Ecological Communities of New York State

Second Edition

A revised and expanded
edition of Carol Reschke's
Ecological Communities
of New York State

Edited by

Gregory J. Edinger
D. J. Evans
Shane Gebauer
Timothy G. Howard
David M. Hunt
Adele M. Olivero

New York Natural Heritage Program
NYS Department of Environmental Conservation
625 Broadway, 5th Floor
Albany, NY 12233-4757

March 2014

New York State Department of Environmental Conservation
Andrew M. Cuomo, *Governor* Joe Martens, *Commissioner*

The NY Natural Heritage Program is a partnership between the NYS Department of Environmental Conservation and the State University of New York College of Environmental Science and Forestry.

This publication should be cited as:

Edinger, G. J., D. J. Evans, S. Gebauer, T. G. Howard, D. M. Hunt, and A. M. Olivero (editors). 2014. Ecological Communities of New York State. Second Edition. A revised and expanded edition of Carol Reschke's *Ecological Communities of New York State*. New York Natural Heritage Program, New York State Department of Environmental Conservation, Albany, NY.

PREFACE

The first edition of *Ecological Communities of New York State* by Carol Reschke was published in 1990 and quickly became the primary source for community classification in the state. Its success and acceptance by a wide range of users was driven by its lofty goal to be an all-inclusive classification intending to fulfill a long-standing need. From communities as large as Lake Ontario to a room-sized vernal pool, from a 50,000 acre (20,000 ha) beech-maple mesic forest to a 40-acre (16 ha) maritime beech forest, from the highest alpine meadow to the deepest terrestrial cave, the original, and continued, goal of this classification is to include *all* ecological communities of the state, even those created by humans. Since the first edition, several neighboring states and Canadian provinces have published community classifications including Pennsylvania (Fike 1999), Massachusetts (Swain and Kearsly 2000), Vermont (Thompson and Sorenson 2001), New Hampshire (Sperduto and Nichols 2004), Maine (Gawler and Cutko 2010), and Ontario (Chambers *et al.* 1997, Harris *et al.* 1996). During that same time, The Nature Conservancy and the Heritage Network (NatureServe) have made significant progress toward the publication of a national community classification over the last decade (Grossman *et al.* 1998, Sneddon *et al.* 1998). Most of these classifications have benefitted from *Ecological Communities of New York State*, a few are modeled after it, and nearly all of them refer to Reschke (1990). While all of these classifications are impressive works in their own right, and are referred to in this publication, none are intended to be as all inclusive as this classification is for New York State. Some classifications exclude aquatic communities (*e.g.,* riverine and lacustrine), and some exclude subterranean communities. Others may focus on one system, such as wetlands or forests while excluding other systems. Most of the other classifications exclude fauna from their descriptions. And despite the prevalence of human land use in the northeast, *Ecological Communities of New York State* remains the only classification that includes a comprehensive treatment of cultural communities along with the natural types. This allows users of this classification to describe and map nearly any ecological community encountered in the state.

Although this edition includes over two dozen new communities, and revised descriptions for most of the previously described communities, it is impressive to see how much of the first edition remains unchanged. This attests to the fact that *Ecological Communities of New York State* was thoroughly researched and ahead of its time. The New York Natural Heritage Program was very fortunate to have a published classification to build upon, and to collect data on individual occurrences. In 1989 there were only 480 community occurrences covering fewer than 100,000 acres (40,500 ha) in the NY Natural Heritage database, today there are over 1,800 occurrences totaling 3.5 million acres (1.4 million ha)! Together with our partners we continue to amass data to further refine our classification and describe new communities. As stated in the first edition, "this classification is our current working hypothesis; it will be refined as new data obtained from field surveys and literature review become available." We have reached a time when the amount of additions and changes to the 1990 classification warranted the publication of this second edition. This edition retains much of the content and format of the original, and although there are a few noticeable changes, we have decided not to do a complete overhaul of the classification. Excellent ideas for improvement, such as the inclusion of photographs, distribution maps, and cross-walks to other classifications will likely be included in future editions.

Both editions of *Ecological Communities of New York State* are available online via the NYS DEC website (http://www.dec.ny.gov/animals/29384.html). Check the NY Natural Heritage web page for the latest information about the program and our classification (http://www.dec.ny.gov/animals/29338.html). NY Natural Heritage natural community Conservation Guides are posted online as well (http://www.acris.nynhp.org/communities.php). The guides include digital photographs, statewide distribution maps, vegetation coverage data, cross-references to other classifications, and more. Please send suggestions for improvement of this classification and ideas on what to include in the future to the NY Natural Heritage chief ecologist. No matter what technological means are used to present the information in the future, the descriptions and the classification will be based on the strong foundations of these earlier editions and the network of dedicated ecologists, botanists, and zoologists.

Lastly, this classification system has proven to be a very valuable tool to a wide array of conservation practitioners and land managers in New York. By using this classification to identify locations of high quality natural communities across the state we have raised awareness of their biodiversity significance. In addition, many of the occurrences identified by NY Natural Heritage, and our partners, have resulted in their protection, ensuring that a good portion of New York's natural heritage will persist for future generations to enjoy, study, and appreciate.

Greg Edinger, Chief Ecologist
NY Natural Heritage Program

ACKNOWLEDGEMENTS
for the 2014 edition

Karl Anderson
Richard Andrus
Spider Barbour
Nancy Barkan
Michael S. Batcher
John Bierhorst
Betsy Blair
Orland Blanchard
Jennie Braden
Alvin Breisch
Shereen Brock*
Warren Broderick
William P. Brown
Bernard Carr
Andrea Chaloux*
Nicholas Conrad*
Douglas Carlson
Andrew Corby
Michael Corey
Jeff Corser*
Scott Crocoll
Nancy Davis-Ricci*
Robert Dirig
Thom Engel
D. J. Evans*
Don Faber-Langendoen
Aissa Feldmann*
Andy Finton*
Wayne Gall
Jennifer Garrett
Sue Gawler
Shane Gebauer*
Evelyn Greene
Andrew M. Greller
Jeff Herter
Elizabeth Hill
Timothy G. Howard*
David M. Hunt*
Jesse Jaycox*
Jerry Jenkins
Anne Johnson
Elizabeth A. Johnson
Marilyn Jordan
Betty Ketcham*
Erik Kiviat
Frank Knight
Heidi Krahling*
Michael Kudish
David Künstler
Eric Lamont
Julie Lundgren*
Lauren Lyons-Swift*
Dana MacDonald*
Teresa Mackey*
John Maerz
Christopher Mangels
Patricia Martin
Philip W. May
Joseph M. McMullen
Daniel Morris
Stephanie Neid
Chuck Neider
Margaret Novak*
Paul Novak*
Rachel Novak*
Leonard Ollivett
Rebecca Quail
Norbert Quenzar Jr.
Gerald Rasmussen
Carol Reschke*
Wayne Richter
Richard Ring*
Ron Rozsa
Paul Rutledge
Tara Salerno*
Matthew Schlesinger*
John Schmid*
Kathryn Schneider*
Edith F. Schrot
Frederick C. Sechler, Jr.*
Hollie Shaw*
Nancy Slack
Charles R. Smith
Kim Smith*
Daniel M. Spada
Elizabeth Spencer*
Lisa St. Hilaire
David Strayer
Patricia Swain
Edwin Sykes
Timothy Tear
James Vanderhorst
David VanLuven*
Troy Weldy*
Erin White*
Stephen M. Young*
Robert E. Zaremba*
Leslie Zucker

*current/former NY Natural Heritage Program staff

ACKNOWLEDGEMENTS
for the 1990 edition

The New York Natural Heritage Program is supported by funds from the New York State Department of Environmental Conservation (NYS DEC) and The Nature Conservancy. Within DEC, funding comes from the Division of Fish and Wildlife and the Division of Lands and Forests. NY Natural Heritage is partly supported by funds contributed by state taxpayers through the voluntary Return a Gift to Wildlife program. NY Natural Heritage has received funding for community inventory work from the Adirondack Council, the Hudson River Foundation, the Sussman Foundation, the National Park Service, US Forest Service (Finger Lakes National Forest), and each of the seven New York chapters of The Nature Conservancy (Adirondack Nature Conservancy, Eastern New York Chapter, Central New York Chapter, Long Island Chapter, Lower Hudson Chapter, South Fork/Shelter Island Chapter, and Western New York Chapter).

This classification has been developed in part from data collected by numerous field biologists. Some of these contributors have worked under contract to NY Natural Heritage, including Caryl DeVries, Brian Fitzgerald, Jerry Jenkins, Al Schotz, Edith Schrot, Paul Sherwood, Nancy Slack, Dan Smith, Gordon Tucker, and F. Robert Wesley. Present and former NY Natural Heritage staff who have contributed a significant portion of field data include Peter Zika, Robert E. Zaremba, Lauren Lyons-Swift, Steven Clemants, and the author. Chris Nadareski helped compile long species lists for many communities by entering data from field survey forms into computer files. Robert E. Zaremba provided preliminary draft descriptions of several estuarine intertidal and open upland communities; Raymond Curran provided a draft description of boreal heath barrens. John Ozard provided reliable assistance in resolving computer problems during the preparation of this manuscript, and he produced the county map. The staff of the New York State Museum's Biological Survey has been very helpful in identifying specimens of plants and animals collected during field surveys.

Earlier drafts of this classification have been reviewed by biologists from the Department of Environmental Conservation, Adirondack Park Agency, the Department of State's Coastal Zone Management Program, The Nature Conservancy, private environmental consulting firms, and from several academic institutions in New York State. Any remaining errors or omissions are the responsibility of the author. Thanks to Walt Sabin and Peter Zika for proofreading the final drafts of this manuscript, and to Frank Orsini for designing the cover. Thanks to all the people who reviewed and commented on various drafts of this manuscript, made suggestions regarding classification of communities, and provided a lot of encouragement, including:

Wint Aldrich
Richard Andrus
Robert H. Bathrick
Barbara Bedford
John M. Bernard
Michael J. Birmingham
Paul Bishop
Elizabeth Blair
Leigh Blake
Alvin Breisch
Lawrence P. Brown
Janet Carroll
Lee Chamberlaine
Kim Chapman
James S. Clark
Steven E. Clemants
Chad Covey
Scott Crocoll
Raymond Curran
Anton Damman
Robert Daniels
Nate Dickinson
Robert Dirig
Steven W. Eaton
Brian Fitzgerald
Eric Fried
Jean Gawalt
Frederick Gerty
Bruce Gilman
James Glidden
Scott Gray
Andrew Greller
Bradley Griffin
Dennis Grossman
Tom Hart
Robert Henshaw
Joel Hermes
David Hunt
Paul Huth
Jerry Jenkins
Arthur Johnsen
Eric Karlin
Edwin Ketchledge
Erik Kiviat
Harold Knoch
Michael Kudish
Donald J. Leopold
Gary Lovett
John Madsen
Peter Marks
Michael J. Matthews
Eugene McCaffrey
Joseph McMullen
Patricia Mehlhop-Cifelli
Robert L. Miller
Charles L. Mohler
Terry Moore
Jack Moser
Paul Novak
John O'Pezio
David Odell
John W. Ozard
Steward T. A. Pickett
Richard Preall
Gerald Rasmussen
Tom Rawinski
John Renkavinsky
Walt Sabin
Kathryn Schneider
Rebecca Schneider
Edith Schrot
Dale Schweitzer
Franz Seischab
Timothy J. Sinnott
Nancy Slack
C. Lavette Smith
Daniel Spada
Margaret Stewart
Lawrence E. Strait
Bryan Swift
Elizabeth Thompson
John Titus
F. Robert Wesley
John White
Kenneth F. Wich
Robert E. Zaremba
Peter Zika

OBJECTIVES

The primary objective of this report is to classify and describe ecological communities representing the full array of biological diversity of New York State. An ecological community is a variable assemblage of interacting plant and animal populations that share a common environment. As part of the New York Natural Heritage Program inventory, this classification has been developed to help assess and protect the biological diversity of the state. NY Natural Heritage inventory work allows us to maintain a regularly updated database of information on rare animals, rare plants, and significant natural communities of New York State. This inventory also provides a ranking system for determining priorities for conservation and management of New York State's significant natural areas.

The Coarse Filter/Fine Filter Approach

NY Natural Heritage inventory methodology works by focusing on the identification, documentation, and mapping of all occurrences of rare species and significant ecological communities. A "coarse filter/fine filter" approach is used to identify and prioritize the protection of these significant biological resources. Ecological communities represent a "coarse filter," an analysis of biodiversity at a larger scale than the species level. Their identification and documentation can be used to describe whole assemblages of plant and animal species, both common and rare. The conservation of high quality examples of the natural communities assures the protection of most of the species that make up the biological diversity of the state. Rare animals and plants often have narrow, or unusual, habitat requirements. These species may "fall through" the coarse filter, and are sometimes not protected in the representative communities. Identifying and documenting viable populations of each of the rare species serves as the "fine filter" for protecting the state's biological diversity. This coarse filter/fine filter approach to a natural resources inventory is an efficient means of identifying the most sensitive animals, plants, and communities of an area.

Developing and refining a classification of communities is an essential step in the NY Natural Heritage inventory process. The inventory requires a classification of discrete community types because these types are used as mapping units, and because the types are assigned ranks that establish priorities for conducting the inventory. This second edition represents the first major revision to Carol Reschke's *Ecological Communities of New York State* published in 1990.

APPLICATIONS

In addition to serving as the framework for the NY Natural Heritage inventory of significant natural communities in New York State, this community classification is designed to meet a variety of needs. The classification provides natural resource managers with a standard set of terms and concepts to describe wildlife habitats, and it also provides mapping units to use in plans for managing public and private natural areas such as forest preserves, wildlife management areas, parks, and nature preserves. The classification can be used to identify ecological communities for environmental impact statements and other forms of environmental review. In combination with NY Natural Heritage ranking system, the classification can be used to establish priorities for land acquisition by public agencies and private conservation organizations. Programs for long-term monitoring of environmental change can use the classification to guide the selection of monitoring sites. The classification and community descriptions provide a general survey useful to students of the natural history of New York State.

COMMUNITY CONCEPTS

In this classification a community is defined as a variable assemblage of interacting plant and animal populations that share a common environment. Most communities occur repeatedly in the landscape. The plants and animals in a community occupy a habitat, often modifying the habitat. For example, the canopy trees in a hemlock-northern hardwood forest shade the ground and keep the forest floor cool and dark, a large white-tailed deer population can modify the structure of a forest community by browsing the understory shrubs and saplings, and beavers can modify a stream corridor by damming the stream and flooding the surrounding habitats.

No two examples of a community are identical in composition or environment; however, they are similar within a given range of variability. The range of variability of each community (or the percent similarity between different examples of a community) is not defined quantitatively in this classification. Some communities are narrowly defined. Different examples of a narrowly defined community, such as alpine krummholz, will be very similar. Other communities are more broadly defined, such as shrub swamp. The more broadly defined community types provide a catch-all category for communities that are quite variable.

Ecological communities form a complex mosaic in the landscape; they change through time, and they intergrade spatially and temporally. This classification is an attempt to establish a set of discrete categories into which units of the

intergrading landscape mosaic can be sorted and organized. The classification is an artificial construct, and the community types are intended to be conceptually discrete, non-overlapping entities. For the purpose of organizing an inventory of ecological communities, artificial boundaries between communities have been drawn across the continuous ecological gradients that occur in the real landscape. For example, near the summits of the Adirondack Mountains there is a continuous change in communities along an elevation gradient. On many mountains at an elevation of 3,000 feet there is a mountain fir forest, a forest dominated by balsam fir trees. At higher elevations the trees become stunted and deformed, and they form dense thickets; this community, at an elevation of 4,000 feet, is alpine krummholz. On the summits of the highest peaks, at elevations above timberline (about 4,900 feet), is an alpine meadow community. The change from mountain fir forest to alpine krummholz to alpine meadow is a gradual transition on the mountain slopes. In order to conduct an inventory and map occurrences, artificial boundaries between these communities are defined, with the recognition that in the landscape the transitions are often not so distinct.

Communities can be described at many scales, ranging from a fine scale "microcosm" (such as the plankton in a drop of pond water) to a large scale "biome" (such as the eastern deciduous forest). An important consideration in the development of this classification has been to distinguish communities at a scale that is appropriate for statewide inventory work (*e.g.*, visible on USGS 7.5 minute topographic maps), yet compatible with community classifications developed by other Heritage programs in the eastern US

ORGANIZATION

The classification is organized by "systems," and each system is composed of two to five "subsystems." Within each subsystem are many community types. System, subsystem, and community descriptions are included in the text. There are seven systems: marine, estuarine, riverine, lacustrine, palustrine, terrestrial, and subterranean. Marine and estuarine systems are divided into subtidal and intertidal subsystems. The palustrine system is divided into open mineral soil wetlands, forested mineral soil wetlands, open peatlands, and forested peatlands. The terrestrial system is divided into open uplands, barrens and woodlands, and forested uplands. The riverine, lacustrine, and subterranean sytems do not have natural subsystems. An additional subsystem, cultural, is included in each system. Definitions of the systems and subsystems are adapted from the US Fish and Wildlife Service wetland classification (Cowardin *et al.* 1979), and a US Department of Agriculture ecological land classification (Driscoll *et al.* 1984).

The communities classified as cultural are created, or maintained, by human activities, or they are modified by human influence to such a degree, that the physical conformation of the land, or the biological composition of the resident community, is significantly different from the character of the land or community prior to modern human influence. Most, if not all, "natural" communities are to some degree exposed to the influence of civilization in the form of acidic deposition, air and groundwater pollution, logging, fire suppression and ignition, road construction, and so forth. There is a continuous gradient of human-influenced disturbances between "natural" and "cultural" communities. The decision to classify an intermediate community as cultural is based on its biological composition (such as presence of non-native species) and its lack of similarity to communities less disturbed by human activities. Rather than emphasizing land use in the classification of cultural communities, the intention is to emphasize biological composition and environmental features. For practical reasons, NY Natural Heritage does very little field work on cultural communities, and occurrences are not mapped, or documented, in the NY Natural Heritage database.

The communities in this classification are intended to include all the resident organisms, including everything from earthworms, bacteria, and fungi to shrubs and trees in a forest, or everything from plankton to fishes, and aquatic macrophytes in aquatic systems. In each system, certain groups of organisms and environmental features are used as an index to habitat conditions. The primary group of organisms and the main environmental characteristics used to describe and distinguish communities within each system are listed in Table 1.

The communities in this classification are distinguished by physiognomy, composition of resident organisms, and ecological processes. The descriptions include *dominant* species (species with the greatest abundance or percent cover), *codominant* species (species with relatively high abundance or percent cover), and *characteristic* species (species that are commonly found in the community, although not necessarily abundant). Species are listed in descending order of dominance when known. The community descriptions are derived from a review of literature sources, species lists compiled from both qualitative and quantitative field surveys conducted by NY Natural Heritage biologists, and in some cases, either from interviews with biologists studying communities, or from reviewers' comments.

Table 1. Organisms and environmental characteristics used to describe communities within systems.

System	Group of organisms	Environmental characteristics
marine	fauna (fishes, invertebrates)	tidal regime, substrate
estuarine	vegetation	tidal regime, salinity, substrate
riverine	fauna (fishes)	watershed position, stream flow
lacustrine	fauna (fishes, invertebrates)	trophic state, stratification, morphometry, water chemistry
palustrine	vegetation	substrate, hydrologic regime
terrestrial	vegetation	substrate, disturbance regime
subterranean	fauna (bats, invertebrates)	hydrology, geological structure

The species lists are presented as a representative sample. An individual occurrence of a community may not include all the species listed in the description, and the description includes only a very small proportion of all the species that may be present in a community. Some descriptions also include a brief discussion of ecologically important environmental characteristics (*e.g.*, geology, soils, and hydrology) and disturbance patterns (*e.g.*, flood regime, fire regime) that distinguish the community. For certain communities a more detailed description is provided than for other communities. In most cases, the communities with more detailed descriptions have been the focus of NY Natural Heritage inventory work; in some cases these communities are not well-documented in the literature, or are described from New York State for the first time. Comments in the descriptions about variability of communities and relationships between communities are qualitative observations; evaluation of these observations will require quantitative sampling and analysis, especially for fauna.

Following each community description is a brief summary of the distribution of the community in New York State, and the state rank and estimated global rank currently assigned by NY Natural Heritage. The statewide distribution of each community is described in terms of "ecozones" or ecological zones of New York State. These ecozones were described by Dickinson (1979) and Will *et al.* (1979), and later adapted by John Ozard of the NYS DEC. NY Natural Heritage further aggregated the northern NY subzones into the Tug Hill Plateau, St. Lawrence Valley, Lake Champlain, and Adirondacks ecozones. A map of these ecozones and Bailey's Ecoregions modified by The Nature Consrvancy is provided on the inside of the back cover.

Community Rarity and Vulnerability (Global Rank and State Rank)

The NY Natural Heritage statewide inventory efforts revolve around lists of rare species and all types of natural communities known to occur, or to have historically occurred, in the state. These lists are based on a variety of sources including museum collections, scientific literature, information from state and local government agencies, regional and local experts and data from neighboring states.

Each natural community is assigned a rank based on its rarity and vulnerability. Like all state heritage programs, the NY Natural Heritage ranking system assesses rarity at two geographic scales. Each community is assigned a global rank and a state rank. The global rank reflects the rarity of the community throughout its range, whereas the state rank indicates its rarity within New York State. Both of these ranks are usually based on the range of the community, the number of occurrences, the viability of the occurrences, and the vulnerability of the community around the globe or across the state. As new data become available, the ranks may be revised to reflect the most current information. See Appendix A for definitions of global and state ranks used in this classification.

Community Occurrence Quality

Community occurrences are assigned ranks based on quality and are evaluated within the context of the known, or hypothesized, distribution of that particular community. Several ecological and spatial factors must be considered when determining the element occurrence rank of a community. These include the occurrence size, maturity, evidence and degree of unnatural disturbance, continued existence of important ecological processes, overall landscape context, and existing and potential threats. Community occurrences assigned a rank of "A" are among the largest and highest quality of their type. These community occurrences should be large enough to provide reasonable assurance for long-term viability of component ecological processes. They are essentially undisturbed by humans, or have nearly recovered from past human disturbance, typically exhibiting little or no unnatural fragmentation. Non-native or particularly invasive native species are usually lacking in high quality community

occurrences, or, if present, are observed at very low levels.

There are three rank factors, each reflecting what is currently known (in an ideal situation) about an occurrence: size, condition, and landscape context. These factors are used as a basis for estimating the viability of an occurrence (*i.e.*, its element occurrence rank. Thus:

Size + Condition + Landscape Context ⇨
Estimated Viability ≈ EO Rank

Occurrence **size** varies as a function of both natural and anthropogenic factors. Larger occurrences are generally presumed to be more valuable for conservation purposes, all other rank factors being equal. Larger occurrences are typically less influenced by edge effects, and less susceptible to degradation or extirpation by stochastic events. Larger occurrences are generally more stable and resilient.

Condition is an integrated measure of the quality of biotic and abiotic factors, structures, and processes *within* the occurrence, and the degree to which they affect the continued existence of the occurrence.

Landscape context is an integrated measure of the quality of biotic and abiotic factors, structures, and processes *surrounding* the occurrence, and the degree to which they affect the continued existence of the occurrence.

These factors helped determine an element occurrence rank which ranges from "A" for an outstanding or pristine example to "D" for a poor quality or degraded example (Table 2).

Table 2. Explanation of element occurrence quality ranks used in NY Natural Heritage database reports.

A	EXCELLENT
B	GOOD
C	MARGINAL
D	POOR
E	EXTANT
F	FAILED TO FIND. Not found at the previously documented site, or more thorough searching needed.
H	HISTORICAL. No recent field information.
X	EXTIRPATED. Believed to no longer exist.

Significant Natural Community Occurrences

"Significant" natural communities are determined using occurrence quality ranks in conjunction with global and state rarity ranks (Table 3). In this way, communities are documented and mapped in the NY Natural Heritage databases if they are either rare in New York State, or are an outstanding example of a more common natural community. For example, all occurrences of very rare communities, such as wet alvar grassland are considered significant, whereas only the high quality occurrences of common communities, such as beech-maple mesic forest are considered significant. Cultural communities are not tracked by NY Natural Heritage.

Table 3. Criteria used by NY Natural Heritage to determine significant communities.

Element Rarity Rank	Element Occurrence Rank
G1, G2 or S1	all occurrences ranked A-D
G3 or S2	all occurrences ranked A-C
G3G4 or S3	all occurrences ranked A-BC
G4, G5 or S4, S5	all occurrences ranked A-B

For most communities, examples are provided and sources of data are listed. Examples are selected from sites documented either in the NY Natural Heritage database or in the listed sources. Each example is given as a site and county in which a good example of the community is present; a map of the counties of New York State is provided following the Index. A single site may include examples of several different communities. Sources are either literature cited in References, or unpublished data collected by NY Natural Heritage and cited as "NYNHP field surveys."

Community names simply provide a label for each community type; the names are not intended to identify all of the dominant or characteristic species, or all the significant environmental qualities. Number codes could be used instead of names, but codes are not as easy to remember, nor as meaningful. In some cases the community name includes dominant species (such as black spruce-tamarack bog). Some names include physiographic provinces to which the community is more or less restricted (such as coastal plain pond shore). Some names include adjectives denoting floristic affinities of the characteristic species (such as alpine meadow or boreal heath barrens).

In a few cases the term "Appalachian" is used in this classification to refer to a community with floristic affinities to the so-called "Alleghenian floristic element" (Curtis 1959, Eaton and Schrot 1987), which refers to a group of species centered in the Cumberland and Great Smoky Mountains of the southern Appalachians. The term "Allegheny" is here reserved for the unglaciated portion of the Appalachian Plateau in Cattaraugus County in and around Allegany State Park and the Allegheny River (note the two different spellings). This area is within the Allegheny Hills subzone within the Appalachian

Plateau ecozone. The terms "Appalachian" and "Allegheny" are used by different authors to refer to the same geographic area. In this classification "Appalachian" is used in a broad sense to refer to the Appalachian highlands that extend from Quebec to Georgia. "Allegheny" is used in a narrow sense to refer to a specific portion of the Appalachian Plateau.

Plant nomenclature used in the community descriptions primarily follows Mitchell and Tucker (1997) for vascular plants; current synonyms for vascular plants follow the New York Flora Atlas (Weldy and Werier 2010). Nonvascular plant nomenclature follows the Missouri Botanical Garden's Tropicos (2010) and the Bryophyte Flora of North America (FNA Editorial Committee 2010) for mosses and liverworts and Hinds and Hinds (2007) for lichens. Animal nomenclature follows C. L. Smith (1985) for fishes; American Ornithologist's Union (1983) for birds; Collins *et al.* (1982) for reptiles; Frost (1985) for amphibians; Honacki *et al.* (1982) for mammals; Miller and Brown (1981) for butterflies; and Hodges *et al.* (1983) for moths. Nomenclature for any other species in a community description is taken from one of the references listed under "Sources" for that community.

HOW TO USE THIS CLASSIFICATION

This classification is designed to be used by biologists to identify communities in the field. It can also be used to identify communities from written descriptions of a site, if enough information on composition and structure is provided in the description. The first step in identifying an unknown community is to determine the system and subsystem. A dichotomous key to systems and subsystems is provided in Appendix C, with instructions on how to use the key to determine system and subsystem. For an explanation of unfamiliar terms, a glossary is provided in Appendix B. Once the system and subsystem are known, then the descriptions in the appropriate section of the text can be reviewed. As a shortcut, you can review the communities listed in the Contents under the appropriate subsystem, and select a few communities that seem most closely related to the site you are trying to identify. The order of the communities in each subsystem reflects environmental and geographical gradients, so that similar communities within a subsystem are usually grouped in the list. Finally, read the descriptions to determine which community type best fits the unknown community. In some cases a site will be equally similar to two different community types; these sites are best described as intermediate between the two most similar community types.

The classification can be used in combination with the NY Natural Heritage ranking system to help make natural resource management decisions. As an example, consider the process of making decisions regarding wildlife management in a natural area. The interactions between wildlife and their habitat can have both positive and negative effects on communities. For example, beaver flooding may increase waterfowl habitat, while at the same time decreasing adjacent wetland or upland habitats for other species. Some types of rare peatlands are vulnerable to flooding by beavers. The costs and benefits of these kinds of modifications need to be weighed in making management decisions. The manager may wish to consider the rarity or significance of a community in the process of evaluating the effects of wildlife on an ecosystem.

This classification of ecological communities is flexible and open to future modifications. New communities can be added as they are discovered, and previously described or designated communities can be changed, divided, or combined as new information becomes available. This classification is our current working hypothesis; it will be refined as new data obtained from field surveys and literature review become available. The NY Natural Heritage welcomes feedback from users of this classification; please send comments or data to the attention of the Chief Ecologist at the following address:

New York Natural Heritage Program
NYS Department of Environmental Conservation
625 Broadway, 5th Floor
Albany, NY 12233-4757.

http://www. nynhp. org

I. MARINE SYSTEM

The marine system consists of open ocean overlying the continental shelf, the associated coastline that is exposed to wind and waves, and shallow coastal bays that are saline because they lack significant freshwater inflow. The limits extend from mean high water seaward, beyond the limits of rooted vascular vegetation. Salinity usually exceeds 30 parts per thousand (ppt) ocean-derived salts, with little or no dilution except outside the mouths of estuaries (Cowardin *et al.* 1979) where it can range as low as 18 ppt in New York.

A. MARINE SUBTIDAL

This subsystem includes the area below the lowest tide that is permanently flooded with tidal water.

1. Marine deepwater community: a broadly-defined community that includes both quiet and rough waters of the open ocean below the lowest tide level and beyond the seaward limits of rooted vascular vegetation. This community includes all *benthic* substrate types (ranging from rock bottom to unconsolidated bottom), as well as the overlying water column or *pelagic* component.

Fish typical of the nearshore zone of the Atlantic Ocean include Atlantic menhaden (*Brevoorita tyrannus*), weakfish (*Cynoscion regalis*), striped bass (*Morone saxatilis*), winter flounder (*Pleuronectes americanus*), summer flounder (*Paralichthys dentatus*), bluefish (*Pomatomus saltatrix*), tautog (*Tautoga onitis*), Atlantic mackerel (*Scomber scombrus*), black sea bass (*Centropristis striata*), Atlantic croaker (*Micropogonias undulatus*), northern kingfish (*Menticirrhus saxatilis*), spot (*Leiostomas xanthurus*), American sandlance (*Ammodytes americanus*), and silversides (*Menidia menidia*) (US Fish and Wildlife Service 1996).

Large quantities of surf clam (*Spisula solidissima*) inhabit the nearshore benthos. Marine sea turtles that use the nearshore zone during migration include Atlantic (Kemp's) ridley turtle (*Lepidochelys kempii*), leatherback (*Dermochelys coriacea*), green (*Chelonia mydas*), and loggerhead sea turtles (*Caretta caretta*) (US Fish and Wildlife Service 1996).

The nearshore zone provides winter habitat for harbor seal (*Phoca vitulina*) and gray seal (*Halichoerus grypus*). Other frequently observed marine mammals include finback (*Balaenoptera physalus*), minke (*B. acutorostrata*), and humpback (*Megaptera novaeangliae*) whales (US Fish and Wildlife Service 1996). A rare mammal that was historically more common in New York's ocean waters is the northern right whale (*Eubalaena glacialis*) (D. Küntsler *pers. comm.*).

Several dolphin species, including common (*Delphinus delphis*), bottle-nosed (*Tursiops truncatus*), white-sided (*Lagenorhynchus acutus*), and striped (*Stenella coerulealba*), as well as pilot whales (*Globicephala melaena*), are often encountered (US Fish and Wildlife Service 1996).

Ocean quahog (*Artica islandica*) is the dominant species in the deeper silty-sand area, and other dominant taxa include echinoderms, annelids, and arthropods (US Fish and Wildlife Service 1996).

Distribution: in the open ocean surrounding Long Island and Staten Island, in the Coastal Lowlands ecozone.

Rank: G5 S5 *Revised:* 2001

Examples: Atlantic Ocean; Peconic Bay, Long Island Sound.

Sources: Brown 1993; Cowardin *et al.* 1979; US Fish and Wildlife Service 1996; Waller 1996.

2. Marine eelgrass meadow: a community of subtidal aquatic beds dominated or codominated by eelgrass (*Zostera marina*) and typically occurring in quiet shallow polyhaline (18 to 30 ppt salinity) waters of temperate tidal embayments below the lowest tide level where fluctuations in salinity are minor.

Characteristic associated plants include a diverse array of attached (rooted and epiphytic) and unattached (suspended) marine algae. Rooted red algae are especially common including graceful red weed (*Gracilaria tikvahiae*), tubed weed (*Polysiphonia denudata*), Grinnell's pink leaf (*Grinnellia americana*), Agardh's red weed (*Agardhiella subulata*), *Rhodomela confervoides*, pod weed (*Chondria baileyana*), *Spyridia filamentosa*, banded weed (*Ceramium* spp.), and rough tangle weed (*Stilophora rhizoides*). Abundant and characteristic epiphytic marine algae include barrel weed (*Champia parvula*), tubed weed (*Polysiphonia stricta*), *Cladophora sericea*, and *Pneophyllum fragile*. Other associated marine algae include the green algae sea lettuce (*Ulva lactuca*), hollow green weed (*Enteromorpha* spp.), *Cladophora gracilis*, and the brown algae gulfweed (*Sargassum filipendula*). A common non-native species is the marine green algae, green fleece (*Codium fragile*).

Characteristic fauna include fish, such as fourspine stickleback (*Apeltes quadracus*), mummichog (*Fundulus heteroclitus*), northern pipefish (*Syngnathus fuscus*), threespine stickleback (*Gasterosteus aculeatus*), silversides (*Menidia* spp.),

naked goby (*Gobiosoma bosci*), menhaden (*Brevoortia tyrannus*), winter flounder (*Pseudopleuronectes americanus*), and northern puffer (*Sphoeroides maculatus*); marine mollusks, such as bay scallop (*Aequipecten irradians*), common Atlantic slippershell (*Crepidula fornicata*), and northern quahog (*Mercenaria mercenaria*); crustaceans, such as nine-spine spider crab (*Libinia emarginata*), mud crabs (*e.g., Dyspanopeus sayi, Panopeus herbstii* and *Rithropanopeus harrisii*), broken-back shrimp (*Hippolyte pleurocantha*); and other marine invertebrates, such as short-spine brittle star (*Ophioderma brevispina*), bamboo worms (Polychaeta), and counterclockwise coiled worm (*Spirobis spirillum*). Comb jellies (*Beroe* spp., *Mnemiopsis leidyi*) are common plankton species. Waterfowl known to extensively feed on eelgrass include brant (*Branta bernicla*) and American black duck (*Anas rubripes*) (Good *et al.* 1978). Plant species composition is known to vary with different rates of exchange with marine waters. As salinity decreases, eelgrass meadows may grade into brackish subtidal aquatic beds dominated by widgeon grass (*Ruppia maritima*) (Macomber and Allen 1979). Eelgrass meadows are highly productive, provide habitat for a rich variety of marine organisms, and enhance sediment stability. They typically occur on sands to sandy loam soils at 0.6 to 4.5 m (2 to 15 ft) below mean sea level.

More data on other marine shallow water communities with very little or no eelgrass are needed (*e.g.*, marine macroalgae beds).

Distribution: in the ocean surrounding Long Island, in the Coastal Lowlands ecozone. Known from the outer Peconic Estuary and multiple bays on the south shore of Long Island including Great South Bay and Shinnecock Bay. Small occurrences are suspected from bays on Staten Island and along the north shore of Long Island bordering Long Island Sound.

Rank: G5 S3 *Revised:* 2001

Examples: Gardiners Bay Shelter Island, Suffolk County; Gardiners Island East Shore, Suffolk County; Shinnecock Bay, Suffolk County; Great South Bay, Suffolk County.

Sources: Briggs and O'Connor 1971; Brown 1993; Cashin Associates, P. C. 1996; Dumais and Smith 1999; Hunt 2000; Good *et al.* 1978; Macomber and Allen 1979; Muenscher 1939; Strieb *et al.* 1995; Thayer *et al.* 1984; Thorne-Miller *et al.* 1983; NYNHP field surveys.

B. MARINE INTERTIDAL

This subsystem includes the area between the highest tide level and the lowest tide level; the substrate is periodically exposed and flooded by semidiurnal tides (two high tides and two low tides per tidal day).

1. Marine intertidal mudflats: a community of quiet waters, with substrates composed of silt or sand that is rich in organic matter and poorly drained at low tide. The substrate may be covered with algae, such as sea lettuce (*Ulva lactuca*).

Characteristic mudflat organisms include polychaetes (*Polydora ligni, Streblospio benedicti, Nereis virens, Lumbrinereis tenuis*, and *Heteromastus filiformis*), mudsnail (*Ilyanassa obsoleta*), softshell clam (*Mya arenaria*), and blue mussel (*Mytilus edulis*). This community is an important feeding ground for shorebirds, such as American oystercatcher (*Haematopus palliatus*) and willet (*Catoptrophorus semipalmatus*).

Distribution: along the seacoast of the Coastal Lowlands and Manhattan Hills ecozones.

Rank: G5 S3S4 *Revised:* 1990

Examples: Jamaica Bay, Kings County and Queens County.

Sources: Brown 1993; Townes 1939; Whitlatch 1982.

2. Marine intertidal gravel/sand beach: a community washed by rough, high-energy waves, with sand or gravel substrates that are well-drained at low tide. These areas are subject to high fluctuations in salinity and moisture, but generally the sand is noticeably wetter than the adjacent maritime beach sand. A relatively low diversity community, it is perhaps best characterized by the benthic invertebrate fauna including polychaetes (*Spiophanes bombyx, Pygospio elegans, Clymenella torquata, Scoloplos fragilis, Nephtys incisa*), amphipods (*Protohaustorius deichmannae, Acanthohaustorius millsi*), and mole crabs (*Emerita* spp.). This community provides feeding grounds for migrant shorebirds, such as sanderling (*Calidris alba*) and semipalmated plover (*Charadrius semipalmatus*), and breeding shorebirds, such as piping plover (*Charadrius melodus*).

Distribution: along the seacoast of the Coastal Lowlands and Manhattan Hills ecozones.

Rank: G5 S3 *Revised:* 2009

Examples: Mashomack Preserve, Suffolk County; Jones Beach, Nassau County; Fire Island, Suffolk County; Montauk Point, Suffolk County.

Sources: Brown 1993; Townes 1939; Whitlatch 1982.

3. Marine rocky intertidal: a community inhabiting rocky shores that are washed by rough, high-energy ocean waves. Characteristic organisms are attached marine algae, mussels, sea stars, urchins, and barnacles that can withstand the impact of the waves and periodic desiccation. Examples of this community in New York typically have gently sloping rocky shores comprised of boulders (0.25 to 3 m diameter) and/or cobbles (6.4 to 25 cm). Bedrock outcrops may be present in a few examples, but not to the extent, or as steep, as those described in other New England states, such as Maine (Brown 1993). The community is typically rich in species. Attached organisms (marine algae and marine invertebrates) cover usually more than 60% of the substrate, especially at the lower intertidal zone.

Characteristic marine algae attached to the rocks include knotted wrack (*Ascophyllum nodosum*), rockweeds (*Fucus vesiculosis, F. spiralis*), Irish moss (*Chondrus crispus*), green seaweed (*Blidingia minima*), hollow green weeds (*Enteromorpha prolifera, E. intestinalis*), sea lettuce (*Ulva lactuca*), green fleece (*Codium fragile*), flimaentous green algae (*Rhizoclonium tortuosum, R. riparium)*, red algae (*Hildenbrandia* sp.), and red tubed weed (*Polysiphonia lanosa*).

Characteristic marine invertebrates include common blue mussel (*Mytilus edulis*), northern rock barnacle (*Balanus balanoides*), common periwinkle (*Littorina littorea*), rough periwinkle (*Littorina saxatilis*), little gray barnacle (*Chthamalus fragilis*), oyster drill (*Urosalpinx cinerea*), and Atlantic dogwinkle (*Nucella lapillus*).

Tidal pools may form within this community and contain many of the characteristic species listed above. Depending on the substrate and the topographic position, pools may also include ribbed mussel (*Geukensia demissa*), Forbes' sea star (*Asterias forbesi*), eastern mudsnail (*Ilyanassa obsoleta*), hermit crabs (*Pagurus* spp.), and eastern oyster (*Crassostrea virginica*).

Ocean deposited wrack and litter is common and may include detached pieces of the marine alga listed above along with eelgrass (*Zostera marina*), common southern kelp (*Laminaria agardhii*), and various empty shells.

More data on species abundance and distribution are needed to more accurately describe the upper and lower littoral gradients.

Distribution: uncommon along the seacoast of the Coastal Lowlands and Manhattan Hills ecozones.

Rank: G5 S1S2 *Revised:* 2003

Examples: Fishers Island, Suffolk County; Montauk Point and south shore of Montauk Peninsula, Suffolk County; Napeague Bay, Suffolk County; Huckleberry Island, Westchester County.

Sources: Brown 1993; Conard 1935; Day 1987; Gosner 1978; Künstler and Capainolo 1987; Weiss 1995; White (ed.) 2003; NYNHP field surveys.

C. MARINE CULTURAL

This subsystem includes communities that are either created and maintained by human activities, or modified by human influence to such a degree that the physical conformation of the substrate, or the biological composition of the resident community, is substantially different from the character of the substrate or community as it existed prior to human influence.

1. Marine submerged artificial structure/reef: the aquatic community associated with an artificially introduced structure submerged in marine waters that provides habitat for marine fish and other marine organisms. This includes structures that have been intentionally sunk for the purpose of attracting fish, as well as sunken ships, disposed waste, submerged bridge abutments, or any other introduced material that provides suitable habitat.

Distribution: in the ocean surrounding Long Island, in the Coastal Lowlands ecozone.

Rank: unranked cultural *Revised:* 1990

Source: Weisburd 1986.

2. Marine dredge spoil shore: the wetland community of a constructed, intertidal or subtidal, marine shore in which the substrate is composed of dredge spoils. This community has minimal vegetative cover and relatively low species diversity. Dredge spoil shores provide foraging habitat for terns, gulls, and several shorebirds.

Characteristic fishes in Great South Bay on sandy dredge spoils include Atlantic silverside (*Menidia menidia*), striped killifish (*Fundulus majalis*), and sheepshead minnow (*Cyprinodon variegatus*).

Distribution: along the seacoast of the Coastal Lowlands and Manhattan Hills ecozones.

Rank: unranked cultural *Revised:* 1990

Source: Briggs and O'Connor 1971.

3. Marine riprap/artificial shore: the wetland community of a constructed marine shore in which the substrate is composed of broken rocks, stones, wooden bulkheads, or concrete placed to reduce erosion.

Characteristic organisms are attached algae, mussels, and barnacles; percent cover and species diversity are low compared with a marine rocky intertidal community.

Distribution: along the seacoast of the Coastal Lowlands and Manhattan Hills ecozones.

Rank: unranked cultural *Revised:* 1990

4. Marine dredge spoil dump site: the benthic and adjacent aquatic community in which the substrate is composed of dredged materials (sediments) that were transported to the dump site. There are at least four ocean dumping sites off shore from Long Island: Fire Island Inlet, Jones Island Inlet, East Rockaway Inlet, and Rockaway Inlet (Environmental Protection Agency 2009).

Distribution: in the ocean south of Long Island, in the Coastal Lowlands ecozone.

Rank: unranked cultural *Revised:* 2009

Source: Environmental Protection Agency 2009.

5. Marine dredge excavation pit/channel: the benthic and adjacent aquatic community created by dredging ocean sediments in order to keep it clear and safe for boat and ship traffic (United States Army Corps of Engineers 2002). Many of the barrier island inlets on the south shore of Long Island are examples of maintained marine dredge excavation channels. Dredged navigation channels are in many of the shallow bays and river mouths along the coast and vary in length and depth. Dredge spoils from these channels are usually deposited into marine dredge spoil dump sites.

Distribution: along the seacoast of the Coastal Lowlands and Manhattan Hills ecozones.

Rank: unranked cultural *Revised:* 2009

Source: United States Army Corps of Engineers 2002.

6. Marine aquaculture areas: the benthic and adjacent aquatic community created for the purpose of cultivating and harvesting products from the marine environment. These products include fish, shellfish, crustaceans, and seaweed. Aquaculture areas often include installed structures needed for cultivating such products, such as cribs, racks, and in-water structures (New York State Department of Environmental Resources 2009).

Distribution: along the seacoast of the Coastal Lowlands ecozones.

Rank: unranked cultural *Revised:* 2009

Source: New York State Department of Environmental Resources 2009.

D. MARINE REFERENCES

Barnes, R. S. K. and K. H. Mann (*editors*). 1991. Fundamentals of Aquatic Ecology. Blackwell Science Ltd. Malden, MA.

Briggs, P. T. and J. S. O'Connor. 1971. Comparison of shore-zone fishes over naturally vegetated and sand-filled bottoms in Great South Bay. NY. Fish and Game J. 18: 15-41.

Brown, B. 1993. A classification system of marine and estuarine habitats in Maine: an ecosystem approach to habitats. Part 1: benthic habitats. First iteration. Maine Natural Areas Program. Department of Economic and Community Development. Augusta, ME.

Cashin Associates, P. C. 1996. Peconic Estuary Program final submerged aquatic vegetation study. Prepared for Suffolk County Department of Health Services. Riverhead, NY.

Conard, H. S. 1935. The plant associations of central Long Island. Am. Mid. Nat. 16: 433-515.

Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. Office of Biological Services, Fish and Wildlife Service, US Dept. of Interior, Washington, DC

Day, C. H. 1987. Life on Intertidal Rocks. Nature Study Guild, Rochester, NY.

Dethier, M. N. 1992. Classifying marine and estuarine natural communities: an alternative approach to the Cowardin system. Natural Areas Journal 12 (2): 90-100.

Dumais, S. and C. Smith. 1999. Peconic Estuary Program. 1998 Eelgrass (*Zostera marina*) Long Term Monitoring Program. Progress Report 2. Marine Program, Cornell Cooperative Extension. Riverhead, NY. 19 pp.

Environmental Protection Agency. 2009. Internet web site. Last updated September 23, 2009. Accessed December 2, 2009. http://www.epa.gov/OWOW/oceans/regulatory/dumpdredged/regiontwo.html

Good, R. E., J. Limb, E. Lyszczek, M. Miernik, C. Ogrosky, N. Psuty, J. Ryan, and F. Sickels. 1978. Analysis and delineation of the submerged vegetation of coastal New Jersey. A case study of Little Egg Harbor. Rutgers University. Center for Coastal and Environmental Studies. New Brunswick, NJ.

Gosner, K. L. 1978. A Field Guide to the Atlantic Seashore. Peterson Field Guides. Houghton Mifflin Company, New York, NY.

Hunt, D. M. 2000. 1999 Mashomack marine and estuarine aquatic community project. Unpublished report. New York Natural Heritage Program, Latham, NY.

Künstler, D. S. and P. Capainolo. 1987. Huckleberry Island: premier waterbird colony of western Long Island Sound. Kingbird 37: 178-188.

Macomber, R. T. and D. Allen. 1979. The New Jersey submersed aquatic vegetation distribution atlas final report. Prepared for the New Jersey Department of Enironmental Protection, Division of Coastal Resources, Bureau of Coastal Planning and Development. Trenton, NJ.

Martinez, A. J. 1994. Marine Life of the North Atlantic. Down East Books. Camden, ME.

Muenscher, W. C. 1939. Aquatic vegetation of Long Island waters. In: A biological survey of the fresh waters of Long Island. Suppl. to the 28th Ann. Rep., 1938. NYS Conserv. Dept., Albany, NY.

New York State Department of Environmental Resources 2009. Internet web site. Environmental Conservation Law, §§ 1-0101, 3-0301, 25-0302. Accessed December 3, 2009. http://www.dec.ny.gov/regs/13337.html

Strieb, M. D., V. M. Bricelj, and S. I. Bauer. 1995. Population biology of the mud crab, *Dyspanopeus sayi*, an important predator of juvenle bay scallops in Long Island (USA) eelgrass beds. Journal of Shellfish Research 14(2):347-357.

Thayer, G. W., W. J. Kenworthy, and M. S. Fonseca. 1984. The ecology of eelgrass meadows of the Atlantic coast: a community profile. US Fish and Wildlife Service, Washington, DC FWS/OBS-84/02. 147 pp.

Thorne-Miller, B., M. M. Harlin, G. B. Thursby, M. M. Brady-Campbell, and B. A. Dworetsky. 1983. Variations in the distribution and biomass of submerged macrophytes in five coastal lagoons in Rhode Island, US A. Botanica Marina 26:231-242.

Townes, H. K. Jr. 1939. Ecological studies on the Long Island marine invertebrates of importance as fish food or bait. In: A biological survey of the salt waters of Long Island, 1938. Suppl. to the 28th Annual Report, 1938. A joint survey with the US Bureau of Fisheries. NYS Conservation Dept., Albany, NY.

United States Army Corps of Engineers. 2002. Internet web site. Last updated on April 23, 2002. Accessed December 3, 2009. http://education.usace.army.mil/navigation/dredging.html

US Fish and Wildlife Service. 1996. Significant habitats and habitat complexes of the New York Bight Watershed. US Fish and Wildlife Service. Southern New England - New York Bight Coastal Ecosystems Program. Charlestown, RI.

Waller G. 1996. SeaLife. A complete guide to the marine environment. Smithsonian Institution Press, Washington, DC

Weisburd, S. 1986. Artificial reefs. Science News 130: 59-61.

Weiss, H. M. 1995. Marine Animals of Southern New England and New York: Identification keys to common nearshore and shallow water macrofauna. Bulletin 115. State Geological and Natural History Survey of Connecticut. Department of Environmental Protection, Hartford, CT.

White, S. K. (ed.). 2003. Life Between the Tides: marine plants and animals of the Northeast. Tilbury House Publishers, Gardiner, ME.

Whitlatch, R. B. 1982. The ecology of New England tidal flats: a community profile. US Fish and Wildlife Service, Biological Services Program, Washington, DC FWS/OBS-81/01. 125 pp.

II. ESTUARINE SYSTEM

The estuarine system consists of deepwater tidal habitats and adjacent tidal wetlands that are usually semienclosed but have open, partly obstructed, or sporadic access to open ocean or tidal fresh waters, and in which ocean water is at least occasionally diluted by freshwater runoff. The limits extend from the upstream limit of tidal influence seaward to an imaginary line closing the mouth of a river or bay. Salinity is usually less than 30.0 parts per thousand (ppt) ocean-derived salts, but can range from hyperhaline (greater than 40 ppt) to oligohaline (0.5-5 ppt) (Cowardin *et al.* 1979).

A. ESTUARINE SUBTIDAL

This subsystem includes the area below the lowest tide; the substrate is permanently flooded with tidal water; it is continuously submerged.

1. Tidal river: the aquatic community of continuously flooded substrates that support no emergent vegetation. Within the river there are two zones; the deepwater zone includes areas where substrates are usually over 2 m (6 ft) deep at low tide, the shallow zone includes submerged areas less than 2 m (6 ft) deep at low tide that lack rooted aquatic vegetation. In the river there is a vertical salinity gradient through most of the year, with a surface layer of fresh water (salinity less than 0.5 ppt) floating over a deeper layer of brackish water (salinity between 0.5 and 18.0 ppt). Salinities at any one place in the river may fluctuate as the tides flow in and out because the "salt wedge" of brackish water alternately rises and falls with the tides. The wedge also fluctuates seasonally and to precipitation runoff.

Characteristic fishes include year-round residents as well as seasonal migrants or anadromous species that enter the river as adults to spawn and return to the ocean afterwards. The progeny of these anadromous fishes occupy the river as a nursery area for the remainder of the year or longer. Characteristic fishes of the deepwater include Atlantic tomcod (*Microgadus tomcod*), hogchoker (*Trinectes maculatus*), and rainbow smelt (*Osmerus mordax*). Rare deepwater species of the Hudson River include sturgeon (*Acipenser brevirostrum* and *A. oxyrhynchus*). Characteristic fishes of the shallows include striped bass (*Morone saxatilis*), American shad (*Alosa sapidissima*), banded killifish (*Fundulus diaphanus*), spottail shiner (*Notropis hudsonius*), tesselated darter (*Etheostoma olmstedi*), and pumpkinseed (*Lepomis gibbosus*). Fishes that occur in both deepwater and shallows include bay anchovy (*Anchoa mitchilli*), blueback herring (*Alosa aestivalis*), white perch (*Morone americana*), and alewife (*Alosa pseudoharengus*).

Smaller tidal rivers on Long Island flow into "tidal bays" or "backbarrier lagoons" before reaching the ocean. Backbarrier lagoons are bodies of water that are protected from oceanic forces by barrier islands. Wave action is less significant in these enclosed water bodies than on the ocean beach, and the primary influences on backbarrier sediment are the rise and fall of the tides and activities of organisms (Leatherman 1979). Tidal bays and backbarrier lagoons may include various marine and estuarine communities, such as marine eelgrass meadow, marine intertidal mudflats, and salt marshes. More data on tidal bays and backbarrier lagoons are needed.

Distribution: in the Hudson Valley and Coastal Lowlands ecozones.

Rank: G4 S3 *Revised:* 2001

Examples: the Hudson River, from New York City to Troy; East River in New York City.

Sources: Boyce Thompson Institute for Plant Research 1977; Gladden *et al.* 1988; Hunt 2001; Leatherman 1979; Moran and Limburg 1986; Oertel 1985; Oertel *et al.* 1992.

2. Saltwater tidal creek: the aquatic community of a shallow, continuously semidiurnally tidally flooded creek with submerged areas averaging less than 2 m (6 ft) deep at low tide. The water is typically saline (18 to 30 ppt or greater) to brackish (0.5 to 18 ppt). Varying depth zones and flow microhabitats often result in a diverse array of ecological associations. Water levels fluctuate with the tides and two community depth zones are typically encountered: 1) the subtidal, permanently flooded, portion of the creek and 2) the intertidal portion including banks and midchannel bars or terraces exposed at low tide. Typical flow microhabitats in a fully-developed creek include abundant slow-flowing pools connected by runs with localized turbulent, fast-flowing riffles. Typical examples drain the waters of semidiurnally tidally flooded coastal salt marshes of the back barrier or finger marsh type. Most tidal creeks flow in a very sinuous (*i.e.*, meandering) pattern through a salt marsh. Although the vertical banks of the creek are regularly eroded and slump into the creek bottom, the position of the creek bed in the marsh is fairly stable and oxbows are rare. The sinuous meanders of the creek are not formed by recent erosion of the marsh, rather they are thought to be relicts of the drainage channels that were active in the tidal flats when the salt marsh grasses first became established.

Widgeon-grass (*Ruppia maritima*) is abundant in brackish to saline tidal creeks. Common epiphytic

plants include the marine red algae tubed weed (*Polysiphonia stricta*) and banded weed (*Ceramium strictum*). Other characteristic plants are the marine red algae tubed weed (*Polysiphonia denudata*), graceful red weed (*Gracilaria tikvahiae*), and *Spyridia filamentosa*, and several cyanobacteria including *Hydrocoleum lyngbaceum*, *Anabaena torulosa*, and *Agmenellum quadruplicatum*.

The fauna in tidal creeks is diverse. Several fishes that are resident in brackish to saline tidal creeks at low tide also use the low salt marsh when it is flooded by high tide. Characteristic fishes that have this distribution pattern include Atlantic silverside (*Menidia menidia*), mummichog (*Fundulus heteroclitus*), striped killifish (*Fundulus majalis*), sheepshead minnow (*Cyprinodon variegatus*), fourspine stickleback (*Apeltes quadracus*), threespine stickleback (*Gasterosteus aculeatus*), and American eel (*Anguilla rostrata*). Brackish to saline tidal creeks are also utilized as nursery areas for several important marine fishes, including winter flounder (*Pseudopleuronectes americanus*), black sea bass (*Centropristis striata*), bluefish (*Pomatomus saltatrix*), and striped bass (*Morone saxatilis*). Great blue heron (*Ardea herodias*) and egrets (*Egretta* spp., *Casmerodius albus*) commonly feed on the fish. Comb jellies (*Beroe* spp., *Mnemiopsis* spp.) are common plankton species. Common benthic epifauna include eastern mud snail (*Nassarius obsoletus*), daggerblade grass shrimp (*Palaemonetes pugio*), longwrist hermit crab (*Pagurus longicarpus*), and common Atlantic slippershell (*Crepidula crepidula*). Common benthic infauna include northern quahog (*Mercenaria mercenaria*), softshell clam (*Mya arenaria*), razor clam (*Ensis directus*), and bamboo worms (Polychaeta). Other characteristic marine invertebrates include blue crab (*Callinectes sapidus*), hairy sea cucumber (*Sclerodactyla briareus*), Atlantic horseshoe crab (*Limulus polyphemus*), acorn worm (Hemichordata), and terrebelid worm (*Amphitrite* spp.).

Tidal creek pools have silty substrate with abundant beds of widgeon grass and tubed weed. Characteristic fauna include hairy sea cucumber, American eel, grass shrimp, and eastern mud snail. Runs have sandy to gravelly substrate supporting the marine algae species tubed weed, graceful red weed, and green fleece (*Codium fragile*), a common non-native marine green algae, benthic marine fish such as naked goby (*Gobiosoma bosci*) and northern pipefish (*Syngnathus fuscus*), and many marine mollusks. Riffles have gravelly to cobbly bottoms with macroalgae beds of hollow green weed (*Enteromorpha* spp.), benthic marine fish such as naked goby, and marine mollusks such as common Atlantic slippershell. Intertidal peaty banks of creeks in salt marshes, especially in pools and runs, are characterized by abundant ribbed mussel (*Modiolus demissus*), mummichog, and killifish.

Brackish tidal creeks that drain brackish tidal marsh and intertidal mudflats are tentatively included here. More data on this type are needed.

Distribution: in salt marshes along the seacoast in the Coastal Lowlands ecozone, and along the Long Island Sound in the Manhattan Hills ecozone.

Rank: G4 S3 *Revised:* 2005

Examples: Bass Creek, Suffolk County; Hubbard Creek Marsh, Suffolk County; Mashomack Creek, Suffolk County; Jamaica Bay Marshes, Kings and Queens Counties.

Sources: Hunt 2000; Kiviat and Stevens 2001; Redfield 1972; Teal 1986; Webber 1967; NYNHP field surveys.

3. Freshwater tidal creek: the aquatic community of a shallow, continuously semidiurnally tidally flooded creek with submerged areas averaging less than 2 m (6 ft) deep at low tide. The water is typically fresh (0 to 0.5 ppt salinity). Varying depth zones and flow microhabitats often result in a diverse array of ecological associations. Water levels fluctuate with the tides and two community depth zones are typically encountered: 1) the subtidal, permanently flooded, portion of the creek and 2) the intertidal portion including banks and midchannel bars or terraces exposed at low tide. Typical flow microhabitats in a fully-developed 1st and 2nd order (*sensu* Strahler 1957) freshwater creek include long, silty runs, densely vegetated pools, and small gravelly riffles with aerated, fast flowing water. Typical examples drain the waters of various freshwater tidal communities, such as freshwater tidal marsh, freshwater intertidal mudflats, and freshwater tidal swamp.

Freshwater tidal creeks may flow in a very sinuous (*i.e.*, meandering) pattern through a freshwater tidal marsh, or flow more linearly as a large tributary to a tidal river. In the latter case, the tidal creek drains the freshwater tidal marsh patches that form narrow bands along the creek. Although the vertical banks of the creek are regularly eroded and slump into the creek bottom, the position of the creek bed in the marsh is fairly stable and oxbows are rare.

Ecological associations include riffles, runs, pools, and sparsely to non-vegetated creek bottoms. Riffles are dominated by filamentous green algae and *Fontinalis* sp. Characteristic aquatic plants of runs and pools include tapegrass or wild celery (*Vallisneria americana*), bur-reed (*Sparganium fluctuans*), fragrant waterlily (*Nymphaea odorata*), golden club (*Orontium aquaticum*), and pondweeds

(*Potamogeton pectinatus, P. natans*). As these areas become more vegetated they may be better classified as freshwater tidal marshes. The submerged nonvascular layer is very sparse and includes mosses in the genus *Fontinalis* as well as green and blue green algae, like stoneworts (*Chara* spp.). Areas dominated by tapegrass or wild celery (*Vallisneria americana*), are better classified as freshwater subtidal aquatic bed. A common weedy non-native plant is Eurasian milfoil (*Myriophyllum spicatum*).

Characteristic freshwater tidal creek fauna include insects, birds, fish, mollusks, and crustaceans. The most abundant fauna include amphipods (*Gammarus* spp.), non-native snails (*Bithynia tentacula*), stoneflies (Plecoptera), midges (Diamesinae), and aquatic mollusks (*Amnicola limosa*). The dominant neuston species is an aquatic bug (*Mesovelia* sp.). The dominant nekton species include banded killifish (*Fundulus diaphanus*), pumpkinseed sunfish (*Lepomis gibbosus*) and smallmouth bass (*Micropterus dolomieui*). Additional characteristic benthic fauna include American eel (*Anguilla rostrata*), blue crab (*Callinectes sapidus*), eastern elliptio (*Elliptio complanata*), and leeches (*Placobdella picta*). Other fauna include aquatic flies (*Lype* sp.). Associated mammals and birds observed at one example include muskrat (*Ondatra zibethicus*), belted kingfisher (*Ceryle alcyon*), wood duck (*Aix sponsa*), and American black duck (*Anas rubripes*).

Freshwater tidal creeks may include small 1st order tributaries, a shallow delta at the mouth, subtidal bottoms, silty intertidal creek banks and mid-channel depositional bars, and tall undercut banks. Water is usually circumneutral, moderately oxygenated, warm, somewhat turbid, very pale yellowish brown, with moderately low transparency and flow conditions. Water levels and flow vary greatly with the tide. Data from more examples are needed.

Distribution: along the Hudson River from Newburgh to Troy, in the Hudson Valley ecozone, and smaller examples on the tidal rivers of Long Island.

Rank: G3G4 S2 *Revised:* 2005

Examples: Catskill Marsh, Greene County; North Tivoli Bay, Dutchess County; Stockport Creek Marshes, Columbia County.

Source: NYNHP field surveys.

4. Brackish subtidal aquatic bed: the aquatic community of continuously flooded substrates with rooted aquatic vegetation. The water is brackish (salinity between 0.5 and 18.0 ppt) and the water is usually less than 2 m (6 ft) deep at low tide.

Characteristic species are sago pondweed (*Potamogeton pectinatus*), horned pondweed (*Zannichellia palustris*), Nuttall's waterweed (*Elodea nuttallii*), coontail (*Ceratophyllum demersum*), naiad (*Najas guadalupensis*), and widgeon grass (*Ruppia maritima*). A common weedy non-native plant is Eurasian milfoil (*Myriophyllum spicatum*).

As salinity increases downstream, brackish subtidal aquatic beds may grade into marine eelgrass meadows dominated by eelgrass (*Zostera marina*) (Macomber and Allen 1979).

Data on characteristic fauna for this community are needed.

Distribution: along the Hudson River from New York City to Newburgh, in the Hudson Valley and Triassic Lowlands ecozones; Coastal Lowlands ecozone.

Rank: G4 S3S4 *Revised:* 2001

Examples: Piermont Marsh, Rockland County; Carmans River, Suffolk County.

Sources: Kiviat and Stevens 2001; Macomber and Allen 1979; Metzler and Rosza 1982; Muenscher 1937; Senerchia-Nardone *et al.* 1985.

5. Freshwater subtidal aquatic bed: the aquatic community of continuously flooded substrates with rooted aquatic vegetation. The water is fresh (salinity less than 0.5 ppt) and the water is usually less than 2 m (6 ft) deep at low tide.

Tapegrass or wild celery (*Vallisneria americana*), is usually abundant. Other characteristic species include clasping-leaved pondweed (*Potamogeton perfoliatus*), Nuttall's waterweed (*Elodea nuttallii*), coontail (*Ceratophyllum demersum*), and naiads (*Najas guadalupensis, N. minor*). Two non-native weeds, Eurasian milfoil (*Myriophyllum spicatum*) and water chestnut (*Trapa natans*), are common in the Hudson River aquatic beds. Large, dense areas of water chestnut on tidal rivers are classified as a cultural community, estuarine water chestnut bed.

A characteristic bird that feeds on the subaquatic vegetation is the canvasback (*Aythya valisneria*). Other birds that feed on plants, fish, and invertebrates in the vegetated shallows during migration, or in winter, include bufflehead (*Bucephala albeola*), common goldeneye (*B. clangula*), common merganser (*Mergus merganser*), and greater scaup (*Aythya marila*). Wading birds such as snowy egret (*Egretta thula*) and great blue heron (*Ardea herodias*) have been frequently observed feeding in freshwater aquatic beds at low tide (Findlay *et al.* 1997).

Distribution: along the Hudson River from Newburgh to Troy, in the Hudson Valley ecozone.

Rank: G4 S3 *Revised:* 2001

Examples: Hudson River from Yonkers to Troy.

Sources: Findlay *et al.* 1997; Kiviat and Stevens 2001; Metzler and Rosza 1982; Muenscher 1937; Schmidt and Kiviat 1988.

B. ESTUARINE INTERTIDAL

This subsystem includes the area between the highest tide level and the lowest tide level; the substrate is periodically exposed and flooded by semidiurnal tides (two high tides and two low tides per tidal day). Some areas are only irregularly exposed at low tide, while other areas are only irregularly flooded at high tide. Semidiurnal submergence, warm water, copious deposits of mud, and varying salinity make the intertidal estuarine communities extreme and specialized habitats (Fassett 1928).

Coastal Salt Marsh Ecosystem: Estuarine and Marine communities often form a complex mosaic along the ocean coastline and within bays. Communities in a salt marsh ecosystem include salt shrub and brackish meadow at the upland border of the high salt marsh; sea level fen in rare cases associated with freshwater seepage at the landward edge; low salt marsh at the seaward border of the high salt marsh and along the edges of tidal creeks that drain the high salt marsh; and salt pannes in shallow depressions within the marsh.

1. Brackish meadow: a moist, moderately well-drained brackish (0.5-18 ppt) perennial grassland with occasional isolated shrubs that is typically situated in a belt at the upper edge of salt marshes bordering sandy uplands where it is the graminoid-dominated counterpart of salt shrub, but may also occupy the drier, less brackish portions of interdunal swales. Brackish meadows may be classified as an upland community based on the presence of several upland dune species, but is placed here because of the strong influence of the infrequent tidal processes and proximity to salt marshes. The community usually develops in areas with a unique combination of soils and hydrology, on deep deposits of periodically windblown or overwashed gleyed sands that are usually flooded only during spring tides and/or during major coastal storms, approximately two to three times per year. Periodic sand deposition and volatilized saltwater deposition are thought to prevent dominance by tall shrubs via burial and top killing of shrubs. Soil salinity over long periods of time is relatively low but may show vast fluctuations over short periods of time, producing a constantly stressed environment. Salinity is periodically raised by the regular cycling of tides, inundation during spring tides and storm surges, and volatilized saltwater deposition. These epsodic pulses of salt result in woody plant die-off (R. Zaremba *pers. comm.*). Salinity is periodically lowered by dilution from rainwater and the presence of a thin fresh groundwater lens elevated over the underlying saltwater.

The meadow is dominated by halophytic plants, including wetland and facultative wetland species, such as perennial graminoids and ephemeral herbs. Dominant species include switchgrass (*Panicum virgatum*), salt-meadow grass (*Spartina patens*), sea-blites (*Suaeda* spp.), and sedge (*Carex silicea*). Other graminoids present may include little bluestem (*Schizachyrium scoparium*), big bluestem (*Andropogon gerardii*), spikegrass (*Distichlis spicata*), knotroot bristlegrass (*Setaria parviflora*), purple lovegrass (*Eragrostis spectabilis*), Virginia wild rye (*Elymus virginicus*), panic grass (*Panicum amarum*), twig-rush (*Cladium mariscoides*), cyperus (*Cyperus polystachyos, C. dentatus*), three-square (*Schoenoplectus pungens*), and black grass (*Juncus gerardii*).

Characteristic herbs include whorled milkwort (*Polygala verticillata*), seaside goldenrod (*Solidago sempervirens*), narrow-leaved goldenrod (*Euthamia caroliniana*), seaside gerardia (*Agalinis maritima*), pinks (*Sabatia* spp.), tall wormwood (*Artemisia campestris* ssp. *caudata*), asters (*Symphyotrichum* spp.), and wild germander (*Teucrium canadense*). Indicator herbaceous species at low abundance may include sedge (*Fimbristylis castanea*), salt marsh plantain (*Plantago maritima* ssp. *juncoides*), evening primrose (*Oenothera parviflora* var. *oakesiana*), and crabgrass (*Digitaria filiformis*). Sparse dwarf shrubs may include groundsel-tree (*Baccharis halimifolia*), bayberry (*Myrica pensylvanica*), and beach-plum (*Prunus maritima*). New England blazing star (*Liatris scariosa* var. *novae-angliae*) may rarely occur along the drier margins of brackish meadows where it transitions to upland (T. Weldy *pers. comm.*). The community is prone to weedy non-native species such as red fescue (*Festuca rubra*), and soapwort (*Saponaria officinalis*). Floristic composition can fluctuate dramatically over several years in response to the fluctuating soil salinities. European common reed (*Phragmites australis*) may become invasive in brackish meadows.

Characteristic fauna include fiddler crabs (*Uca pugilator* and *U. pugnax*). The community usually occurs in close association with salt shrub and at slightly higher elevation than high salt marsh. It may develop into high salt marsh after occupation by

Spartina patens and development of a peat layer in response to a more regular tidal influence.

Distribution: restricted to the estuarine portion of the Coastal Lowlands ecozone. Expected to be scattered along the shore of Long Island, concentrated on the south shore, especially the South Fork of Long Island. May also occur on Staten Island.

Rank: G2G3 S1S2 *Revised:* 2001

Examples: Walking Dunes, Napeague Meadows, and Fire Island, Suffolk County.

Sources: Johnson 1985; Nixon 1982; NYNHP field surveys.

2. Salt shrub: a shrubland community that forms the ecotone between salt marsh and upland vegetation. Salinity levels are generally lower here than in the salt marsh (soil pore salinity ranges 7 ppt to 27 ppt) and thus technically brackish. Salt shrub areas are slightly higher in elevation than the salt marsh. Salt shrub does not usually develop on deep peat. More often, it occurs on a thin (0-10 cm) layer of peat, and soils share characteristics of both estuarine and maritime terrestrial settings. Periodic disturbance associated with storms causes die-back of shrubs.

Characteristic shrubs are groundsel-tree (*Baccharis halimifolia*), saltmarsh-elder (*Iva frutescens*), and pasture rose (*Rosa carolina*); salt-meadow grass (*Spartina patens*), black-grass (*Juncus gerardii*), and switchgrass (*Panicum virgatum*) are typical herbs. Salt shrub is almost always dominated by *Iva frutescens* on the marshward edge of the community, often forming a stunted leading edge of the community. *Baccharis halimifolia* becomes more dominant only in the older, more developed, landward side. The landward side of salt shrub is usually the most diverse.

Salt shrub is usually present as a linear feature at the upper edge of a salt marsh marking the limit of the highest spring and storm tides within a given estuarine basin. In areas where the local topography is nearly level an extensive shrubland, or brackish meadow may occur. This community is often invaded by European common reed (*Phragmites australis*). See estuarine common reed marsh for areas with abundant common reed in tidal settings.

Distribution: in sheltered areas of the seacoast in the Coastal Lowlands and Manhattan Hills ecozones. Best examples of salt shrub are within the Peconic Bay, but also along the south shore of Long Island. Salt shrub is poorly developed along the north shore where tidal areas are steep.

Rank: G5 S4 *Revised:* 2001

Examples: Hubbard Creek Marsh, Suffolk County; Northwest Creek, Suffolk County; Orient Point Marsh, Suffolk County; Cow Neck Marsh, Suffolk County; Mashomack Point Marsh, Suffolk, County.

Sources: Clark 1985; Clark 1986; Conard 1935; Hayden *et al.* 1995; MacDonald and Edinger 2000; Nixon 1982; Redfield 1972; NYNHP field surveys.

3. High salt marsh: a coastal marsh community that occurs in sheltered areas of the seacoast, in a zone extending from mean high tide up to the limit of spring tides. It is periodically flooded by spring tides and flood tides. High salt marsh typically consists of a mosaic of patches that are mostly dominated by a single graminoid species.

The dominant species in many large areas are either salt-meadow grass (*Spartina patens*) or a dwarf form (15 to 30 cm tall) of cordgrass (*Spartina alterniflora*); also common are large areas dominated by spikegrass (*Distichlis spicata*), black-grass (*Juncus gerardii*), and glassworts (*Salicornia* spp.), or a mixture of salt-meadow grass and cordgrass. Characteristic species of the upper slope of the high marsh (the area that grades into salt shrub) are black-grass, switchgrass (*Panicum virgatum*), sea-lavender (*Limonium carolinianum*), seaside gerardia (*Agalinis maritima*), and slender perennial saltmarsh aster (*Symphyotrichum tenuifolium* var. *tenuifolium*).

Characteristic birds at varying abundance that breed in or near salt marshes include marsh wren (*Cistothorus palustris*), saltmarsh sharp-tailed sparrow (*Ammodramus caudacutus*), red-winged blackbird (*Agelaius phoeniceus*), black-crowned night heron (*Nycticorax nycticorax*), Canada goose (*Branta canadensis*), American black duck (Anas rubripes), clapper rail (*Rallus longirostris*), and willet (*Catoptrophorus semipalmatus*) (Niedowski 2000). Many more birds depend on salt marshes for food, such as green heron (*Butorides striatus*), great egret (*Casmerodius albus*), snowy egret (*Egretta thula*), glossy ibis (*Plegadis falcinellus*), tree swallow (*Tachycineta bicolor*), and terns (*Sterna* spp.) (Niedowski 2000).

Characteristic insects include salt marsh mosquitoes (*Aedes* spp.) and greenhead flies (Tabanidae). A characteristic butterfly of the high salt marsh is the salt marsh skipper (*Panoquina panoquin*) where the caterpillar feeds on spikegrass (Glassberg 1999, R. Dirig *pers. comm.*).

High salt marshes can be further classified by landform type following Oertel and Woo (1994) into mainland fringe-marshes, mid-lagoon marshes, and backbarrier fringe-marshes.

Distribution: in sheltered areas of the seacoast in the Coastal Lowlands and Manhattan Hills ecozones. High salt marsh is best developed in the Peconic Bay and along the south shore of Long Island.

Rank: G4 S3S4 *Revised:* 2001

Examples: Hubbard Creek Marsh, Suffolk County; Northwest Creek, Suffolk County; Fire Island Wilderness, Suffolk County; Orient Point Marsh, Suffolk County; Wading River Marsh, Suffolk County; Hempstead Bay Wetlands, Nassau County.

Sources: Clark 1985; Clark 1986a; Conard 1935; Glassberg 1999; MacDonald and Edinger 2000; Niedowski 2000; Nixon 1982; Oertel and Woo 1994; Redfield 1972; United States Army Corps of Engineers 1995, 1999; NYNHP field surveys.

4. Salt panne: a shallow depression in a salt marsh where the marsh is poorly drained. Pannes occur in both low and high salt marshes. Pannes in low salt marshes usually lack vegetation, and the substrate is a soft, silty mud. Pannes in a high salt marsh are irregularly flooded by spring tides or flood tides, but the water does not drain into tidal creeks. After a panne has been flooded the standing water evaporates and salinity of the soil water is raised well above the salinity of sea-water. Soil water salinities fluctuate in response to tidal flooding and rainfall. Small pond holes occur in some pannes; the pond holes are usually deeper than the thickness of the living salt marsh turf, and the banks or "walls" of the pond holes are either vertical or they undercut the peat. Salt pannes can be formed by ponding of water on the marsh surface, scouring of wrack or coverage by storm wrack, and possibly by ice scour. Salt panne formation appears to be favored by a mean tidal range of about 20-80 cm and are poorly developed in settings with a mean tidal range greater than 1.6 m.

Characteristic plants of a salt panne include the dwarf form (15 to 30 cm tall) of cordgrass (*Spartina alterniflora*), glassworts (*Salicornia depressa* and *Sarcocornia pacifica*), marsh fleabane (*Pluchea odorata*), salt marsh plantain (*Plantago maritima* ssp. *juncoides*), arrow-grass (*Triglochin maritimum*), spikegrass (*Distichlis spicata*), sea-blites (*Suaeda* spp.), and salt marsh sand spurry (*Spergularia marina*). High salt marsh communities that are dominated by the dwarf form of *Spartina alterniflora* appear to support larger, better developed pannes than marshes dominated by *S. patens* and *Distichlis spicata.* Widgeon-grass (*Ruppia maritima*) grows in the pond holes; fishes that may be permanent residents in large pond holes include mummichog (*Fundulus heteroclitus*) and sheepshead minnow (*Cyprinodon variegatus*).

The salt pannes on the south shore of Long Island are intensely used by feeding shorebirds. A characteristic butterfly of salt pannes is the salt marsh skipper (*Panoquina panoquin*) where the caterpillar feeds on spikegrass (Glassberg 1999, R. Dirig *pers. comm.*).

More data on the pond-like variant dominated by *Ruppia maritima* are needed. A comparison of this community with coastal salt pond needs to be made.

Distribution: in salt marshes along the seacoast of the Coastal Lowlands ecozone. Salt pannes are best developed on the south shore of Long Island, especially in areas of low mean tidal range. They are poorly developed in the Peconic Bay and very poorly developed on the north shore of Long Island.

Rank: G3G4 S3 *Revised:* 2001

Examples: Gilgo Beach Backbarrier Marsh, Suffolk County; Hubbard Creek Marsh, Suffolk County; Northwest Creek, Suffolk County; Hempstead Bay Wetlands, Nassau County.

Sources: Glassberg 1999; MacDonald and Edinger 2000; Miller and Egler 1950; Niedowski 2000; Nixon 1982; Redfield 1972; NYNHP field surveys.

5. Low salt marsh: a coastal marsh community that occurs in sheltered areas of the seacoast, in a zone extending from mean high tide down to mean sea level or to about 2 m (6 ft) below mean high tide. It is regularly flooded by semidiurnal tides. The mean tidal range of low salt marshes on Long Island is about 80 cm, and they often form in basins with a depth of 1.6 m or greater.

The vegetation of the low salt marsh is a nearly monospecific stand of cordgrass (*Spartina alterniflora*), a coarse grass that grows up to about 3 m (10 ft) tall. Salt marshes with large tidal ranges are often dominated by the tall form of *Spartina alterniflora,* while those with more restricted tidal ranges will maintain a short form *Spartina alterniflora* zone and grade into high salt marsh (Niedowski 2000). A few species of marine algae can form dense mats on the surface sediments between the cordgrass stems, including knotted wrack (*Ascophyllum nodosum*) and rockweed (*Fucus vesiculosus*); sea lettuce (*Ulva* spp.) and hollow green weeds (*Enteromorpha* spp.) can be abundant, especially in early summer. Other plants that are present in very low numbers include glassworts (*Salicornia depressa, S. bigelovii*), salt marsh sand-spurry (*Spergularia marina*), and sea blites (*Suaeda* spp.).

Several birds that nest in salt marshes include marsh wren (*Cistothorus palustris*), saltmarsh sharp-

tailed sparrow (*Ammodramus caudacutus*), red-winged blackbird (*Agelaius phoeniceus*), black-crowned night heron (*Nycticorax nycticorax*), Canada goose (*Branta canadensis*), American black duck (Anas rubripes), and sometimes clapper rail (*Rallus longirostris*) and willet (*Catoptrophorus semipalmatus*) (Niedowski 2000). Many more birds depend on salt marshes for food, such as green heron (*Butorides striatus*), great egret (*Casmerodius albus*), snowy egret (*Egretta thula*), glossy ibis (*Plegadis falcinellus*), tree swallow (*Tachycineta bicolor*), and terns (*Sterna* spp.) (Niedowski 2000).

Other characteristic salt marsh fauna include fiddler crabs (*Uca pugilator* and *U. pugnax*) nesting along creek banks, ribbed mussel (*Geukensia dimissa*), and at high tide mummichog (*Fundulus heteroclitus*), and several other small fishes that live in the tidal creeks at low tide. Characteristic molluscs include coffeebean snails (*Melampus bidentatus*) and salt marsh periwinkles (*Littorina irrorata*).

The low salt marsh is one zone within a coastal salt marsh ecosystem; it occurs in a mosaic with several other communities. Low salt marsh grades into high salt marsh at slightly higher elevations, and into intertidal mudflats at slightly lower elevations. Saltwater tidal creeks that drain the salt marsh flow in a sinuous pattern through the marsh, with a narrow band of low marsh lining the banks of the saltwater tidal creeks. Shallow depressions, or pannes, may also occur in the low marsh.

Distribution: in sheltered areas of the seacoast in the Coastal Lowlands and Manhattan Hills ecozones. Low salt marsh is well-developed on the south shore of Long Island, and within the small basins of the north shore where it is the dominant community type.

Rank: G4 S3S4 *Revised:* 2001

Examples: Hubbard Creek Marsh, Suffolk County; Northwest Creek, Suffolk County; Lloyd Neck Marsh, Suffolk County; Nissequogue River, Suffolk County; Westhampton Island-Tiana Beach, Suffolk County; Flax Pond, Suffolk County; Jamaica Bay Marshes, Kings and Queens Counties; Hempstead Bay Wetlands, Nassau County.

Sources: Clark 1985, 1986a; Conard 1935; Dreyer and Niering 1995; Houghton and Woodwell 1980; Joneja 1981; MacDonald and Edinger 2000; Niedowski 2000; Nixon 1982; Redfield 1972; Spinner 1969; Teal 1986; United States Army Corps of Engineers 1995, 1999; NYNHP field surveys.

6. Coastal salt pond: A community inhabiting marine shoreline lakes or ponds formed by sandspits that close off a lagoon or bay. The water typically averages brackish or slightly brackish over long periods of time, but may range rapidly from fresh to saline. Occasionally the barrier beach is broken by hurricanes and the pond becomes saline until the sandspit closes the pond again. Many ponds have permanent (natural or artificial) inlets. Two community microhabitats are typically encountered within one pond complex: 1) the "pond" or aquatic portion of the complex and 2) the "shore" or the non-aquatic part of the complex. These two microhabitats are likely to warrant separate communities and may be distinguished in a future version of the state community classification: the former retaining the name "coastal salt pond," the latter designated as a "coastal salt pond shore."

Dominant plants of the pond can vary considerably with the frequency of exchange of marine waters. Typical ponds are dominated by the submergent vascular plant widgeon grass (*Ruppia maritima*) and the marine red algae tubed weed (*Polysiphonia* spp.). Other characteristic plants of the pond include the marine green algae *Cladophora* spp. Marine algae are often less frequent in more saline examples. Needle spikerush (*Eleocharis acicularis*) is typical of temporarily flooded edges of ponds. Brackish ponds may contain flora typical of brackish subtidal aquatic beds including sago pondweed (*Potamogeton pectinatus*), clasping-leaved pondweed (*Potamogeton perfoliatus*), and horned pondweed (*Zannichellia palustris*). Four pond associations have been listed by Thorne-Miller *et al.* (1983) including widgeon grass beds, marine green algae beds, tubed weed beds and sago pondweed beds.

Characteristic pond fauna include multiple species of grass shrimp (*Palaemonetes* spp.), and the estuarine minnows mummichog (*Fundulus heteroclitus*), sheepshead minnow (*Cyprinodon variegatus*), silversides (*Menidia* spp.), and various killifish. Coastal waterbirds in the heron family (Ardeidae) including great blue heron (*Ardea herodias*) and egrets (*Egretta* spp., *Casmerodius albus*) feed on the fish.

The pond shore typically consists of an assemblage of up to several narrow zones floristically resembling other estuarine community types. Along a wet to dry moisture gradient and low to high elevation gradient, these community types may include: intertidal mudflats, low salt marsh, high salt marsh, salt panne, salt shrub and brackish meadow. Similar zones resembling palustrine communities may occur in examples with freshwater.

Characteristic species of the pond shore are dwarf spikerush (*Eleocharis parvula*), switchgrass (*Panicum virgatum*), salt-meadow grass (*Spartina patens*), cordgrass (*Spartina alterniflora*), saltmarsh fleabane (*Pluchea odorata*), three-square (*Schoenoplectus pungens, S. americanus*), rose-mallow (*Hibiscus moscheutos*), pigweeds

(*Chenopodium* spp.), mock bishop's-weed (*Ptilimnium capillaceum*), spikegrass (*Distichlis spicata*), saltmarsh-elder (*Iva frutescens*), and groundsel-tree (*Baccharis halimifolia*). This community is often invaded by European common reed (*Phragmites australis*).

Abundant pond shore fauna include saltmarsh mosquitoes (*Aedes* spp.). Other characteristic pond shore fauna include green-headed fly (*Tabanus nigrovittatus*) and planthoppers (*Prokelisia marginata*).

Distribution: along the seacoast in the Coastal Lowlands ecozone.

Rank: G4 S1S2 *Revised:* 2001

Examples: Oyster Pond, Suffolk County; Tobaccolot Pond, Suffolk County; Fishers Island Pond, Suffolk County.

Sources: Harlin *et al.* 1995; Hunt 2000; Thorne-Miller *et al.* 1983; NYNHP field surveys.

7. Brackish interdunal swales: a brackish marsh community in interdunal swales that are infrequently flooded by unusually high tides. Ths community is dominated by halophytic graminoids. Individual swales occur as small patches positioned between fore-, primary, and secondary dunes in a maritime dunes system, typically on barrier islands. Swales experience dynamic fluctuations in water levels and salinity. Water levels are highest after infrequent and sporadic overwash that occurs when tides or waves overtop the highest part of the dunes that usually forms a barrier to waves, transporting water and suspended sand through the foredune into low-lying areas within the dune system, usually during spring tides, full moons or major storms. Flood frequency can vary from several times per year to as little as once every 25 years forming temporary ponds. During the driest times, ponds evaporate, surface sands are no longer saturated, salt concentrates then enters the groundwater, and salt deposits form on the surface. Salinity is typically mixohaline, water being derived from a mix of saline ocean overwash and freshwater groundwater lens. However, salinity can vary greatly at certain times of the year from oligohaline (0 ppt) to supersaline (70 ppt) in response to the salinity of the groundwater and accumulation of salt during evaporation.

The dominant flora are mostly grasses, sedges and rushes including salt-meadowgrass (*Spartina patens*), dwarf spikerush (*Eleocharis parvula*), three-square (*Schoenoplectus pungens*), flatsedge (*Cyperus polystachyos*), and jointed rush (*Juncus articulatus*). The abundance of any one dominant can vary widely year to year in response to salinity fluctuations. Other characteristic flora includes halophytes such as salt-meadow grass (*Leptochloa fusca* ssp. *fascicularis*), seaside bulrush (*Bolboschoenus maritimus* ssp. *paludosus*), toad-rush (*Juncus ambiguus*), sedge-rush (*Juncus scirpoides*), mock bishop's-weed (*Ptilimnium capillaceum*), golden dock (*Rumex maritimus*), eastern annual saltmarsh aster (*Symphyotrichum subulatum* var. *subulatum*), red pigweed (*Chenopodium rubrum*), saltmarsh fleabane (*Pluchea odorata*), rose-mallow (*Hibiscus moscheutos*), bushy knotweed (*Polygonum ramosissimum*), and saltmarsh-elder (*Iva frutescens*). Seabeach amaranth (*Amaranthus pumilus*) may grow at the upper edge of this community in drift lines, but is more successful on maritime beaches and dunes. European common reed (*Phragmites australis*) may become invasive in brackish interdunal swales.

The community is known for its importance to wildlife. Characteristic fauna include piping plovers (*Charadrius melodus*), American oystercatchers (*Haematopus palliatus*), yellowlegs (*Tringa melanolueca* and *T. flavipes*) (during migration), and Canada geese (*Branta canadensis*), which use the community as a foraging ground, abundant salt marsh mosquitoes (*Aedes* spp.), and fiddler crabs (*Uca* spp.). Eastern mud turtle (*Kinosternon subrubrum subrubrum*), and eastern spadefoot toad (*Scaphiopus holbrookii holbrookii*) reportedly use this habitat (United States Army Corps of Engineers 1995, 1999).

Soils are deep sands, often become anaerobic but lack peat accumulation. The surface is often rusty colored from a coating of blue-green algae. Community variants include semi-permanent pools, long-lived wet swales with perennial graminoids, and newly-formed sparsely-vegetated damp swales with early successional annual forbs. Occurrences of this community are sometimes ephemeral, representing the early stages of salt marsh or coastal salt pond formation or rapidly transforming into common reed marshes. For examples in non-tidal settings with negligible halophytic plants see "maritime freshwater interdunal swales" within the Palustrine System. Brackish interdunal swales were previously included in coastal salt pond (Reschke 1990).

Distribution: restricted to estuarine portion of Coastal Lowlands ecozone, probably only on the south shore of Long Island. Known occurrences are restricted to barrier islands from Jones Beach Island West to Westhampton Beach. Additional occurrences are possible west to Gateway National Recreation Area and east to Montauk Point, Orient Point, and Gardiners Island.

Rank: G3G4 S1S2 *Revised:* 2001

Examples: Jones Beach Island East, Suffolk County;

Jones Beach Island West, Suffolk County.

Sources: United States Army Corps of Engineers 1995, 1999; NYNHP field surveys.

8. Brackish tidal marsh: a marsh community that occurs where water salinity ranges from 0.5 to 18.0 ppt and water is less than 2 m (6 ft) deep at high tide. This community consists of a diverse mixture of salt marsh and freshwater tidal marsh species, with no species attaining dominance over extensive areas (although some species are locally abundant in patches). The vegetation in a brackish tidal marsh is dense and dominated by tall graminoids.

Characteristic plants are narrowleaf cattail (*Typha angustifolia*), rose-mallow (*Hibiscus moscheutos*), wild rice (*Zizania aquatica*), pickerel-weed (*Pontederia cordata*), arrowleaf (*Peltandra virginica*), water smartweed (*Persicaria punctata*), marsh fern (*Thelypteris palustris*), bulrushes (*Schoenoplectus americanus, S. tabernaemontani, Bolboschoenus. fluviatilis, B. novae-angliae, B. robustus*), water-hemp (*Amaranthus cannabinus*), dwarf spikerush (*Eleocharis parvula*), arrowhead (*Sagittaria latifolia*), lilaeopsis (*Lilaeopsis chinensis*), hedge bindweed (*Calystegia sepium*), seaside goldenrod (*Solidago sempervirens*), yellow iris (*Iris pseudacorus*), and saltmarsh fleabane (*Pluchea odorata*). Purple loosestrife (*Lythrum salicaria*) and European common reed (*Phragmites australis*) are may become invasive in brackish marshes.

Birds that nest in cattail dominated, or graminoid, brackish tidal marshes include least bittern (*Ixobrychus exilis*), American bittern (*Botaurus lentiginosus*), sora (*Porzana carolina*), Virginia rail (*Rallus limicola*), king rail (*Rallus elegans*), common moorhen (*Gallinula chloropus*), and marsh wren (*Cistothorus palustris*) (Kiviat and Stevens 2001; Swift 1987, 1989). Other characteristic birds with varying abundance include red-winged blackbird (*Agelaius phoeniceus*), swamp sparrow (*Melospiza georgiana*), yellow warbler (*Dendroica petechia*), common yellowthroat (*Geothlypis trichas*), song sparrow (*Melospiza melodia*), American goldfinch (*Carduelis tristis*), and eastern kingbird (*Tyrannus tyrannus*) (Swift 1987, 1989).

Brackish marshes are best developed on large river systems characterized by gentle slopes coupled with tidal influence over considerable distances. The downstream limits of the community begin where cordgrass (*Spartina alterniflora*) no longer dominates tidal creek or river banks, and the upstream limits extend to where the hollow green weeds (*Enteromorpha intestinalis*) can no longer be found. Brackish tidal marshes can be distinguished from freshwater tidal marshes by the lack of species restricted to freshwater, such as broad-leaved spatterdock (*Nuphar advena* ssp. *advena*), sweetflag (*Acorus americanus*), and blue flag (*Iris versicolor*), and a decrease in cover of sedges (*Carex* spp. and *Cyperus* spp.). European common reed (*Phragmites australis*) and purple loosestrife (*Lythrum salicaria*) may become invasive in brackish tidal marshes. Brackish marshes that are dominated by common reed as a result of anthropogenic disturbance should be classified as one of the following cultural communities: estuarine common reed marsh, estuarine impoundment marsh, or estuarine dredge spoil shore. If tidal influence has been eliminated, then it may be classified as palustrine common reed marsh. In droughty years purple loosestrife may disappear as salinity increases (R. Roza *pers. comm.*)

Brackish tidal marshes may grade into "supratidal marshes" in areas above mean high water where salt can concentrate by evaporation (Buckley and Ristich 1976, Kiviat 1979, Kiviat and Stevens 2001). More data on supratidal communities are needed.

Distribution: along the seacoast of the Coastal Lowlands ecozone, and along the Hudson River from New York City to Newburgh in the Triassic Lowlands and Hudson Valley ecozones.

Rank: G4 S3S4 *Revised:* 2001

Examples: Constitution Marsh, Putnam County; Iona Island, Rockland County; Piermont Marsh, Rockland County; Nissequogue River, Suffolk County; Carmans River, Suffolk County.

Sources: Buckley and Ristich 1976; Dreyer and Niering 1995; Kiviat 1979; Kiviat and Stevens 2001; MacDonald and Edinger 2000; Metzler and Rosza 1982; Muenscher 1937; Odum *et al.* 1984; Senerchia-Nardone *et al.* 1985; Swift 1987, 1989; NYNHP field surveys.

9. Brackish intertidal mudflats: a sparsely vegetated community, characterized by low-growing, rosette-leaved aquatics. The community occurs on exposed intertidal mudflats where water salinity ranges from 0.5 to 18.0 ppt. This community is best developed where mudflats are nearly level so that broad expanses are exposed at low tide. The rosette-leaved aquatics are completely submerged at high tide, and they are usually coated with mud.

Characteristic species are spongy arrowhead (*Sagittaria calycina* var. *spongiosa*), strap-leaf arrowhead (*Sagittaria subulata*), mudwort (*Limosella australis*), three-square (*Schoenoplectus pungens, S. americanus*), and tapegrass or wild celery (*Vallisneria americana*).

More data on the unvegetated and algal variants of this community and characteristic fauna are needed.

Distribution: restricted to the Hudson River from New York City to Newburgh in the Triassic Lowlands and Hudson Valley ecozones.

Rank: G3G4 S1S2 *Revised:* 2001

Examples: Piermont Marsh, Rockland County; Constitution Marsh, Putnam County; Iona Marsh, Rockland County.

Sources: MacDonald and Edinger 2000; Muenscher 1937; NYNHP field surveys.

10. Brackish intertidal shore: a community of the intertidal gravelly or rocky shores of brackish tidal rivers and creeks where water salinity ranges from 0.5 to 18.0 ppt. This community is usually sparsely vegetated. Much more data on this community are needed.

Distribution: along the seacoast of Long Island in the Coastal Lowlands ecozone, and along the Hudson River from New York City to Poughkeepsie in the Triassic Lowlands and Hudson Valley ecozones.

Rank: G3G4 S1S2 *Revised:* 1990

Example: Hands Creek, Suffolk County.

Sources: Kiviat and Stevens 2001; NYNHP field surveys.

11. Freshwater tidal swamp: a forested or shrub-dominated tidal wetland that occurs in lowlands along large river systems characterized by gentle slope gradients coupled with tidal influence over considerable distances. The swamp substrate is always wet and is subject to semidiurnal flooding by fresh tidal water (salinity less than 0.5 ppt).

The characteristic trees are green ash (*Fraxinus pennsylvanica*), black ash (*F. nigra*), red maple (*Acer rubrum*), slippery elm (*Ulmus rubra*), and in a few cases American hornbeam (*Carpinus caroliniana*). Northern white cedar (*Thuja occidentalis*) is an unusual associate in at least one example in the Hudson Valley.

Characteristic shrubs and vines include alders (*Alnus serrulata, A. incana* ssp. *rugosa*), spicebush (*Lindera benzoin*), arrowwood (*Viburnum dentatum* var. *lucidum*), silky dogwood (*Cornus amomum*), red-osier dogwood (*C. sericea*), gray dogwood (*C. racemosa*), Virginia creeper (*Parthenocissus quinquefolia*), and poison ivy (*Toxicodendron radicans*).

Characteristic groundlayer species are rice cutgrass (*Leersia oryzoides*), sensitive fern (*Onoclea sensibilis*), clearweed (*Pilea fontana, P. pumila*), spotted jewelweed (*Impatiens capensis*), common monkeyflower (*Mimulus ringens*), knotweeds (*Persicaria hydropiper, P. hydropiperoides*), tearthumbs (*Persicaria arifolia, P. sagittata*), skunk cabbage (*Symplocarpus foetidus*), arrowleaf (*Peltandra virginica*), hog peanut (*Amphicarpaea bracteata*), groundnut (*Apios americana*), wild yam (*Dioscorea villosa*), sedge (*Carex grayi*), Jack-in-the-pulpit (*Arisaema triphyllum*), and swamp milkweed (*Asclepias incarnata*). Invasive non-native herbs in freshwater tidal swamps include yellow iris (*Iris pseudoacorus*), purple loosestrife (*Lythrum salicaria*), and moneywort (*Lysimachia nummularia*).

Data on characteristic fauna are needed.

Distribution: restricted to the Hudson River from Newburgh to Troy, in the Hudson Valley ecozone.

Rank: G2G3 S2 *Revised:* 2004

Examples: Roger's Island, Columbia County; North Tivoli Bay, Dutchess County; Catskill Marsh, Greene County.

Sources: DeVries and DeWitt 1986; Kiviat 1983; Kiviat and Stevens 2001; Leonardi 1991; Leonardi and Kiviat 1990; McVaugh 1958; Westad 1987; Westad and Kiviat 1986; NYNHP field surveys.

12. Freshwater tidal marsh: a marsh community that occurs in shallow bays, shoals, and at the mouth of tributaries of large tidal river systems, where the water is usually fresh (salinity less than 0.5 ppt), and less than 2 m (6 ft) deep at high tide. The vegetation is dominated by aquatics that are emergent at high tide. Typically there are two zones in a freshwater tidal marsh: a low-elevation area dominated by short, broad-leaf emergents bordering mudflats or open water, and a slightly higher-elevation area dominated by tall graminoids.

Characteristic plants of the low-elevation, broad-leaf emergent zone include broad-leaved spatterdock (*Nuphar advena* ssp. *advena*), pickerel-weed (*Pontederia cordata*), and arrowleaf (*Peltandra virginica*). Under the canopy of emergents (or between clones) there may be a sparse understory of rosette-leaved aquatics such as narrow-leaved arrowheads (*Sagittaria subulata, S. graminea,* and *S. rigida*), golden club (*Orontium aquaticum*), and mud-plantain (*Heteranthera reniformis*).

Characteristic plants of the slightly higher, graminoid zone include narrowleaf cattail (*Typha*

angustifolia), river bulrush (*Bolboschoenus fluviatilis*), bur-reed (*Sparganium eurycarpum*), wild rice (*Zizania aquatica*), and blue flag (*Iris versicolor*).

Other characteristic plants include arrowhead (*Sagittaria latifolia*), rice cutgrass (*Leersia oryzoides*), water-hemp (*Amaranthus cannabinus*), spotted jewelweed (*Impatiens capensis*), beggar-ticks (*Bidens bidentoides, B. cernua, B. frondosa, B. laevis*), sweetflag (*Acorus americanus*), bulrushes (*Bolboschoenus fluviatilis, Schoenoplectus tabernaemontani*), sedges (*Carex hystericina, C. lacustris*), spotted joe–pye-weed (*Eutrochium maculatum*), sneezeweed (*Helenium autumnale*), spotted jewelweed (*Impatiens capensis*), false-pimpernel (*Lindernia dubia*), monkey-flowers (*Mimulus alatus, M. ringens*), clearweeds (*Pilea fontana, P. pumila*), smartweeds (*Persicaria hydropiperoides*), and flat sedges (*Cyperus* spp.). Purple loosestrife (*Lythrum salicaria*), yellow iris (*Iris pseudoacorus*), and European common reed (*Phragmites australis*) are common non-native plants in this community.

Some marshes include small areas of sandflats often dominated by one or a few species. Characteristic plants of sandflats include three-square (*Schoenoplectus americanus*), water horsetail (*Equisetum fluviatile*), Pennsylvania bittercress (*Cardamine pensylvanica*), mud-hyssop (*Gratiola neglecta*), water smartweed (*Persicaria punctata*), and black mustard (*Brassica nigra*).

Characteristic birds with varying abundance include marsh wren (*Cistothorus palustris*), red-winged blackbird (*Agelaius phoeniceus*), swamp sparrow (*Melospiza georgiana*), Virginia rail (*Rallus limicola*), song sparrow (*Melospiza melodia*), yellow warbler (*Dendroica petechia*), least bittern (*Ixobrychus exilis*), American goldfinch (*Carduelis tristis*), willow flycatcher (*Empidonax traillii*) - in shrub patches, and common yellowthroat (*Geothlypis trichas*) (Swift 1987, 1989). A characteristic mammal of freshwater tidal marshes is the muskrat (*Ondatra zibethicus*).

Distribution: along the Hudson River from Newburgh to Troy, in the Hudson Valley ecozone, and smaller examples on Long Island tidal rivers.

Rank: G3G4 S2 *Revised:* 2004

Examples: Stockport Creek Marshes, Columbia County; Rogers Island, Columbia County; North Tivoli Bay, Dutchess County; Catskill Marsh, Greene County.

Sources: DeVries and DeWitt 1986; Kiviat 1974; Kiviat 1979; Kiviat and Stevens 2001; Leck *et al.* 1988; Metzler and Rosza 1982; Muenscher 1937; Odum *et al.* 1984; Swift 1987, 1989; NYNHP field surveys.

13. Freshwater intertidal mudflats: a sparsely vegetated, to non-vegetated, community characterized by low rosette-leaved aquatics. This community occurs on exposed intertidal mudflats, or muddy sand, where the water is fresh (salinity less than 0.5 ppt). This community is best developed where mudflats are nearly level so that broad expanses are exposed at low tide. The plants are completely submerged in 0.9 to 1.2 m (3 to 4 ft) of water at high tide; and they are usually coated with mud.

Characteristic species include various arrowheads often with reduced-size rosette leaves, such as strap-leaf arrowhead (*Sagittaria subulata*), grass-leaf arrowhead (*Sagittaria graminea*), stiff arrowhead (*Sagittaria rigida*), and spongy arrowhead (*Sagittaria montevidensis*). Other characteris plants include mud-plantain (*Heteranthera reniformis*), three-square (*Schoenoplectus americanus*), golden club (*Orontium aquaticum*), and broad-leaved spatterdock (*Nuphar advena* ssp. *advena*). Other plants, more typical of freshwater tidal marsh, that may occur on mudflats with low percent cover include arrow-arum (*Peltandra virginica*), smartweed (*Persicaria hydropieroides*), and pickerelweed (*Pontederia cordata*).

Data on characteristic fauna are needed.

Distribution: along the Hudson River from Newburgh to Troy, in the Hudson Valley ecozone.

Rank: G3G4 S2 *Revised:* 2004

Examples: Stockport Creek Marshes, Columbia County; North Tivoli Bay, Dutchess County; Rogers Island, Columbia County.

Sources: Kiviat and Stevens 2001; Muenscher 1937; NYNHP field surveys.

14. Freshwater intertidal shore: a community of the intertidal gravelly or rocky shores of freshwater tidal rivers and creeks. The community sometimes occurs at the base of cliffs, where the water is fresh (salinity less than 0.5 ppt). The vegetation may be very sparse.

Characteristic species are heartleaf plantain (*Plantago cordata*), estuary beggar-ticks (*Bidens bidentoides*), water-hemp (*Amaranthus cannabinus*), smartweed (*Persicaria hydropiperoides*), cardinal flower (*Lobelia cardinalis*), bittercresses (*Cardamine pensylvanica, C. longii*), mud-hyssop (*Gratiola neglecta*), Davis' sedge (Carex davisii), and black

mustard (*Brassica nigra*).

Data on characteristic fauna are needed.

Distribution: along the Hudson River from Newburgh to Troy, in the Hudson Valley ecozone.

Rank: G3G4 S2S3 *Revised:* 2004

Examples: Tivoli Bays, Dutchess County; Inbocht Bay, Greene County.

Sources: Kiviat and Stevens 2001; McVaugh 1958; Muenscher 1937; NYNHP field surveys.

C. ESTUARINE CULTURAL

This subsystem includes communities that are either created and maintained by human activities, or are modified by human influence to such a degree that the physical conformation of the substrate, or the biological composition of the resident community is substantially different from the character of the substrate or community as it existed prior to human influence.

1. Estuarine submerged structure: the aquatic community associated with an artificially introduced structure submerged in estuarine waters, such as a tidal river or creek, that provides habitat for fish and other organisms. This includes structures that have been intentionally sunk for the purpose of attracting fish, as well as sunken ships, disposed waste, submerged bridge abutments, or any other introduced material that provides suitable habitat.

Distribution: in the Hudson Valley, Hudson Highlands, Manhattan Hills, and Coastal Lowlands ecozones.

Rank: unranked cultural *Revised:* 2004

2. Estuarine water chestnut bed: the aquatic community within the freshwater to brackish portion of a tidal river that is dominated by large, nearly continuous mats of non-native water chestnut (*Trapa natans*). This community may develop in open water bays behind tidally connected impoundments, such as railroad beds, or along the river in more shallow and sheltered coves with slow moving water.

Distribution: along the Hudson River from Albany to Garrison in the Town of Philipstown (Kiviat and Stevens 2001).

Rank: unranked cultural *Revised:* 2004

Examples: South Tivoli Bay, Dutchess County.

Sources: Anderson and Schmidt 1989; Golhammer and Findlay 1988; Kelley and Peritte 1989; Kiviat and Stevens 2001; Pelczarski and Schmidt 1991.

3. Estuarine channel/artificial impoundment: the aquatic community of an estuarine channel or bay that was created or modified by a barrier or dam which obstructs the outflow of water; an artificial estuarine deepwater community.

Distribution: in the Hudson Valley, Hudson Highlands, Manhattan Hills, and Coastal Lowlands ecozones.

Rank: unranked cultural *Revised:* 1990

4. Estuarine ditch: the aquatic community of a ditch or narrow channel excavated in an estuarine marsh for the intended purpose of reducing mosquito populations. These ditches have not been very effective in reducing mosquito populations; the ditches have probably done more harm to the salt marsh vegetation than is justified by the effectiveness of the mosquito control efforts.

Distribution: along the seacoast of the Coastal Lowlands and Manhattan Hills ecozones.

Rank: unranked cultural *Revised:* 1990

5. Estuarine impoundment marsh: a marsh community that occurs in a wetland created or modified by a barrier or dam that obstructs the outflow or inflow of water and which has a biological composition significantly different from the composition of a natural estuarine marsh. Estuarine impoundment marshes may occur in tidal freshwater, brackish, and salt marsh settings. The freshwater tidal type is common along the Hudson River behind railroad beds that function as a tidal barrier. This marsh community is characterized by an abundance of weedy species, such as purple loosestrife (*Lythrum salicaria*) and European common reed (*Phragmites australis*). Channels within the marsh may contain water chestnut (*Trapa natans*). Impoundments with large, continuous mats of water chestnut may be classified as estuarine water chestnut bed and those dominated by common reed may be classified as estuarine common reed marsh.

Distribution: in the Hudson Valley, Hudson Highlands, Manhattan Hills, and Coastal Lowlands ecozones.

Rank: unranked cultural *Revised:* 2004

6. Estuarine common reed marsh: a tidal marsh dominated by European common reed (*Phragmites australis*). Estuarine common reed marshes may become established in tidal freshwater, brackish, and salt marsh settings, usually following artificial alteration to natural hydrology, or change in marsh configuration (*e.g.*, via dredging and/or ditching, etc.). See estuarine impoundment marsh for wetlands created or modified by a barrier or dam that obstructs the outflow or inflow of water. Although remnant native plants may be present, the abundance of common reed makes it impossible to classify the marsh as one of the esturine natural communities. In extreme examples, common reed may form a monotypic stand.

Distribution: in the Hudson Valley, Hudson Highlands, Manhattan Hills, and Coastal Lowlands ecozones.

Rank: unranked cultural *Revised:* 2004

7. Estuarine dredge spoil shore: the wetland community of a constructed estuarine shore in which the substrate is composed of dredge spoils. This is a community with minimal vegetative cover and relatively low species diversity, but the upper edges may have high diversity. Several distinct types of dredge spoil habitats have been described (Kiviat and Stevens 2001).

Distribution: in the Hudson Valley, Hudson Highlands, Manhattan Hills, and Coastal Lowlands ecozones.

Rank: unranked cultural *Revised:* 2004

Source: Kiviat and Stevens 2001.

8. Estuarine riprap/artificial shore: the wetland community of a constructed estuarine shore in which the substrate is composed of broken rocks, wooden bulkheads, or concrete placed so as to reduce erosion. Vegetative cover and species diversity are low compared to natural estuarine shores.

Distribution: in the Hudson Valley, Hudson Highlands, Manhattan Hills, and Coastal Lowlands ecozones.

Rank: unranked cultural *Revised:* 1990

9. Estuarine dredge excavation pit/channel: the benthic and adjacent aquatic community created by dredging tidal river sediments in order to keep it clear and safe for boat and ship traffic (United States Army Corps of Engineers 2002). Sections of the main channel of the Hudson River are examples of maintained estuarine dredge excavation channels. Dredged navigation channels vary in length and depth.

Distribution: along the seacoast of the Coastal Lowlands and Manhattan Hills ecozones.

Rank: unranked cultural *Revised:* 2009

Source: United States Army Corps of Engineers 2002.

D. ESTUARINE REFERENCES

Anderson, A. B. and R. E. Schmidt. 1989. Survey of larval and juvenile fish populations in water-chestnut *(Trapa natans)* beds in Tivoli South Bay, a Hudson River tidal marsh. Section VI: 34 pp. *In* E. A. Blair and J. R. Waldman (eds.), Polgar Fellowship Reports of the Hudson River National Estuarine Research Reserve Program, 1988. Hudson River Foundation, NY.

Amos, W. H. and S. H. Amos. 1985. Atlantic & Gulf Coasts. The Audubon Society Nature Guides. Alfred A. Knopf, New York, NY.

Berrill, M. and D. Berrill. 1981. The North Atlantic Coast. A Sierra Club Naturalist's Guide. Sierra Book Clubs, San Francisco, CA.

Boyce Thompson Institute for Plant Research. 1977. An atlas of biologic resources of the Hudson estuary. Boyce Thompson Institute for Plant Research., Yonkers, NY.

Buckley, E. H. and S. S. Ristich. 1976. Distribution of rooted vegetation in the brackish marshes and shallows of the Hudson River Estuary. Paper 20 In Hudson River Ecology, 4th Symposium Hudson River Environ. Soc., Bronx, NY.

Clark, J. S. 1985. The development of a tidal marsh: upland and oceanic influences. Ecol. Monogr. 55(2): 189-217.

Clark, J. S. 1986. Dynamism in the barrier-beach vegetation of Great South Beach, New York. Ecol. Monogr. 56(2): 97-126.

Conard, H. S. 1935. The plant associations of central Long Island. Am. Mid. Nat. 16: 433-515.

Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. Office of Biological Services, Fish and Wildlife Service, US Dept. of Interior, Washington, DC

Day Jr., J. W., C. A. S. Hall, W. M. Kemp, and A. Yanez-Arancibia. 1989. Estuarine Ecology. John Wiley & Sons, Inc. New York, NY.

DeVries, C. and C. B. DeWitt. 1986. Freshwater tidal wetlands community description and relation of plant distribution to elevation and substrate. In: Polgar Fellowship Reports of the Hudson River National Estuarine Sanctuary Program 1986. E. A. Blair and J. C. Cooper, editors. Hudson River Foundation, New York, NY.

Dreyer, G. D. and W. A. Niering. 1995. Tidal marshes of Long Island Sound: ecology, history, and restoration. Connecticut College Arboretum, Bulletin No. 34. Connecticut College, New London, CT.

Fassett, N. C. 1928. The vegetation of the estuaries of northeastern North America. Proc. Boston Sox. Nat. Hist. 39: 73-130.

Findlay, S., E. A. Blair, W. C. Neider, E. Barnaba, and S. Hoskins. 1997. Distribution of submerged rooted vegetation beds of the tidal Hudson River. Unpublished report prepared for New York Sea Grant. Institute of Ecosystem Studies, Millbrook, NY.

Gladden, J. B., F. R. Cantelmo, J. M. Croom, and R. Shapot. 1988. Evaluation of the Hudson River ecosystem in relation to the dynamics of fish populations. Am. Fisheries Soc. Monogr. 4: 37-52.

Goldhammer, A. and S. E. G. Findlay. 1988. Estimation of suspended material flux between a *Trapa natans* stand and the Hudson River Estuary. Section VIII: 46 pp. *In* J. R. Waldman and E. A. Blair (eds.), Polgar Fellowship Reports of the Hudson River National Estuarine Research Reserve Program, 1987. Hudson River Foundation, NY.

Glassberg, J. 1999. Butterflies through the Binoculars: The East. Oxford University Press, New York. 242 p.

Gosner, K. L. 1978. A Field Guide to the Atlantic Seashore. Peterson Field Guides. Houghton Mifflin Company, New York, NY.

Harlin, M. M., V. J. Masson, and R. E. Flores. 1995. Distribution and abundance of submerged aquatic vegetation in Trustom Pond, Rhode Island. Report submitted to US Fish and Wildlife Service, October 13, 1995.

Hayden, B. P., M. C. F. V. Santos, G. Shao, R. C. Cochlea. 1995. Geomophological controls on coastal vegetation at the Virginia Coast Reserve. Geomorphology 13:283-300.

Houghton, R. A. and G. M. Woodwell. 1980. The Flax Pond ecosystem study: exchanges of CO_2 between a salt marsh and the atmosphere. Ecology 61(6):1434-1445.

Hunt, D. M. 2001. Community ranking and general description of the Hudson River estuary, tidal river. Unpublished report. New York Natural Heritage Program, Albany, NY.

Hunt, D. M. 2000. 1999 Mashomack marine and estuarine aquatic community project. Unpublished report. New York Natural Heritage Program, Latham, NY.

Johnson, A. F. 1985. A guide to the plant communities of the Napeague Dunes. Publ. by the author, Southampton, NY. 58 pp.

Joneja, DC 1981. Sedimentary dynamics of Fire Island, New York. Unpublished masters Thesis, University of Massachusetts, Amherst, MA.

Kelly, M. and W. Perritte. 1989. The epiphytic invertebrates of *Trapa natans* and *Myriophyllum* at Roosevelt Cove, Hyde Park, NY. Section IV: 19 pp. *In* E. A. Blair and J. R. Waldman (eds.), Polgar Fellowship Reports of the Hudson River National Estuarine Research Reserve Program, 1988. Hudson River Foundation. NY.

Kiviat, E. 1974. A fresh-water tidal marsh on the Hudson, Tivoli North Bay. Paper 14, *In* Third Symposium on Hudson River Ecology, Hudson River Environmental Society, Bronx, NY.

Kiviat, E. 1979. Hudson River Estuary shore zone: ecology and management. MA Thesis, State University College, New Paltz, NY.

Kiviat, E. 1983. Fresh-tidal swamp vegetation, Hudson River. Estuaries 6(3):279.

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

Kulik, S., P. Salmansohn, M. Schmidt, and H. Welch. 1984. The Audubon Society Field Guide to the Natural Places of the Northeast: Coastal. Random House, Inc. New York, NY.

Leatherman, S. P. 1979. Barrier Island Handbook. University of Maryland, College Park, MD.

Leck, A. L., R. L. Simpson, D. F. Whigham, and C. F. Leck. 1988. Plants of the Hamilton Marshes: A Delaware River freshwater tidal wetland. Bartonia 54:1-17.

Leonardi, L. 1991. Bryophytes of two New York State freshwater tidal swamps. Evansia 8(1):22-25.

Leonardi, L. and E. Kiviat. 1990. The bryophytes of the Tivoli Bays freshwater tidal swamps. Section III: 23 pp. *In* J. R. Waldman and E. A. Blair (eds.), Final Reports of the Tibor T. Polgar Fellowship Program, 1989. Hudson River Foundation, NY.

MacDonald, D. and G. J. Edinger. 2000. Identification of reference wetlands on Long Island, New York. Final report for US Environmental Protection Agency. New York Natural Heritage Program, Latham, NY.

Macomber, R. T. and D. Allen. 1979. The New Jersey submersed aquatic vegetation distribution atlas final report. Prepared for the New Jersey Dept. of Env. Protection, Division of Coastal Resources, Bureau of Coastal Planning and Development. Trenton, NJ.

McVaugh, R. 1958. Flora of Columbia County area, New York. NYS Mus. and Sci. Service, Bull. No. 360, Albany, NY.

Metzler, K. and R. Rosza. 1982. Vegetation of fresh and brackish tidal marshes in Connecticut. Newsletter of the Connecticut Botanical Society 10(1): 1-3.

Miller, W. R. and F. E. Egler. 1950. Vegetation of the Wequetequock-Pawcatuck tidal marshes, Connecticut. Ecological Monographs 20: 143-172.

Moran, M. A. and K. E. Limburg. 1986. The Hudson River ecosystem. *In* K. E. Limburg, M. A. Moran, and W. H. McDowell. The Hudson River Ecosystem. SpringerVerlag, NY.

Muenscher, W. C. 1937. Aquatic vegetation of the lower Hudson area. In: A biological survey of the lower Hudson watershed. Suppl. to the 26th Ann. Rep., 1936. NYS Conserv. Dept., Albany, NY.

Niedowski, N. L. 2000. New York State salt marsh restoration and monitoring guidelines. Prepared for New York Department of State, Albany, NY, and New York Department of Environmental Conservation, East Setauket, NY.

Nixon, S. W. 1982. The ecology of New England high salt marshes: a community profile. US Fish and Wildlife Service, Office of Biological Services, Washington, DC FWS/OBS-81/55.

Odum, W. E., T. J. Smith III, J. K. Hoover, and C. C. McIvor. 1984. The ecology of tidal freshwater marshes of the United States east coast: a community profile. US Fish and Wildlife Service, Washington, DC FWS/OBS-83/17.

Oertel, G. F. 1985. The barrier island system. Marine Geology 63:1-18.

Oertel, G. F., J. C. Kraft, M. S. Kearnery and H. J. Woo 1993. A rational theory for barrier lagoon development. SEPM:. Special Publication #48. Quaternary Coasts of the United States: Marine and Lacustrine Systems. Old Dominion University. Norfolk, VA.

Oertel, G. F. and H. J. Woo. 1994. Landscape classification and terminology for marsh in deficit coastal lagoons. Journal of Coastal Research 10(4):919-932.

Pelczarski, K. and R. Schmidt. 1991. Estimates of fish biomass in Trapa beds using a pop net. Section V: 33 pp. In E. A. Blair and J. R. Waldman (eds.). Final Reports of the Tibor T. Polgar Fellowship Program, 1990. Hudson River Foundation, NY.

Redfield, A. C. 1972. Development of a New England salt marsh. Ecol. Monogr. 42(2): 201-237.

Schmidt, R. E., and E. Kiviat. 1988. Communities of larval and juvenile fish associated with water chestnut, watermilfoil and water celery in the Tivoli Bays of the Hudson River. Final report to Hudson River Foundation.

Senerchia-Nardone, P., A. Reilly, and M. M. Holland. 1985. Comparison of vascular plant zonation at Iona Island Marsh (Hudson River Estuary) and Lord's Cove Marsh (Connecticut River Estuary). In: Polgar Fellowship Reports of the Hudson River National Estuarine Sanctuary Program 1985. J. C. Cooper, Editor. Hudson River Foundation, New York, NY.

Spinner, G. P. 1969. A plan for marine resources of the Atlantic coastal zone. Published in conjunction with Folio 18: The wildlife and shellfish areas of the Atlantic coastal zone. Serial atlas of the marine environment. American Geographic Society, NY.

Strahler, A. N. 1957. Quantitative analysis of watershed geomorphology. American Geophysical Union Transactions. 38: 913-920.

Swift, B. 1987. An analysis of avian breeding habitats in Hudson River tidal marshes. Final report. June 1987. New York State Department of Environmental Conservation, Delmar, NY.

Swift, B. 1989. Avian breeding habitats in Hudson River tidal marshes. Final report. August 1989. New York State Department of Environmental Conservation, Delmar, NY.

Teal, J. M. 1986. The ecology of regularly flooded salt marshes of New England: a community profile. US Fish and Wildlife Service. Biol. Rep. 85(7.4).

Thorne-Miller, B., M. M. Harlin, G. B. Thursby, M. M. Brady-Campbell, and B. A. Dworetsky. 1983. Variations in the distribution and biomass of submerged macrophytes in five coastal lagoons in Rhode Island, USA. Botanica Marina 26:231-242.

United States Army Corps of Engineers. 1995 (revised 1996). Fire Island Inlet to Montauk Point, Long Island, New York. Breach contingency plan. United States Army Corps of Engineers. New York District.

United States Army Corps of Engineers. 1999. Fire Island Inlet to Montauk Point, Long Island, New York. Reach 1. Fire Island Inlet. Draft decision document an evaluation of an interim plan for storm damage protection. Volume 1. Main report and draft environmental impact statement. United States Army Corps of Engineers. New York District.

Webber, E. E. 1967. Bluegreen algae from a Massachusetts salt marsh. Bull. Torrey Bot. Club 94: 99-106.

Westad, K. E. 1987. Addendum to flora of freshwater tidal swamps at Tivoli Bays. Section X: 1 p. *In* E. A. Blair (eds.), Final Reports of the Tibor T. Polgar Fellowship Reports of the Hudson River National Estuarine Research Reserve Program, 1986. Hudson River Foundation, NY.

Westad, K. E. and E. Kiviat. 1986. Flora of freshwater tidal swamps at Tivoli Bays, Hudson River National Estuarine Sanctuary. *In*: Polgar Fellowship Reports of the Hudson River National Estuarine Sanctuary Program 1985. J. C. Cooper, Editor. Hudson River Foundation, New York, NY.

III. RIVERINE SYSTEM

The riverine system consists of linear aquatic communities of flowing, non-tidal waters with a discrete channel, with persistent emergent vegetation sparse or lacking, but may include areas with abundant submerged or floating-leaved aquatic vegetation. The riverine communities in this classification are distinguished primarily by position of the stream in the watershed and water flow characteristics.

These communities are broadly defined at the macrohabitat level, and may include two or more finer scale habitats or microhabitats, such as *riffles* (which include waterfalls), *runs*, and *pools;* these habitats usually have distinctive species assemblages (*i.e.*, "associations"). A *riffle* is a part of the stream that is shallow and has a comparatively fast current; the water surface is disturbed by the current and may form standing waves (*i.e.*, it is "turbulent"). A *run* is a part of the stream that has a moderate to fast current; the water is deep enough that the water surface is smooth and unbroken by the water current (although it may be disturbed by wind). A *pool* is a part of the stream that is deep and has a comparatively slow current; the water surface is calm unless disturbed by wind. Species assemblages may additionally vary within a microhabitat over different substrate types.

The riverine communities are also distinguished by size of the stream including stream order (*sensu* Strahler 1957). In New York, 1st to 2nd order streams can be very small to small in size and generally correspond to intermittent and headwater streams in this classification. Some larger headwater streams may be 3rd order. Small streams have an average flow width less than about 3 m (10 ft). The 3rd to 4th order streams can be medium to large in size and generally correspond to larger header headwater streams and confined rivers in this classification. Medium streams have an average flow width from about 3 to 30 m (10 ft to 100 ft). The 5th to 6th order streams are large in size and generally correspond to unconfined rivers in this classification. Large streams have an average flow width greater than about 30 m (100 ft). Deepwater rivers are the largest in the state and correspond to 8th order or higher.

This classification of riverine communities is based on a combination of NYNHP field surveys, literature review, and discussions with aquatic ecologists. Several dozen plots have been sampled statewide by NY Natural Heritage in riverine communities. Bob Daniels of the New York State Museum provided much of the initial information on fish communities. Although NY Natural Heritage has conducted inventory work on streams since 1995, we do not currently have sufficient field data for confidently undertaking any major restructuring of the Reschke (1990) riverine classification. To do this with confidence for characteristic invertebrates would require the use of standardized sampling methods in the development of an extensive database (M. Novak *pers. comm.*). However, limited NYNHP field work has suggested that this classification works well for representing the coarse scale distinctions between both abiotic and biotic features of river types.

This classification is intended to represent entire riverine macrohabitats. Although physically based, it is meant to serve as a coarse filter emphasizing resident riverine biota. It is recognized that streams and rivers may contain numerous pelagic and benthic associations and that there is often much overlap in association distribution across riverine macrohabitats. For now, NY Natural Heritage is maintaining this macrohabitat classification while evaluating the utility and feasibility of replacing or supplementing this classification with an association classification.

Further refinement of the riverine classification to distinguish regional variants will likely be based on additional field surveys and analysis of existing data collected by various aquatic scientists and agencies statewide. Regional variation in many of the designated riverine communities is evident, but we do not currently have enough information nor have we undertaken analyses to confidently split common and widespread stream types into more specific regional variants. A finer scale classification of streams that distinguishes types according to ecoregion and/or watershed is being evaluated. Preliminary conclusions suggest that vascular plant, bryophyte, algae, fish, mollusk, insect, and plankton assemblages may follow different distribution patterns, some more closely correlated with ecoregion boundaries, some more closely with major ecological drainage units. The fish and mollusk assemblages in the riverine communities (especially in unconfined rivers and deepwater rivers) generally vary according to the watershed.

A. NATURAL STREAMS

This subsystem includes streams in which the stream flow, morphometry, and water chemistry have not been substantially modified by human activities, and the native plants and animals are dominant. There may be some introduced plants and animals (*e.g.,* stocked or accidentally introduced fishes), however the introduced species are not usually dominant in the stream community as a whole. The streams are presented here in stream order (*sensu* Strahler 1957) from smallest to largest (*i.e.*, 1st to 8th order).

1. Spring: the aquatic community of very small, cold stream sources where the flow is perennial. Springs are characterized by water with constant cold temperature and rich in dissolved oxygen. These streams are typically very shallow and have a short length and relatively constant and very low discharge. Stream gradient, substrate, and the proportion of flow microhabitats can vary greatly between examples. These streams may adjoin to any other aquatic community, but are typically 1st order streams (*sensu* Strahler 1957) found in association with headwater streams.

Species diversity may be high, and assemblages characteristic of riffles may dominate the community. They are known in the literature as "madicolous habitat" or "spring creeks" (Sutton 1998). Fishes are absent. Characteristic amphibians may include northern dusky salamander (*Desmognathus fuscus fuscus*). Characteristic and dominant macroinvertebrates may include flatworms (Tricladida), several caddisflies (Limnephilidae, *Lepidostoma* spp., *Rhyacophila* spp., *Dolophilodes distinctus*, *Pycnopsyche gentilis*), several stoneflies (Perlodidae, Chloroperlidae, *Peltoperla* spp., *Sweltsa* spp.), craneflies (Tipulidae), springtails (*Orchesella* spp.), mayflies (Ephemeroptera), clubtails (*Lanthus parvulus, L. vernalis*), and beetles (Coleoptera). Some low diversity examples studied by Sutton (1998) with cold alklaline water on the Great Lakes Plain are dominated by amphipods (*e.g., Gammarus pseudolimnaeus*), mayflies (*Ephemerella* spp.), and midges (Chironomidae).

Characteristic vascular plants may include water-carpet (*Chrysosplenium americanum*), wood nettle (*Laportea canadensis*), clearweed (*Pilea pumila*), sedge (*Carex scabrata*), and Pennsylvania bittercress (*Cardamine pensylvanica*). Characteristic mosses may include *Brachythecium* spp. and *Fissidens* spp.

Four to seven ecoregional variants (including Northern Appalachian, Lower New England, Great Lakes and Allegheny Plateau types) are suspected to differ in dominant and characteristic vascular plants, mollusks, and insects as well as water chemistry, water temperature, underlying substrate type, and surrounding forest type. More data on this community are needed.

Distribution: throughout New York State.

Rank: G4 S3 *Revised:* 2001

Examples: Murray Brook, Cattaraugus County; Caledonia Spring Creek, Livingston County; Cedar Springs, Monroe County; Mossy Brook Bank Spring, Ulster County; Zoar Valley, Cattaraugus County.

Sources: Hynes 1970; Sutton 1998; Williams 1979; NYNHP field surveys.

2. Intermittent stream: the community of a small, intermittent, or ephemeral streambed in the uppermost segments of stream systems where water flows only during the spring or after a heavy rain and often remains longer, ponded in isolated pools. Intermittent streams may be classified as 1st order streams (*sensu* Strahler 1957), but may be excluded from the stream order scheme, if only perennial streams are classified (*i.e.*, headwater streams are 1st order and intermittent streams have "zero order"). These streams typically have a moderate to steep gradient and hydric soils.

The streambed may be covered with diverse emergent and submergent bryophytes; characteristic species may include the mosses *Bryhnia novae-angliae, Bryum pseudotriquetrum, Hygrohypnum ochraceum, H. eugyrium, Hygroamblystegium tenax, Fontinalis* spp., *Brachythecium rivulare, B. plumosum, Platyhypnidium riparioides, Plagiomnium ciliare*, and the leafy liverworts *Chiloscyphus polyanthus, Scapania nemorea,* and *S. undulata*.

Characteristic vascular plants are hydrophytic and may include water-carpet (*Chrysosplenium americanum*) and pennywort (*Hydrocotyle americana*).

The fauna is diverse and limited to species that do not require a permanent supply of running water, that inhabit the streambed only during the rainy season, or that are pool specialists. Characteristic fauna include amphibians such as immature or hibernating green frog (*Rana clamitans*) (A. Briesch *pers. comm.*) and northern two-lined salamander (*Eurycea bislineata*); macroinvertebrates such as water striders (*Gerris* spp.), water boatman (Corixidae), caddisflies (Trichoptera), mayflies (Ephemeroptera), stoneflies (Plecoptera), midges (Chironomidae), blackflies (Simuliidae) and crayfish (*Cambarus bartoni*).

Four to seven ecoregional variants are suspected to differ in dominant and characteristic bryophytes and insects as well as water chemistry, water temperature, underlying substrate type, and surrounding forest type. In addition, there may be a unique alpine/subalpine variant and different variants associated with acidic versus calcareous substrates. Examples surveyed on the Allegheny Plateau are dominated by stoneflies (Perlodidae) and several mayflies (Heptageniidae, *Sweltsa* spp., *Clioperla* spp., *Ameletus* spp.). Other characteristic intermittent stream inscects in this region may include northern pygmy clubtail (*Lanthus parvulus*), craneflies (*Hexatoma* spp.), caddisflies (*Pycnopsyche* spp., *Neophylax* spp.) and stoneflies (*Peltoperla* spp.).

More data on regional variants are needed.

Distribution: throughout New York State.

Rank: G4 S4 *Revised:* 2001

Examples: Carrollton Run, Cattaraugus County; Chicken Coop Brook, Essex County; Porter Mountain, Essex County; Waterman Brook Headwaters, Cattaraugus County; Chautauqua Gorge, Chautauqua County; Quackenkill Headwaters, Rensselaer County.

Sources: Hunt 2001; N. Slack *pers. comm.;* NYNHP field surveys.

3. Rocky headwater stream: the aquatic community of a small- to medium-sized perennial rocky stream typically with a moderate to steep gradient, and cold water that flows over eroded bedrock, boulders, and/or cobbles in the area where a stream system originates. These streams usually have poorly defined meanders (*i.e.,* low sinuosity) and occur in confined landscapes. These streams are typically shallow, narrow, have a relatively small low flow discharge, and usually represent a network of mostly 1st and 2nd order stream segments (*sensu* Strahler 1957), although larger rocky headwater streams may be 3rd order. These streams typically include alternating riffle and pool sections. Most of the erosion is headward, and deposition is minimal. Waterfalls, chutes, flumes, and cascades are typically present; these are treated here as features of the more broadly defined community. The predominant source of food energy to the stream biota is terrestrial leaf litter or organic matter from the surrounding forest (*i.e.,* these are allochthonous streams); trees shading the stream reduce primary productivity. These streams have high water clarity and are well oxygenated. They are typically surrounded by upland forests and situated in a confined valley. Stream segments can alternate between rocky and marsh headwater streams (described below).

Species assemblages characteristic of riffles and rocky substrate and good water quality dominate the community. Characteristic fishes are coldwater species including eastern blacknose dace (*Rhinichthys atratulus*), creek chub (*Semotilus atromaculatus*), common shiner (*Luxilus cornutus*), slimy sculpin (*Cottus cognatus*) or mottled sculpin (*C. bairdi*), and brook trout (*Salvelinus fontinalis*). Additional characteristic fishes may include longnose dace (*Rhinichthys cataractae*), redside dace (*Clinostomus elongatus*), and, in pools, white sucker (*Catostomus commersoni*). Common introductions are rainbow trout (*Salmo gairdneri*) and brown trout (*S. trutta*). Characteristic amphibians may include northern two-lined salamander (*Eurycea bislineata*) and immature or hibernating green frog (*Rana clamitans*) (A. Briesch *pers. comm.*).

Characteristic macroinvertebrates are riffle and rocky bottom specialists as well as leaf and algae shredders such as stoneflies (Plecoptera including Chloroperlidae, Leuctridae, Perlidae), mayflies (Ephemeroptera including Heptageniidae, *Isonychia* spp.), and caddisflies (Trichoptera, including *Rhyacophila* spp., *Neophylax* spp., *Goera* spp., *Glossosoma* spp., *Psilotreta* spp.), midges (Chironomidae), crayfish (Cambaridae including *Cambarus robustus*, *C. bartonii*), water penny beetle (Psephenidae), riffle beetles (Elmidae), craneflies (*Hexatoma* spp.), and blackflies (Simuliidae). Freshwater sponges may be abundant and coating rocks in some examples.

Characteristic pool macroinvertebrates may include true bugs (Gerridae, Velliidae and Mesovelliidae). Mollusks are typically lacking or very sparse and of low diversity. These streams typically have bryophytes and periphytic/epilithic algae present at moderate amounts, but few larger rooted plants. Characteristic bryophytes include the mosses *Brachythecium rivulare, B. plumosum, Eurhynchium riparioides, Hygroamblystegium tenax, Hygrohypnum ochraceum, Rhizomnium punctatum, Mnium hornum, Fontinalis* spp., *Racomitrium aciculare,* and liverworts (*Scapania* spp.). The aquatic lichen *Dermatocarpon luridum* may be common.

Four to six ecoregional variants (including Northern Appalachian, Lower New England, Allegheny Plateau and Great Lakes types) are suspected to differ in dominant and characteristic vascular plants, fishes, bryophytes, and insects as well as water chemistry, water temperature, underlying substrate type, and surrounding forest type. Major watershed may be a secondary factor in distinguishing streams lower in a drainage basin.

Additional species characteristic of streams in the Northern Appalachians may include fishes such as fantail darter (*Etheostoma flabellare*), pearl dace (*Margariscus margarita*), and northern redbelly dace (*Phoxinus eos*); and macroinvertebrates such as caddisflies (*Parapsyche* spp., *Palegapetus* spp., *Symphitopsyche* spp.), stoneflies (Capniidae, *Taenionema* spp., *Peltoperla* spp.), mayflies (*Eurylophella* spp., *Ephemera* spp.), midges (*Eukiefferiella* spp.), and fishflies (Corydalidae).

Additional species characteristic of streams in the St. Lawrence River and Lake Champlain Valleys may include fishes such as common shiner (*Luxilus cornutus*), bluntnose minnow (*Pimephales notatus*), fathead minnow (*P. promelas*) and slimy sculpin (*Cottus cognatus*); and macroinvertebrates such as

stoneflies (*Neoperla* spp.), fingernet caddisflies (*Chimarra* spp., *Dolophilodes* spp.), riffle beetles (Elmidae), odonate (*Ophiogomphus compressa*), and midges (*Polypedilum* spp.).

Additional species characteristic of streams in the Allegheny Plateau may include fishes such as tonguetied minnow (*Exoglossum laurae*), variegated darter (*Etheostoma variatum*), greenside darter *(Etheostoma blenniodes*), rainbow darter (*Etheostoma caeruleum*), mimic shiner (*Notropis volucellus*), bigmouth shiner (*N. dorsalis*), striped shiner (*Luxilus chrysocephalus*) golden redhorse (*Moxostoma erythrurum*) and log perch (*Percina caprodes*); and macroinvertebrates, such as mayflies (*Stenacron* spp., *Paraleptophlebia* spp.), stoneflies (*Sweltsa* spp., *Leuctra* spp., *Yugus* spp.), alderflies (*Sialis* spp.), water penny beetles (*Ectopria* spp.), northern pygmy clubtail (*Lanthus parvulus*), and several caddisflies (*Diplectrona modesta, Glossosoma nigrior, Goera stylata, Hydropsyche* spp., *Lepidostoma* spp., *Neophylax* spp., *Polycentropus* spp., *Pycnopsyche psilotreta).* More data on regional variants are needed.

Distribution: throughout upstate New York north of the Coastal Lowlands ecozone, especially at high elevations.

Rank: G4 S4 *Revised:* 2001

Examples: Opalescent River Headwaters, Essex County; Johns Brook, Essex County; East Branch Fish Creek, Lewis County; Poesten Kill Headwaters from waterfall to the village of Sand Lake, Rensselaer County; Beaver Kill River, Ulster County; Quaker Run, Cattaraugus County; Chaumont River, Jefferson County.

Sources: Cornett 1996; Daniels 1998;Hunt 2001; Slack and Glime 1985; Smith 1985; NYNHP field surveys.

4. Marsh headwater stream: the aquatic community of a small, marshy perennial brook with a very low gradient, slow flow rate, and cool to warm water that flows through a marsh, fen, or swamp where a stream system originates. These streams usually have clearly distinguished meanders (*i.e.*, high sinuosity) and are in unconfined landscapes. Marsh headwater streams are relatively deepfor a headwater stream. These streams are typically dominated by runs with interspersed pool sections and usually lack riffles; they are typically narrow, have a relatively small low flow discharge and usually represent a network of mostly 1st and 2nd order stream segments (*sensu* Strahler 1957), although some larger marsh headwater streams may be 3rd order. Most of the erosion is primarily lateral, and deposition can be substantial. Sparse emergent marshes, floating aquatic beds, submergent aquatic beds, and mussel beds are typically present in this broadly defined community. The substrate is typically gravel or sand, but some examples or segments may be dominated by silt, muck, peat, marl deposits or woody or leafy debris. These streams may have high turbidity and be somewhat poorly oxygenated and can vary in alkalinity and color. Generally, marsh headwater streams are surrounded by, or run through, palustrine communities. Stream segments can alternate between marsh and rocky headwater streams (described above).

Species assemblages characteristic of pools and soft bottoms dominate the community. Characteristic fishes are warmwater minnows including fathead minnow (*Pimephales promelas*), northern redbelly dace (*Phoxinus eos*), golden shiner (*Notemigonus crysoleucas*), and central mudminnow (*Umbra limi*). Additional characteristic fishes may include brook trout (*Salvelinus fontinalis*), white sucker (*Catostomus commersoni*), longnose sucker (*C. catostomus*), pumpkinseed (*Lepomis gibbosus*), brown bullhead (*Ameiurus nebulosus*), and bluntnose minnow (*Pimephales notatus*).

A characteristic mammal is beaver (*Castor canadensis*), and beaver dams and pools are typical of this stream type. Other characteristic vertebrates include ducks and eastern newt (*Notophthalamus viridescens*).

Pool and soft bottom invertebrate specialists are typically common. Characteristic macroinvertebrates include true bugs (Gerridae, Velliidae), mayflies (Heptageniidae), caddisflies (Hydropsychidae, Platycentropus, and possibly *Molanna* sp.), odonates (*Aeshna* spp., *Argia* spp., *Gomphus* spp.), deerflies (*Merycomyia* spp.), water boatman (Corixidae), the mollusks eastern floater (*Pyganodon cataracta*), pea clams (*Pisidium* spp.), and marsh rams-horn snail (*Heliosoma trivolvis*), leeches (Hirudinea), amphipods, (Amphipoda), freshwater sponge (Porifera). Macroinvertebrates found in this stream near lake outlets include insects such as blackflies (Simuliidae), caddisflies (*Hydropsyche* spp., *Cheumatopsyche* spp., *Symphytopsyche* spp.), midges (Chironomidae in the Tanytarsini tribe), and the mollusk fingernail clams (*Sphaerium* spp.).

Submergent vascular plants may be abundant; characteristic aquatic macrophytes include water milfoil (*Myriophyllum heterophyllum*), coontail (*Ceratophyllum demersum*), pondweeds (*Potamogeton epihydrus, P. natans*), duckweeds (*Lemna minor, L. trisulca*), water stargrass (*Heteranthera dubia*), tapegrass or wild celery (*Vallisneria americana*), bladderworts (*Utricularia*

spp.), bur-reeds (*Sparganium americanum, S. angustifolium, S. fluctuans*), Nuttall's waterweed (*Elodea nuttallii*), naiad (*Najas* spp.), white water-lily (*Nymphaea odorata*) and common yellow pond-lily (*Nuphar variegata*). Algae are primarily epiphytic and suspended.

Four to seven ecoregional variants of marsh headwater stream are suspected to differ in dominant and characteristic vascular plants, fishes, bryophytes, invertebrates, and algae as well as water chemistry, water temperature, underlying substrate type, and surrounding forest type. Major watershed may be a secondary factor in distinguishing streams lower in a drainage basin.

Fishes characteristic of streams in the St. Lawrence River and Lake Champlain Valleys may include muskellunge (*Esox masquinongy*), mooneye (*Hiodon tergisus*), northern pike (*Esox lucius*), black crappie (*Pomoxis nigromaculatus*), walleye (*Stizostedion vitreum*), rock bass (*Ambloplites rupestris*), yellow perch (*Perca flavescens*), northern hog sucker (*Hypentelium nigricans*), cutlips minnow (*Exoglossum maxillingua*), fallfish (*Semotilus corporalis*), blackchin shiner (*Notropis heterodon*), spottail shiner *(N. hudsonius*), common shiner (*Luxilus cornutus*), Iowa darter (*Etheostoma exile*), northern brook lamprey (*Ichthyomyzon fossor*), shorthead redhorse (*Moxostoma macrolepidotum*), and banded killifish (*Fundulus diaphanus*). Pugnose shiner (*Notropis anogenus*) is a rare fish of St. Lawrence Valley marsh headwater streams.

Characteristic macroinvertebrates of these streams may include true flies (*Tipula* spp., *Atherix* spp., *Simulum* spp.), crustaceans (*Hyallela* spp.), pea clams (*Pisidium* spp.) and mayflies (*Stenonema* spp.). Characteristic plants of these streams may include water starwort (*Callitriche hermaphroditica*), pondweeds (*Potamogeton hillii, P. filiformis*), milfoil (*Myriophyllum* spp.), and water marigold (*Megalodonta beckii*).

Species characteristic of examples in the Northern Appalachians may include the fishes blacknose dace (*Rhinichthys atratulus*), longnose dace (*R. cataractae*), redside dace (*Clinostomus elongatus*), creek chub (*Semotilus atromaculatus*), and blacknose shiner (*Notropis heterolepis*). Two fishes that are endemic to this region, swallowtail shiner (*Notropis procne*) and comely shiner (*N. amoenus*), may be good indicators of the Northern Appalachian variant. Other characteristic fauna include the macroinvertebrates fingernail clam (*Sphaerium striatum*), caddisflies (*Polycentropus* spp.), mayflies (*Litobrancha* spp.) and odonate (*Cordulegaster* spp.), water scorpions (Nepidae, *Nepa* sp.), and the vascular plants milfoil (*Myriophyllum farwellii*) and water-shield (*Brasenia schreberi*).

More data on regional variants are needed.

Distribution: throughout New York State.

Rank: G4 S4 *Revised:* 2001

Examples: Campbell Marsh, Jefferson County; South Branch Mad River, Lewis County; North Branch Fish Creek, Lewis County; Swarte Kill, Ulster County; Poesten Kill Headwaters from its origin downstream 1 mi. to waterfall, Rensselaer County; Upper Main Branch Oswegatchie River, Herkimer, St. Lawrence and Hamilton Counties; Brandy Brook, St. Lawrence County.

Sources: Gilman 1976; Haslam 1978; Peverly 1979; Smith 1985; NYNHP field surveys.

5. Coastal plain stream: the aquatic community of slow-moving, often darkly-stained, streams of the coastal plain of Long Island. In New York, coastal plain streams are small to medium in size and can range from 1st to 3rd order stream segments (*sensu* Strahler 1957).

Often there is abundant submerged vegetation: characteristic aquatic plants include pondweeds (*Potamogeton pusillus, P. epihydrus*), naiads (*Najas flexilis, N. guadalupensis*), waterweeds (*Elodea nuttallii, E. canadensis*), Brazilian waterweed (*Egeria densa*), stonewort (*Nitella* spp.), bladderwort (*Utricularia macrorhiza*), duckweed (*Lemna minor*), Tuckerman's quillwort (*Isoetes tuckermanii*) and white water-crowfoot (*Ranunculus trichophyllus*). Watercress (*Nasturtium officinale*), an introduced species, is also common.

Characteristic fishes include American eel (*Anguilla rostrata*), redfin pickerel (*Esox americanus americanus*), banded killifish (*Fundulus diaphanus*), pumpkinseed (*Lepomis gibbosus*), banded sunfish (*Enneacanthus obesus*), swamp darter (*Etheostoma fusiforme*), and possibly pirate perch (*Aphredoderus sayanus*). The non-native bivalve Asian clam (*Corbicula fluminea*) may have recently become a widespread invasive species in coastal plain streams.

Distribution: restricted to the Coastal Lowlands ecozone.

Rank: G3G4 S1 *Revised:* 2001

Examples: Carmans River, Suffolk County; Peconic River, Suffolk County.

Sources: Beitel 1976; Faigenbaum 1939; Greeley 1939; Muenscher 1939; NYNHP field surveys.

6. Backwater slough: the aquatic community of quiet to stagnant waters in sloughs that form in embayments and old meanders that are cut off from an unconfined river or marsh headwater stream only at the upstream end by deposition of a natural levee. Many examples of this river type may be relatively short-lived in dynamic river complexes, transforming into an oxbow lake through permanent formation of a downstream natural levee, or into an associated river type through permanent breaching of the upstream natural levee. The water is typically warm. Although classified as a river type, many hydrological characteristics may resemble those of lacustrine communities.

Characteristic plants and animals include pool specialists and may resemble those of lacustrine species assemblages, or marsh headwater streams. Aquatic vegetation is usually abundant; characteristic aquatic plants include waterweed (*Elodea canadensis*), milfoil (*Myriophyllum* spp.), duckweed (*Lemna minor*), and pondweeds (*Potamogeton* spp.). Emergent aquatic plants may be abundant along the shores. Characteristic fishes are golden shiner (*Notemigonus crysoleucas*), pumpkinseed (*Lepomis gibbosus*), brown bullhead (*Ameiurus nebulosus*), and chain pickerel (*Esox niger*). Characteristic macroinvertebrates may include odonates (Odonata), diving beetles (Dytiscidae), mosquitoes (Culicidae), true flies (*Tipula* spp., *Atherix* spp., *Simulum* spp.), midges (Chironomidae), crustaceans (*Hyalella* spp.), clams (*Pisdium* spp.), and mayflies (*Stenonema* spp.). Characteristic wading birds and ducks include great blue heron (*Ardeas herodias*) and pied-billed grebe (*Podilymbus podiceps*). A characteristic mammal is muskrat (*Ondatra zibethicus*).

Four to seven ecoregional variants are suspected to differ in dominant and characteristic vascular plants, fishes, mollusks, insects, and birds as well as water chemistry, water temperature, underlying substrate type, surrounding forest type, and associated stream type. Major watershed may be a secondary factor in distinguishing streams lower in a drainage basin. More data on this community are needed.

Distribution: throughout upstate New York north of the Coastal Lowlands ecozone, usually at low elevations.

Rank: G4 S2S3 *Revised:* 2001

Examples: Raquette River, Franklin County; North Branch Moose River, Herkimer County; Log Pond Flats, Livingston County; Ausable Delta, Clinton County; Little River Canton, St. Lawrence County.

Sources: Smith 1985; NYNHP field surveys.

7. Confined river: the aquatic community of relatively large, fast flowing sections of streams with a moderate to gentle gradient. This river was formerly called "midreach stream" in Reschke (1990). Although these rivers can have a well-defined pattern of alternating pools, riffles, and runs, riffles tend to predominate. Confined rivers usually have poorly defined meanders (*i.e.,* low sinuosity), occur in confined valleys, and are most typical of the midreaches of stream systems. These rivers are typically of moderate depth, width, and have low flow discharge. They usually represent a network of 3rd to 4th order stream segments (*sensu* Strahler 1957). Most of the erosion is lateral, creating braids, channel islands, and bars, and deposition is moderate with a mix of coarse rocky to sandy substrate. Waterfalls are typically present; these are treated here as features of the more broadly defined community. Other features include plunge pools, flumes, chutes, cascades, alluvial fans, and mussel beds. The predominant source of food energy to the river biota is generated in the river (these are autochthonous rivers). These rivers have high water clarity, are well oxygenated, and typically have cool water. They are typically surrounded by open upland riverside communities including riverside sand/gravel bar, cobble shore, or one of the two shoreline outcrop communities.

Species assemblages characteristic of riffles and rocky bottoms and good water quality dominate the community. Fish diversity is typically high to moderate. Characteristic fishes include creek chub (*Semotilus atromaculatus*), pumpkinseed (*Lepomis gibbosus*), common shiner (*Luxilus cornutus*), and trout-perch (*Percopsis omiscomaycus*) in pools; rosyface shiner (*Notropis rubellus*) at the head of pools; tessellated darter (*Etheostoma olmstedi*), longnose dace (*Rhinichthys cataractae*), slimy sculpin (*Cottus cognatus*) or mottled sculpin (*C. bairdi*), and stonecat (*Noturus flavus*) in riffles; and bluntnose minnow (*Pimephales notatus*) and northern hogsucker (*Hypentelium nigricans*) in runs. Other characteristic fishes may include blacknose dace (*Rhinichthys atratulus*) and fantail darter (*Etheostoma flabellare*). Common introductions are rainbow trout (*Salmo gairdneri*), brown trout (*S. trutta*), and (in rivers where it is not native) smallmouth bass (*Micropterus dolomieu*).

Characteristic mollusks include eastern elliptio (*Elliptio complanta*), eastern floater (*Pyganodon cataracta*), and fingernail clams (*Sphaerium* spp.). Other macroinvertebrates are diverse, often dominated by net-spinning caddisflies (Hydropsychidae); characteristic macroinvertebrates include riffle and rocky bottom specialists as well as algae shredders such as crayfish (Cambaridae), mayflies (Ephemeroptera including Ephemeridae,

Heptageniidae, Baetidae, *Isonychia* spp., *Eurylophella* spp.), stoneflies (Plecoptera including Chloroperlidae and Perlidae, such as *Agnetina* spp.), caddisflies (Trichoptera including Hydropsychidae, *Helicopsyche* spp., *Dolophilodes* spp., *Rhyacophila* spp., *Nectopsyche* spp., *Psilotreta* spp., *Glossosoma* spp., *Brachycentrus* spp., *Neophylax* spp., *Goera* spp.), craneflies (*Hexatoma* spp.), beetles (Elmidae, *Psephenus* spp.), dobsonflies (Corydalidae), midges (*Polypedilum* spp.), and blackflies (Simuliidae). Odonate (Odonata including Calopteryidae) larvae may be characteristic of runs. True bugs (Gerridae, Velliidae, Mesovelliidae) are characteristic of pools.

Epilithic algae are predominant, often at moderate percent cover. Aquatic macrophytes are usually sparse; typical aquatic macrophytes include waterweed (*Elodea canadensis*) and linear-leaved pondweeds such as sago pondweed (*Potamogeton pectinatus*). An additional characteristic vascular plant may be *Podostemum ceratophyllum*. Bryophytes such as the moss *Schistidium rivulare* are often confined to shallows and the intermittently exposed channel perimeter.

Four to six variants associated with a combination of ecoregions (including Northern Appalachian, Great Lakes, Lower New England and Allegheny Plateau ecoregions) or major watersheds (including Great Lakes, Hudson River, Allegheny River, Susquehanna/Delaware Rivers) are suspected to differ substantially in dominant and characteristic vascular plants, fishes, mollusks, insects, and algae as well as water chemistry (especially alkalinity and color), water temperature, underlying substrate type, and surrounding forest type. In addition, the biota is suspected to differ among riverss of medium size (roughly 3rd to 4th order streams) and large size (roughly 5th to 6th order streams). Aquatic connectivity factors are thought to strongly influence the fish and mollusk composition.

Northen Appalachian riverss may represent a coldwater variant. Species characteristic of Northern Appalachian rivers may include the fishes brook trout (*Salvelinus fontinalis*), slimy sculpin (*Cottus cognatus*), fantail darter (*Etheostoma flabellare*), cutlips minnow (*Exoglossum maxillingua*), longnose sucker (*Catostomus catostomus*), and white sucker (*Catostomus commersoni*), and possibly margined madtom (*Noturus insignis*); and the macroinvertebrates eastern pearlshell (*Margaritifera margaritifera*), snipe flies (*Atherix* spp.), and odonates (*Gomphus* spp.). Atlantic salmon (*Salmo salar*) was historically known from some of these rivers.

St. Lawrence River and lake Champlain Valley riverss may represent a warmwater variant. Species characteristic of rivers in the St. Lawrence River and Lake Champlain Valley may include a diverse assemblage of fishes including tessellated darter (*Etheostoma olmstedi*), chain pickerel (*Esox niger*), northern pike (*Esox lucius*), golden shiner (*Notemigonus crysoleucas*), smallmouth bass (*Micropterus dolomieu*), and rock bass (*Ambloplites rupestris*), and mollusks such as heelsplitters (*Potamilus* spp. and *Lasmigona* spp.), lampmussels (*Lampsilus* spp. including *L. cariosa*), *Leptodea* spp., triangle floater (*Alasmidonta undulata*), creekmussel (*Strophitus* spp.), pondmussel (*Ligumia* spp.), *Anodontoides* spp., and pea clams (*Pisidium* spp.). Other macroinvertebrates characteristic of rivers in this region may include beetles (*Promoresia* spp., *Stenelmis* spp., *Dubiraphia* spp.), caddisflies (*Chimarra* spp., *Phylocentropus* spp.), mayflies (*Hexagenia* spp.), amphipods (*Gammarus* spp.), and true flies (*Sphaeromias* spp., *Culicoides* spp.). Atlantic salmon (*Salmo salar*) was historically known from some of these rivers.

Species characteristic of Allegheny Plateau and Great Lakes rivers may include the fishes greenside darter (*Etheostoma blennioides*), rainbow darter (*Etheostoma caeruleum*), central stoneroller (*Campostoma anomalum*), silverjaw minnow (*Ericymba buccata*), golden redhorse (*Moxostoma erythrurum*), black redhorse (*M. duquesnei*), and shorthead redhorse (*M. macrolepidotum*). An extremely rare fish in smaller confined rivers of this region is the spotted darter (*Etheostoma maculatum*). Other characteristic faina include the mollusks mucket (*Actinonaias ligmentina*), Ohio pigtoe (*Pleurobema cordatum*), kidneyshell (*Ptychobranchus fasciolaris*), fluted-shell (*Lasmigona costata*), lampmussels (*Lampsilis fasciola, L. ventricosa*), and spike (*Elliptio dilatata*); and the other widespread macroinvertebrates, such as mayflies (*Stenonema* spp.) and caddisflies (*Cheumatopsyche* spp.).

More data on regional variants are needed.

Distribution: throughout New York State.

Rank: G4 S3S4 *Revised:* 2001

Examples: French Creek, Chautauqua County; Moose River, Herkimer, Lewis, and Oneida Counties; Middle Branch Oswegatchie River (Adler Bed Swamp to Middle Branch Corners), St. Lawrence, Herkimer, and Lewis Counties; Hudson River, Essex, Warren and Saratoga Counties; East Branch Fish Creek, Lewis County; Rondout Creek; Ulster County; Shawangunk Kill, Ulster County; Hoosic River; Rensselaer County.

Sources: Smith 1985; NYNHP field surveys.

8. Unconfined river: the aquatic community of large, quiet, base level sections of streams with a very low gradient. This community was formerly called "main channel stream" in Reschke (1990). These rivers are typically dominated by runs with interspersed pool sections and a few short or no distinct riffles. Unconfined rivers usually have clearly distinguished meanders (*i.e.,* high sinuosity) and well developed natural levees, are in unconfined valleys and are most typical of the lowest reaches of stream systems. These rivers are typically deep, wide, have a high low flow discharge, and usually represent a network of 5th to 6th and up to 7th order stream segments (*sensu* Strahler 1957). They are characterized by considerable deposition, predominated by fine substrates such as silt, with a relatively minor amount of erosion. Waterfalls may be present; these are treated here as features of the more broadly defined community. The predominant source of food energy to the river biota is generated in the river (these are autochthonous rivers). These rivers are usually warm water, may have high turbidity and be somewhat poorly oxygenated. They are typically surrounded by floodplain forest or eroded sand or clay banks or fine sediment bars.

Species assemblages characteristic of pools and soft bottoms dominate the community. Characteristic fishes are deep-bodied fishes, such as sturgeon (*Acipenser* spp.), shad (*Alosa* spp.), and suckers (Catostomids) – especially redhorses (*Moxostoma* spp.). Many of the fishes are anadromous. Other characteristic fishes include warmwater fishes such as rock bass (*Ambloplites rupestris*), northern pike (*Esox lucius*), largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieui*), pumpkinseed (*Lepomis gibbosus*), brown bullhead (*Ameiurus nebulosus*), and white sucker (*Catostomus commersoni*). Pools may also contain pickerel (*Esox americanus*). Characteristic macroinvertebrates may include numerous species of mollusks such as pea clams (*Pisidium* spp.), suspected to differ substantially among regional variants, as well as stoneflies (Plecoptera), beetles (*Stenelmis* spp.), midges (*Polypedilum* spp.), mayflies (Baetidae, Heptageniidae, Ephemeridae), clams, odonates (Aeshnidae, Calopterygidae, Coenagrionidae, Gomphidae), caddisflies (*Cheumatopsyche* spp.), and leeches (Hirudinea).

Although the middle of an unconfined river is usually too deep for aquatic macrophytes to occur, the shallow shores and backwaters typically have rooted macrophytes. Characteristic submergent vascular plants may include naiad (*Najas flexilis*), pondweeds (*Potamogeton epihydrus, P. perfoliatus, P. spirillus*), bur-reed (*Sparganium fluctuans*), tapegrass or wild celery (*Vallisneria americana*), and Robbins spikerush (*Eleocharis robbinsii*). Floating aquatic macrophytes such as white water-lily (*Nymphaea* spp.) may be common in pools along shallow shores and in backwaters. Two non-native weeds, Eurasian milfoil (*Myriophyllum spicatum*) and water chestnut (*Trapa natans*) may also occur along shores and backwaters. Mosses in the genus *Fontinalis* may be characteristic of shallow areas. Plankton assemblages may be abundant.

Four to six variants associated with a combination of ecoregions (including Northern Appalachian, Great Lakes, Lower New England and Allegheny Plateau types) or major watersheds distinguished by Smith (1985) (the St. Lawrence River basin, Hudson River, Delaware River, Susquehanna River, and Allegheny River) are suspected to differ substantially in dominant and characteristic vascular plants, fishes, mollusks, and insects as well as water chemistry, water temperature, underlying substrate type, and surrounding forest type. For example, the species of fish genera present in any one river varies between major watersheds. In addition, the biota is suspected to differ among rivers of medium size (roughly 3rd to 4th order streams) and large size (roughly 5th to 6th order streams). Aquatic connectivity factors are thought to strongly influence the fish and mollusk composition.

Fishes characteristic of the St. Lawrence River and Lake Champlain Valley may include muskellunge (*Esox masquinongy*), yellow perch *(Perca flavescens*), white perch (*Morone americana*), walleye (*Stizostedion vitreum*), mooneye (*Hiodon tergisus*), longnose sucker (*Catostomus catostomus*), Iowa darter (*Etheostoma exile*), johnny darter (*Etheostoma nigrum*), banded killifish (*Fundulus diaphanus*), spottail shiner (*N. hudsonius*), and blackchin shiner (*N. heterodon*). Pugnose shiner (*Notropis anogenus*) is a rare fish of some unconfined rivers in this region.

The Northern Appalachian variant of this river type has relatively cool water. Characteristic fishes of of this variant may include brook trout (*Salvelinus fontinalis*), slimy sculpin (*Cottus cognatus*), creek chub (*Semotilus atromaculatus*), longnose dace (*Rhinichthys cataractae*), tessellated darter (*Etheostoma olmstedi*), fathead minnow (*Pimephales promelas*) and bluntnose minnow (*Pimephales notatus*). Characteristic macroinvertebrates of the Northern Appalachian river variant may include caddisflies (*Helicopsyche* spp., *Brachycentrus* spp., *Psilotreta* spp.).

More data on flora (macrophytes and algae) and invertebrate fauna, as well as regional variants, are needed.

Distribution: throughout the state north of the Coastal Lowlands ecozone, usually at low elevations.

Rank: G4 S3S4 *Revised:* 2001

Examples: Unimpounded sections of the following rivers: Mohawk River from Utica to the Hudson River; Hudson River from Glens Falls to the Troy Dam; Rondout Creek, Ulster County; Raquette River, Franklin County; Oswegatchie River, St. Lawrence County; Poultney River, Washington County; Black River, Lewis, Jefferson and Oneida Counties; Genesee River, Livingston and Monroe Counties.

Sources: Smith 1985; NYNHP field surveys.

9. Deepwater river: the aquatic community of very large, very deep, quiet, base level sections of streams with a very low gradient and where there are profundal areas. These rivers are typically dominated by runs with interspersed pools and a few short or no distinct riffles. Deepwater rivers are restricted to the largest of stream systems, often corresponding to segments of 8th order or higher (*sensu* Strahler 1957).

Species diversity is high, and assemblages characteristic of runs, pools and the pelagic zone dominate the community. Many of the fishes are anadromous. Characteristic fishes include redhorses (*Moxostoma* spp.), lake sturgeon (*Acipenser fulvescens*), northern pike (*Esox lucius*), smallmouth bass (*Micropterus dolomieui*), channel darter (*Percina copelandi*), Iowa darter (*Etheostoma exile*), eastern sand darter (*Ammocrypta pellucida*), walleye (*Stizostedion vitreum*), mooneye (*Hiodon tergisus*), fallfish (*Semotilus corporalis*), spottail shiner *(Notropis hudsonius*), and blackchin shiner (*N. heterodon*).

Characteristic macroinvertebrates may include oligochaetes (Oligochaeta) and mollusks; oligochaetes may be abundant in the profundal zone. Many mollusks that were historically present in the St. Lawrence River have presumably become extirpated. Although the middle of a deepwater river is too deep for aquatic macrophytes to occur, the shallow shores and backwaters may have rooted macrophytes. Plankton assemblages may be abundant. More data on this community are needed.

Distribution: restricted to Great Lakes drainage in the Great Lakes Plain ecozone.

Rank: G2G3 S1S2 *Revised:* 2001

Examples: St. Lawrence River, St. Lawrence, Jefferson and Franklin Counties; Niagara River, Erie and Niagara Counties.

Sources: Greeley 1929; Muenscher 1929.

B. RIVERINE CULTURAL

This subsystem includes communities that are either created and maintained by human activities, or are modified by human influence to such a degree that stream flow, morphometry, water chemistry, or the biological composition of the resident community are substantially different from the character of the stream community as it existed prior to human influence.

1. Riverine submerged structure: the aquatic community associated with an artificially introduced structure submerged in riverine waters that provides habitat for fish and other organisms. This includes structures that have been intentionally sunk for the purpose of attracting fish, as well as sunken ships, disposed waste, submerged bridge abutments, or any other introduced material that provides suitable habitat.

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 2001

2. Riverine water chestnut bed: the aquatic community within a non-tidal stream or river that is dominated by large, nearly continuous mats of non-native water chestnut (*Trapa natans*). This community may develop in open water bays behind connected impoundments, such as railroad beds, or along the river in more shallow and sheltered coves with slow moving water.

Distribution: in larger non-tidal rivers of the Hudson Valley.

Rank: unranked cultural *Revised:* 2004

Examples: Mohawk River, Schenectady and Albany Counties; Hudson River, Saratoga County.

Sources: Muenscher 1935.

3. Acidified stream: the aquatic community of a stream that has received so much acid deposition that the pH of the stream has decreased significantly. The dominant anions in precipitation in the Northeast US are sulfate and nitrate; the pH of this precipitation is less than 4.7.

The biota of streams may be more sensitive to acidification than the biota of lakes. Genera that are often found in very acidified situations include stoneflies (*Leuctra* spp., *Amphinemura* spp.), mayflies (*Epeorus* spp.), caddisflies (*Ryacophila*

spp.), black flies (*Simulium* spp.), and midges (*Eukiefferiella* spp., *Cricotopus* spp.) (M. Novak *pers. comm.*).

In the Algonquin Highlands of Ontario, several species of mayflies and stoneflies have disappeared from acidified reaches of streams. Fish kills have been observed in streams following acid pulses (for example, after snowmelt). More data on the characteristic plants and animals are needed for this community.

Distribution: most common in the Adirondacks, may also occur throughout eastern New York in the Appalachian Plateau, Taconic Highlands, and Hudson Valley ecozones.

Rank: unranked cultural *Revised:* 2010

Source: Schindler 1988.

4. Canal: the aquatic community of an artificial waterway or modified stream channel constructed for inland navigation or irrigation. Most canals have a low gradient between locks; however, some feeder canals (built to supply water to another canal) have a steep gradient and are not navigable.

Characteristic fishes include brown bullhead (*Ameiurus nebulosus*), brook stickleback (*Culaea inconstans*), central mudminnow (*Umbra limi*), brook silverside (*Labidesthes sicculus*), golden shiner (*Notemigonus crysoleucas*), and pikes (Esocidae). More data on the characteristic plants and animals are needed for this community.

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 2001

5. Ditch/artificial intermittent stream: the aquatic community of an artificial waterway constructed for drainage or irrigation of adjacent lands. Water levels either fluctuate in response to variations in precipitation and groundwater levels, or water levels are artificially controlled. The sides of ditches are often vegetated, with grasses and sedges usually dominant. Non-native or weedy species are common. Purple loosestrife (*Lythrum salicaria*), European common reed (*Phragmites australis*), and reed canary grass (*Phalaris arundinacea*) often become established and may form dense, monospecific stands. Reed canary grass is often planted along ditches for erosion control. Other plants that are characteristic include sedges (*Carex* spp.) and cattails (*Typha* spp.). Algae indicative of eutrophic conditions may be abundant.

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 1990

6. Industrial effluent stream: the aquatic community of a stream or a small section of a stream in which the temperature, chemistry, or transparency of the water is significantly modified by discharge of effluent from an industrial, commercial, or sewage treatment plant. The water or sediments may contain elevated concentrations of heavy metals, PCBs, ammonia, and other pollutants. Relative to unpolluted streams of similar morphology, species richness of fishes is low, and pollution-intolerant species (*e.g.*, lampreys, darters, sculpins) may be absent. Algae indicative of eutrophic conditions and iron fixing bacteria may be abundant.

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 1990

Source: Reash and Berra 1987.

C. RIVERINE REFERENCES

Bain, M. B. and N. J. Stevenson. 1999. Aquatic Habitat Assessment. Common Methods. American Fisheries Society, Bethesda, MD.

Beitel, J. 1976. A vegetative survey of the freshwater wetlands of nine major streams in southwestern Suffolk County and southern Nassau County, New York. Unpublished report for the Environmental Defense Fund, Inc.

Caduto, M. J. 1990. Pond and Brook. A guide to nature in freshwater environments. Prentice-Hall, Inc., Englewood Cliffs, NJ.

Carlson, D. 1993. Deer River Fish Survey. Draft. New York State Department of Environmental Conservation.

Carlson, D. M. 1996. Proposed Standards for Comparisons of Warmwater Fish Communities in New York Rivers. Draft. New York State Department of Environmental Conservation, Watertown, NY.

Cornett, S. C. 1996. The trout streams of Allegany State Park. Unpublished report. New York State Department of Environmental Conservation, Bureau of Fisheries, Region 9, Olean, NY.

Daniels, R. A. 1998. Fishes of the Allegany State Park. Unpublished report submitted to the New York Natural Heritage Program, Latham, NY.

Faigenbaum, H. M. 1939. Biological survey of the fresh waters of Long Island. New York State Department of Environmental Conservation, Albany, NY.

Frissell, C. A., W. J. Liss, C. E. Warren and M. D. Hurley. 1986. Environmental Management 10 (2): 199-214.

Gilman, B. A. 1976. Wetland plant communities along the eastern shoreline of Lake Ontario. M. S. thesis, SUNY College of Environmental Science and Forestry, Syracuse, N. Y.

Gordon, N. D., T. A. McMahon and B. L. Finlayson. 1992. Stream Hydrology. An Introduction for Ecologists. John Wiley & Sons, New York., NY.

Greeley, J. R. 1929. Fishes of the Erie-Niagara watershed. pp. 150-179 In: A biological survey of the Erie-Niagara system. Suppl. to the 18th Ann. Rep., 1928. NYS Conserv. Dept., Albany, NY.

Greeley, J. R. 1939. Fresh-water fishes of Long Island and Staten Island with annotated list. *In* A biological survey of the fresh waters of Long Island. Suppl. to the 28th Ann. Rep., 1938. New York State Department of Environmental Conservation., Albany, NY.

Halliwell, D. B., R. W. Langdon, R. A. Daniels, J. P. Kurtenbach and R. A. Jacobsen. 1999. Classification of Freshwater Fish Species of the Northeastern United States for Use in the Development of Indices of Biological Integrity, with Regional Applications. pp. 301-337. *In* Assessing the Sustainability and Biological Integrity of Water Resources Using Fish Communities. CRC Press.

Haslam, S. M. 1978. Riverplants. The marcrophytic vegetation of watercourses. Cambridge Univ. Press, New York, NY.

Hauer, F. R. and G. A. Lamberti. 1996. Stream Ecology. Academic Press, New York, NY.

Higgins, J., M. Lammert, M. Bryer, M. DePhilip and D. Grossman. 1998. Freshwater conservation in the Great Lakes Basin: Development and application of an aquatic community framework. The Nature Conservancy, Chicago, IL.

Hunt, D. M. 2001. High Allegheny Plateau stream community inventory project: Western New York Portion. Unpublished report. New York Natural Heritage Program, Latham, NY.

Hunt, D. M. 2000. St. Lawrence/Champlain Valley (SLCV) known or suspected, extirpated or extant riverine macrohabitats/alliances. Unpublished report. New York Natural Heritage Program, Latham, NY.

Hynes, H. B. N. 1970. The Ecology of Running Waters. Univ. of Toronto Press, Toronto, Canada.

Lampert, W. and U. Sommer. 1997. Limnoecology: the ecology of lakes and streams. Oxford University Press, New York, NY.

Maxwell, J. R., C. J. Edwards, M. E. Jensen, S. J. Paustian, H. Parrott and D. M. Hill. 1995. Hierarchical framework of aquatic ecological units in North America (Nearctic Zone). USDA. Forest Service. Gen. Tech. Rep. NC-176.

Moyle, P. B. and J. P. Ellison. 1991. A conservation-oriented classification system for the inland waters of California. Calif. Fish and Game 77 (4):161-180.

Muenscher, W. C. 1929. Vegetation of the Niagara River and the eastern end of Lake Erie. In: A biological survey of the Erie-Niagara system. Suppl. to the 18th Ann. Rep., 1928. NYS Conserv. Dept., Albany, NY.

Muenscher, W. C. 1935. Aquatic vegetation of the Mohawk-Hudson watershed. In: A biological survey of the Mohawk-Hudson watershed. Biological Survey IX. J. B. Lyon, Albany, NY.

Muenscher, W. C. 1939. Aquatic vegetation of Long Island waters. In: A biological survey of the fresh waters of Long Island. Suppl. to the 28th Ann. Rep., 1938. New York State Department of Environmental Conservation, Albany, NY.

Peverly, J. H. 1979. Elemental distribution and macrophyte growth downstream from an organic soil. Aquatic Botany 7:319-338.

Pielou, E. C. 1998. Fresh Water. University of Chicago Press, Chicago, IL.

Reash, R. J. and T. M. Berra. 1987. Comparison of fish communities in a clean-water stream and an adjacent polluted stream. Am. Midl. Nat. 118(2):301-322.

Rosgen, D. L. 1994. A Classification of Natural Rivers. Catena 22:169-199.

Strayer, D. L. 1993. Macrohabitats of Freshwater Mussels (Bivalvia: Unionacea) in Streams of the northern Atlantic Slope. J. N. Am. Benthol. Soc. 12 (3):236-246.

Sutton, W. L. 1998. Biological exploration of spring creeks in western New York State. New York State Department of Environmental Conservation, Albany, NY.

Schindler, D. W. 1988. Effects of acid rain on freshwater ecosystems. Science 239:149-157.

Slack, N. G. and J. M. Glime. 1985. Niche relationships of mountain stream bryophytes. Bryologist 88:7-18.

Smith, C. L. 1985. The inland fishes of New York State. New York State Department of Environmental Conservation,

Albany,NY.

Strahler, A. N. 1957. Quantitative analysis of watershed geomorphology. American Geophysical Union Transactions. 38: 913-920.

Vermont Aquatic Working Group. 1998. A classification of aquatic communities for Vermont. Unpublished report. The Nature Conservancy and Vermont Biodiversity Project.

Williams, D. D. 1979. Aquatic habitats of Canada and their insects. pp. 211-234. *In* Canada and its Insect Fauna (H. V. Danks, ed) Entomological Society of Canada Memoir 108. 573 pp

IV. LACUSTRINE SYSTEM

The lacustrine system consists of ponded waters situated in topographic depressions or dammed river channels, with persistent emergent vegetation sparse or lacking, but including any areas with abundant submerged or floating-leaved aquatic vegetation. The lacustrine communities in this classification are distinguished primarily by trophic state, alkalinity, annual cycles of thermal stratification, circulation, morphometry (size and shape of the lake basin and drainage area; water permanence), and water chemistry (including salinity).

The communities are described in terms of the free-floating organisms of the open water, or the limnetic or pelagic zone (including plankton and fish), the aquatic macrophytes and fish near the shore or littoral zone, and the bottom-dwelling organisms or benthos. The limnetic (pelagic) zone may be divided into the epilimnion (upper lake zone), which is sunny, mixed by the wind, and comparatively rich in oxygen, and the hypolimnion (lower lake zone), which is darker, and comparatively rich in carbon dioxide from respiration and decay. The transition between the epilimnion and hypolimnion is called the thermocline (or the metalimnion). The lake bottom or benthic zone may be divided into the peripheral, well-lit shallows or littoral zone, the slightly deeper and darker sublittoral zone, and (in summer-stratified lakes) the deep, cold region where currents are minimal and light is much reduced, called the profundal zone. Benthic zones may each have a distinctive resident biota; however, many of the plankton and fish move between pelagic zones on a regular basis. In this classification, deep lakes have an average depth greater than about 60 m (200 ft), moderately deep lakes are from about 6 to 60 m (20 ft to 200 ft) deep, and shallow lakes have an average depth less than about 6 m (20 ft). Large lakes are greater than about 200 acres (80 ha) and small lakes are less than this size.

This classification of lacustrine communities is based on a combination of NYNHP field surveys, literature review, and discussions with aquatic scientists. To date, several dozen plots have been sampled statewide by NY Natural Heritage in lacustrine communities. Although NY Natural Heritage has conducted inventory work on lakes since 1995; currently we do not have sufficient field data for confidently undertaking any major restructuring of the Reschke (1990) lacustrine classification. However, field work has suggested that this classification works well for representing the coarsest scale distinctions between both biotic and abiotic features of lacustrine community types.

This classification is intended to represent entire lake macrohabitats. Although physically based, it is meant to serve as a coarse filter emphasizing resident lake biota. It is recognized that lakes may contain numerous pelagic and benthic associations and that there is often much overlap in association distribution across lake macrohabitat types. For now, NY Natural Heritage is maintaining this macrohabitat classification while evaluating the utility and feasibility of replacing or supplementing this classification with an association classification. Further evaluation of the macrohabitat classification is underway to compare trophic state versus alkalinity as a factor more important in driving the distribution of biota and more resistent to human alteration of water chemistry. Tentatively, it is thought that alkalinity is a stronger driving force, thus suggesting a switch of the Reschke (1990) classification of common pond types from oligotrophic and eutrophic to acidic and alkaline, and common dimictic lake types from oligotrophic, mesotrophic, and eutrophic to acidic and alkaline, perhaps with trophic state as a secondary modifier.

We are evaluating the addition of three “intermittent pond” types to this system: vernal pool and pine barrens vernal pond (both currently treated under the palustrine system), and sinkhole pond (proposed split from sinkhole wetland in the palustrine system). Other types under evaluation include “flow-through” or “fluvial pond,” a potential split from the currently recognized oligotrophic pond and eutrophic pond, closely associated with riverine complexes rather than in the typical isolated basin setting.

Further refinement of the lacustrine classification to distinguish regional variants will likely be based on additional field surveys and analysis of data collected by various aquatic scientists and agencies statewide. Regional variation in many of the designated lacustrine communities is evident, but we do not currently have in our files enough information or have undertaken analyses to confidently split common and widespread lake types into more specific regional variants. A finer scale classification of lakes that distinguishes types according to ecoregion and/or watershed is being evaluated. Preliminary conclusions suggest that vascular plant, bryophyte, algae, fish, mollusk, insect, and plankton assemblages may follow different distribution patterns, some more closely correlated with ecoregion boundaries, some more closely with major ecological drainage units.

A. NATURAL LAKES AND PONDS

This subsystem includes the Great Lakes, and inland lakes and ponds in which the trophic state, morphometry, and water chemistry have not been substantially modified by human activities, and the native biota is dominant. The biota may include some introduced species (for example, non-native macrophytes, stock or accidentally introduced fishes),

however the introduced species are not usually dominant in the lake or pond community as a whole.

1. Great Lakes deepwater community: the open water community in any of the Great Lakes. In general, the Great Lakes are summer-stratified monomictic lakes: they usually do not freeze over in winter, they are mixed and isothermal in winter, and thermally stratified in summer (warmest water at the surface). One exception is that portions of eastern Lake Erie, along the New York shores, freeze over quite frequently. These lakes are primarily mesotrophic with eutrophic nearshore areas. Specialized habitats include nearshore fluvial deposits, deepwater reefs and trenches. The Great Lakes are distinguished from inland summer-stratified monomictic lakes because of their size and access to estuarine biota through the St. Lawrence River and Welland Canal. Lake Champlain is similar to this lake type. However, it is classified as a summer-stratified monomictic lake.

Characteristic fishes of the epilimnion include alewife (*Alosa pseudoharengus*), rainbow smelt (*Osmerus mordax*), yellow perch (*Perca flavescens*), white sucker (*Catostomus commersoni*), lake chub (*Couesius plumbeus*), lake trout (*Salvelinus namaycush*), Atlantic salmon (*Salmo salar*), lake sturgeon (*Acipenser fulvescens*), lake herring (*Coregonus artedii*), deepwater sculpin (*Myxocephalus thompsoni*), and walleye (*Stizostedion vitreum*). Characteristic fishes of the hypolimnion include slimy sculpin (*Cottus cognatus*) and round whitefish (*Prosopium cylindraceum*).

Other characteristic fishes of the Great Lakes deepwater community include cisco (*Coregonus artedii*), lake whitefish (*Coregonus clupeaformis*), quillback (*Carpiodes cyprinus*), white bass (*Morone chrysops*), burbot (*Lota lota*), emerald shiner (*Notropis atherinoides*), mooneye (*Hiodon tergisus*), and silver chub (*Hybopsis storeriana*). Sea lamprey (*Petromyzon marinus*) is an introduced species. Two introduced salmonids that are now common in Lake Ontario are coho salmon (*Oncorhynchus kisutch*), and chinook salmon (*O. tshawytscha*).

A diverse set of diving birds use this community as a staging area during fall migration, and include oldsquaw (*Clangula hyemalis*), common goldeneye (*Bucephala clangula*), scaup (*Aythya* spp.), redhead (*Aythya americana*), bufflehead (*Bucephala albeola*), canvasbacks (*Aythya valisneria*), and scoters (*Melanitta* spp.).

Characteristic invertebrates include the oligochaetes *Potamothrix* spp. and *Aulodrilus* spp. Characteristic plankton include diatoms, green algae, dinoflagellates, flagellates, cladocerans, and, in the profundal zone, the zooplankton *Pontoporeia hoyi* and *Mysis relicta.*

New York's share of the Great Lakes has been significantly polluted and modified by introductions of non-native species; some introductions have resulted from migrations through the Welland and Erie canals. Non-native fishes of Lake Ontario include rudd (*Scardinus erythrophthalmus*), blueback herring (*Alosa aestivalis*), and round goby (*Neogobius melanostomus*). Many of the formerly common native fish have apparently disappeared from Lake Erie, or Lake Ontario, including blue pike (*Stizostedion vitreum glaucum*), bloater (*Coregonus hoyi*), kiyi (*C. kiyi*), shortnose cisco (*C. reighardi*), shortjaw cisco (*C. zenithicus*), and spoonhead sculpin (*Cottus ricei*).

Distribution: restricted to the Great Lakes Plain ecozone.

Rank: G2G3 S1S2 *Revised:* 2001

Examples: Lake Ontario; Lake Erie.

Sources: Baker 1997; Berg 1963; Croskery 1995; Hunt 1998b; Smith 1985; US Fish and Wildlife Service 1992.

2. Great Lakes aquatic bed: the aquatic community of the protected shoals of the Great Lakes or Lake Champlain. They occur in quiet bays that are protected from extreme wave action by islands, shoals or barrier bars, and typically support large areas of “weeds” or aquatic macrophytes. These bays may freeze over in winter and become inversely stratified (coldest water at the surface). They are warm, mesotrophic, and alkaline. Substrate can vary among sand, silt, muck, and rock. Two variants are known: classical “aquatic beds” with abundant macrophytes and sparsely-vegetated or unvegetated bays.

This community serves as a spawning and nursery habitat for a wide variety of warmwater fishes. Characteristic fishes in the aquatic bed include pickerel (*Esox americanus*), threespine stickleback (*Gasterosteus aculeatus*), longnose gar (*Lepisosteus osseus*), bluegill (*Lepomis macrochirus*), largemouth bass (*Micropterus salmoides*), Iowa darter (*Etheostoma exile*), tadpole madtom (*Noturus gyrinus*), muskellunge (*Esox masquinongy*), white perch (*Morone americana*), white sucker (*Catostomus commersoni*), smallmouth bass (*Micropterus dolomieu*), brown bullhead (*Ameiurus nebulosus*), and northern pike (*Esox lucius*). Common carp (*Cyprinus carpio*) and goldfish (*Carassius auratus*) are introduced fishes that are well-established in Great Lakes aquatic beds.

This community serves as feeding and resting habitat for dabbling ducks and other waterfowl

during spring and fall migration, and also as an overwintering ground. Other characteristic fauna include a diverse mollusk assemblage, bryozoans, ostrocods, and cyclopoid copepods.

Characteristic macrophytes include the algae *Cladophora* and *Chara*, tape grass, or wild celery (*Vallisneria americana*), pondweeds (*Potamogeton richardsonii, P. pectinatus, P. gramineus, P. pusillus, P. freisii*), naiad (*Najas flexilis*), horned pondweed (*Zannichellia palustris*), water stargrass (*Heteranthera dubia*), coontail (*Ceratophyllum demersum*), waterweed (*Elodea canadensis*), duckweed (*Lemna trisulca*), and bladderwort (*Utricularia macrorhiza*). Additional species in Lake Champlain examples include water-plantain (*Alisma gramineum*), pondweeds (*Potamogeton zosteriformis, P. natans, P. perfoliatus, P. spirillus*), white water-crowfoot (*Ranunculus trichophyllus*), and Tuckerman's quillwort (*Isoetes tuckermanii*). Common non-native plants include Eurasian water milfoil (*Myriophyllum spicatum*) and curly pondweed (*Potamogeton crispus*). Growth of *Cladophora* has been related to point sources of nutrient enrichment, especially phosphorus enrichment.

Distribution: restricted to the Great Lakes Plain, Lake Champlain Valley, and Adirondacks ecozones, in direct association with the Great Lakes (including downstream along the St. Lawrence River to Chippewa Bay) and Lake Champlain.

Rank: G4 S3 *Revised:* 2001

Examples: Irondequoit Bay, Monroe County; North Pond, Oswego County; Chippewa Bay, St. Lawrence County; Braddock Bay, Monroe County; Sodus Bay, Wayne County; Kings Bay, Clinton County.

Sources: Clausen 1940; NYNHP field surveys.

3. Great Lakes exposed shoal: the aquatic community of the shallow littoral zone of the Great Lakes that occurs along windswept shores that are exposed to wave action, typically associated with islands and points. The lake substrate may be sandy, gravelly, cobbly, bouldery, or with submerged bedrock outcrops. These shoals also occur downstream from Lake Ontario along the St. Lawrence River to about American Island.

Characteristic fishes include stonecat (*Noturus flavus*), freshwater drum (*Aplodinotus grunniens*), mottled sculpin (*Cottus bairdi*), lake chub (*Couesius plumbeus*), muskellunge (*Esox masquinongy*), and a diversity of minnows and small fish such as river redhorse (*Moxostoma carinatum*), greater redhorse (*M. valenciennesi*), channel darter (*Perca copelandi*), and in weedy bays, pugnose shiner (*Notropis anogenus*). Lake sturgeon (*Acipenser fulvescens*) was once abundant in shoal waters in the Great Lakes, has declined sharply, but may someday recover (Carlson *et al.* 2002).

Double-crested cormorant (*Phalacrocorax auritus*) is a characteristic bird. Zebra mussels (*Dreissena polymorpha*) have become abundant in this community.

Aquatic macrophytes are uncommon and include milfoil (*Myriophyllum* spp.) and coontail (*Ceratophyllum* spp.). The alga *Cladophora* grows on rocks in the wave zone; growth of *Cladophora* has been related to point sources of nutrient enrichment, especially phosphorus enrichment. More data on this community are needed.

Distribution: restricted to the Great Lakes Plain ecozone in direct association with the Great Lakes (including downstream along the St. Lawrence River to about American Island).

Rank: G4 S4 *Revised:* 2001

Examples: Indian Chief Shoal, St. Lawrence County; Dana Point Shoals, St. Lawrence County; Gull Shoal, Jefferson County; Upper Shoal, Jefferson County.

Sources: Carlson *et al.* 2002; Knutson *et al.* 1990; Smith 1985; NYNHP field surveys.

4. Bog lake/pond: the aquatic community of a dystrophic lake that typically occurs in a small, shallow basin (*e.g.*, a kettehole) that is protected from wind and is poorly drained. These lakes occur in areas with non-calcareous bedrock or glacial till; many are fringed or surrounded by a floating mat of vegetation (in New York usually either bog or poor fen). Characteristic features of a dystrophic lake include the following: murky water that is stained brown, with low transparency; water that is low in plant nutrients (especially low in calcium), with naturally low pH (less than 5.4); and the lake may have oxygen deficiencies in deeper water (the profundal zone). The lack of calcium blocks bacterial action, reducing the rate of decay of organic matter with subsequent accumulation of peat or muck sediments. Colloidal and dissolved humus material reduces transparency and increases acidity of the water.

Species diversity in bog lakes is low in all types of aquatic organisms (phytoplankton, macrophytes, zooplankton, zoobenthos, and fish); many bog lakes have no fish at all. The abundance of each species present is also low in all types of organisms, except for aquatic macrophytes and peat mosses (*Sphagnum* spp.) along the edge of the bog mat.

A characteristic fish is brown bullhead (*Ameiurus nebulosus*). Characteristic invertebrates include larvae of midges (*Chironomus* spp.) and phantom midges (*Chaoborus* spp.) in the benthos. Other characteristic invertebrates may include amphipods (*e.g., Hyallela azteca*), mollusks (*Musculium* spp., *Ferresia* californica) and midges (*Tribelos* spp., *Phaenopsectra* spp., *Zalutschia* spp.)

Characteristic macrophytes include water-shield (*Brasenia schreberi*), white water-lily (*Nymphaea odorata*), yellow pond-lilies (*Nuphar microphylla*, *N. variegata*), bladderworts (*Utricularia macrorhiza*, *U. geminiscapa, U. purpurea*), pondweeds (*Potamogeton epihydrus, P. oakesianus*), bur-reeds (*Sparganium fluctuans, S. angustifolium*), and clubrush (*Schoenoplectus subterminalis*). Characteristic zooplankton may include the rotifers *Keratella* spp. and *Brachionus* spp.

A common feature of bog lakes is the development of a false bottom at a depth of about 0.3 to 0.9 m (1 to 3 ft) below the surface. The false bottom is composed of colloidal material and dissolved humus held in suspension that appears to be a more or less continuous bottom. When disturbed, the suspended material quickly clouds the upper layer of clear water, then slowly settles when the water becomes quiet again. Occasionally bog lakes become meromictic, or chemically stratified; the chemical gradient supercedes the usual stratification by temperature. Up to four ecoregional variants (Northern Appalachian, Allegheny Plateau, Great Lakes, and Lower New England types) are suspected to differ in dominant and characteristic vascular plants and insects. More data on ecoregional variants are needed.

Distribution: sparsely scattered throughout New York State north of the Coastal Lowlands ecozone; especially common in the Adirondacks.

Rank: G4 S3 *Revised:* 2001

Examples: Spring Pond, Franklin County; Pink Pond, Franklin County; Rolley Pond, Franklin County; Mud Lake, Rensselaer County; Hosford Pond, Rensselaer County; Joyce Bog, Oneida County; Louisa Pond, Ulster County; Emmons Pond, Delaware County; Moss Pond, Otsego County.

Sources: Clausen 1940; Cole 1975; Maitland 1978; NYNHP field surveys.

5. Oligotrophic dimictic lake: the aquatic community of a nutrient-poor lake that typically occurs in a deep, steeply-banked basin. These lakes are dimictic: they have two periods of mixing or turnover (spring and fall), they are thermally stratified in the summer (warmest water at the surface), and they freeze over and become inversely stratified in the winter (coldest water at the surface).

Characteristic features of an oligotrophic lake include the following: blue or green water with high transparency (Secchi disk depths of 4 to 8 m); water low in plant nutrients (especially low in nitrogen, also low in calcium); low primary productivity (inorganic carbon fixed = 7 to 25 $g/m^2/yr$); lake sediments that are low in organic matter (usually consisting of stones and inorganic silt); epilimnion volume that is relatively small compared with hypolimnion; and an abundance of oxygen all year, in all strata. Alkalinity is typically low (less than 12.5 mg/l calcium carbonate).

Profundal and pelagic species assemblages are usually well developed. The profundal benthos includes many species, but the abundance of each species is very low. Characteristic fishes are warmwater species such as smallmouth bass (*Micropterus dolomieui*), redbreast sunfish (*Lepomis auritus*), pumpkinseed (*Lepomis gibbosus*), rock bass (*Ambloplites rupestris*), and yellow perch (*Perca flavescens*) in shallow areas, and coldwater species such as lake trout (*Salvelinus namaycush*) and round whitefish (*Prosopium cylindraceum*) in deep water, and either slimy sculpin (*Cottus cognatus*) or mottled sculpin (*C. bairdi*). Shiners and minnows are often diverse. Brown trout (*Salmo trutta*) and rainbow trout (*S. gairdneri*) are commonly introduced.

Characteristic mollusks may include the clams eastern lampmussel (*Lampsilis radiata*), eastern elliptio (*Elliptio complanata*), and eastern floater (*Pyganodon cataracta*), and the snails ramshorn snail (*Heliosoma trivolvis*), physid snail (*Physa heterostropha*), amnicolas (*Amnicola* spp.), and mystery snail (*Campeloma decisum*).

Characteristic profundal invertebrates include midge larvae such as *Tanytarsus*; in contrast to bog lakes, oligotrophic lakes usually lack phantom midges (*Chaoborus* spp.). Other characteristic and dominant invertebrates may include alderflies (*Sialis* spp.), midges (*Procladious* spp., *Heterotrissocladius* spp.), mayflies (*Stenonoma* spp.), caddisflies (Trichoptera), and oligochaetes (Oligochaeta).

Phytoplankton and zooplankton also have many species, with low abundance; characteristic phytoplankton include desmids (*Staurastrum* spp.), chrysophytes (*Dinobryum* spp.), the diatoms *Tabellaria, Cyclotella,* and *Asterionella.* Characteristic zooplankton may include cladocerans, rotifers, copepods, scuds, cyclopoids, and *Daphnia* spp.

In the Adirondacks, this community provides habitat for the common loon (*Gavia immer*).

Characteristic macrophytes include small rosette-leaved aquatics that are restricted to shallow bottoms from 1 to 3 m (3 to 10 ft) deep. Characteristic rosette-

leaved aquatics include pipewort (*Eriocaulon aquaticum*), water lobelia (*Lobelia dortmanna*), and quillworts (*Isoetes echinospora* ssp. *muricata, I. lacustris*). Other characteristic vascular plants include milfoils (*Myriophyllum alterniflorum, M. tenellum*), bladderworts (*Utricularia purpurea, U. resupinata*), mud purslane (*Elatine minima*), creeping buttercup (*Ranunculus flammula* var. *reptans*), pondweeds (*Potamogeton robbinsii, P. gramineus, P. perfoliatus*), and tapegrass or wild celery (*Vallisneria americana*). The macroalgae *Nitella flexilis* may be abundant in the sublittoral zone.

This lake type may contain numerous habitat features including underwater cliffs, talus slopes, boulder fields, pavement, sand flats, as well as differing vegetation associations at different depths and on different substrates. Four to seven ecoregional variants are suspected to differ in dominant and characteristic vascular plants, fishes, mollusks, and insects. More data on regional variants are needed.

Distribution: throughout New York State, usually at high elevations, especially common in the Adirondacks.

Rank: G4 S3 *Revised:* 2001

Examples: Lake George, Warren and Essex Counties; Schroon Lake, Essex and Warren Counties; Wolf Pond, Essex County; Lake Lila, Hamilton County; Pine Pond, Franklin County; Chubb Lake, St. Lawrence County; Shaver Pond, Rensselaer County; Skaneateles Lake, Onondaga and Cayuga Counties.

Sources: Bloomfield 1978a; Cole 1975; Ferris *et al.* 1980; Hunt 1999, 2000; Maitland 1978; Roberts *et al.* 1985; NYNHP field surveys.

6. Mesotrophic dimictic lake: the aquatic community of a lake that is intermediate between an oligotrophic lake and a eutrophic lake. These lakes are dimictic: they have two periods of mixing or turnover (spring and fall), they are thermally stratified in the summer (warmest water at the surface), and they freeze over and become inversely stratified in the winter (coldest water at the surface).

Characteristic features of a mesotrophic lake include the following: water with medium transparency (Secchi disk depths of 2 to 4 m); water with moderate amounts of plant nutrients; moderate primary productivity (inorganic carbon fixed = 25 to 75 g/m^2/yr); lake sediments with moderate amounts of organic matter; and moderately well-oxygenated water. Alkalinity is typically moderate (slightly greater than 12.5 mg/l calcium carbonate).

Profundal and pelagic species assemblages are usually well developed. Characteristic fishes are mostly warmwater fishes, such as yellow perch (*Perca flavescens*), largemouth bass (*Micropterus salmoides*), northern pike (*Esox lucius*), bluegill (*Lepomis macrochirus*), and pumpkinseed (*Lepomis gibbosus*). Smallmouth bass (*Micropterus dolomieui*) is a characteristic cool water fish in these lakes.

Characteristic invertebrates may include pea clams (*Pisidium* spp.) and mayflies (*Hexagenia* spp.).

These lakes typically have a diverse mixture of submerged macrophytes, such as several species of pondweeds (*Potamogeton amplifolius, P. praelongus, P. robbinsii*), tapegrass or wild celery (*Vallisneria americana*), and bladderworts (*Utricularia* spp.).

Characteristic plankton may include the phytoplankton *Asterionella* and the zooplankton *Daphnia dubia.* More data on this community are needed.

Distribution: throughout New York State.

Rank: G4 S3S4 *Revised:* 2001

Examples: Hemlock Lake, Livingston and Ontario Counties; Lower St. Regis Lake, Franklin County; Rich Lake, Essex County; Yellow Lake, St. Lawrence County.

Sources: Bloomfield 1978a; Cole 1975; Maitland 1978; NYNHP field surveys.

7. Eutrophic dimictic lake: the aquatic community of a nutrient-rich lake that occurs in a broad, shallow basin. These lakes are dimictic: they have two periods of mixing or turnover (spring and fall), they are thermally stratified in the summer (warmest water at the surface), and they freeze over and become inversely stratified in the winter (coldest water at the surface).

Characteristic features of a eutrophic lake include the following: yellow, green, or brownish-green water that is murky, with low transparency (Secchi disk depths typically less than 2.5 m, but up to 4 m in some cases); water rich in plant nutrients (especially high in phosphorus, nitrogen and calcium), high primary productivity (inorganic carbon fixed = 75 to 250 g/m^2/yr); lake sediments that are rich in organic matter (usually consisting of a fine organic silt or copropel), water that is well-oxygenated above the summer thermocline, but oxygen-depleted below the summer thermocline or under ice; epilimnion volume that is relatively large compared with hypolimnion; and a weedy shoreline. Alkalinity is typically high (greater than 12.5 mg/l calcium carbonate).

Profundal and pelagic species assemblages are usually well developed. Usually there are many species of fish, especially minnows (Cyprinidae).

Characteristic fishes are warmwater fishes such as yellow perch (*Perca flavescens*), largemouth bass (*Micropterus salmoides*), chain pickerel (*Esox niger*), bluegill (*Lepomis macrochirus*), pumpkinseed (*L. gibbosus*), yellow bullhead (*Ameiurus natalis*), brown bullhead (*A nebulosus*), white sucker (*Catostomus commersoni*), golden shiner (*Notemigonus crysoleucas*), common shiner (*Luxilus cornutus*), northern redbelly dace (*Phoxinus eos*) and stocked white perch (*Morone americana*). Two species that are characteristic of eutrophic lakes on Long Island include banded sunfish (*Enneacanthus obesus*) and swamp darter (*Etheostoma fusiforme*) (D. Carlson *pers. comm.*). Eutrophic ponds on Long Island associated with coastal plain streams may have eastern mudminnow (*Umbra pygmaea*) and pirate perch (*Aphredoderus sayanus*).

Although the profundal benthos habitat is abundant, it is species poor, including only species tolerant of low oxygen; characteristic profundal invertebrates are oligochaetes (Oligochaeta), larvae of midges (*Chironomus* spp.), and phantom midges (*Chaoborus* spp.). Phytoplankton and zooplankton are usually abundant, but there are only a few species present; characteristic phytoplankton are cyanobacteria (blue-green algae); other characteristic plankton may include the phytoplankton *Ceolosphaerium, Dinobryon*, and *Asterionella,* and the zooplankton *Bosmina, Keratella, Diaptomus,* and *Daphnia dubia.*

Aquatic macrophytes are abundant in shallow water, and there are many species present, but species diversity is generally lower than in mesotrophic lakes. Characteristic plants include tapegrass or wild celery (*Vallisneria americana*), pondweeds (*Potamogeton* spp.), bur-reeds (*Sparganium* spp.), and the floating aquatic plants white water-lily (*Nymphaea odorata*), common yellow pond-lily (*Nuphar variegata*), and water-shield (*Brasenia schreberi*). Typically these are the lakes with nuisance problems of non-native plants such as Eurasian water milfoil (*Myriophyllum spicatum*), water chestnut (*Trapa natans*), and pondweed (*Potamogeton crispus*).

Three to six ecoregional variants are suspected to differ in dominant and characteristic fishes, mollusks, and insects. More data on aquatic macrophytes and macroinvertebrates, as well as regional variants, are needed.

Distribution: throughout New York State, usually at low elevations, especially common in the Great Lakes Plains ecozone.

Rank: G4 S3S4 *Revised:* 2001

Examples: Canandarago Lake, Otsego County; Honeoye Lake, Ontario County; Onondaga Lake, Onondaga County; Saratoga Lake, Saratoga County; Streeter Lake, St. Lawrence County; Chodikee Lake, Ulster County.

Sources: Bloomfield 1978a, 1980; Cole 1975; Maitland 1978; NYNHP field surveys.

8. Summer-stratified monomictic lake: the aquatic community of a lake that is so deep (or large) that it has only one period of mixing or turnover each year (monomictic), and one period of stratification. These lakes generally do not freeze over in winter (except in unusually cold years), or form only a thin or sporadic ice cover during the coldest parts of midwinter, so the water circulates and is isothermal during the winter (similar temperature though the water column). These lakes are typically thermally stratified only in the summer (warmest water at the surface); they are oligotrophic to mesotrophic and alkaline.

Profundal and pelagic assemblages are usually well developed. The dominant fishes include salmonids such as cisco (*Coregonus artedii*), and lake trout (*Salvelinus namaycush*) as well as yellow perch (*Perca flavescens*), rainbow smelt (*Osmerus mordax*), rock bass (*Ambloplites rupestris*), walleye (*Stizostedion vitreum*), brown bullhead (*Ameiurus nebulosus*), white sucker (*Catostomus commersoni*), and northern pike (*Esox lucius*). Other characteristic fishes may include longnose gar (*Lepisosteus osseus*), bowfin (*Amia calva*), lampreys (Petromyzontidae), lake sturgeon *(Acipenser fulvescens*), burbot (*Lota lota*), sauger (*Stizostedion canadense*), and round whitefish (*Prosopium cylindraceum*).

Characteristic invertebrates may include the mollusks eastern elliptio (*Elliptio complanata*), eastern lampmussel (*Lampsilis radiata*), pocketbook (*L. ovata*), pink heelsplitter (*Potamilus alatus*), floaters (*Pyganodon cataracta, P. grandis*), and mud amnicola (*Amnicola limosa*).

A characteristic crustacean of the hypolimnion of Finger Lake examples is *Senecella calanoides*, which was named after Seneca Lake. Dominant invertebrates of the profundal zone of Lake Champlain are Spheriidae and the oligochaetes *Stylodrilus heringianus* and *Peloscolex variegatus.* Winter epilimnion plankton species assemblages are usually well developed. Characteristic plankton may include the following phytoplankton: *Fragilaria* spp. and *Anabaena* spp. in summer; *Melosira* spp. and *Cryptomonas ovata* in winter; and the following the zooplankton: *Daphnia* spp., and *Diaptomus* spp. in summer; *Limnocalanus macrurus*, and *Cyclops bicuspidatus* in winter.

Characteristic aquatic macrophytes include pondweeds (*Potamogeton gramineus, P. richardsonii, P. pectinatus*), horned pondweed (*Zannichellia palustris*), naiad (*Najas flexilis*),

waterweed (*Elodea canadensis*), tapegrass or wild celery (*Vallisneria americana*), and coontail (*Ceratophyllum demersum*).

The best-known examples in New York are Cayuga Lake, Seneca Lake, and Lake Champlain. These lakes are very deep relative to their size, with mean depths of 54.5 m (179 ft), 88 m (290 ft), and over 18m (60 ft) respectively. The area of these three lakes are 172 km^2 (66.4 mi^2), 175 km^2 (67.7 mi^2), and 1,331 km^2 (514 mi^2) respectively. The Great Lakes (*e.g.*, Lake Ontario and Lake Erie) are also summer-stratified monomictic lakes, but they are not included in this community because of their larger size, and access to estuarine biota through the St. Lawrence River, and the Welland Canal (see Great Lakes deepwater community).

Up to two ecoregional variants are possible (St. Lawrence-Lake Champlain, and Finger Lakes types) with one to few examples of each, potentially differing in dominant, and characteristic vascular plants, fishes, mollusks, and insects.

Rank: G3G4 S1S2 *Revised:* 2001

Examples: Cayuga Lake, Cayuga, Seneca, and Tompkins Counties; Seneca Lake, Seneca, Schuyler, and Yates Counties; Lake Champlain, Clinton, Essex, and Washington Counties.

Sources: Berg 1963; Bloomfield 1978a; Fiske and Levey 1996; Greeley 1930; Hunt 1998a; Lake Champlain Basin Study 1979; Levey and Fiske 1996; Muenscher 1928.

9. Winter-stratified monomictic lake: the aquatic community of a large, shallow lake that has only one period of mixing each year because it is very shallow in relation to its size (*e.g.*, Oneida Lake, with a mean depth less than 6 m (20 ft), and surface area of approx. 200 km^2 (80 mi^2), and is completely exposed to winds. These lakes continue to circulate throughout the summer; stratification becomes disrupted at some point during an average summer. These lakes typically never become thermally stratified in the summer, but they freeze over and become inversely stratified in the winter (coldest water at the surface). They are eutrophic to mesotrophic lakes.

Littoral, and epilimnion species assemblages are dominant. Pelagic species assemblages are well developed. Characteristic fishes are walleye (*Stizostedion vitreum*), largemouth bass (*Micropterus salmoides*), yellow perch (*Perca flavescens*), bullhead (*Ameiurus* spp.), white sucker (*Catostomus commersoni*), muskellunge (*Esox masquinongy*), and trout perch (*Percopsis omiscomaycus*).

Characteristic macroinvertebrates may include isopods (Isopoda), amphipods (Amphipoda), and ramshorn snails (Planorbidae). Characteristic phytoplankton may include *Dinobryon* spp., and *Ceratium* spp. Vascular plants are typically diverse. Characteristic aquatic macrophytes include water stargrass (*Heteranthera dubia*), coontail (*Ceratophyllum demersum*), waterweed (*Elodea* spp.), naiad (*Najas flexilis*), tapegrass or wild celery (*Vallisneria americana*), and pondweeds (*Potamogeton perfoliatus, P. pectinatus, P. pusillus, P. richardsonii, P. nodosus, P. zosteriformis*). Stoneworts (*Chara* spp.) may be abundant.

Only two to three ecoregional variants are suspected (Great Lakes, Northern Appalachian, and possibly Lower New England types), potentially differing in dominant, and characteristic vascular plants, fishes, mollusks, and insects. More data on this community are needed.

Distribution: uncommon in upstate New York, north of the Coastal Lowlands ecozone, and probably restricted to the Great Lakes Plains and St. Lawrence River Valley ecozones.

Rank: G3G4 S2 *Revised:* 2001

Examples: Oneida Lake, Oneida, and Oswego Counties; Horseshoe Lake, St. Lawrence County; Black Lake, St. Lawrence County; Perch Lake, Jefferson County.

Sources: Berg 1963; Bloomfield 1978b; Hunt 1998a; Schiavone 1984; NYNHP field surveys.

10. Meromictic lake: the aquatic community of a relatively deep lake with small surface area that is so protected from wind-stirring that it has no annual periods of complete mixing, and remains chemically stratified throughout the year. These lakes may be protected from mixing by a sheltered surrounding landscape (*e.g.*, a deep basin) or by adjacent tree cover. Meromictic lakes in New York freeze over and become inversely stratified in the winter (coldest water at the surface); they pass through spring, and fall periods of isothermy without circulating. Meromictic lakes frequently have dichothermic stratification, meaning that the minimum temperature occurs in the middle stratum. The stagnant waters in the lower part of a meromictic lake become heavily loaded with dissolved salts, and lack oxygen. Chemical stratification is most often measured by salinity gradients, or total cation and anion concentrations. Gradients may be present for chemicals, such as hydrogen sulfide, ammonia, phosphorus, or iron. Flushing rates are typically low. Some examples of this lake type may be dystrophic, and thus resemble bog lakes.

Species diversity is low because very few organisms can tolerate the extreme chemical conditions of the lower strata of a meromictic lake. Fishes are absent or sparse, and confined to the epilimnion. Characteristic fishes are warmwater species, and may include brown bullhead (*Ameiurus nebulosus*), yellow perch (*Perca flavescens*), and white sucker (*Catostomus commersoni*). Characteristic macroinvertebrates may include gastropods (six species of snails in Green Lake Fayetteville).

Freshwater sponge forms a dense cover in the littoral zone of one example (Potters Pond). Plankton is typically diverse and dense. A purple sulfur bacterium (*Lamprocystis roseopersicina*) is characteristic of the hypolimnion of Green Lake Fayetteville. Other characteristic plankton may include cyanobacteria, the phytoplankton *Synura* spp., *Asterionella* spp., *Peridium* spp., and *Ceratium hirundinella*, and the zooplankton *Diaphanasoma brachyurum*, *Ceriodaphnia* spp., and cyclopoid copepods.

Characteristic vascular plants may include stoneworts (*Chara* spp.), waterweeds (*Elodea* spp.), and pondweeds (*Potamogeton* spp.).

The best-known example in New York is Green Lake in the town of Fayetteville. Two or more ecoregional variants (Great Lakes, Northern Appalachian types) are suspected, potentially differing in dominant and characteristic vascular plants, insects, and plankton. More data on this community are needed.

Distribution: uncommon in upstate New York, north of the Coastal Lowlands ecozone.

Rank: G3G4 S1S2 *Revised:* 2001

Examples: Green Lake and Round Lake (GreenLakes State Park), Onondaga County; Glacier Lake (Clark Reservation State Park), Onondaga County; Lowery Pond, one of Junius Ponds, Seneca County; Potters Pond, Franklin County; Ballston Lake, Saratoga County.

Sources: Berg 1963; Bohannan *et al.* 1994; Eggleton 1956; Fry 1986; Pendl and Stewart 1986; NYNHP field surveys.

11. Marl pond: the aquatic community of a small, shallow spring-fed pond in which the water has a high concentration of calcium; as a result of chemical or photosynthetic removal of carbon dioxide from the water, the calcium precipitates out of the water as calcium carbonate ($CaCO_3$). This calcium carbonate is deposited on the substrate, and forms a marl sediment. Marl is a white-colored precipitate that consists of calcium carbonate mixed with clay. Calcium carbonate levels are typically greater than 50 ppm.

Stoneworts (*Chara* spp.), some other algae, cyanobacteria, and at least one species of moss (*Didymodon tophaceus*) can be involved in photosynthetic precipitation of calcium carbonate; stoneworts are usually abundant in marl ponds. Marl ponds have very low primary productivity and sparse growth of aquatic macrophytes. Characteristic vascular plants may include pondweeds (*Stuckenia filiformis*, *Potamogeton strictifolius*).

Certain diatoms may be abundant, but low levels of available plant nutrients restrict growth of other algae and cyanobacteria. Characteristic plankton in nearby states includes calciphilic desmids, cladocerans (*Holopedium* spp.), and calciphilic rotifers (*Brachionus* spp.). More data on this community are needed.

Distribution: known only from the Finger Lakes Highlands subzone of the Appalachian Plateau ecozone; may be other examples in the Great Lakes Plain ecozone.

Rank: G3G4 S1 *Revised:* 2001

Examples: Cortland Marl Ponds, Cortland County.

Sources: Cole 1979; NYNHP field surveys.

12. Inland salt pond: the aquatic community of a small, spring-fed pond in which the water is salty from flowing through salt beds in the aquifer. These salt springs occur in central New York, and were once common around Onondaga Lake in Syracuse, and near Montezuma. Most of the springs have been exploited for the production of salt, and are very disturbed or completely destroyed. The pond is permanently flooded, but the water levels fluctuate seasonally. The bottom, and shores of an inland salt pond are very mucky.

The one example of this community that has remained least disturbed is dominated by ditch grass (*Ruppia maritima*), and has at least one species of small fish (probably a killifish, *Fundulus* spp.). Another characteristic plant is the pondweed *Stuckenia pectinatus.* More data on this community are needed.

Distribution: known only from the Great Lakes Plain ecozone.

Rank: G2 S1 *Revised:* 1990

Example: Carncross Salt Pond, Wayne County.

Sources: Catling and McKay 1981; NYNHP field surveys.

13. Oxbow lake/pond: the aquatic community of a small, shallow, usually stagnant lake or pond of fluvial origin that occurs in an old river meander or oxbow that has been cut off from an unconfined river or marsh headwater stream by deposition of a natural levee. Typically, the associated river periodically overflows this natural levee, restoring river water and biota to this lake type. Many examples of this lake type may be relatively short-lived in dynamic river complexes, transforming into a backwater slough through permanent breaching of the downstream natural levee, or into a riverine community through permanent breaching of the upstream natural levee. These are usually eutrophic lakes.

Characteristic biota is typically riverine species assemblages. Aquatic vegetation is abundant; characteristic aquatic macrophytes may include species typical of eutrophic ponds such as pondweeds (*Potamogeton* spp.), white water-lily (*Nymphaea odorata*), and water-shield (*Brasenia schreberi*).

Four to seven ecoregional variants are suspected to differ in dominant, and characteristic vascular plants, fishes, mollusks, and insects. Up to three morphological variants are known: 1) classical oxbow lakes formed from old river channels, 2) small natural levee lakes formed as pools from natural levee overwash, and 3) floodplain lakes formed, and replenished during high annual water of the associated river. More data on this community are needed.

Distribution: throughout New York State north of the Coastal Lowlands ecozone, usually at low elevations.

Rank: G4 S3 *Revised:* 2001

Examples: Raquette River, Franklin County; North Branch Moose River, Herkimer County; Schroon River, Essex County; Little River, St. Lawrence County; Hemp Pond, Livingston County.

Source: NYNHP field surveys.

14. Coastal plain pond: the aquatic community of the permanently flooded portion of a coastal plain pond with seasonally and annually fluctuating water levels. These are shallow, groundwater-fed ponds that occur in kettleholes or shallow depressions in the outwash plains south of the terminal moraines of Long Island, and New England. A series of coastal plain ponds are often hydrologically connected, either by groundwater, or sometimes by surface flow in a small coastal plain stream. Water is typically acidic, darkly stained, and has low transparency. However, coastal plain ponds in adjacent states typically have high transparency (P. Swain *pers. comm.*). The substrate is typically sand to muck.

Aquatic vegetation may be abundant; characteristic plants include water-shield (*Brasenia schreberi*), white water-lily (*Nymphaea odorata*), bayonet-rush (*Juncus militaris*), Robbins spikerush (*Eleocharis robbinsii*), bladderworts (*Utricularia purpurea, U. fibrosa*), water milfoil (*Myriophyllum humile*), naiad (*Najas flexilis*), waterweed (*Elodea* spp.), pondweed (*Potamogeton oakesianus*), pipewort (*Eriocaulon aquaticum*), brown-fruited rush (*Juncus pelocarpus*), golden-pert (*Gratiola aurea*), water bulrush (*Schoenoplectus subterminalis),* Small's yellow-eyed-grass (*Xyris smalliana*), horse-tail spikerush (*Eleocharis equisetoides*), and various peat mosses (*Sphagnum torreyanum, S. lescurii, S. cuspidatum,* and *S. macrophyllum*). See coastal plain pond shore for pond margins dominated by emergent vegetation after water drawdown.

Characteristic fishes include chain pickerel (*Esox niger*), banded sunfish (*Enneacanthus obesus*), and eastern mudminnow (*Umbra pygmaea*). Some coastal plain ponds are breeding ponds for tiger salamander (*Ambystoma tigrinum*). Other characteristic fauna may include painted turtle (*Chrysemys picta*), wood duck (*Aix sponsa*), and muskrat (*Ondatra zibethicus*). More data on this community are needed.

Distribution: in the Coastal Lowlands ecozone on Long Island.

Rank: G3G4 S2 *Revised:* 2001

Examples: Crooked Pond, Suffolk County; Scoys Pond, Suffolk County; Kents Pond, Suffolk County; Weeks Pond, Suffolk County.

Sources: Muenscher 1939; Theall 1983; R. Zaremba *pers. comm.*; NYNHP field surveys.

15. Oligotrophic pond: the aquatic community of a small, shallow, nutrient-poor pond. The water is very clear, and the bottom is usually sandy or rocky. Oligotrophic ponds are too shallow to remain thermally stratified throughout the summer; they often freeze and become inversely stratified in the winter (coldest water at the surface), therefore they are winter-stratified monomictic ponds. Additional characteristic features of an oligotrophic pond include the following: blue or green water with high transparency (Secchi disk depths of 4 to 8 m); water low in plant nutrients (especially low in nitrogen, also low in calcium); low primary productivity (inorganic carbon fixed = 7 to 25 $g/m^2/yr$). Alkalinity is typically low (less than 12.5 mg/l calcium carbonate).

Aquatic vegetation is typically sparse, and species diversity is low. Littoral, epilimnion, and acidic tolerant species assemblages are usually dominant. Characteristic species are rosette-leaved aquatics such as pipewort (*Eriocaulon aquaticum*), water lobelia (*Lobelia dortmanna*), and quillwort (*Isoetes echinospora*). Additional characteristic aquatic macrophytes may include pondweed (*Potamogeton epihydrus*), milfoil (*Myriophyllum farwellii*), bladderwort (*Utricularia macrorhiza*), and bur-reed (*Sparganium fluctuans*).

Fish diversity is typically low, and fish assemblages are generally poorly developed. Oligotrophic ponds may have either coldwater or warmwater fishes, depending upon summer temperatures. Very small ponds with no inlet or outlet may lack fish, and have an abundance of aquatic insects. A characteristic fish of the coldwater ponds is brook trout (*Salvelinus fontinalis*). Native populations of brook trout have been extirpated from most examples in the state. Additional characteristic fishes may include creek chub (*Semotilus atromaculatus*). Characteristic macroinvertebrates may include pea clams (*Pisidium* spp.), several odonates (*Aeshna* spp., *Ischnura* spp., *Cordulia shurtleffii*, and *Leccorrhinia* spp.), diving beetles (Dytiscidae), water boatman (Corixidae), and backswimmers (Notonectidae). Characteristic plankton may include phytoplankton (*Tabellaria* spp., *Asterionella* spp.) and zooplankton (*Keratella* spp.) including various nauplii (crustacean larvae).

Three to four ecoregional variants (Northern Appalachian, Lower New England, Allegheny Plateau, and possibly North Atlantic Coast types) are suspected to differ in dominant, and characteristic vascular plants, fishes, mollusks, and insects.

Tarn ponds, and flow-through or fluvial ponds, might be distinct variants worthy of recognition as separate communities, but need further evaluation. Tarn ponds occur in alpine to subalpine zones, and are typically frozen annually for extended periods. Characteristic vegetation of tarn ponds may include bladderwort (*Utricularia geminiscapa*), pondweed (*Potamogeton confervoides*), and floating-heart (*Nymphoides cordata*). A characteristic fish of tarn ponds may include lake trout (*Salvelinus alpinus*). Flow-through or fluvial ponds are closely associated with riverine complexes (*e.g.*, large natural widenings of rivers or large impoundments of river channels dammed by beaver), and have a high flushing rate. A characteristic mammal of flow-through ponds may include beaver *(Castor canadensis*). More data on regional variants are needed.

Distribution: throughout New York State, usually at high elevations; more common in the Adirondacks, also occurs in the Appalachian Plateau, Taconic Highlands, and Tug Hill Plateau ecozones.

Rank: G4 S4 *Revised:* 2001

Examples: South Pond, Hamilton County; Kildare Pond, St. Lawrence County; Rensselaer Plateau, Rensselaer County; Tug Hill Plateau, Lewis, Oswego, and Jefferson Counties.

Sources: Roberts *et al.* 1985; NYNHP field surveys.

16. Eutrophic pond: the aquatic community of a small, shallow, nutrient-rich pond. The water is usually green with algae, and the bottom is mucky. Eutrophic ponds are too shallow to remain thermally stratified throughout the summer; they often freeze and become inversely stratified in the winter (coldest water at the surface), therefore they are winter-stratified monomictic ponds. Additional characteristic features of a eutrophic pond include the following: water that is murky, with low transparency (Secchi disk depths typically less than 4 m); water rich in plant nutrients (especially high in phosphorus, nitrogen, and calcium), high primary productivity (inorganic carbon fixed = 75 to 250 $g/m^2/yr$) and a weedy shoreline. Alkalinity is typically high (greater than 12.5 mg/l calcium carbonate).

Species diversity is typically high. Aquatic vegetation is abundant. Littoral, and epilimnion species assemblages usually dominate the community. Characteristic plants include coontail (*Ceratophyllum demersum*), duckweeds (*Lemna minor, L. trisulca*), waterweed (*Elodea canadensis*), pondweeds (*Potamogeton* spp.), water starwort (*Heteranthera dubia*), bladderworts (*Utricularia* spp.), naiad (*Najas flexilis*), tapegrass or wild celery (*Vallisneria americana*), algae (*Cladophora* spp.), common yellow pond-lily (*Nuphar variegata*), and white water-lily (*Nymphaea odorata*). Characteristic fishes are usually warmwater fishes. Characteristic macroinvertebrates may include several types of odonates (*Aeshna* spp., *Ischnura* spp., *Gomphus* spp., and *Basiaeschna* spp.), and leeches (Hirudinae). Characteristic, and dominant plankton may include the phytoplankton *Chrysosphaerella longispina*, and *Ceratium* spp., and the zooplankton, including various nauplii (crustacean larvae), rotifers such as *Keratella*, cyclopoids, and cladocerans.

Three to seven ecoregional variants (including Northern Appalachian, Great Lakes, Lower New England types) are suspected to differ in dominant, and characteristic vascular plants, fishes, mollusks, and insects. Flow-through or fluvial pond might be a distinct variant worthy of recognition as a separate community type, but needs further evaluation. Flow-through ponds are closely associated with riverine complexes (*e.g.*, large natural widenings of rivers or large beaver impoundments of river channels), and

have a high flushing rate. A characteristic mammal of flow-through ponds may include beaver *(Castor canadensis*).

More data on this community are needed.

Distribution: throughout New York State, and is more common at low elevations, especially in the Great Lakes Plain and St. Lawrence River Valley ecozones.

Rank: G4 S4 *Revised:* 2001

Examples: Black Pond, Jefferson County; Deer Pond, Essex County; Lima Ponds, Livingston County; Rogers Pond, Essex County; Sullivan Pond, Warren County; White Lily Pond, Rensselaer County; Little Dam Lake – Sterling Forest, Orange County.

Sources: Gilman 1976; NYNHP field surveys.

B. LACUSTRINE CULTURAL

This subsystem includes communities that are either created, and maintained by human activities, or are modified by human influence to such a degree that the trophic state, morphometry, water chemistry, or biological composition of the resident community are substantially different from the character of the lake community as it existed prior to human influence.

1. Lacustrine submerged structure: the aquatic community associated with an artificially introduced structure submerged in lacustrine waters, such as a pond or lake, that provides habitat for fish and other organisms. This includes structures that have been intentionally sunk for the purpose of attracting fish, as well as sunken ships, disposed waste, submerged bridge abutments, or any other introduced material that provides suitable habitat.

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 2001

2. Acidified lake: the aquatic community of a formerly alkaline (oligotrophic or mesotrophic), dimictic lake that has received so much acid deposition (pH less than 4.7; sulfate, and nitrate are now the dominant anions in precipitation in the Northeast) that the pH of the lake has decreased significantly. The changes in diatom assemblages in sediment cores from a few of these lakes have been used to infer the pH history of these lakes. Acidified lakes show a large decrease in pH (with pH usually less than 5.25) during the last 30 years relative to pH changes during the previous centuries. Associated with the decrease in pH are significant changes in the biota of the lake, such as a decrease in the number of species of fishes, diatoms, and most aquatic macrophytes present, and a change in the composition of species assemblages. Typically there are blooms of benthic green algae, and cyanobacteria, and an increase in the growth of peat mosses (*Sphagnum* spp.) or bladderworts (*Utricularia* spp.). One bladderwort (*Utricularia geminiscapa*), and one pondweed (*Potamogeton confervoides*) are reported to be restricted to lakes with pH less than 5.1. These lakes may be best distinguished from naturally acidic lakes (*e.g.,* bog lake) through historical comparisons.

Distribution: most common in the Adirondacks, but may also occur throughout eastern New York in the Appalachian Plateau, Taconic Highlands, and Hudson Valley ecozones.

Rank: unranked cultural *Revised:* 1990

Example: Silver Lake Webb, Herkimer County.

Sources: Charles 1984; Roberts *et al.* 1985; Schindler 1988; Singer *et al.* 1983; Whitehead *et al.* 1986.

3. Cultural eutrophic lake: the aquatic community of a formerly eutrophic to mesotrophic lake that has received an increase in nutrients (especially phosphorus, and nitrogen) from sewage effluent, agricultural runoff, and other pollutants. This nutrient enrichment has resulted in a significant increase in productivity of the lake (especially in the phytoplankton); annual productivity of these lakes exceeds 300 g carbon/m^2/yr. An extremely eutrophic lake is characterized by high amounts of photosynthetic pigment in the water and, consequently, low transparency; blooms of cyanobacteria are common from midsummer through fall.

Characteristic macrophytes are weedy non-natives such as Eurasian water milfoil (*Myriophyllum spicatum*), water chestnut (*Trapa natans*), and pondweed (*Potamogeton crispus*). These macrophytes may grow to high densities, excluding other species, and thus severely reduce species diversity.

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 1990

Sources: Bloomfield 1978a, 1980.

4. Lacustrine water chestnut bed: the aquatic community within a lake or pond that is dominated by large, nearly continuous mats of non-native water chestnut (*Trapa natans*). This community may develop in open water bays behind connected impoundments, such as railroad beds, or form patches within large lakes in more shallow and sheltered coves.

Distribution: lakes and ponds within the Hudson Valley, Lake George Valley, and Lake Champlain Valley.

Rank: unranked cultural *Revised:* 2004

Examples: Southern Lake Champlain, Washington and Essex Counties.

5. Farm pond/artificial pond: the aquatic community of a small pond constructed on agricultural or residential property. These ponds typically lack perennially flowing inlets and outlets. These ponds are often eutrophic, and may be stocked with panfish such as bluegill (*Lepomis macrochirus*), and yellow perch (*Perca flavescens*). The biota is variable (within limits), reflecting the species that were naturally or artificially seeded, planted, or stocked in the pond.

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 2004

6. Reservoir/artificial impoundment: the aquatic community of an artificial lake created by the impoundment of a river with a dam. Reservoirs are constructed to collect water for municipal and/or agricultural water use, to provide hydroelectric power, and to improve opportunities for recreational activities (*e.g.,* boating, swimming), and development. These impoundments typically have perennially flowing inlets and human-regulated outlets.

Characteristic fishes include chain pickerel (*Esox niger*), and other pikes (Esocidae); brown bullhead (*Ameiurus nebulosus*) or yellow bullhead (*A natalis*) or both of these; bluegill (*Lepomis macrochirus*) or pumpkinseed (*Lepomis gibbosus*) or both of these; golden shiner (*Notemigonus crysoleucas*), and fathead minnow (*Pimephales promelas*). Reservoirs are often stocked with rainbow trout (*Salmo gairdneri*).

Artificial impoundments underlain by limestone bedrock may be distinguished as "alkaline impoundments." A rare plant of some of these impoundments is Hill's pondweed (*Potamogeton hillii*) (T. Weldy *pers. comm.*).

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 2004

7. Quarry pond: the aquatic community of an excavated basin that is created as part of a rock quarrying operation. The sides of the basin are often very steep, thereby eliminating any shallow shoreline habitats. Water levels usually fluctuate, reflecting recent precipitation patterns. Includes ponds formed in sand mining quarries.

Distribution: throughout New York State north of the Coastal Lowlands ecozone.

Rank: unranked cultural *Revised:* 2004

8. Artificial pool: the aquatic community of a small pool that is constructed for recreational activities (*e.g.,* swimming) or as a decorative element in a landscape design. The water is typically chlorinated, and flushed on a regular basis to reduce or eliminate the growth of algae, and bacteria; there is minimal development of any aquatic biota.

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 1990

9. Industrial cooling pond: the aquatic community of an artificial pond constructed as a holding pond to allow for cooling of high temperature industrial effluents.

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 1990

10. Sewage treatment pond: the aquatic community of an artificial pond constructed for sewage treatment (chemical, and biological decomposition of sewage) prior to release to a stream or aquifer.

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 1990

C. LACUSTRINE REFERENCES

Adirondack Lakes Survey. 1986. Adirondack lakes survey 1985 report. Volumes 6-10. Unpublished report. Adirondack Lake Survey Corporation, Ray Brook, NY.

Adirondack Lakes Survey. 1987. Adirondack lakes survey 1986 report. Volumes 11-15. Unpublished report. Adirondack Lake Survey Corporation, Ray Brook, NY.

Bain, M. B. and N. J. Stevenson. 1999. Aquatic Habitat Assessment. Common Methods. American Fisheries Society, Bethesda, MD.

Berg, C. O. 1963. Middle Atlantic States. Chapter 6 (pp. 191-237) in: Limnology in North America. D. G. Frey, ed. Univ. of Wisconsin Press, Madison, WI.

Bloomfield, J. A., ed. 1978a. Lakes of New York State. Vol. I. Ecology of the Finger Lakes. Academic Press, NY.

Bloomfield, J. A., ed. 1978b. Lakes of New York State. Vol. II. Ecology of the lakes of western New York. Academic Press, NY.

Bloomfield J. A. 1980. Lake of New York State. Vol. III. Ecology of the lakes of east-central New York. Academic Press, NY.

Bohannan, B., J. D'Angelo, T. Hunter, L. VanHorn, and M. Lyzwa. 1994. Physical and chemical analysis of Potters Pond. Limnology Report. Adirondack Aquatic Institute, Paul Smith's College, Paul Smiths, NY.

Busch, W. N. and P. G. Sly. 1992. The Development of an Aquatic Habitat Classification System for Lakes. CRC Press. Ann Arbor, MI.

Carlson, D. M., R. Colesante, J. S. Hayes, and S. L. Schlueter. 2002. Lake sturgeon (*Acipenser fulvescens*) and its recovery programs in New York State. New York State Department of Environmental Conservation, Albany, NY.

Catling, P. M. and S. M. McKay. 1981. A review of the occurrences of halophytes in the eastern Great Lakes region. Mich. Bot. 20:167-179.

Charles, D. F. 1984. Recent pH history of Big Moose Lake (Adirondack Mountains, New York, USA.) inferred from sediment diatom assemblages. Verh. Internat. Verien. Limnol. 22: 559-566.

Clausen, R. T. 1940. Aquatic vegetation of the Lake Ontario watershed. In: A biological survey of the Lake Ontario watershed. Suppl. to the 29th annual report, 1939. NYS Conservation Dept., Albany, NY.

Cole, G. A. 1979. Textbook of limnology. The C. V. Mosby Co., Saint Louis, MO.

Croskery, P. R. 1995. A review of Lake Ontario's fish and wildlife resources. Unpublished report. Peter Croskery and Associates, Grimsby, Ontario, Canada.

Eggleton, F. E. 1956. Limnology of a meromictic, interglacial, plunge-basin lake. Trans. Amer. Microscop. Soc. 75: 334-378.

Ferris, J. J., N. J. Clesceri, and D. B. Aulenbach. 1980. The limnology of Lake George, New York. Rensselaer Freshwater Institute, Report #76-5, Troy, NY.

Fiske, S. and R. Levey. 1996. Survey of Shale and Cobble Zone Macroinvertebrate Community 1995. Vermont Deparment of Environmental Conservation. Waterbury, VT.

Fry, B. 1986. Sources of carbon and sulfur nutrition for consumers in three meromictic lakes of New York State. Limnol. Oceanogr. 31(1): 79-88.

Gilman, B. A. 1976. Wetland plant communities along the eastern shoreline of Lake Ontario. M. S. thesis, SUNY College of Environmental Science, and Forestry, Syracuse, NY.

Greeley, J. R. 1930. Fishes of the Lake Champlain watershed. *In* A biological survey of the Lake Champlain watershed. E. Moore (editor). Supplemental to the 19th annual report, New York State Department of Environmental Conservation, Albany, NY.

Halliwell, D. B., R. W. Langdon, R. A. Daniels, J. P. Kurtenbach, and R. A. Jacobsen. 1999. Classification of Freshwater Fish Species of the Northeastern United States for Use in the Development of Indices of Biological Integrity, with Regional Applications. pp. 301-337. In: Assessing the Sustainability and Biological Integrity of Water Resources Using Fish Communities. CRC Press.

Higgins, J., M. Lammert, M. Bryer, M. DePhilip and D. Grossman. 1998. Freshwater Conservation in the Great Lakes Basin: Development and Application of an Aquatic Community Framework. The Nature Conservancy, Chicago, IL.

Hunt, D. M. 1998a. Community ranking and general description. Lake Champlain, summer-stratified monomictic lake. Unpublished report. New York Natural Heritage Program, Latham, NY.

Hunt, D. M. 1998b. Community ranking and general description. Lake Ontario, Great Lakes deepwater community. Unpublished report. New York Natural Heritage Program, Latham, NY.

Hunt, D. M. 1999. A proposed littoral association classification for Lake George: Implications for state & national community classifications, benthic association mapping, and monitoring & management of the lake. Unpublished report. New York Natural Heritage Program, Latham, NY.

Hunt, D. M. 2000. Lake George littoral association pilot mapping project: Implications for lake monitoring efforts and comparison of mapping methods. Unpublished report. New York Natural Heritage Program, Latham, NY.

Hunt, D. M. 2001. St. Lawrence/Champlain Valley (STL) known or suspected, extirpated or extant lacustrine macrohabitats/alliances. Unpublished report. New York Natural Heritage Program, Latham, NY.

Jackson, S. T. and D. F. Charles. 1988. Aquatic macrophytes in Adirondack (New York) lakes: Patterns of species composition in relation to environment. Canadian Journal of Botany 66:1449-1460.

Knutson, M. G., D. J. Leopold, R. C. Smardon, and S. R. LaPan. 1990. Conservation of small islands and emergent shoals in the Thousand Islands region. IEPP Publication 90-001. Unpublished report. State University of New York, College of Environmental Science and Forestry, Syracuse, NY.

Lake Champlain Basin Study. 1979. Limnology of Lake Champlain. US Department of Commerce National Technical Information Service PB-295 612. January 1979.

Lampert, W. and U. Sommer. 1997. Limnoecology: the ecology of lakes and streams. Oxford University Press, New York.

Levey, R. and S. Fiske. 1996. Survey of Native Mussel-Beds in Lake Champlain 1995. Vermont Deparment of Environmental

Conservation. Waterbury, VT.

Maitland, P. S. 1978. Biology of Fresh Waters. John Wiley, and Sons, NY.

Maxwell, J. R., C. J. Edwards, M. E. Jensen, S. J. Paustian, H. Parrott and D. M. Hill. 1995. Hierarchical framework of aquatic ecological units in North America (Nearctic Zone). USDA. Forest Service. Gen. Tech. Rep. NC-176.

Moyle, P. B. and J. P. Ellison. 1991. A conservation-oriented classification system for the inland waters of California. Calif. Fish and Game 77 (4): 161-180.

Muenscher, W. C. 1928. Vegetation of Cayuga, and Seneca Lakes. Appendix XII in: A biological survey of the Oswego River system. Suppl. to the 17th Ann. Rep., 1927. NYS Conservation Dept., Albany, NY.

Muenscher, W. C. 1939. Aquatic vegetation of Long Island waters. In: A biological survey of the fresh waters of Long Island. Suppl. to the 28th Ann. Rep., 1938. NYS Conserv. Dept., Albany, NY.

Pendl, M. P. and K. M. Stewart. 1986. Variations in carbon fractions within a dimictic, and a meromictic basin of the Junius Ponds, New York. Freshwater Biology 16: 539-555.

Pielou, E. C. 1998. Fresh Water. University of Chicago Press, Chicago, IL.

Roberts, D. A., R. Singer, and C. W. Boylen. 1985. The submersed macrophyte communities of Adirondack lakes (New York, USA.) of varying degrees of acidity. Aquatic Botany 21: 219-235.

Schiavone, A. 1984. Black Lake, a Changing Sportsfishery. Conservationist May-June: 9-11.

Schindler, D. W. 1988. Effects of acid rain on freshwater ecosystems. Science 239: 149-157.

Siegfried, C. A. 1986. Understanding New York Lakes. New York State Museum, Educational Leaflet 26, Albany, NY.

Singer, R., D. A. Roberts, and C. W. Boylen. 1983. The macrophytic community of an acidic lake in Adirondack (New York, USA.): a new depth record for aquatic angiosperms. Aquatic Bot. 16: 49-57.

Smith, C. L. 1985. The inland fishes of New York State. NYS Dept. of Environmental Conservation, Albany, NY.

Sutherland, J. W. 1989. Field surveys of the biota and selected water chemistry parameters in 50 Adirondack Mountain lakes. NYS Department of Environmental Conservation, Albany, NY.

Swart, J. M. and J. A. Bloomfield. 1987. Characteristics of New York State lakes, ponds and reservoirs. Third edition. NYS Department of Environmental Conservation, Albany, NY.

Theall, O. 1983. An investigation into the hydrology of Massachusetts' coastal plain ponds. Unpublished report for the Massachusetts Natural Heritage Program, Massachusetts Div. of Fisheries, and Wildlife, Boston. MA.

US Fish and Wildlife Service. 1992. Development of aquatic habitat units applicable to Lake Ontario. Unpublished report. US Fish and Wildlife Service, Lower Great LakesFisheries Resource Office, Buffalo, NY.

Vermont Aquatic Working Group. 1998. A Classification of Aquatic Communities for Vermont. The Nature Conservancy and Vermont Biodiversity Project.

Welch, P. S. 1935. Limnology. McGraw-Hill Book Co., Inc. New York, NY.

Whitehead, D. R., D. F. Charles, S. T. Jackson, S. E. Reed, and M. C. Sheehan. 1986. Late-glacial, and Holocene acidity changes in Adirondack (N. Y.) lakes. In: Diatoms, and lake acidity. J. P. Smol, R. W. Battarbee, R. B. Davis, and J. Meriläinen (eds.), Dr. W. Junk, Dordrecht.

Widoff, L. 1986. Classification of Maine and New England Lacustrine Communities. Draft. Maine Natural Heritage Program. Augusta, ME.

V. PALUSTRINE SYSTEM

The palustrine system consists of non-tidal, perennial wetlands characterized by emergent vegetation. The system includes wetlands permanently saturated by seepage, permanently flooded wetlands, and wetlands that are seasonally or intermittently flooded (these may be seasonally dry) if the vegetative cover is predominantly hydrophytic and soils are hydric. Wetland communities are distinguished by their plant composition (hydrophytes), substrate (hydric soils), and hydrologic regime (frequency of flooding) (Cowardin *et al.* 1979).

Peatlands are a special type of wetland in which the substrate primarily consists of accumulated peat (partly decomposed plant material such as mosses, sedges, and shrubs) or marl (organically derived calcium carbonate deposits), with little or no mineral soil. Stable water levels or constant water seepage allow little aeration of the substrate in peatlands, slowing decomposition of plant litter, and resulting in peat or marl accumulation. In this classification, peatlands are characterized by their hydrologic regime; water source and water chemistry are important factors. Minerotrophic peatlands (fens) are fed by groundwater that contains minerals obtained during passage through or over mineral soils or aquifers. Ombrotrophic peatlands (bogs) are fed primarily by direct rainfall, with little or no groundwater influence (Damman and French 1987). The vegetation of ombrotrophic peatlands is depauperate; plants in the families Sphagnaceae and Ericaceae are prominent. The vegetation of minerotrophic peatlands is comparatively rich in species; plants in the families Cyperaceae and Poaceae are prominent (Heinselman 1970).

In a natural landscape there are continuous gradients from ombrotrophic to strongly minerotrophic wetlands; there are also continuous gradients in soils from mineral soils to peat soils. The boundaries between different types of wetlands are not always discrete. Several different types of wetlands may occur together in a complex mosaic.

A. OPEN MINERAL SOIL WETLANDS

This subsystem includes wetlands with less than 50% canopy cover of trees. In this classification, a tree is defined as a woody plant usually having one principal stem or trunk, a definite crown shape, and characteristically reaching a mature height of at least 5 m (16 ft) (Driscoll *et al.* 1984). The dominant vegetation may include shrubs or herbs. Substrates range from mineral soils or bedrock to well-decomposed organic soils (muck). Fluctuating water levels allow enough aeration of the substrate to allow plant litter to decompose, so there is little or no accumulation of peat.

1. Deep emergent marsh: a marsh community that occurs on mineral soils or fine-grained organic soils (muck or well-decomposed peat); the substrate is flooded by waters that are not subject to violent wave action. Water depths can range from 15 cm to 2 m (6 in to 6.6 ft); water levels may fluctuate seasonally, but the substrate is rarely dry, and there is usually standing water in the fall. This is a somewhat broadly defined type that includes several variants based on the dominant plants. Deep emergent marshes are quite variable. They may be codominated by a mixture of species, or have a single dominant species. It is likely that an individual occurrence of deep emergent marsh will not include all of the species listed below.

In shallower areas the most abundant emergent aquatic plants are cattails (*Typha angustifolia, T. latifolia, T.* x *glauca*), wild rice (*Zizania aquatica*), bur-reeds (*Sparganium eurycarpum, S. androcladum*), pickerel weed (*Pontederia cordata*), bulrushes (*Schoenoplectus tabernaemontani, S. heterochaetus, S. acutus, S. pungens, S. americanus Bolboschoenus fluviatilis),* arrowhead (*Sagittaria latifolia*), arrowleaf (*Peltandra virginica*), rice cutgrass (*Leersia oryzoides*), bayonet rush (*Juncus militaris*), water horsetail (*Equisetum fluviatile*) and bluejoint grass (*Calamagrostis canadensis*).

The most abundant floating-leaved aquatic plants interspersed with emergents include fragrant water lily (*Nymphaea odorata*), duckweeds (*Lemna minor, L. trisulca*), pondweeds (*Potamogeton natans, P. epihydrus, P. friesii, P. oakesianus, P. crispus, P. pusillus, P. zosteriformis, P. strictifolius*), common yellow pond-lily (*Nuphar variegata*), frog's-bit (*Hydrocharis morsus-ranae*), watermeal (*Wolffia* spp.), and water-shield (*Brasenia schreberi*).

The most abundant submerged aquatic plants are pondweeds (*Potamogeton richardsonii, P. amplifolius, P. spirillus, P. crispus, P. zosteriformis*), coontail (*Ceratophyllum demersum*), stonewort (*Chara globularis*), water milfoils (*Myriophyllum spicatum, M. sibericum*), pipewort (*Eriocaulon aquaticum*), tapegrass or wild celery (*Vallisneria americana*), a thallose liverwort (*Riccia fluitans*), naiad (*Najas flexilis*), water lobelia (*Lobelia dortmanna*), waterweed (*Elodea canadensis*), water stargrass (*Heteranthera dubia*), and bladderworts (*Utricularia macrorhiza, U. intermedia*).

Characteristic birds with varying abundance include swamp sparrow (*Melospiza georgiana*), red-winged blackbird (*Agelaius phoeniceus*), marsh wren (*Cistothorus palustris*), American bittern (*Botaurus lentiginosus*), Virginia rail (*Rallus limicola*), and

pied-billed grebe (*Podilymbus podiceps*) (P. Novak *pers. comm.*).

Characteristic amphibians and reptiles include bullfrog (*Rana catesbeiana*), snapping turtle (*Chelydra serpentina*), and painted turtle (*Chrysemys picta*).

Deep emergent marshes typically occur in lake basins and along non-tidal rivers (or in semi-closed embayments) often intergrading with shallow emergent marshes, shrub swamps and sedge meadