus opisthomelas*
storm-petrel, ashy	*Oceanodroma homochroa*
storm-petrel, black	*Oceanodroma melania*
cormorant, red-faced	*Phalacrocorax urile*
egret, reddish	*Egretta rufescens*
goose, Ross's	*Chen rossii*
brant	*Branta bernicla*
swan, trumpeter	*Cygnus buccinator*
duck, American black*	*Anas rubripes*
duck, mottled	*Anas fulvigula*
kite, swallow-tailed	*Elanoides forficatus*

Common Name	Scientific Name
MODERATE PRIORITY (cont.)	
hawk, short-tailed	*Buteo brachyurus*
rail, yellow	*Coturnicops noveboracensis*
plover, snowy	*Charadrius alexandrinus*
willet*	*Catoptrophorus semipalmatus*
curlew, long-billed	*Numenius americanus*
godwit, hudsonian	*Limosa haemastica*
turnstone, black	*Arenaria melanocephala*
surfbird	*Aphriza virgata*
knot, red	*Calidris canutus*
sandpiper, rock	*Calidris ptilocnemis*
sandpiper, stilt	*Calidris himantopus*
sandpiper, buff-breasted	*Tryngites subruficollis*
dowitcher, short-billed	*Limnodromus griseus*
gull, Franklin's	*Larus pipixcan*
gull, Heermann's	*Larus heermanni*
gull, yellow-footed	*Larus livens*
murrelet, Xantus'	*Synthliboramphus hypoleucus*
auklet, whiskered	*Aethia pygmaea*
pigeon, white-crowned	*Columba leucocephala*
pigeon, band-tailed	*Columba fasciata*
owl, elf	*Micrathene whitneyi*
owl, short-eared*	*Asio flammeus*
Chuck-will's-widow*	*Caprimulgus carolinensis*
swift, black	*Cypseloides niger*
hummingbird, buff-bellied	*Amazilia yucatanensis*
hummingbird, lucifer	*Calothorax lucifer*
hummingbird, rufous	*Selasphorus rufus*
hummingbird, Allen's	*Selasphorus sasin*
woodpecker, Lewis's	*Melanerpes lewis*
woodpecker, red-headed*	*Melanerpes erythrocephalus*
woodpecker, Nuttall's	*Picoides nuttallii*
woodpecker, Strickland's	*Picoides stricklandi*
woodpecker, white-headed	*Picoides albolarvatus*
flicker, gilded	*Colaptes chrysoides*
pewee, greater	*Contopus pertinax*
vireo, gray	*Vireo vicinior*
titmouse, bridled	*Baeolophus wollweberi*
titmouse, oak	*Baeolophus inornatus*
nuthatch, brown-headed	*Sitta pusilla*
thrush, Bicknell's*	*Catharus bicknelli*
thrush, wood*	*Hylocichla mustelina*

(continued)

TABLE 13. NATIONAL BIRD LISTS (cont.)

B. Partners in Flight Watch List. (cont.)

Common Name	Scientific Name	Common Name	Scientific Name
MODERATE PRIORITY (cont.)			
thrasher, long-billed	*Toxostoma longirostre*	sparrow, Cassin's	*Aimophila cassinii*
thrasher, curve-billed	*Toxostoma curvirostre*	sparrow, Botteri's	*Aimophila botterii*
thrasher, California	*Toxostoma redivivum*	sparrow, clay-colored*	*Spizella pallida*
pipit, Sprague's	*Anthus spragueii*	sparrow, Brewer's	*Spizella breweri*
warbler, olive	*Peucedramus taeniatus*	sparrow, black-chinned	*Spizella atrogularis*
warbler, Virginia's	*Vermivora virginiae*	sparrow, sage	*Amphispiza belli*
warbler, Lucy's	*Vermivora luciae*	bunting, lark	*Calamospiza melanocorys*
warbler, black-throated blue*	*Dendroica caerulescens*	sparrow, seaside*	*Ammodramus maritimus*
warbler, prairie*	*Dendroica discolor*	sparrow, Harris'	*Zonotrichia querula*
warbler, prothonotary*	*Protonotaria citrea*	bunting, McKay's	*Plectrophenax hyperboreus*
warbler, worm-eating*	*Helmitheros vermivorus*	bunting, painted	*Passerina ciris*
warbler, Kentucky*	*Oporornis formosus*	dickcissel*	*Spiza americana*
towhee, Abert's	*Pipilo aberti*	bobolink*	*Dolichonyx oryzivorus*

(continued)

TABLE 13. NATIONAL BIRD LISTS (cont.)

C. Migratory Nongame Birds of Management Concern in the Northeast.

Twenty northeastern species that have experienced population declines due apparently to habitat loss and degradation, human disturbance, and contaminants. These species were selected from a national list of species of management concern compiled by the U.S. Fish and Wildlife Service (1987), and were profiled in Schneider and Pence (1992).

Common Name	Scientific Name
WETLANDS	
loon, common	*Gavia immer*
grebe, pied-billed	*Podilymbus podiceps*
bittern, American	*Botaurus lentiginosus*
bittern, least	*Ixobrychus exilis*
harrier, northern	*Circus cyaneus*
rail, black	*Laterallus jamaicensis*
tern, gull-billed	*Sterna nilotica*
tern, black	*Chlidonias niger*
owl, short-eared	*Asio flammeus*
wren, sedge	*Cistothorus platensis*
sparrow, seaside	*Ammodramus maritimus*
FIELDS	
sandpiper, upland	*Bartramia longicauda*
owl, barn	*Tyto alba*
shrike, loggerhead	*Lanius ludovicianus*
sparrow, Bachman's	*Aimophila aestivalis*
sparrow, Henslow's	*Ammodramus henslowii*
FORESTS	
hawk, red-shouldered	*Buteo lineatus*
flycatcher, olive-sided	*Contopus cooperi*
warbler, golden-winged	*Vermivora chrysoptera*
warbler, cerulean	*Dendroica cerulea*

Appendix 4

Common and Scientific Names of Plants and Animals

TABLE 14. PLANT NAMES

Common and scientific names of plant taxa mentioned in the Manual. Scientific names of vascular plants follow Mitchell and Tucker (1997).

Common Name	Scientific Name
agrimony, small-flowered	*Agrimonia parviflora*
ailanthus	*Ailanthus altissima*
alder	*Alnus*
Allegheny-vine	*Adlumia fungosa*
amaranth	*Amaranthus*
arrowhead, broadleaf	*Sagittaria latifolia*
arrowhead, spongy	*Sagittaria calycina* var. *spongiosa*
arrowhead, stiff	*Sagittaria rigida*
arrowhead, strapleaf	*Sagittaria subulata*
arrowwood, northern	*Viburnum dentatum* var. *lucidum*
arrowwood, downy	*Viburnum rafinesquianum*
arum, arrow	*Peltandra virginica*
ash, black	*Fraxinus nigra*
ash, red	*Fraxinus pennsylvanica*
ash, white	*Fraxinus americana*
aspen, quaking	*Populus tremuloides*
aster	*Aster*
aster, flat-topped white	*Aster umbellata*
aster, stiff-leaved	*Aster linariifolius*
aster, white wood	*Aster divaricatus*
aster, whorled wood	*Aster verticillata*
avens, purple	*Geum rivale*
azalea, swamp	*Rhododendron viscosum*
banana-vine	*Akebia quinata*
baneberry, red	*Actaea spicata* ssp. *rubra*
baneberry, white	*Actaea pachypoda*
barberry, Japanese	*Berberis vulgaris*
basswood	*Tilia americana*
bayberry	*Myrica pensylvanica*
beakrush	*Rhynchospora*
beakrush, white	*Rhynchospora alba*
bearberry	*Arctostaphylos uva-ursi*
bedstraw	*Galium*
bedstraw, yellow	*Galium verum*
beech, American	*Fagus grandifolia*
beggar-ticks, estuary	*Bidens bidentoides*
bellwort, large-flowered	*Uvularia grandiflora*
betony, wood	*Pedicularis canadensis*
birch, black	*Betula lenta*
birch, gray	*Betula populifolia*
birch, mountain paper	*Betula cordifolia*
birch, paper	*Betula papyrifera*
birch, river	*Betula nigra*
birch, swamp	*Betula pumila*
birch, yellow	*Betula alleghaniensis*
bittercress, Long's	*Cardamine longii*
bittercress, small-flowered	*Cardamine parviflora*
bittersweet, Oriental	*Celastrus orbiculata*
blackberry, northern	*Rubus alleghaniensis*
black-haw	*Viburnum prunifolium*
bladdernut	*Staphylea trifolia*
bladderwort, floating	*Utricularia radiata*
bladderwort, hidden-fruit	*Utricularia geminiscapa*
bladderwort, inflated	*Utricularia inflata*
blazing-star	*Liatris scariosa* var. *novae-angliae*
blueberry, early low	*Vaccinium pallidum*
blueberry, highbush	*Vaccinium corymbosum*
blueberry, late low	*Vaccinium angustifolium*
blueberry, sour-top	*Vaccinium myrtilloides*
blue-curls	*Trichostema dichotomum*
bluegrass, Kentucky	*Poa pratensis*
bluestem, little	*Schizachyrium scoparium*
bog-rosemary	*Andromeda glaucophylla*
boneset, purple	*Eupatorium dubium*
bouncing-bet	*Saponaria officinalis*
boxelder	*Acer negundo*
bracken	*Pteridium aquilinum*
brambles	*Rubus*
brome, Hungarian	*Bromus erectus*
buckbean	*Menyanthes trifoliata* var. *minor*
buckthorn, alderleaf	*Rhamnus alnifolia*
buckthorn, common	*Rhamnus cathartica*
bugleweed	*Ajuga reptans*
bugloss, viper's	*Echium vulgare*
bulrush, drooping	*Scirpus pendulus*
bulrush, hardstem	*Scirpus acutus*
bulrush, river	*Scirpus fluviatilis*
bulrush, softstem	*Scirpus tabernaemontanii*
bunchberry	*Cornus canadensis*
bur-marigold	*Bidens*
bur-marigold, smooth	*Bidens laevis*
bur-reed	*Sparganium*
bur-reed, big	*Sparganium eurycarpum*
bush-clover	*Lespedeza*
bush-clover, hairy	*Lespedeza hirta*
bush-clover, violet	*Lespedeza violacea*
bush-clover, wand-leaf	*Lespedeza intermedia*
butter-and-eggs	*Linaria vulgaris*
butterflyweed	*Asclepias tuberosa*
buttonbush	*Cephalanthus occidentalis*
campion, bladder-	*Silene vulgaris*
cardinal-flower	*Lobelia cardinalis*
cattail, broadleaf	*Typha latifolia*
cattail, hybrid	*Typha* x *glauca*
cattail, narrow-leaf	*Typha angustifolia*
cedar, eastern red	*Juniperus virginiana*

(continued)

TABLE 14. PLANT NAMES (cont.)

Common Name	Scientific Name
cedar, northern white	*Thuja occidentalis*
cherry, black	*Prunus serotina*
cherry, choke	*Prunus virginiana*
cherry, pin	*Prunus pensylvanica*
chokeberry	*Aronia*
chokeberry, black	*Aronia melanocarpa*
cinquefoil, shrubby	*Potentilla fruticosa*
cinquefoil, three-toothed	*Potentilla tridentata*
clammy-weed	*Polanisia dodecandra*
cliffbrake, purple	*Pellaea atropurpurea*
cliffbrake, smooth	*Pellaea glabella*
clover, white sweet	*Melilotus alba*
cohosh, blue	*Caulophyllum thalictroides*
columbine, wild	*Aquilegia canadensis*
coneflower, green-headed	*Rudbeckia laciniata*
coontail, common	*Ceratophyllum demersum*
coontail, spiny	*Ceratophyllum echinatum*
cordgrass	*Spartina*
cordgrass, saltmeadow	*Spartina alterniflora*
cordgrass, tall	*Spartina cynosuroides*
cottongrass	*Eriophorum viridi-carinatum*
cottongrass, tussock	*Eriophorum vaginatum*
cottonwood, eastern	*Populus deltoides*
cottonwood, swamp	*Populus heterophylla*
cranberry, large	*Vaccinium macrocarpon*
cranberry, small	*Vaccinium oxycoccos*
creeper, Virginia	*Parthenocissus quinquefolia*
cress, spring	*Cardamine bulbosa*
crowfoot, small-flowered	*Ranunculus micranthus*
cutgrass, rice	*Leersia oryzoides*
cynthia, two-flowered	*Krigia biflora*
devil's-bit	*Chamaelirium luteum*
dewberry, bristly	*Rubus hispidus*
dewberry, prickly	*Rubus flagellaris*
diarrhena	*Diarrhena obovata*
dittany	*Cunila origanoides*
dock, great water	*Rumex orbiculatus*
dodder, buttonbush	*Cuscuta cephalanthi*
dodder, common	*Cuscuta gronovii*
dodder, field	*Cuscuta pentagona*
dodder, smartweed	*Cuscuta polygonorum*
dodder, southern	*Cuscuta obtusiflora* var*. glandulosa*
dogwood, roundleaf	*Cornus rugosa*
dogwood, flowering	*Cornus florida*
dogwood, gray	*Cornus foemina* ssp. *racemosa*
dogwood, red-osier	*Cornus sericea*
dogwood, silky	*Cornus amomum*
dragon, green	*Arisaema dracontium*
duckweed, common	*Lemna minor*
duckweed, greater	*Spirodela polyrhiza*
duckweed, ivy-leaf	*Lemna trisulca*
Dutchman's-breeches	*Dicentra cucullaria*
elder, common	*Sambucus canadensis*
elder, red-berried	*Sambucus racemosa*
elm	*Ulmus*
elm, American	*Ulmus americana*
elm, slippery	*Ulmus rubra*
evening-primrose	*Oenothera biennis*
eyebane	*Chamaesyce maculata*
false-foxglove	*Penstemon digitalis*
false-indigo	*Amorpha fruticosa*
false-mermaid	*Floerkea proserpinacoides*
false-nettle	*Boehmeria cylindrica*
featherfoil	*Hottonia inflata*
fern, bulblet	*Cystopteris bulbifera*
fern, cinnamon	*Osmunda cinnamomea*
fern, crested wood	*Dryopteris cristata*
fern, fancy	*Dryopteris intermedia*
fern, fragile	*Cystopteris fragilis*
fern, maidenhair	*Adiantum pedatum*
fern, ostrich	*Matteucia struthiopteris*
fern, royal	*Osmunda regalis*
fern, sensitive	*Onoclea sensibilis*
fern, Virginia chain	*Woodwardia virginica*
fern, walking	*Asplenium rhizophyllum*
fern, woolly lip	*Cheilanthes lanosa*
fir, balsam	*Abies balsamea*
flag, blue	*Iris versicolor*
flatsedge, Schweinitz's	*Cyperus schweinitzii*
flax, yellow wild	*Linum sulcatum*
four-o'clock	*Mirabilis nyctaginea*
foxtail, short-awn	*Alopecurus aequalis*
fumitory, climbing	*Fumaria officinalis*
galingale	*Cyperus filiculmis*
garlic-mustard	*Alliaria petiolata*
gentian, closed	*Gentiana andrewsii*
gentian, closed	*Gentiana clausa*
gentian, fringed	*Gentianopsis crinita*
gentian, stiff	*Gentianella quinquefolia*
gerardia, slender	*Agalinis tenuifolia*
ginger, wild	*Asarum canadense*
ginseng, American	*Panax quinquefolius*
globeflower, spreading	*Trollius laxus*
goat's-rue	*Tephrosia virginiana*
goldenclub	*Orontium aquaticum*
goldenrod	*Solidago*

(continued)

TABLE 14. PLANT NAMES (cont.)

Common Name	Scientific Name	Common Name	Scientific Name
goldenrod, bog	*Solidago uliginosa*	knapweed	*Centaurea*
goldenrod, downy	*Solidago puberula*	knotweed, slender	*Polygonum tenue*
goldenrod, late	*Solidago gigantea*	ladyslipper, pink	*Cypripedium acaule*
goldenrod, spreading	*Solidago patula*	ladyslipper, yellow	*Cypripedium parviflorum*
goldenrod, stiff-leaf	*Solidago rigida*	lady's-tresses, nodding	*Spiranthes cernua*
goldenrod, tall hairy	*Solidago rugosa*	lady's-tresses, slender	*Spiranthes lacera*
golden-saxifrage	*Chrysosplenium americanum*	larch, American	*Larix laricina*
goldenseal	*Hydrastis canadensis*	larch, European	*Larix decidua*
grama, side-oats	*Bouteloua curtipendula*	laurel, mountain	*Kalmia latifolia*
grass-of-Parnassus	*Parnassia glauca*	laurel, sheep	*Kalmia angustifolia*
grass, deer-tongue	*Panicum clandestinum*	leatherleaf	*Chamaedaphne calyculata*
grass, fowl meadow	*Poa palustris*	leatherwood	*Dirca palustris*
grass, orchard	*Dactylus glomerata*	(lichen)	*Acarospora subfuscescens*
grass, pale alkali-	*Torreyochloa pallida* var. *pallida*	(lichen)	*Caloplaca scotoplaca*
grass, poverty	*Danthonia spicata*	lily, Canada	*Lilium canadense*
grass, reed canary	*Phalaris arundinacea*	lily, wood-	*Lilium philadelphicum*
gromwell, false	*Onosmodium virginianum*	(liverwort)	*Aneura pinguis*
ground-cherry, downy	*Physalis pubescens* var. *integrifolia*	(liverwort)	*Riccia fluitans*
hackberry	*Celtis occidentalis*	(liverwort)	*Ricciocarpus natans*
hairgrass	*Deschampsia flexuosa*	(liverwort)	*Trichocolea tomentella*
hair-rush	*Bulbostylis capillaris*	lizard's-tail	*Saururus cernuus*
harebell	*Campanula rotundifolia*	lobelia, Kalm's	*Lobelia kalmii*
harlequin, yellow	*Corydalis flavula*	locust, black	*Robinia pseudo-acacia*
hatpins, estuary	*Eriocaulon parkeri*	loosestrife, purple	*Lythrum salicaria*
hawthorn	*Crataegus*	loosestrife, winged	*Lythrum alatum*
hazel, American	*Corylus americana*	lousewort, swamp	*Pedicularis lanceolata*
hazel, beaked	*Corylus cornuta*	lovegrass, purple	*Eragrostis spectabilis*
hemlock, eastern	*Tsuga canadensis*	lovegrass, teal	*Eragrostis hypnoides*
hepatica	*Hepatica nobilis*	lupine, wild	*Lupinus perennis*
hickory, pignut	*Carya glabra*	maleberry	*Lyonia ligustrina*
hickory, shagbark	*Carya ovata*	maple, mountain	*Acer spicatum*
hobblebush	*Viburnum lantanoides*	maple, Norway	*Acer platanoides*
hogweed	*Conyza canadensis*	maple, red	*Acer rubrum*
honeysuckle, Eurasian	*Lonicera morrowi, L.tatarica, L.* x *bella*	maple, silver	*Acer saccharinum*
honeysuckle, fly	*Lonicera canadensis*	maple, striped	*Acer pensylvanicum*
honeysuckle, Japanese	*Lonicera japonica*	maple, sugar	*Acer saccharum*
hop-hornbeam	*Ostrya virginiana*	marsh-marigold	*Caltha palustris*
hornbeam, American	*Carpinus caroliniana*	may-apple	*Podophyllum peltatum*
horsemint, dotted	*Monarda punctata*	meadowsweet	*Spiraea latifolia*
huckleberry	*Gaylussacia*	micranthemum, Nuttall's	*Micranthemum micranthemoides*
huckleberry, black	*Gaylussacia baccata*	milkweed, blunt-leaf	*Asclepias amplexicaulis*
iris, yellow	*Iris pseudacorus*	milkweed, four-leaved	*Asclepias quadrifolia*
ironweed, New York	*Vernonia noveboracensis*	milkweed, whorled	*Asclepias verticillata*
jewelweed, spotted	*Impatiens capensis*	milkwort, whorled	*Polygala verticillata*
jimsonweed	*Datura stramonium*	monkey-flower, winged	*Mimulus alatus*
Joe-Pye-weed	*Eupatorium*	(moss)	*Brachythecium turgidum*
Joe-Pye-weed, spotted	*Eupatorium maculatum*	(moss)	*Desmatodon obtusifolius*
jointweed	*Polygonella articulata*	(moss)	*Fissidens fontanus*

(continued)

TABLE 14. PLANT NAMES (cont.)

Common Name	Scientific Name	Common Name	Scientific Name
(moss)	*Helodium paludosum*	pipewort	*Eriocaulon septangulare*
(moss)	*Lindbergia brachyptera*	pitcher-plant	*Sarracenia purpurea*
(moss)	*Orthotrichum ohioense*	plantain, common	*Plantago major*
(moss)	*Orthotrichum sordidum*	plantain, heartleaf	*Plantago cordata*
(moss)	*Orthotrichum stellatum*	pod-grass	*Scheuchzeria palustris*
(moss)	*Philonotis muhlenbergii*	poison-ivy	*Toxicodendron radicans*
(moss)	*Taxiphyllum taxirameum*	pokeweed	*Phytolacca americana*
moss, cushion	*Leucobryum*	polypody, rock	*Polypodium vulgare*
(peat moss)	*Sphagnum*	pond-lily, fragrant	*Nymphaea odorata*
(peat moss)	*Sphagnum compactum*	pond-lily, yellow	*Nuphar advena*
mountain-ash, American	*Sorbus americana*	pondweed	*Potamogeton*
mountain-mint	*Pycnanthemum clinopodioides*	pondweed, clasping	*Potamogeton perfoliatus*
mountain-mint, blunt	*Pycnanthemum muticum*	pondweed, curly	*Potamogeton crispus*
mountain-mint, Torrey's	*Pycnanthemum torrei*	pondweed, flat-stemmed	*Potamogeton zosteriformis*
mud-plantain, kidneyleaf	*Heteranthera reniformis*	pondweed, horned	*Zannichellia palustris*
mudwort	*Limosella australis*	pondweed, Illinois	*Potamogeton illinoensis*
mullein, common	*Verbascum thapsus*	pondweed, sago	*Coleogeton pectinatum*
naiad	*Najas*	pondweed, spotted	*Potamogeton pulcher*
nannyberry	*Viburnum lentago*	pondweed, water-thread	*Potamogeton diversifolius*
nettle, stinging	*Urtica dioica*	prickly-ash	*Zanthoxylum americanum*
ninebark	*Physocarpus opulifolius*	prickly-pear, eastern	*Opuntia humifusa*
oak	*Quercus*	quillwort, river	*Isoetes riparia*
oak, black	*Quercus velutina*	ragweed	*Ambrosia artemisiifolia*
oak, chestnut	*Quercus montana*	raspberry, black	*Rubus occidentalis*
oak, dwarf chestnut	*Quercus prinoides*	rattlebox	*Crotalaria sagittalis*
oak, pin	*Quercus palustris*	reed, common	*Phragmites australis*
oak, red	*Quercus rubra*	reedgrass, wood	*Cinna arundinacea*
oak, scarlet	*Quercus coccinea*	riverweed	*Podostemum ceratophyllum*
oak, scrub	*Quercus ilicifolia*	rock-cress, Drummond's	*Arabis drummondii*
oak, swamp white	*Quercus bicolor*	rock-cress, hairy	*Arabis hirsuta* var. *pycnocarpa*
oak, white	*Quercus alba*	rock-cress, lyre-leaved	*Arabis lyrata*
orangeweed	*Hypericum gentianoides*	rock-cress, smooth	*Arabis laevigata*
orchid, ragged fringed	*Platanthera lacera*	rose-mallow, swamp	*Hibiscus moscheutos*
orchid, small purple fringed	*Platanthera psycodes*	rose, multiflora	*Rosa multiflora*
orchid, snakemouth	*Pogonia ophioglossoides*	rue-anemone	*Thalictrum thalictroides*
paintbrush, Indian	*Castilleja coccinea*	rush, path	*Juncus tenuis*
pellitory	*Parietaria pensylvanica*	rush, scouring	*Equisetum hyemale*
pepperbush, sweet	*Clethra alnifolia*	rush, soft	*Juncus effusus*
pickerelweed	*Pontederia cordata*	rush, toad	*Juncus bufonius*
pignut, sweet	*Carya ovalis*	saltgrass	*Spartina patens*
pimpernel, false	*Lindernia dubia* var. *inundata*	sandspur	*Cenchrus longispinus*
pine-drops, giant	*Pterospora andromeda*	sandwort, mountain	*Minuartia groenlandica*
pine, pitch	*Pinus rigida*	sandwort, rock	*Minuartia michauxii*
pine, red	*Pinus resinosa*	sarsaparilla, bristly	*Aralia hispida*
pine, Scotch	*Pinus sylvestris*	sassafras	*Sassafras albidum*
pine, white	*Pinus strobus*	saxifrage, early	*Saxifraga virginiensis*
pinweed, racemed	*Lechea racemulosa*	sedge	*Carex hirsutella*
pinweed, slender	*Lechea tenuifolia*	sedge, Bicknell's	*Carex bicknellii*

(continued)

TABLE 14. PLANT NAMES (cont.)

Common Name	Scientific Name	Common Name	Scientific Name
sedge, bronze	*Carex aenea*	spike-muhly	*Muhlenbergia glomerata*
sedge, Bush's	*Carex bushii*	spikenard	*Aralia racemosa*
sedge, cattail	*Carex typhina*	spikerush, ovate	*Eleocharis obtusa* var. *ovata*
sedge, clustered	*Carex cumulata*	spleenwort, ebony	*Asplenium platyneuron*
sedge, crested	*Carex cristatella*	spleenwort, maidenhair	*Asplenium trichomanes*
sedge, Davis'	*Carex davisii*	spleenwort, mountain	*Asplenium montanum*
sedge, Emmons'	*Carex albicans* var. *emmonsii*	spleenwort, silvery	*Deparia acrostichoides*
sedge, false hop	*Carex lupuliformis*	spruce, Norway	*Picea abies*
sedge, Fernald's	*Carex merritt-fernaldii*	spruce, red	*Picea rubra*
sedge, fox	*Carex vulpinoidea*	spurge, cypress	*Euphorbia cyparissias*
sedge, Frank's	*Carex frankii*	St. Johnswort, shrubby	*Hypericum prolificum*
sedge, golden-fruit	*Carex aurea*	starflower	*Trientalis borealis*
sedge, handsome	*Carex formosa*	star-grass, water	*Heteranthera dubia*
sedge, hay	*Carex argyrantha*	starwort, terrestrial	*Callitriche terrestris*
sedge, lakeside	*Carex lacustris*	starwort, water	*Callitriche palustris*
sedge, marsh-straw	*Carex hormathodes*	stonewort	Characeae
sedge, meadow	*Carex granularis*	sumac, dwarf	*Rhus copallinum*
sedge, Pennsylvania	*Carex pensylvanica*	sumac, fragrant	*Rhus aromatica*
sedge, plantain	*Carex plantaginea*	sumac, poison	*Toxicodendron vernix*
sedge, pointed broom	*Carex scoparia*	sumac, smooth	*Rhus glabra*
sedge, porcupine	*Carex hystericina*	sumac, staghorn	*Rhus typhina*
sedge, prairie	*Carex prairea*	sundew, narrow-leaf	*Drosera intermedia*
sedge, reflexed	*Carex retroflexa*	sundew, roundleaf	*Drosera rotundifolia*
sedge, Schweinitz's	*Carex schweinitzii*	swallow-wort, black	*Cynanchum louiseae*
sedge, Sprengel's	*Carex sprengelii*	sweet-clover, white	*Melilotus alba*
sedge, sterile	*Carex sterilis*	sweetflag	*Acorus americanus*
sedge, three-seed	*Carex trisperma*	sweet-gum	*Liquidambar styraciflua*
sedge, tussock	*Carex stricta*	switchgrass	*Panicum virgatum*
sedge, woolly-fruit	*Carex lasiocarpa*	sycamore, American	*Platanus occidentalis*
sedge, yellow	*Carex flava*	tamarack	*Larix laricina*
sedge, yellow-fruit	*Carex annectens* var*. annectens*	tearthumb, arrowleaf	*Polygonum sagittatum*
sensitive-plant, wild	*Chamaecrista nictitans*	thistle, swamp	*Cirsium muticum*
serviceberry (shadbush)	*Amelanchier*	three-square, common	*Scirpus pungens*
silver-rod	*Solidago bicolor*	three-square, Olney's	*Scirpus americanus*
silverweed	*Potentilla anserina*	tick-trefoil	*Desmodium*
skullcap, common	*Scutellaria galericulata*	tick-trefoil, round-leaved	*Desmodium rotundifolia*
skullcap, small	*Scutellaria parvula* var. *parvula*	tree, tulip	*Liriodendron tulipifera*
skunk-cabbage	*Symplocarpus foetidus*	trillium, painted	*Trillium undulatum*
smartweed	*Polygonum*	trillium, purple	*Trillium erectum*
smartweed, dotted	*Polygonum punctatum*	tupelo	*Nyssa sylvatica*
snakeroot, black	*Sanicula marilandica*	turtlehead	*Chelone glabra*
snakeroot, Virginia	*Aristolochia serpentaria*	twig-rush	*Cladium mariscoides*
snapdragon	*Antirrhinum*	twin-leaf	*Jeffersonia diphylla*
sneezeweed	*Helenium autumnale*	twisted-stalk, rose	*Streptopus roseus*
spatterdock	*Nuphar advena*	valerian, bog	*Valeriana uliginosa*
spicebush	*Lindera benzoin*	vetchling	*Lathyrus palustris*
spikemoss, creeping	*Selaginella apoda*	viburnum, mapleleaf	*Viburnum acerifolium*
spikemoss, rock	*Selaginella rupestris*	violet	*Viola*

(continued)

TABLE 14. PLANT NAMES (cont.)

Common Name	Scientific Name
violet, birdsfoot	*Viola pedata*
water-chestnut	*Trapa natans*
water-hemp	*Amaranthus cannabinus*
water-marigold	*Megalodonta beckii*
watermeal	*Wolffia*
watermeal, Brazilian	*Wolffia braziliensis*
watermilfoil, Eurasian	*Myriophyllum spicatum*
water-nymph, Hudson River	*Najas guadalupensis* var. *muenscheri*
water-purslane	*Ludwigia palustris*
waterweed	*Elodea*
waterweed, common	*Elodea canadensis*
waterweed, Nuttall's	*Elodea nuttallii*
water-willow	*Decodon verticillata*
waterwort, American	*Elatine americana*
whitegrass	*Oryzopsis asperifolia*
whitlow-grass, Carolina	*Draba reptans*
wild-celery	*Vallisneria americana*
wild-oats	*Uvularia sessilifolia*
wild-rice	*Zizania aquatica*
wild-rye, blue	*Elymus glaucus*
willow	*Salix*
willow, autumn	*Salix serissima*
willow, crack	*Salix fragilis*
willow, hoary	*Salix candida*
willow, pussy	*Salix discolor*
willow, silky	*Salix sericea*
willow, stiff	*Salix eriocephala*
willow, white	*Salix alba*
willow-herb	*Epilobium*
wingstem	*Verbesina alternifolia*
winterberry	*Ilex verticillata*
wintergreen, pink	*Pyrola asarifolia*
witchgrass, wiry	*Panicum flexile*
witch-hazel	*Hamamelis virginiana*
wood-nettle	*Laportea canadensis*
wood-sorrel, common	*Oxalis montana*
wood-sorrel, violet	*Oxalis violacea*
woolgrass	*Scirpus cyperinus*
yew, American	*Taxus canadensis*

TABLE 15. ANIMAL NAMES

Common and scientific names of animal taxa mentioned in the Manual.

Common Name	Scientific Name
INVERTEBRATES	
EARTHWORMS AND LEECHES	**PHYLUM ANNELIDA**
earthworm	Family Lumbricidae
leech	Class Hirudinea
CRUSTACEANS	**PHYLUM ARTHROPODA -CLASS CRUSTACEA**
(amphipod)	*Gammarus pseudolimnaeus*
amphipod, Piedmont groundwater	*Stygobromus tenuis tenuis*
copepod	Order Copepoda
crab, blue	*Callinectes sapidus*
crayfish	Order Decapoda
shrimp, fairy	Order Anostraca
sowbug, water	Order Isopoda
water-flea	Order Cladocera
MILLIPEDES	**PHYLUM ARTHROPODA - CLASS DIPLOPODA**
anise millipede	*Apheloria virginiensis*
INSECTS	**PHYLUM ARTHROPODA - CLASS INSECTA**
Dragonflies & Damselflies	**Order Odonata**
baskettail, beaverpond	*Epethica canis*
clubtail, russet-tipped	*Stylurus plagiatus*
clubtail, sable	*Gomphus rogersi*
damsel, eastern red	*Amphiagrion saucium*
emerald, mocha	*Somatochlora linearis*
petaltail, gray	*Tachopteryx thoreyi*
spiketail, arrowhead	*Cordulegaster obliqua*
spiketail, tiger	*Cordulegaster erronea*
Grasshoppers	**Order Orthoptera**
grasshoppers, pygmy	Family Tetrigidae
grasshoppers, yellow-winged short-horned	Family Acrididae
Stoneflies	**Order Plecoptera**
(stonefly)	*Pteronarcys*
Bugs	**Order Hemiptera**
backswimmer	Family Notonectidae
boatman, water	Family Corixidae
water-strider	Family Gerridae
Cicadas, Aphids, & Relatives	**Order Homoptera**
cicada	*Magicicada septendecim*
adelgid, hemlock woolly	*Adelges tsugae*
Beetles	**Order Coleoptera**
beetle, diving	Family Dytiscidae
beetle, long-horned	Family Cerambycidae
beetle, tiger	Family Cicindelidae
Caddisflies	**Order Trichoptera**
Butterflies & Moths	**Order Lepidoptera**
angle-wing	*Polygonia*
azure, spring	*Celastrina ladon*
Baltimore (Baltimore checkerspot)	*Euphydryas phaeton*
blue, Appalachian	*Celastrina neglectamajor*
blue, eastern tailed	*Everes comyntas*
blue, Karner	*Lycaeides melissa samuelis*
brown, eyed	*Satyrodes eurydice*
buckmoth, inland barrens	*Hemileuca maia* ssp. 3
butterfly, hackberry	*Asterocampa celtis*
checkerspot, Harris'	*Chlosyne harrisii*
cloak, mourning	*Nymphalis antiopa*
copper, bronze	*Lycaena hyllus*
dash, black	*Euphyes conspicua*
duskywing, Horace's	*Erynnis horatius*
duskywing, Juvenal's	*Erynnis juvenalis*
elfin, brown	*Callophrys augustinus*
elfin, pine	*Callophrys niphon*
fritillary, aphrodite	*Speyeria aphrodite*
fritillary, meadow	*Boloria bellona*
fritillary, silver-bordered	*Boloria selene*
hairstreak, Edward's	*Satyrium edwardsii*
hairstreak, gray	*Strymon melinus*
hairstreak, northern	*Fixsenia faconius ontario*
hairstreak, olive	*Callophrys gryneus*
hairstreak, striped	*Satyrium liparops*
moths, underwing	Order Lepidoptera
orange tip, falcate	*Anthocharis midea*
purple, red-spotted	*Basilarchia arthemis astyanax*
skipper, coastal broad-winged	*Poanes viator zizanae*
skipper, cobweb	*Hesperia metea*
skipper, Dion (sedge skipper)	*Euphyes dion*
skipper, dusted	*Atrytonopsis hianna*
skipper, least	*Ancyloxypha numitor*
skipper, Leonard's	*Hesperia leonardus*
skipper, swarthy	*Nastra lherminier*
skipper, two-spotted	*Euphyes bimacula*
swallowtail, black	*Papilio polyxenes*
tortoiseshell, Compton's	*Nymphalis vaualbum*
tortoiseshell, Milbert's	*Nymphalis milberti*
wing, mulberry	*Poanes massasoit*
yellow, little	*Eurema lisa*
Flies	**Order Diptera**
cranefly, phantom	*Bittacomorpha clavipes*
fly, blow	Family Calliphoridae
mosquito	Family Culicidae

(continued)

TABLE 15. ANIMAL NAMES (cont.)

Bees, Wasps, & Ants	**Order Hymenoptera**
ant, velvet	Family Mutillidae
bee, digger	*Emphor*
bee-wolf	*Phyllanthus*
cicada-killer	*Sphecius speciosus*
wasp, sand	*Bembix*
SPIDERS & MITES	**PHYLUM ARTHROPODA - CLASS ARACHNIDA**
harvestman (daddy longlegs)	Order Phalangida
mite, water	Order Acarina
SNAILS & SLUGS	**PHYLUM MOLLUSCA - CLASS GASTROPODA**
physa, springtime	*Physa vernalis*
(pondsnail)	*Stagnicola*
slug	Order Notaspidea
(snail)	*Pomatiopsis lapidaria*
(snail)	*Marstonia decepta*
(snail, pouch)	*Physa*
BIVALVES	**PHYLUM MOLLUSCA - CLASS BIVALVIA**
(clam, fingernail)	*Pisidium adamsi*
(clam, fingernail)	Order Bivalva
floater, alewife	*Anodonta implicata*
lampmussel, yellow	*Lampsilis cariosa*
mucket, tidewater	*Leptodea ochracea*
mussel, zebra	*Dreissena polymorpha*
mussel, freshwater (unionids)	Family Mytilidae
FISHES	[SUPERCLASS PISCES]
alewife	*Alosa pseudoharengus*
bass, largemouth	*Micropterus salmoides*
bass, smallmouth	*Micropterus dolomieui*
bass, striped	*Morone saxitilis*
carp, common	*Cyprinus carpio*
char	*Salvelinus*
pickerel, chain	*Esox niger*
chubsucker, creek	*Erimyzon oblongus*
darter, tessellated	*Etheostoma olmstedi*
eel, American	*Anguilla rostrata*
herring, blueback	*Alosa aestivalis*
killifish	Family Cyprinodontidae
killifish, banded	*Fundulus diaphanus*
lamprey, American brook	*Lampetra appendix*
lamprey, sea	*Petromyzon marinus*
madtom, tadpole	*Noturus gyrinus*
minnow, eastern silvery	*Hybognathus regius*
mudminnow, central	*Umbra limi*
mudminnow, eastern	*Umbra pygmaea*
mummichog	*Fundulus heteroclitus*
perch, white	*Morone americana*
perch, yellow	*Perca flavescens*
pickerel, chain	*Esox niger*
pickerel, grass	*Esox americanus vermiculatus*
pumpkinseed	*Lepomis gibbosus*
sculpin, mottled	*Cottus bairdi*
sculpin, slimy	*Cottus cognatus*
shad, American	*Alosa sapidissima*
shiner, bridle	*Notropis bifrenatus*
shiner, spottail	*Notropis hudsonius*
smelt, rainbow	*Osmerus mordax*
sturgeon, shortnose	*Acipenser brevirostrum*
sucker, longnose	*Catostomus catostomus*
sucker, northern hog	*Hypentelium nigricans*
sucker, white	*Catostomus commersoni*
sunfish, mud	*Acantharchus pomotis*
trout, brook	*Salvelinus fontinalis*
trout, brown	*Salmo trutta*
AMPHIBIANS	CLASS AMPHIBIA
bullfrog	*Rana catesbeiana*
frog, green	*Rana clamitans melanota*
frog, northern cricket	*Acris crepitans*
frog, northern leopard	*Rana pipiens*
frog, pickerel	*Rana palustris*
frog, southern leopard	*Rana utricularis sphenocephalis*
frog, wood	*Rana sylvatica*
newt, red-spotted	*Notophthalmus viridescens*
peeper, spring	*Pseudacris crucifer*
salamander, blue-spotted	*Ambystoma laterale*
salamander, four-toed	*Hemidactylium scutatum*
salamander, Jefferson	*Ambystoma jeffersonianum*
salamander, long-tailed	*Eurycea longicauda*
salamander, marbled	*Ambystoma opacum*
salamander, mountain dusky	*Desmognathus ochrophaeus*
salamander, northern dusky	*Desmognathus fuscus*
salamander, northern two-lined	*Eurycea bislineata*
salamander, red	*Pseudotriton ruber*
salamander, red-backed	*Plethodon cinereus*
salamander, slimy	*Plethodon glutinosus*
salamander, spotted	*Ambystoma maculatum*
salamander, spring	*Gyrinophilus porphyriticus*
salamanders, mole	Family Ambystomatidae
toad, American	*Bufo americanus*
toad, eastern spadefoot	*Scaphiopus holbrookii*
toad, Fowler's	*Bufo woodhousii*
treefrog, gray	*Hyla versicolor*
REPTILES	CLASS REPTILIA
copperhead, northern	*Agkistrodon contortrix*
lizard, eastern fence	*Sceloporus undulatus*
racer, northern black	*Coluber constrictor*
rattlesnake, timber	*Crotalus horridus*
skink, five-lined	*Eumeces fasciatus*
sliders	*Chrysemys*
snake, black rat	*Elaphe obsoleta*
snake, eastern hognose	*Heterodon platyrhinos*
snake, eastern milk	*Lampropeltis triangulum*

(continued)

TABLE 15. ANIMAL NAMES (cont.)

snake, eastern garter	*Thamnophis sirtalis*
snake, northern water	*Natrix sipedon*
snake, ribbon	*Thamnophis sauritus*
snake, smooth green	*Opheodrys vernalis*
snake, worm	*Carphophis amoenus*
terrapin, diamondback	*Malaclemys terrapin*
turtle, Blanding's	*Emydoidea blandingii*
turtle, bog	*Clemmys muhlenbergii*
turtle, eastern painted	*Chrysemys picta*
turtle, eastern box	*Terrapene carolina*
turtle, map	*Graptemys geographica*
turtle, snapping	*Chelydra serpentina*
turtle, spotted	*Clemmys guttata*
turtle, wood	*Clemmys insculpta*

BIRDS	CLASS AVES
bittern, American	*Botaurus lentiginosus*
bittern, least	*Ixobrychus exilis*
blackbird, red-winged	*Agelaius phoeniceus*
bluebird, eastern	*Sialia sialis*
bobolink	*Dolichonyx oryzivorus*
bobwhite, northern	*Colinus virginianus*
catbird, gray	*Dumetella carolinensis*
chat, yellow-breasted	*Icteria virens*
coot, American	*Fulica americana*
cormorant, double-crested	*Phalacrocorax auritus*
cowbird, brown-headed	*Molothrus ater*
crow, fish	*Corvus ossifragus*
cuckoo, black-billed	*Coccyzus erythropthalmus*
cuckoo, yellow-billed	*Coccyzus americanus*
duck, American black	*Anas rubripes*
duck, ruddy	*Oxyura jamaicensis*
duck, wood	*Aix sponsa*
eagle, bald	*Haliaeetus leucocephalus*
eagle, golden	*Aquila chrysaetos*
falcon, peregrine	*Falco peregrinus*
flycatcher, Acadian	*Empidonax virescens*
flycatcher, alder	*Empidonax alnorum*
flycatcher, willow	*Empidonax traillii*
goldfinch, American	*Carduelis tristis*
goose, Canada	*Branta canadensis*
goshawk, northern	*Accipiter gentilis*
grosbeak, evening	*Coccothraustes vespertinus*
grouse, ruffed	*Bonasa umbellus*
harrier, northern	*Circus cyaneus*
hawk, broad-winged	*Buteo platypterus*
hawk, Cooper's	*Accipiter cooperii*
hawk, red-shouldered	*Buteo lineatus*
hawk, red-tailed	*Buteo jamaicensis*
hawk, sharp-shinned	*Accipiter striatus*
heron, great blue	*Ardea herodias*
heron, green	*Butorides virescens*
hummingbird, ruby-throated	*Archilochus colubris*
junco, dark-eyed	*Junco hyemalis*
kestrel, American	*Falco sparverius*
killdeer	*Charadrius vociferus*
kingfisher, belted	*Ceryle alcyon*
kinglet, golden-crowned	*Regulus satrapa*
mallard	*Anas platyrhynchos*
martin, purple	*Progne subis*
meadowlark, eastern	*Sturnella magna*
merganser, common	*Mergus merganser*
merganser, red-breasted	*Mergus serrator*
mockingbird, northern	*Mimus polyglottos*
moorhen, common	*Gallinula chloropus*
nighthawk, common	*Chordeiles minor*
nuthatch, red-breasted	*Sitta canadensis*
oldsquaw	*Clangula hyemalis*
oriole, orchard	*Icterus spurius*
osprey	*Pandion haliaetus*
ovenbird	*Seiurus aurocapillus*
owl, barred	*Strix varia*
owl, eastern screech-	*Otus asio*
owl, great horned	*Bubo virginianus*
owl, long-eared	*Asio otus*
owl, northern saw-whet	*Aegolius acadicus*
owl, short-eared	*Asio flammeus*
phoebe, eastern	*Sayornis phoebe*
rail, black	*Laterallus jamaicensis*
rail, clapper	*Rallus longirostris*
rail, king	*Rallus elegans*
rail, Virginia	*Rallus limicola*
raven, common	*Corvus corax*
redhead	*Aythya americana*
redstart, American	*Setophaga ruticilla*
robin, American	*Turdus migratorius*
sandpiper, spotted	*Actitis macularia*
sandpiper, upland	*Bartramia longicauda*
sapsucker, yellow-bellied	*Sphyrapicus varius*
shrike, loggerhead	*Lanius ludovicianus*
shrike, northern	*Lanius excubitor*
siskin, pine	*Carduelis pinus*
snipe, common	*Gallinago gallinago*
sora	*Porzana carolina*
sparrow, clay-colored	*Spizella pallida*
sparrow, grasshopper	*Ammodramus savannarum*
sparrow, Henslow's	*Ammodramus henslowii*
sparrow, saltmarsh sharp-tailed	*Ammodramus caudacutus*
sparrow, savannah	*Passerculus sandwichensis*
sparrow, seaside	*Ammodramus maritimus*
sparrow, song	*Melospiza melodia*
sparrow, swamp	*Melospiza georgiana*
sparrow, vesper	*Pooecetes gramineus*
swallow, bank	*Riparia riparia*

(continued)

TABLE 15. ANIMAL NAMES (cont.)

swallow, barn	*Hirundo rustia*
swallow, tree	*Tachycineta bicolor*
tanager, scarlet	*Piranga olivacea*
teal, blue-winged	*Anas discors*
thrasher, brown	*Toxostoma rufum*
thrush, Bicknell's	*Catharus bicknelli*
thrush, hermit	*Catharus guttatus*
thrush, Swainson's	*Catharus ustulatus*
thrush, wood	*Hylocichla mustelina*
towhee, eastern	*Pipilo erythrophthalmus*
turkey, wild	*Meleagris gallopavo*
veery	*Catharus fuscescens*
vireo, blue-headed	*Vireo solitarius*
vireo, red-eyed	*Vireo olivaceus*
vireo, white-eyed	*Vireo griseus*
vulture, black	*Coragyps atratus*
vulture, turkey	*Cathartes aura*
warbler, Blackburnian	*Dendroica fusca*
warbler, black-throated blue	*Dendroica caerulescens*
warbler, black-throated green	*Dendroica virens*
warbler, blue-winged	*Vermivora pinus*
warbler, Canada	*Wilsonia canadensis*
warbler, cerulean	*Dendroica cerulea*
warbler, chestnut-sided	*Dendroica pensylvanica*
warbler, golden-winged	*Vermivora chrysoptera*
warbler, hooded	*Wilsonia citrina*
warbler, Kentucky	*Oporornis formosus*
warbler, magnolia	*Dendroica magnolia*
warbler, mourning	*Oporornis formosus*
warbler, Nashville	*Vermivora ruficapilla*
warbler, pine	*Dendroica pinus*
warbler, prairie	*Dendroica discolor*
warbler, prothonotary	*Protonotaria citrea*
warbler, worm-eating	*Helmitheros vermivorus*
warbler, yellow	*Dendroica petechia*
waterthrush, Louisiana	*Seiurus motacilla*
waterthrush, northern	*Seiurus noveboracensis*
whip-poor-will	*Caprimulgus vociferus*
woodcock, American	*Scolopax minor*
woodpecker, pileated	*Dryocopus pileatus*
woodpecker, red-bellied	*Melanerpes carolinus*
woodpecker, red-headed	*Melanerpes erythrocephalus*
wood-pewee, eastern	*Contopus virens*
wren, Carolina	*Thryothorus ludovicianus*
wren, marsh	*Cistothorus palustris*
wren, sedge	*Cistothorus platensis*
wren, winter	*Troglodytes troglodytes*
yellowthroat, common	*Geothlypis trichas*

MAMMALS	CLASS MAMMALIA
bat, big brown	*Eptesicus fuscus*
bat, hoary	*Lasiurus cinereus*
bat, Indiana	*Myotis sodalis*
bat, Keen's	*Myotis keeni*
bat, little brown	*Myotis lucifugus*
bat, red	*Lasiurus borealis*
bat, silver-haired	*Lasionycteris noctivagans*
bat, small-footed	*Myotis leibii*
bear, black	*Ursus americanus*
beaver	*Castor canadensis*
bobcat	*Lynx rufus*
chipmunk, eastern	*Tamias striatus*
cottontail, eastern	*Sylvilagus floridanus*
cottontail, New England	*Sylvilagus transitionalis*
coyote	*Canis latrans*
deer, white-tailed	*Odocoileus virginianus*
fisher	*Martes pennanti*
lemming, southern bog	*Synaptomys cooperi*
mink	*Mustela vison*
mole, hairy-tailed	*Parascalops breweri*
mouse, meadow jumping	*Zapus hudsonius*
mouse, white-footed	*Peromyscus leucopus*
mouse, woodland jumping	*Napaeozapus insignis*
muskrat	*Ondatra zibethica*
otter, river	*Lutra canadensis*
pipistrelle, eastern	*Pipistrellus subflavus*
porcupine	*Erethizon dorsatum*
raccoon	*Procyon lotor*
rat, Norway	*Rattus norvegicus*
seal, gray	*Halichoerus grypus*
seal, harbor	*Phoca vitulina*
seal, harp	*Phoca groenlandica*
seal, hooded	*Cystophora cristata*
(shrew)	Family Soricidae
shrew, longtail	*Sorex dispar*
skunk, striped	*Mephitis mephitis*
squirrel, gray	*Sciurus carolinensis pennsylvanicus*
squirrel, red	*Tamiasciurus hudsonicus*
squirrel, southern flying	*Glaucomys volans*
vole, boreal redback	*Clethrionomys gapperi*
vole, meadow	*Microtus pennsylvanicus*
vole, pine	*Pitmys pinetorum*
woodchuck	*Marmota monax*
woodrat, eastern	*Neotoma magister*

Appendix 5

Hudson Valley Calcicoles

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TABLE 16. HUDSON VALLEY CALCICOLES

Some plant indicators of calcareous environments in the Hudson Valley.
Scientific nomenclature for vascular plants follows Mitchell and Tucker (1997).

Common Name	Scientific Name
agrimony, small-flowered	*Agrimonia parviflora*
alexanders, golden	*Zizia aptera*
alum-root	*Heuchera americana*
anemone, rue	*Thalictrum thalictroides*
anise-root	*Osmorhiza longistylis*
aster, heart-leaved	*Aster cordifolius*
avens, purple	*Geum rivale*
baneberry, white	*Actaea alba*
basswood	*Tilia americana*
beakrush, needle	*Rhynchospora capillacea*
bedstraw, catchweed	*Galium aparine*
bedstraw, northern bog	*Galium labradoricum*
bellflower, marsh	*Campanula aparinoides*
bellwort, large-flowered	*Uvularia grandiflora*
birch, swamp	*Betula pumila*
bittercress, small-flowered	*Cardamine parviflora*
bladdernut	*Staphylea trifolia*
bloodroot	*Sanguinaria canadensis*
boneset, upland	*Eupatorium sessilifolium*
brome, fringed	*Bromus ciliata*
brome, woodland	*Bromus latiglumis*
buckbean	*Menyanthes trifoliata* var. *minor*
buckthorn, alder-leaf	*Rhamnus alnifolia*
bur-marigold, nodding	*Bidens cernua*
butternut	*Juglans cinerea*
cattail, narrow-leaf	*Typha angustifolia*
cedar, northern white	*Thuja occidentalis*
cinquefoil, shrubby	*Potentilla fruticosa*
cliffbrake, purple	*Pellaea atropurpurea*
cliffbrake, smooth	*Pellaea glabella*
clubrush, wood	*Scirpus verecundus*
cohosh, black	*Cimicifuga racemosa*
cohosh, blue	*Caulophyllum thalictroides*
columbine, wild	*Aquilegia canadensis*
coneflower, green-headed	*Rudbeckia laciniata*
coontail, spiny	*Ceratophyllum echinatum*
cottongrass	*Eriophorum viride-carinatum*
cranesbill, Carolina	*Geranium carolinianum*
devil's-bit	*Chamaelirium luteum*
dewberry, swamp	*Rubus pubescens*
dogwood, red-osier	*Cornus sericea*
dogwood, roundleaf	*Cornus rotundifolia*
dragon, green	*Arisaema dracontium*
Dutchman's-breeches	*Dicentra cucullaria*
false-foxglove, small-flower	*Agalinis paupercula*
fern, bulblet	*Cystopteris bulbifera*
fern, fragile	*Cystopteris fragilis*
fern, maidenhair	*Adiantum pedatum*
fern, walking	*Asplenium rhizophyllum*
fernmoss, fir	*Thuidium abietinum*
fescue, blunt	*Festuca obtusa*
fescue, nodding	*Festuca subverticillata*
feverwort	*Triosteum perfoliatum*
flatsedge, shining	*Cyperus bipartitus*
flax, yellow wild	*Linum sulcatum*
gentian, fringed	*Gentianopsis crinita*
gentian, stiff	*Gentianella quinquefolia*
geranium, wild	*Geranium maculatum*
ginger, wild	*Asarum canadense*
ginseng, American	*Panax quinquefolius*
goldenrod, blue-stem	*Solidago caesia*
goldenrod, bog	*Solidago uliginosa*
goldenrod, spreading	*Solidago patula*
goldenrod, zigzag	*Solidago flexicaulis*
gooseberry, northern	*Ribes hirtellum*
grama, side-oats	*Bouteloua curtipendula*
grass, bottlebrush	*Elymus hystrix*
grass-of-Parnassus	*Parnassia glauca*
grass, wedge	*Sphenopholis obtusata*
gromwell, false	*Onosmodium virginianum*
hackberry	*Celtis occidentalis*
hairgrass, tufted	*Deschampsia cespitosa*
hemlock-parsley	*Conioselinum chinense*
hepatica, sharp-lobed	*Hepatica nobilis* var. *acutiloba*
herb-robert	*Geranium robertianum*
hickory, bitternut	*Carya cordiformis*
honewort	*Cryptotaenia canadensis*
honeysuckle, mountain	*Lonicera dioica*
ladyslipper, showy	*Cypripedium reginae*
ladyslipper, yellow	*Cypripedium parviflorum*
larch, American	*Larix laricina*
leatherwood	*Dirca palustris*
leek, wild	*Allium tricoccum*
lobelia, Kalm's	*Lobelia kalmii*
loosestrife, winged	*Lythrum alatum*
marjoram	*Origanum vulgare*
may-apple	*Podophyllum peltatum*
meadow-rue, early	*Thalictrum dioicum*
melic, false	*Schizachne purpurascens*
mermaid-weed	*Proserpinaca palustris*
milkweed, four-leaved	*Asclepias quadrifolia*
milkweed, poke	*Asclepias exaltata*
milkweed, whorled	*Asclepias verticillata*
miterwort	*Mitella diphylla*

(continued)

TABLE 16. HUDSON VALLEY CALCICOLES (cont.)

Common Name	Scientific Name
moonseed	*Menispermum canadense*
(moss)	*Anomodon attenuatus*
(moss)	*Anomodon rostratus*
(moss)	*Encalyptera ciliata*
moss, limestone cushion	*Gymnostomum*
(moss)	*Tortella tortuosa*
moss, rose	*Rhodobryum roseum*
mountain-mint, Torrey's	*Pycnanthemum torrei*
oak, Chinquapin	*Quercus muehlenbergii*
onion, nodding wild	*Allium cernuum*
orchis, showy	*Galearis spectabilis*
paintbrush, Indian	*Castilleja coccinea*
paw paw	*Asimina triloba*
pellitory	*Parietaria pensylvanica*
phlox, blue	*Phlox divaricata*
prickly-ash	*Zanthoxylum americanum*
ragwort, round-leaf	*Senecio obovatus*
riccia	*Riccia fluitans*
ricciocarpus	*Ricciocarpus natans*
ricegrass	*Oryzopsis racemosa*
rock-cress, hairy	*Arabis hirsuta*
rue, wall	*Asplenium ruta-muraria*
rush, knotted	*Juncus nodosus*
rush, small-headed	*Juncus brachycephalus*
sandwort, grove	*Moehringia lateriflora*
sandwort, rock	*Minuartia michauxii*
saxifrage, early	*Saxifraga virginiensis*
saxifrage, golden	*Chrysosplenium americanum*
sedge	*Carex albursina*
sedge	*Carex digitalis*
sedge	*Carex laxiculmis*
sedge, bristle-leaf	*Carex eburnea*
sedge, bur-reed	*Carex sparganioides*
sedge, Davis'	*Carex davisii*
sedge, golden	*Carex aurea*
sedge, handsome	*Carex formosa*
sedge, Peck's	*Carex peckii*
sedge, plantain	*Carex plantaginea*
sedge, porcupine	*Carex hystericina*
sedge, rigid	*Carex tetanica*
sedge, Schweinitz's	*Carex schweinitzii*
sedge, Sprengel's	*Carex sprengelii*
sedge, sterile	*Carex sterilis*
sedge, yellow	*Carex flava*
serviceberry, oblong-leaf	*Amelanchier canadensis*
sicklepod	*Arabis canadensis*
skullcap, small	*Scutellaria parvula*
snakeroot, black	*Sanicula marilandica*
snakeroot, Virginia	*Aristolochia serpentaria*
sneezeweed	*Helenium autumnale*
Solomon's-seal, starry	*Maianthemum stellatum*
spike-muhly	*Muhlenbergia glomerata*
spikemoss, creeping	*Selaginella apoda*
spikerush, beaked	*Eleocharis smallii*
spikerush, matted	*Eleocharis intermedia*
spikerush, olivaceous	*Eleocharis flavescens*
spleenwort, ebony	*Asplenium platyneuron*
spleenwort, maidenhair	*Asplenium trichomanes*
squawroot	*Conopholis americana*
squirrel-corn	*Dicentra canadensis*
St. Johnswort, marsh	*Triadenum fraseri*
(stonewort)	*Chara*
(stonewort)	*Nitella*
sumac, fragrant	*Rhus aromatica*
sweet-cicely	*Osmorhiza claytoni*
thimbleweed	*Anemone virginiana*
thistle, swamp	*Cirsium muticum*
thyme, wild	*Thymus pulegioides*
toothwort, cut-leaf	*Cardamine concatenata*
trillium, large-flowered	*Trillium grandiflorum*
trout-lily, white	*Erythronium albidum*
valerian, bog	*Valeriana uliginosa*
vervain	*Verbena simplex*
violet, bluntspur	*Viola adunca*
violet, Canada	*Viola canadensis*
violet, cutleaved	*Viola palmata*
violet, longspur	*Viola rostrata*
violet, northern blue	*Viola septentrionalis*
violet, Selkirk's	*Viola selkirkii*
whitlow-grass, Carolina	*Draba reptans*
wild-licorice	*Galium circaezans*
wild-licorice	*Galium lanceolatum*
willow, autumn	*Salix serissima*
willow, beaked	*Salix bebbiana*
willow, hoary	*Salix candida*

Appendix 6

Soils and Geology Information

TABLE 17. SOILS INFORMATION

A. Soils of the ten counties of the Hudson River Estuary Corridor, and some characteristics useful for biodiversity assessments.

All information is from the Soil Conservation Service county soil surveys. See part B of this table for explanation of data.

SOIL SERIES	PHASE(S)	REACTION	ORGANIC or MINERAL	DEPTH TO BEDROCK (in inches)	PARENT MATERIAL	DRAINAGE CLASS
Adrian	muck	C	O	>60	Organic	VP
Albrights	silt loam to very stony silt loam	SC	M	>60	Till	MW
Alden	mucky silt loam to extremely stony silt loam	C	M	>60	Till	P-VP
Allard	silt loam	SC	M	>60	Alluvium	W
Allis	silt loam	C	M	20-40	Till	P
Angola	silt loam	C	M	20-40	Till	SP
Aquents	(variable, mineral)	SC	M	>60	(variable)	VP
Arnot	channery silt loam to very channery silt loam	NC	M	≤20	Till	MW-SX
Atherton	silt loam	C	M	>60	Outwash	P-VP
Aurelie	silt loam	SC	M	>60	Till	P
Barbour	silt loam to fine sandy loam	NC	M	>60	Alluvium	W
Basher	fine sandy loam to silt loam	NC	M	>60	Alluvium	MW-SP
Bath	gravelly silt loam to very stony soils	SC, NC	M	>40	Till	W
Bernardston	silt loam to very stony silt loam	NC	M	>60	Till	W
Beseman	muck	C	O	>60	Organic	VP
Birdsall	silt loam to mucky silt loam	C	M	>60	Lacustrine	VP
Blasdell	channery loam to channery silt loam	NC	M	>60	Outwash	W
Brayton	very stony silt loam	SC	M	>60	Till	SP-P
Buckland	very stony loam	NC	M	>60	Till	W-MW
Burdett	silt loam to channery silt loam, very stony	C	M	>60	Till	SP
Busti	silt loam	NC	M	>60	Till	SP
Cambridge	gravelly silt loam	SC	M	>60	Till	MW
Canandaigua	silt loam	C	M	>60	Lacustrine	P-VP
Cardigan	silt loam	NC	M	20-40	Till	W
Carlisle	muck	C	O	>60	Organic	VP
Castile	gravelly silt loam to gravelly loam	SC, NC	M	>60	Outwash	MW
Cayuga	silt loam	C	M	>60	Lacustrine	W-MW
Cazenovia	silt loam	C	M	>60	Till	W-MW
Charlton	fine sandy loam to loam, very stony	NC	M	>60	Till	W
Chatfield	loam	NC	M	20-40	Till	SX-W
Chatauqua	loam to gravelly silt loam	SC, NC	M	>60	Till	MW
Chenango	gravelly silt loam to very gravelly loam	SC, NC	M	>60	Outwash	SX-W
Cheshire	gravelly fine sandy loam	NC	M	>60	Till	W
Churchville	silt loam	C	M	>60	Lacustrine	SP
Claverack	loamy fine sand	C	M	>60	Lacustrine	MW
Collamer	silt loam	C	M	>60	Lacustrine	MW

(continued)

TABLE 17. SOILS INFORMATION (cont.)

A. Soils of the ten counties (cont.)

SOIL SERIES	PHASE(S)	REACTION	ORGANIC or MINERAL	DEPTH TO BEDROCK (in inches)	PARENT MATERIAL	DRAINAGE CLASS
Colonie	loamy fine sand	SC	M	>60	Lacustrine	SX-W
Copake	gravelly silt loam to channery silt loam fan	C	M	>60	Outwash, Alluvium	W
Cosad	loamy fine sand	C	M	>60	Lacustrine	SP
Covington	silty clay	C	M	>60	Lacustrine	P
Dutchess	silt loam	NC	M	>60	Till	W
Elka	channery loam to channery loam, very stony	NC	M	>60	Till	W
Elmridge	very fine sandy loam to fine sandy loam	SC, NC	M	>60	Lacustrine	MW
Elnora	fine sandy loam to loamy fine sand	SC	M	>60	Lacustrine	MW
Erie	gravelly silt loam to extremely stony soils	C	M	>60	Till	SP
Farmington	silt loam to gravelly silt loam, rocky	C	M	≤20	Till	SX-W
Fluvaquents	(variable)	(variable)	M	>5	Alluvium	SP-VP
Fredon	silt loam to loam	C	M	>60	Outwash	SP-P
Galway	gravelly silt loam, rocky to gravelly loam, rocky	C	M	20-40	Till	W-MW
Georgia	silt loam	C	M	>60	Till	MW
Glover	very stony loam, very rocky	NC	M	≤20	Till	SX
Granby	loamy fine sand	C	M	>60	Lacustrine	P-VP
Greene	channery silt loam	NC	M	20-40	Till	SP
Halcott	channery silt loam	NC	M	≤20	Till	SX-MW
Halsey	mucky silt loam to silt loam	C	M	>60	Outwash	VP
Hamlin	silt loam	C	M	>60	Alluvium	W
Haven	silt loam to loam	NC	M	>60	Outwash	W
Hinckley	gravelly loamy sand	NC	M	>60	Outwash	X
Histic Humaquepts	(variable)	(variable)	M	>5	(variable)	VP
Hollis	fine sandy loam	NC	M	≤20	Till	SX-W
Holyoke	silt loam	NC	M	≤20	Till	W
Hoosic	gravelly sandy loam to cobbly loam	NC	M	>60	Outwash	X-W
Hornell	silt loam	NC	M	20-40	Till	SP
Howard	gravelly silt loam	C	M	>60	Outwash	SX-W
Hudson	silt loam	C	M	>60	Lacustrine	MW
Hydraquents	silty clay loam to loamy sand	(variable)	M	>5	(variable)	VP
Ilion	silt loam	C	M	>60	Till	P
Ipswich	mucky peat	C	O	>60	Organic	VP
Kearsarge	silt loam	NC	M	≤20	Till	SX
Kingsbury	silty clay loam	C	M	>60	Lacustrine	SP
Knickerbocker	fine sandy loam	NC	M	>60	Outwash	SX
Lackawanna	flaggy silt loam to channery silt loam, very stony	NC	M	>60	Till	W

(continued)

TABLE 17. SOILS INFORMATION (cont.)

A. Soils of the ten counties (cont.)

SOIL SERIES	PHASE(S)	REACTION	ORGANIC or MINERAL	DEPTH TO BEDROCK (in inches)	PARENT MATERIAL	DRAINAGE CLASS
Lamson	fine sandy loam	C	M	>60	Outwash	P-VP
Lanesboro	channery silt loam, stony	NC	M	>60	Till	W
Leicester	loam (stony to very stony)	NC	M	>60	Till	SP
Lewbeach	channery silt loam to channery silt loam, bouldery	NC	M	>60	Till	W
Limerick	silt loam	C	M	>60	Alluvium	P
Linlithgo	silt loam	NC, SC	M	>60	Alluvium	SP
Livingston	silty clay loam	C	M	>60	Lacustrine	VP
Lordstown	channery silt loam	NC	M	20-40	Till	W
Loxley	muck	NC	O	>60	Organic	VP
Lyons	silt loam to silt loam, very stony	C	M	>60	Till	P-VP
Macomber	channery or shaly silt loam, very rocky	NC	M	20-40	Till	W
Madalin	silt loam to silty clay loam	C	M	>60	Lacustrine	P-VP
Manlius	channery or shaly silt loam	NC	M	20-40	Till	X-W
Maplecrest	gravelly silt loam	NC	M	>60	Till	W
Mardin	gravelly silt loam to gravelly silt loam, very stony	SC	M	>40	Till	MW
Massena	silt loam	C	M	>60	Till	SP-P
Medihemists	(variable, organic)	(variable)	O	>5	Organic	VP
Medisaprists	(variable, organic)	SC	O	>5	Organic	VP
Menlo	silt loam to very bouldery soils	NC	M	>60	Till	VP
Middlebury	silt loam	C	M	>60	Alluvium	MW-SP
Monarda	channery silt loam, very rocky	NC	M	>60	Till	P
Morris	flaggy silt loam to channery silt loam, very rocky	NC	M	>60	Till	SP
Nassau	shaly silt loam to channery silt loam, very rocky	NC	M	≤20	Till	SX
Nellis	silt loam, very rocky	C	M	>60	Till	W
Niagara	silt loam	C	M	>60	Lacustrine	SP
Nunda	silt loam to silt loam,very stony	C	M	>60	Till	MW
Oakville	loamy fine sand	C	M	>60	Outwash	W
Occum	silt loam to loam	NC	M	>60	Alluvium	MW-W
Ochrepts	(variable)	(variable)	M	>10	Alluvium	X-MW
Odessa	silt loam	C	M	>60	Lacustrine	SP
Onteora	silt loam to silt loam, very bouldery	NC	M	>60	Till	SP
Oquaga	channery silt loam to very channery silt loam	NC	M	20-40	Till	W-X
Otisville	gravelly sandy loam	NC	M	>60	Outwash	X
Ovid	silt loam	C	M	>60	Till	SP
Palms	muck	C	O	>60	Organic	VP
Pawling	silt loam	C	M	>60	Alluvium	MW
Paxton	fine sandy loam to very stony loam	NC	M	>60	Till	W

(continued)

TABLE 17. SOILS INFORMATION (cont.)

A. Soils of the ten counties (cont.)

SOIL SERIES	PHASE(S)	REACTION	ORGANIC or MINERAL	DEPTH TO BEDROCK (in inches)	PARENT MATERIAL	DRAINAGE CLASS
Pittsfield	gravelly loam	C	M	>60	Till	W
Pittstown	silt loam to gravelly silt loam	NC	M	>60	Till	MW
Plainfield	loamy sand	SC	M	>60	Outwash	X
Pompton	fine sandy loam to silt loam	NC	M	>60	Outwash	MW-SP
Punsit	silt loam	NC	M	>60	Till	SP
Raynham	silt loam to very fine sandy loam	C	M	>60	Lacustrine	SP-P
Red Hook	gravelly silt loam	C	M	>60	Outwash	SP
Rhinebeck	silt loam to silty clay loam	C	M	>60	Lacustrine	SP
Ridgebury	loam to very stony loam	NC	M	>60	Till	SP-P
Rippowam	sandy loam	C	M	>60	Alluvium	P
Riverhead	fine sandy loam to loam	SC, NC	M	>60	Outwash	W
Saprists	(variable, organic)	(variable)	O	>60	Organic	VP
Scarboro	mucky sandy loam	NC	M	>60	Outwash	VP
Schoharie	silt loam	C	M	>60	Lacustrine	MW-W
Scio	silt loam to very fine sandy loam	SC, NC	M	>60	Lacustrine, Alluvium	MW
Scriba	silt loam to gravelly fine sandy loam, bouldery	C	M	>60	Till	SP
Shaker	very fine sandy loam to loam	C,SC	M	>60	Lacustrine	SP-P
Sloan	silt loam	C	M	>60	Alluvium	VP
Stafford	loamy fine sand	NC	M	>60	Lacustrine	SP
Stockbridge	silt loam to gravelly silt loam	C	M	>40	Till	W
Sudbury	fine sandy loam	C	M	>60	Outwash	MW
Sun	silt loam to loam, extremely stony	C	M	>60	Till	P-VP
Suncook	loamy fine sand to sandy loam	NC	M	>60	Alluvium	X
Suny	gravelly silt loam, very stony	NC	M	>60	Till	P-VP
Sutton	loam	NC	M	>60	Till	MW
Swartswood	stony fine sandy loam to gravelly loam	NC	M	>60	Till	MW-W
Taconic	channery or slaty silt loam, very rocky	NC	M	<=20	Till	SX-W
Teel	silt loam	C	M	>60	Alluvium	MW-SP
Tioga	silt loam to fine sandy loam	C	M	>60	Alluvium	W
Tor	flaggy loam to flaggy loam, very bouldery	NC	M	≤20	Till	SP-P
Tuller	flaggy silt loam to channery silt loam, very stony	NC	M	≤20	Till	SP-P
Tunkhannock	gravelly loam	SC, NC	M	>60	Outwash	SX-W
Udifluvents	silt loam to fine sandy loam	(variable)	M	>5	Alluvium	X-MW
Udipsamments	(variable, sandy)	SC	M	>60	Disturbance (dredge)	X-W
Udorthents	(variable)	(variable)	M	(variable)	Disturbance (fill)	X-SP

(continued)

TABLE 17. SOILS INFORMATION (cont.)

A. Soils of the ten counties (cont.)

SOIL SERIES	PHASE(S)	REACTION	ORGANIC or MINERAL	DEPTH TO BEDROCK (in inches)	PARENT MATERIAL	DRAINAGE CLASS
Unadilla	silt loam	(variable)	M	>60	Lacustrine, Alluvium	W
Valois	gravelly loam to very bouldery soils	SC	M	>60	Till	W
Vergennes	silty clay loam	C	M	>60	Lacustrine, Estuarine	MW
Vly	very channery silt loam	NC	M	20-40	Till	W-SX
Volusia	gravelly silt loam to channery silt loam, stony	SC	M	>60	Till	SP
Wakeland	silt loam	C	M	>60	Alluvium	SP
Wallington	silt loam	SC	M	>60	Lacustrine	SP
Wallkill	silt loam	C	M	>60	Alluvium	VP
Walpole	fine sandy loam to sandy loam	C, NC	M	>60	Outwash, Lacustrine	SP
Wappinger	loam	C	M	>60	Alluvium	W
Wassaic	silt loam	C	M	20-40	Till	MW-W
Watchaug	fine sandy loam	NC	M	>60	Till	MW
Wayland	silt loam to mucky silt loam	C	M	>60	Alluvium	P-VP
Wellsboro	silt loam,very stony to flaggy silt loam, bouldery	NC	M	>60	Till	MW
Wethersfield	gravelly silt loam	SC	M	>60	Till	W
Williamson	silt loam	SC	M	>60	Lacustrine	MW
Willowemac	channery silt loam	NC	M	>60	Till	MW
Windsor	loamy sand	NC	M	>60	Outwash	X
Woodbridge	loam	NC	M	>60	Till	MW
Wurtsboro	gravelly loam	NC	M	>60	Till	MW-SP
Yalesville	sandy loam	NC	M	20-40	Till	W

TABLE 17. SOILS INFORMATION (cont.)

B. Explanation of protocols used for compiling Table 17A.

See Glossary for definitions.

Phase(s)	Phase is a subdivision of a soil series, based on slope, texture, and thickness of soil layers. In Table 17A, we do not distinguish between slope categories. In certain cases, Table 17A gives a range of textures (e.g., loamy fine sand to sandy loam) for a single series, incorporating the different phases reported in different county surveys. Where more than two phases were described for a series, we list only the finest and coarsest textures to describe the range. Information on substrata is not included. For highly variable soil types without typical pedons, phase is reported as "variable." If known, the general character of the phase is given; e.g., "(variable, organic)." For soil complexes and other cases where phase of the particular soil type was not given, the predominant texture of the "typical pedon" described in the series description was used, or the phases listed in other county surveys were reported.
Reaction	Determined from table of Physical and Chemical Properties in soil surveys, and classified as follows: C — Calcareous: When more than one of at least three layers had pH >6.5; if only one or two layers were measured, at least one layer had pH >6.5. SC — Somewhat calcareous: When one of multiple layers (usually the deepest) had pH >6.5. NC — Not calcareous: When all layers had pH ≤6.5. (variable) — Soil reaction highly variable between locations; if two different reactions were reported in different counties, both appear on table.
Organic or Mineral	Classified as follows: O — organic soils (mucks and peats) M — mineral soils (all non-organic soils)
Depth to Bedrock	Determined from Soil and Water Features table in soil surveys, and placed in the following categories: >5 inches ≤20 20–40 >40 20-60 >60 (variable) When depth to bedrock varied from one county to the next, the most conservative value (i.e., the shallowest depth) was reported. Where depth to bedrock was extremely variable, it was reported as "(variable)."

(continued)

TABLE 17. SOILS INFORMATION (cont.)

B. Explanation of protocols used for compiling Table 17A. (cont.)

Parent Material

Determined from series or type descriptions, wherever possible, and placed in the following categories: alluvium, disturbance, estuarine, lacustrine, outwash, or till.

Parent material was identified in the Classification of the Soils section of the county soil surveys by the language "formed in" (e.g., "These soils were formed in glacial outwash"). Parent materials of most series were clearly reported as either alluvium, lacustrine, outwash, or till. Where determination of the parent material was more difficult, we used the following guidelines:

If parent material was reported as "glaciofluvial deposits," it was considered outwash. (Glaciofluvial deposits occur at the limits of outwash, but before the post-glacial lake, or lacustrine, deposits.)

If soils were described as "water-sorted," "water-deposited," or "water-laid," we considered texture classification to distinguish parent material: in those cases, if soil was gravelly, the parent material was considered outwash; if sand or finer than sand, it was considered lacustrine.

If a soil series was described as having two parent materials, both were included in the table. However, underlying materials were excluded. (For example, in the following case, only alluvium was considered the parent material: "Soils formed in old alluvial deposits underlain by outwash sand and gravel.") The relationship between underlying materials and biodiversity is not yet understood. This factor may be noteworthy in some instances (as in the case of the deep-burrowing animals).

Drainage Class

The following codes were used to denote standard classifications (determined from series descriptions):

X = excessively drained

SX = somewhat excessively drained

W = well drained

MW = moderately well drained

SP = somewhat poorly drained

P = poorly drained

VP = very poorly drained

A hyphenated range was reported in Table 17A if the soil type included two or more drainage classes (e.g., “MW-P”).

All information in Table 17A is from the soil surveys of the ten counties of the Hudson River estuary corridor:

Albany County	Brown (1992)
Columbia County	Case (1989)
Dutchess County	Anonymous (1991)
Greene County	Broad (1993)
Orange County	Olsson (1981)
Putnam and Westchester counties	Seifried (1994)
Rensselaer County	Work (1988)
Rockland County	Bonnell (1990)
Ulster County	Tornes (1979)

TABLE 18. GEOLOGY INFORMATION

Mapped bedrock of the ten counties of the Hudson River Estuary Corridor. Use this table with the Geologic Map of New York, Hudson-Mohawk and Lower Hudson sheets (Fisher et al. 1970) to help determine the calcareous or acidic nature of the mapped bedrock. Consult those sheets for more detailed descriptions.

Map Code	Formation, Group, or Sequence	Primary Derivation	Primary Materials	Calcareous or Acidic[1]
am	Middle Proterozoic, unknown	metamorphic	amphibolite, gneiss, calcsilicate rock	V
amg	Middle Proterozoic, unknown	metamorphic	amphibolite and gneiss	A
bg	Middle Proterozoic, unknown	metamorphic	gneiss	A
bqpc	Middle Proterozoic, unknown	metamorphic	gneiss, with amphibolite and calcsilicate rock	V
?€ev	Everett Schist	metamorphic	schist, with graywacke lenses	V
?€g	Germantown Formation	sedimentary	shale, conglomerate, limestone	pC
?€n	Nassau Formation	sedimentary	slate, shale, quartzite	A
€pg	Poughquag Quartzite	sedimentary	quartzite	A
?€r	Rensselaer Graywacke	sedimentary	graywacke, with some shale	A
cs	Middle Proterozoic, unknown	metamorphic	calcsilicate rock	sC
Dbg	Devonian Intrusives	metamorphic	gneiss	A
Dgl	Glenerie Formation	sedimentary	limestone, chert	C
Dh	Hamilton Group	sedimentary	shale, siltstone	V
Dhg	Helderberg Group	sedimentary	limestone	C
Dhm	Hamilton Group	sedimentary	shale, sandstone	sC
Dhpl	Plattekill or Ashokan Formations	sedimentary	shale, sandstone	sC
Dou	Onandaga Limestone and Ulster Group	sedimentary	shale, limestone, siltstone	pC
Dpgd	Peekskill Pluton	igneous	granodiorite	A
Dpgr	Peekskill Pluton	igneous	granite	A
DS	Lower Devonian and Silurian Rocks (undifferentiated)	sedimentary	limestone, dolostone, sandstone, shale, conglomerate	pC
fb	Fordham Gneiss	metamorphic	gneiss	A
fc	Fordham Gneiss	metamorphic	gneiss	A
fd	Fordham Gneiss	metamorphic	gneiss, quartzite	A
fe	Fordham Gneiss	metamorphic	gneiss, amphibolite	A
hg	Middle Proterozoic, unknown	igneous and metamorphic	granite and gneiss	A
lg	Middle Proterozoic, unknown	metamorphic	gneiss	A
mb	Middle Proterozoic, unknown	sedimentary	marble, with calcsilicate rock and amphibolite	C
Oag	Austin Glen Formation	sedimentary	graywacke, shale	pC
Oba	Balmville Limestone	sedimentary	limestone	C
Oban	Cortlandt & Smaller Mafic Complexes	igneous	norite	a
O€e	Elizaville Formation	sedimentary	shale, argillite, quartzite	A
O€h	Lorraine, Trenton, and Black River Groups	(various)	(various along faults)	V
O€i	Inwood Marble	metamorphic	marble, calc-schist, granulite, quartzite	C
O€s	Cambrian through Middle Ordovician	sedimentary	(slivers or blocks of carbonate rock)	C
O€w	Wappinger Group	sedimentary	limestone, dolostone, shale	C
Od	Cortlandt & Smaller Mafic Complexes	igneous	diorite, with hornblende or biotite	a

(continued)

TABLE 18. GEOLOGY INFORMATION (cont.)

Map Code	Formation, Group, or Sequence	Primary Derivation	Primary Materials	Calcareous or Acidic[1]
Oh	Cortlandt & Smaller Mafic Complexes	igneous	hornblendite	a
Ohn	Cortlandt & Smaller Mafic Complexes	igneous	norite	a
?Om	Manhattan Formation	metamorphic	schist and amphibolite	A
?Oma	Manhattan Formation	metamorphic	schist, with marble and calcsilicate rock	pC
?Omb	Manhattan Formation	metamorphic	schist and amphibolite	A
Omi	Mount Merino and Indian River Formations	sedimentary	shale, slate, argillite, chert	a
On	Normanskill Group	sedimentary	shale, argillite, siltstone	a
Oopx	Cortlandt & Smaller Mafic Complexes	igneous	pyroxenite, with hornblende and local peridotite	a
Opx	Cortlandt & Smaller Mafic Complexes	igneous	pyroxenite	a
Oqu	Quassaic Quartzite	sedimentary	quartzite, conglomerate, sandstone	a
?Os	Lower Ordovician Intrusive	metamorphic	serpentinite	a
Osf	Stuyvesant Falls Formation	sedimentary	shale, siltstone, chert	a
Otm	Taconic Melange	(various)	(various)	pC
Owl	Walloomsac Formation	metamorphic	slate, phyllite, schist	a
Q	Cenozoic, Quarternary, unknown	(glacial and alluvial deposits)	(various)	U
qpg	Middle Proterozoic, unknown	metamorphic	gneiss, with other constituents	A
qtcs	Middle Proterozoic, unknown	metamorphic	gneiss, quartzite, calcsilicate rock	V
qtlg	Middle Proterozoic, unknown	metamorphic	gneiss, quartzite	A
rg	Middle Proterozoic, unknown	metamorphic	gneiss, with other constituents	V
sc	Middle Proterozoic, unknown	metamorphic	gneiss	A
TRba	Brunswick Formation	sedimentary	mudstone, sandstone, arkose	V
TRp	Palisade Diabase	igneous	basalt	A
TRs	Stockton Formation	sedimentary	arkose, conglomerate, mudstone	V
y	Yonkers Gneiss	metamorphic	gneiss	A

[1] A = acidic; a = alkaline but not calcareous; C = calcareous; pC = potentially calcareous; sC = somewhat calcareous; U = unknown; V = variable.

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Appendix 7

Finding Information for Biodiversity Assessments

Appendix 7. Finding Information for Biodiversity Assessments

Much information on known and potential biodiversity resources can be obtained from existing maps, public records, and other easily accessible documents. Table 19 lists some of the most useful documents, maps, and other resources for biodiversity assessments. The subsections below describe the kinds of information available from government agencies, private organizations, biologists, and the literature.

Government Agencies—Federal

The **United States Geological Survey (USGS)** publishes standard topographic maps (scale = 1:24,000), showing 10- or 20- foot elevation contours, permanent water bodies, and roads, buildings, and other cultural features. These maps are essential tools for preliminary biological and ecological assessment of a site or a region.

The USGS also makes available aerial photographs of New York State, in paper and digital forms, flown during the period 1994–1998 (part of the National Aerial Photography Program or NAPP). These are "orthophotos"; that is, they have been digitally corrected to remove the distortions inherent in aerial photos due to camera location and ground relief.

In 1994 the U.S. Department of Agriculture's **Soil Conservation Service (SCS)** was renamed the **Natural Resources Conservation Service (NRCS)**. In the 1970s–90s, the SCS conducted soil surveys for all counties in the study area. As of January 2001, the county soil survey reports and maps have been published for all but Dutchess County. The latter may be published in 2001; until then, draft maps and an interpretive guide are available from the Soil and Water Conservation District office. The published soil surveys contain general information on regional climate, physiography, and geology, as well as soil maps and soil descriptions. Because the habitats at any site are largely determined by the texture, chemistry, and drainage of soils, the county soil surveys are indispensable resources for understanding or predicting the occurrences of particular habitats or species. See Section 5.1 for cautions about the accuracy of county soil maps.

NWI maps are the most comprehensive wetland maps available on a regional scale, but users should not assume that all wetlands have been mapped or that the boundaries are mapped correctly.

The **U.S. Fish and Wildlife Service (USFWS)** publishes maps of federally regulated wetlands prepared by the **National Wetland Inventory (NWI)**. The NWI maps are produced on the same map scale and quadrangle grid as the USGS topographic maps, using aerial photo-interpretation with some field checking. The NWI maps show wetlands of all sizes, but the completeness and accuracy of the maps vary from region to region. Users should not assume that all wetlands have been mapped or that the boundaries are mapped correctly. NWI maps are, nonetheless, the most comprehensive wetland maps available on a regional scale.

The USFWS publishes a series of profiles (part of their Biological Reports series) on the ecology of a variety of wetland and deepwater habitats (e.g., Odum et al. 1984, Golet et al. 1993). These profiles include detailed habitat descriptions, including physiography, geology and soils, characteristic species, rare species, and ecological processes, and are excellent sources of background information on particular types of wetland habitats. The profiles are somewhat generalized across broad geographic areas, however, and some are out of date.

Government Agencies—New York State

Department of Environmental Conservation (NYSDEC)

New York Natural Heritage Program

The New York Natural Heritage Program (NYNHP), a collaboration of NYSDEC and The Nature Conservancy, surveys and monitors rare species and significant ecological communities in the state, and maintains a database of historical and extant occurrences. The database contains information on the biology, habitats, locations, status, management needs, and data sources for the species and communities of concern. The rare element data comes from field surveys by NYNHP staff and NYNHP contractors, and from museums, herbaria, and cooperating biologists.

At the commencement of a biological assessment, we recommend a routine inquiry to the NYNHP for records of rare element occurrences.

At the commencement of a biological assessment of a site or a region, we recommend a routine inquiry to the NYNHP for records of rare element occurrences. The protocol for such an inquiry is given in Appendix 2. The NYNHP recommends that inquiries be updated annually to take advantage of new information. Due to concerns about collecting, harassment, or other disturbance of rare plants or animals, the NYNHP provides rare species data based on a requestor's "need-to-know." These data are also available through the regional NYSDEC office.

All persons using NYNHP records should understand that most sites have never been surveyed for rare species, and some sites may harbor rare elements not documented in the NYNHP files. In the absence of NYNHP records, onsite surveys by qualified biologists during appropriate seasons are essential to determine whether rare species do or could occur at a site.

The NYNHP report, *Ecological Communities of New York State* (Reschke 1990), describes the rare and common ecological communities recognized by the NYNHP in New York. Each community type is described according to its dominant and characteristic plants and animals, typical position in the landscape, geology, hydrologic regime, rare species (if any), known distribution in New York, and state and global rarity status. This is a very useful guide for identifying significant habitats in New York. The NYNHP community classifications and descriptions are necessarily generalized, however (as are those in this *Manual*); one should not expect to find communities in nature that conform exactly to Reschke's descriptions. Also, some Hudson Valley communities are not described by Reschke. The habitats profiled in Section 7 of this *Manual* are cross-referenced to the communities described by Reschke wherever possible.

Endangered Species Unit

The Endangered Species Unit of NYSDEC monitors the populations and habitats of state-listed endangered or threatened animal species, maintains data on and assesses potential impacts to those species, reviews permit applications for development projects potentially affecting endangered and threatened species, and reviews license applications for research on endangered and threatened species.

New York State Freshwater Wetland Maps

The State of New York regulates activities only in wetlands of 5 ha (12.4 ac) or larger, and in certain smaller wetlands with special ecological or cultural features, such as endangered or threatened species, or connection to a public drinking water supply (Article 24 of the Environmental Conservation Law). NYSDEC publishes Freshwater Wetlands Maps for the entire state, depicting the approximate locations and boundaries of state jurisdictional wetlands. The maps are overlays of the USGS topographic maps (scale = 1:24,000), and show many of the same physiographic and cultural features, but do not depict elevation contours. These maps can be useful for locating the largest wetlands and wetland complexes. Because most small wetlands are excluded, however, the maps are not useful for identifying all the small wetlands that are essential to maintaining local biological diversity.

Hudson River Almanac

In 1994, the NYSDEC Hudson River Estuary Management Program, with support from the Greenway Heritage Conservancy and the Hudson River Foundation, began compiling citizens' natural history observations of the Hudson River, its tributaries, and adjacent uplands. These observations are summarized, indexed, and published annually as *The Hudson River Almanac*. This has proven to be a valuable depository of information on ordinary and unusual occurrences of plants, animals, and natural phenomena in the Hudson Valley, from Mount Marcy to the New York Bight.

New York State Amphibian and Reptile Atlas Project

The Division of Fish, Wildlife and Marine Resources conducted a ten-year survey to document the geographic distribution of reptiles and amphibians in the state. The purpose was to provide a basis for monitoring changes in populations, and to inform future management decisions. The project (also called the Herp Atlas) produced a series of newsletters and distribution maps that are available directly from NYSDEC (see Table 19).

Breeding Bird Atlas

In the early 1980s, the New York State Department of Environmental Conservation, the Federation of New York State Bird Clubs, and the Cornell University Laboratory of Ornithology collaborated on a project to determine the breeding distribution of birds in the state. Using a block system, the entire state was surveyed by volunteers and paid workers over a five-year period. The results were published in the *Breeding Bird Atlas of New York State* (Andrle and Carroll 1988). Another five-year survey was initiated in 2000.

Hudson River National Estuarine Research Reserve

The Hudson River National Estuarine Research Reserve (HRNERR), a program of NYSDEC based at Bard College in Dutchess Co., is part of a national system of Estuarine Research Reserves supported by state and federal funds. HRNERR manages four tidal wetland areas on the Hudson River, conducts long term physical and biological monitoring on those sites, maps Hudson River habitats, and administers fellowship programs for Hudson River environmental research. HRNERR also conducts a variety of education, interpretive, and outreach programs. Research reports on studies conducted under the HRNERR auspices cover wide ranging topics such as marsh insects, fish communities, tidal marsh mammals, water quality, hydrodynamics, and archaeology.

New York State Museum (NYSM)

New York Biological Survey

The New York State Biological Survey (NYBS) conducts research and maintains scientific collections in botany, mycology, entomology, zoology, and aquatic ecology. NYBS also serves as a clearinghouse for natural history information in New York State. The NYBS publishes bulletins focusing on regions, species, or groups of species; some of these bulletins contain detailed discussions of habitats, populations, and historical and current distributions. A catalogue of NYSM bulletins is available from the New York Biological Survey, Cultural Education Center – Room 3140, Albany, NY 12230, or at www.nysm.nysed.gov/biopub.html.

Biodiversity Research Institute

The New York State Biodiversity Research Institute (BRI) was established in 1993, under the State Education Law, to promote efforts to increase knowledge and awareness of biodiversity in the state. The BRI focuses on biodiversity research, education, and monitoring, and building a database on the status of biodiversity in the state. NYS Biodiversity Research Institute, New York State Museum, Cultural Education Center – Rm 3140, Albany, NY 12230. www.nysm.nysed.gov/bri.html.

New York State Geological Survey

The New York State Geological Survey (NYGS) publishes maps of the surficial and bedrock geology of the state (scale = 1:250,000) (Fisher et al. 1970, Cadwell et al. 1986). The Lower Hudson and Hudson-Mohawk sheets encompass the study area and the entire Hudson Valley. The geologic formations mapped at this scale are usually combinations of bedrock types. Although the maps are not at an appropriate scale for detailed interpretations, they describe well the overall geological character of a region, and can be used to predict soil conditions and groundwater chemistry that may be associated with significant habitats. Local features such as glacial erratics and rock outcrops which may have important biodiversity implications, however, are not depicted.

The NYGS has published a very useful general reference for New York geology, called *Geology of New York: A Simplified Account* (Isachsen et al. 2000). The NYGS also publishes bulletins that focus on the geology of specific regions and include detailed descriptions of local geological features. A catalogue of geology publications is available at www.nysm.nysed.gov/geolpub.html. Maps and other documents can be ordered from NYSM Publication Sales, Cultural Education Center – Room 3140, Albany, NY 12230.

New York State Department of Transportation (NYSDOT)

The New York State Department of Transportation (1994) published a comprehensive source of information on obtaining aerial photographs: *Inventory of Aerial Photography and Other Remotely Sensed Imagery of New York State*. This describes aerial photographs available for viewing or purchase from a variety of public and private sources. Photograph descriptions include area of coverage, date, film type, scale, camera focal length, and where the photos can be obtained. Information is organized by county.

Other State Agencies

The New York Office of Parks, Recreation, and Historic Preservation (OPRHP) has commissioned biological surveys of several of the state parks and historic sites in the Hudson River corridor.

The New York Cooperative Fish and Wildlife Research Unit is the lead organization for the New York Gap Analysis Project (NYGAP), part of a nationwide effort to identify the distributions of plant and animal species that contribute to the national biological diversity. The project uses geographic information system (GIS) technology to map the known distributions and habitats of butterflies, amphibians, reptiles, birds, and mammals, including but not limited to threatened, endangered, and sensitive species. These distribution maps are overlaid on maps of publicly and privately held conservation lands. Those areas with high apparent biological diversity that are not on such conservation lands are considered "gaps." The "gap" information will enable cooperating agencies and organizations to focus their conservation efforts on (so far) unprotected lands and regions that are of the greatest importance to maintaining native biological diversity.

A biodiversity project of the Palisades Interstate Park Commission (PIPC) involves biodiversity surveys conducted by the Bear Mountain League of Naturalists in the vicinity of Bear

Mountain and Harriman state parks. As of winter 2000, the database included approximately 50,000 records of plants and animals, with locations identified on a grid system to the nearest 500 ft (150 m). For more information, contact Alan W. Wells at awells@bestweb.net.

Government Agencies—County

Soil and Water Conservation District

The county Soil and Water Conservation District (SWCD) is the main local source for the SCS county soils surveys described above (Government Agencies—Federal). The SWCD can also help with interpretation of county soil surveys, and identify local soil scientists (consultants) qualified to conduct site-specific soil surveys. Most or all SWCD offices in the study area also have USGS topographic maps available for purchase.

Planning Department

Most county Planning Departments have oblique aerial photographs (see Glossary) available for photocopying or purchase. Some also have factor maps (e.g., steep slopes, floodplains, wetlands), other federal and state agency maps (e.g., wetland maps), and reports treating biological subjects. A few Planning Departments have developed other materials than can be very useful for biodiversity assessments. Westchester County, for example, has produced a GIS map of current land use in the county, depicting the extent and kinds of developed land uses, and various kinds of protected and unprotected open space (Strauss 1997). County planners can also assist individuals in locating other research tools.

Environmental Management Council

Several of the counties in the study area have Environmental Management Councils (EMCs) composed of representatives from local Conservation Advisory Councils and similar local boards. The EMCs compile planning resources, sponsor public education programs, and advise county and local agencies on environmental policy issues. The Dutchess County EMC, for example, maintains a county-wide inventory of natural resources, and has developed an extensive Geographic Information System (GIS) program whose services are available to municipalities.

Real Property Tax Office

The Real Property Tax Office (RPTO) in each county has aerial photos at various scales, and tax maps that may be photocopied or purchased. Tax maps are useful for identifying and locating landowners and property boundaries prior to field research. The accuracy of tax maps is variable.

Government Agencies—Municipal

The Town Clerk's office or the Town Assessor's office has tax maps that may be viewed by the public. The Town Master Plan (or Comprehensive Plan) may also be viewed (or sometimes purchased) from the Town Clerk or the Planning Board. The Master Plan usually includes natural resource information, but the accuracy and detail of the information is variable.

The Planning Boards of many towns have town-wide maps showing general information such as wetlands, steep slopes, floodplains, prime farmland, zoning districts, and other features relevant to land use planning. Some Planning Board members are knowledgeable about the town's natural resources. Planning Boards are often charged with reviewing permit applications for developments. Files associated with permit applications submitted to public agencies may be viewed by the public or obtained through a Freedom of Information request (FOIL). These files contain any maps and environmental assessment reports submitted with permit applications for land development. Environmental assessment documents sometimes have information on rare species and special habitats, but completeness and accuracy are inconsistent (see Section 5.3).

The municipal conservation advisory board (variously called the Conservation Advisory Commission or Council, the Environmental Conservation Commission, the Conservation Advisory Board, etc.) often has members who are knowledgeable about the natural resources of the town, or the history of local land uses. Some board members are naturalists themselves, or can make referrals to local or regional naturalists in various specialties. Among other tasks, the CAC conducts and maintains a Natural Resource Inventory (NRI) of the town, and prepares maps of natural features such as wetlands, aquifers, land use, streams, and steep slopes. Some NRIs have information useful to biodiversity surveys.

Non-Governmental Agencies and Organizations

Research Institutes

The Institute of Ecosystem Studies, based in Millbrook (Town of Washington, Dutchess Co.) conducts research on a broad range of topics at study sites throughout the world. Some of their Hudson Valley research has been on aspects of Hudson River ecology including food webs, invertebrates, invasive species, tidal wetlands, and fishes. Descriptions of their educational programs, and lists of other research topics and of publications can be found on their website: www.ecostudies.org.

Hudsonia Ltd. is an institute for research and education in the environmental sciences, based at the Bard College Field Station in Dutchess Co. Hudsonia conducts pure and applied research on natural and social science aspects of the environment, offers technical assistance to public and private agencies and individuals, and produces educational publications on natural history and conservation topics. Hudsonia studies have focused on rare species and rare habitats of the Hudson Valley, the ecology of wetlands and streams, the ecology of invasive plants, Hudson River fishes, and Hudson River tidal marshes. Descriptions of Hudsonia's work, and lists of publications can be found on their website: www.hudsonia.org.

Reserves, Sanctuaries, and Museums

Some of the privately or publicly owned preserves and small museums collect regional and local biological resource data. Some examples are the Trailside Museum at Bear Mountain State Park, the Environmental Education Center at Constitution Marsh, the Hudson River Museum (in Yonkers), the Beczak Environmental Education Center, and the Hudson River National Estuarine Research Reserve.

Nature Clubs and Associations

Local nature clubs can be excellent resources for information on rare species, significant habitats, special geological features, and significant archaeological sites. Table 20 lists some of the clubs and associations with publications that may have valuable information on local biodiversity.

The Preliminary Vouchered Atlas of New York State Flora (New York Flora Association 1990), contains state distribution maps for vascular plant species (common and rare) of New York based on vouchered specimens on record at the New York State Museum. The Atlas does not reflect plants vouchered since 1990 however, and many other plant species occurrences have not been documented by a voucher specimen, or reported at all to the museum. The Atlas, therefore, should not be regarded as comprehensive, or up-to-date.

Other organizations with a more global focus, such as the Wildlife Conservation Society, the New York Botanical Garden, the Brooklyn Botanic Garden, the American Museum of Natural History, and the Lamont-Doherty Geological Observatory also publish occasional monographs, articles, and reports on topics relevant to Hudson Valley biodiversity.

Conservation Organizations and Land Trusts

Many conservation organizations have staff who are knowledgeable about biodiversity resources in their region of concern. Some organizations are landowners or holders of conservation easements in the Hudson Valley and have considerable knowledge about natural features on their properties. Examples of the latter are listed in Section 4.5 of the Manual. Some of these organizations sponsor biodiversity investigations or act as clearinghouses for information on rare biota or significant habitats in the region. Federated Conservationists of Westchester County, for example, a 30-year-old coalition of Westchester County organizations, has initiated a longterm project to identify, catalog, and protect sites of high biological diversity located on public lands throughout the county. The organization also sponsors a public education program which includes publications and conferences on the subject of biodiversity conservation. The Metropolitan Conservation Alliance conducts ecological research in Westchester, Putnam, Dutchess, and Orange counties, and helps local decision-makers develop strategies for ecologically sound land use.

Published Literature

In addition to the specific references cited in the text of the *Manual*, we recommend two bibliographies, Kiviat (1981) and Anonymous (1994), which focus on the estuarine and land-edge environments of the Hudson River, and an extensive bibliography, Flores et al. (1997), relevant to Westchester and the New Jersey shore of the Hudson. The latter includes an extensive list of available geographic information system (GIS) information relevant to natural resource subjects in the New York City metropolitan area.

Other Literature

Other literature, often referred to as "gray literature" includes quasi-published, formal or informal documents such as Environmental Impact Statements, reports from governmental agencies and non-governmental organizations, industries, environmental consultants, technical newsletters, and similar materials. Gray literature is difficult to find, and difficult to catalog in libraries. The editorial control and technical review of information in the gray literature tends to be loose or incomplete.

Gray literature can be found by contacting agencies and organizations and requesting lists of reports, using government documents repositories and vertical files in libraries, and tracing citations from other gray literature. This material may also be tracked by seeking information on specific proposals or projects that have been considered for the subject area or its vicinity; local Planning Boards and Conservation Advisory Councils may be helpful in finding such information. Screening gray literature for the quality of information can be difficult. You may be able to contact an author or editor and ask questions about sources of information. An experienced field scientist or naturalist can often look at literature and judge its reliability, at least as it relates to a topic within their expertise.

Naturalists and Biologists

Local naturalists and biologists are often the best sources of site- or region-specific biological information. There are several ways to find qualified local naturalists who can assist with specimen identifications, biological site assessments, rare species surveys, and ecological information on particular habitats, species, or groups of species. Local nature clubs and conservation organizations can often recommend naturalists in various specialties. The New York Natural Heritage Program and scientists at the New York State Museum may be able to recommend experts in particular regions of the state. There are also published directories with extensive but unscreened lists of naturalists, biologists, and ecologists, often indexed by geographic region (see Appendix 9).

TABLE 19. OBTAINING MAPS, AERIAL PHOTOGRAPHS, AND OTHER DOCUMENTS

How to obtain maps, aerial photographs, and other documents useful for biodiversity assessments.

Materials with an asterisk (*) should be considered essential for a biodiversity assessment.

Document Type	Source	How to Obtain	Notes
Maps[1]			
County soil survey maps*	County Soil and Water Conservation District	Order county soil survey by phone from county SWCD office	Soil unit boundaries on soil maps are only approximate; small soil units are not mapped.
National Wetland Inventory maps	US Fish & Wildlife Service	Order paper maps from Cornell Institute for Resource Information Systems 302 Rice Hall Ithaca, NY 14853-5601 607-255-6520 Download digital maps from www.nwi.fws.gov	Maps show wetlands of all sizes, but some wetlands are missing. Mapped boundaries must be verified by a wetland scientist on site.
NYS Freshwater Wetland maps	NYS Department of Environmental Conservation	For paper maps, write or call regional NYSDEC office; provide USGS quad names. Or, order from Syracuse Blue Print Company, Inc., 825 E. Genesee St., Syracuse, NY 13210 (315-476-4084) Download digital maps from cugir.mannlib.cornell.edu/index.html	With a few exceptions, only wetlands ≥5 hectares are shown. Mapped boundaries must be verified by a wetland scientist onsite.
NYS surficial & bedrock geology maps*	New York State Museum	NYSM Publication Sales Cultural Education Ctr., Room 3140 Albany, NY 12230 518-402-5344 (ph) 518-486-3696 (fax) www.nysm.nysed.gov/geolpub.html	The Hudson-Mohawk, and Lower Hudson Sheets cover the subject area of this *Manual*. Catalogue of maps and publications can be viewed on website.
NYS Tidal Wetland maps	NYS Department of Environmental Conservation	Contact NYSDEC-Stony Brook (631-444-0295) to obtain map numbers. Then call or write to Nassau-Suffolk Blue Print Co., Inc. 354 Wheeler Rd, Hauppauge, NY 11788 (516-234-0666)	Only tidal wetlands south of the Tappan Zee Bridge have been mapped, but mapping is underway for tidal wetlands north of the bridge
USGS topographic maps*	US Geological Survey	County Soil and Water Conservation District; USGS distribution centers; certain local book, map, stationery, or outfitting stores; or from mapping.usgs.gov/esic/to_order.html	Obtain quad name from USGS map index available at distribution sites, or from USGS website.
Aerial Photographs[1]			
aerial photographs, digital	U.S. Geological Survey	Index and ordering information at USGS website: www.usgs.gov Also at NYSGIS Clearinghouse website: www.nysgis.state.ny.us/gateway/index.html	Digital orthophotos at 1:40,000 scale are available for the Hudson Valley. Also available are satellite imagery, digital elevation models, and other digital spatial data.
aerial photographs, vertical, paper	U.S. Geological Survey	Index and ordering information at USGS website: www.usgs.gov.	This site includes photos that have become available since publication (1994) of the NYSDOT document described below.
aerial photographs, vertical, paper	(various)	Obtain copy of Inventory of Aerial Photography and Other Remotely Sensed Imagery of New York State, from NYS Dept. of Transportation, Albany, NY 12232. Order from sources listed (public and private).	Vertical stereo photos at scales between 1:4800 and 1:40,000, viewed with a stereoscope, are best for predicting habitats.
aerial photographs, oblique, paper	county planning departments	View photos at, and order from county office.	Kinds of photos and availability vary by county.

(continued)

TABLE 19. OBTAINING MAPS, AERIAL PHOTOGRAPHS, AND OTHER DOCUMENTS (cont.)

Document Type	Source	How to Obtain	Notes
Soil Surveys[1]			
County soil survey*	County Soil and Water Conservation District	Call county SWCD office	County soil surveys include soil type descriptions and soil maps.
On-site soil surveys	(rarely available) landowner or developer	Sometimes (but rarely) found in EIS prepared for proposed development project. If so, may be available for viewing at municipal offices.	Most soil maps and descriptions in EISs are from county soil surveys, and are not reliable for site-specific purposes.
Other Documents			
Atlas of Breeding Birds in New York State (Andrle and Carroll 1988)	Cornell University Press	Order at local bookstore.	Distribution and status of breeding birds in New York, based on field surveys conducted 1980–1985.
Ecological Communities of New York State (Reschke 1990)	New York Natural Heritage Program	New York Natural Heritage Program, 700 Troy-Schenectady Road, Latham, NY 12110-2400	Describes and classifies the common and rare ecological communities of New York State.
Flora of the Columbia County Area, New York (McVaugh 1958)	New York State Museum	NYSM Publication Sales, Cultural Education Ctr. Room 3140 Albany, NY 12230 518-402-5344 (ph) 518-486-3696 (fax) www.nysm.nysed.gov	Systematic accounts of the vascular plants of Columbia Co., including keys, and descriptions of physiography, habitats, and communities.
Natural Heritage Program active inventory lists*	New York Natural Heritage Program	New York Natural Heritage Program, 700 Troy-Schenectady Road, Latham, NY 12110-2400. www.dec.state.ny.us/website/dfwmr/heritage	Lists, updated periodically, of rare species and rare natural communities, their known distributions in the state, and rarity status.
New York Metropolitan Flora: Woody Plant Workbook (Clemants 1999)	Brooklyn Botanic Garden	Brooklyn Botanic Garden 1000 Washington Ave. Brooklyn, NY 11225	Distribution of and keys for woody plant species in Putnam, Orange, Rockland, and Westchester cos., NY, as well the counties of Long Island, greater New York City, and northern NJ. (1999 review draft will be updated [see www.bbg.org/research/nmf] and incorporated into the New York Metropolitan Flora.)
NYS Herp Atlas	NYS Department of Environmental Conservation	www.dec.state.ny.us/website/dfwmr/wildlife/herp/index.html	Distribution and status of reptiles and amphibians in the state, based on surveys conducted 1990–1998.
Revised Checklist of New York State Plants (Mitchell and Tucker 1997)	New York State Museum	NYSM Publication Sales, Cultural Education Ctr. Room 3140 Albany, NY 12230 518-402-5344 (ph) 518-486-3696 (fax) www.nysm.nysed.gov	List of vascular plants occurring in New York State, outside of cultivation.
The Wildlife Resources of Westchester County (Wear and Schreiner 1987)	Westchester County Department of Planning	Westchester Co. Dept. of Planning 148 Martine Ave. White Plains, NY 10601	Lists, habitats, and status of reptiles, amphibians, birds, and mammals occurring in Westchester Co.

[1] The New York State GIS Clearinghouse (www.nysgis.state.ny.us) is a group of governmental entities and not-for-profit organizations that have agreed to share their GIS data sets. The current inventory can be viewed on the website. This promises to be an extremely valuable resource for spatial data of all kinds, including those listed in this table, as well as data that are much more site- and region-specific.

TABLE 20. NATURE CLUB PUBLICATIONS

Some nature clubs and associations with publications useful for biodiversity surveys.

Organization	Contact	Publications	Geographic Area
Alan Devoe Bird Club	P.O. Box 20 Chatham, NY 12037	The Warbler	Columbia & southern Rensselaer counties
Capital Region Audubon	PO Box 487 Latham, NY 12110	Wing Beats	Albany County
Federated Conservationists of Westchester County	FCWC Hartford Hall Weschester Community College Valhalla, NY 10595	Westchester Environment	Westchester County
Hudson River Audubon Society (formerly Yonkers Audubon Society)	PO Box 616 Yonkers, NY 10703	Rivertown Naturalist	Westchester County
Hudson River Environmental Society	HRES Hudson River Collection Marist College Library Poughkeepsie, NY	(library collection)	Books, periodicals, reports on the Hudson River as an environment. Catalogue will eventually be available at http://voyager.marist.edu
Hudson River Foundation	40 West 20th Street 9th Floor New York, NY 10011	(library collection)	Library of technical information on the Hudson River estuary, and NYC waterbodies; available to the public by appointment
Hudson-Mohawk Bird Club	c/o Five Rivers Environmental Education Center Game Farm Rd Delmar, NY 12054	Feathers	Eleven counties surrounding Albany
John Burroughs Natural History Society	P.O. Box 206 Stone Ridge, NY 12484	The Chirp	Ulster County
Linnaean Society of New York	15 West 77th St. New York, NY 10024	Linnaean News-Letter	New York City region
The Nature Conservancy, Eastern New York Chapter	(northern office) 200 Broadway, 3rd floor Troy, NY 12180 (southern office) 19 North Moger Ave Mt. Kisco, NY 10549	Eastern New York Chapter Newsletter	Eastern NY, excluding the Adirondacks
New York City Butterfly Club	Don Riepe 28 W 9th Rd Broad Channel, NY 11693 (members.aol.com/pondhawk/mulberry/mulberry.htm)	Mulberry Wing	Southeastern NY and northern NJ (Putnam & Orange counties, NY, south through Monmouth County and to Lakehurst, Ocean County, NJ)
Federation of New York State Bird Clubs	Emanuel Levine 585 Mead Terrace South Hempstead, NY 11550	Kingbird	Statewide

TABLE 20. NATURE CLUB PUBLICATIONS (cont.)

New York Flora Association	c/o NY Biological Survey 3140 CEC Albany, NY 12230	NYFA Newsletter Preliminary Vouchered Atlas of NYS Flora	Statewide
New York Mycological Society	34 South Fairview Paramus, NJ 07652	NYMS Newsletter	Published seasonally. Long Island, northern NJ, and Rockland, Westchester, and Putnam counties.
Northern Catskills Audubon Society	PO Box 68 Palenville, NY 12463	Seed for Thought	Greene County, northern Ulster County, and western Columbia County
Putnam Highlands Audubon Society	c/o Paul Kuznia, President 75 Mountain Laurel Rd Cold Spring, NY 10516	The Putnam Highlands Audubon Newsletter	Putnam County
Ralph T. Waterman Bird Club	Barbara Mansell 354 Allen Rd Salt Point, NY 12578	Wings Over Dutchess	Dutchess County
Rockland Audubon Society	c/o James Prezidi, President 26 Rammler Lane Bardonia, NY 10954	The Observer	Rockland County
Torrey Botanical Society	Journal of the Torrey Botanical Society Publications Office N.Y. Botanical Garden Bronx, NY 10458	Torreya (a section in the Journal of the Torrey Botanical Society)	Western hemisphere, but field trips mostly within 150 km of NYC

(continued)

Appendix 8

Bibliographic Guide to Taxonomic Sources

BIBLIOGRAPHIC GUIDE TO TAXONOMIC SOURCES

GEOLOGY

Cadwell, D.H., ed. 1986. The Wisconsinan Stage of the First Geological District, eastern New York. Bulletin No. 455, New York State Museum, Albany. 192 p.

Cadwell, D.H., ed. 1989. Surficial geologic map of New York. New York State Museum, Map and Chart Series 40, 5 sheets, 1:250,000, 100 ft contour. (The Hudson-Mohawk and Lower Hudson sheets cover the Hudson Valley.)

Fisher, D.W., Y.W. Isachsen and L.V. Rickard. 1970. Geologic map of New York 1970. New York State Museum and Science Service, Map and Chart Series 15, 5 sheets, 1:250,000, 100 ft contour. (The Hudson-Mohawk and Lower Hudson sheets cover the Hudson Valley.)

Isachsen, Y.W., E. Landing, J.M. Lauber, L.V. Rickard, and W.B. Rogers, eds. 2000. Geology of New York: A simplified account. Educational Leaflet No. 28, 2nd ed. New York State Museum/Geological Survey, Albany. 300 p.

Rich, J.L. 1935. Glacial geology of the Catskills. Bulletin 299, New York State Museum, Albany. 180 p.

Ruedemann, R., J.H. Cook, and D.H. Newland. 1942. Geology of the Catskill and Kaaterskill quadrangles. Bulletin 331, New York State Museum, Albany. 251 p. (Hudson to Barrytown.)

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Appendix 9

Published Directories of Naturalists, Biologists, and Ecologists

APPENDIX 9. PUBLISHED DIRECTORIES OF NATURALISTS, BIOLOGISTS, AND ECOLOGISTS

American Institute of Biological Sciences
P.O. Box 27417
Central Station
Washington, D.C. 20038-7417

(Membership Directory and Handbook published every two years)

American Society of Ichthyologists and Herpetologists
P.O. Box 1897
Lawrence, KA 66044-8897
(800) 627-0629 FAX (785) 843-1274

(Membership directory published annually in a supplement to the journal Copeia.)

Ecological Society of America
2010 Massachusetts Ave. NW
Washington, D.C. 20036

(Membership Directory published as annual supplement to the Bulletin of the ESA)

Estuarine Research Foundation
P.O. Box 544
Crownsville, MD 21032-0544

(Directory published every two years as a supplement to the journal Estuaries.)

The Flock
OSNA Services, Allen Press
P.O. Box 1897
Lawrence, KS 66044-8897

(Membership Directory for American Ornithologists' Union, Association of Field Ornithologists, Cooper Ornithological Society and Wilson Ornithological Society)

The Naturalists Directory and Almanac (International)
P.O. Box 382595
Cambridge, MA 02238-2595

(Directory published every few years with annual supplements.)

Society of Wetland Scientists
P.O. Box 189
Lawrence, KS 66044-8897

(Membership Directory and Handbook published annually as supplement to the journal Wetlands)

The Wildlife Society, Inc.
5410 Grosvenor Lane
Bethesda, MD 20814-2197
(301) 897-9770 FAX (301) 530-2471

(Membership Directory and Certification Registry published annually and distributed to members)

Abbreviations

ac	acre (1 ac = 0.4 ha)
ATV	all-terrain vehicle
BRI	Biodiversity Research Institute
Bti	*Bacillus thuringiensis israelensis*
C & D	construction and demolition
C	Celsius
ca	circa
CAC	Conservation Advisory Council
CCC	Civilian Conservation Corps
cm	centimeter (1 cm = 0.39 inch)
dbh	diameter-at-breast-height
DEIS	Draft Environmental Impact Statement
dm	decimeter (1 dm = 3.9 in)
e.g.	for example (*exempli gratia*)
EAF	Environmental Assessment Form
EIS	Environmental Impact Statement
EMC	Environmental Management Council
F	Fahrenheit
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Act
FOIL	Freedom of Information Law
ft	feet (1 ft = 0.3048 m)
FWS	Fish and Wildlife Service
GIS	Geographic Information System
GLIS	Global Land Information Systems
ha	hectare (1 ha = 2.47 ac)
HRNERR	Hudson River National Estuarine Research Reserve
i.e.	that is (*id est*)
in	inch (1 in = 2.54 cm)
IWP	intermittent woodland pool
km	kilometer (1 km = 0.62 mile)
m	meter (1 m = 3.28 feet)
MHW	mean high water
mi	mile (1 mi = 1.61 km)
MLW	mean low water
mm	millimeter (1 mm = 0.039 inch)
NRCS	Natural Resources Conservation Service
NRI	Natural Resource Inventory
NWI	National Wetland Inventory
NYBS	New York Biological Survey
NYCRR	New York Code of Rules and Regulations
NYFA	New York Flora Association
NYGAP	New York Gap Analysis Project
NYGS	New York State Geological Survey
NYNHP	New York Natural Heritage Program
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
NYSDOT	Department of Transportation
NYSM	New York State Museum
OPRHP	New York Office of Parks, Recreation, and Historic Preservation
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PIPC	Palisades Interstate Park Commission
ppt	parts per thousand
RPTO	Real Property Tax Office
SAB	subtidal aquatic beds
SAV	submerged aquatic vegetation
SCS	Soil Conservation Service
SEQR(A)	State Environmental Quality Review (Act)
SFEIS	Supplemental Final Environmental Impact Statement
SWCD	Soil and Water Conservation District
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey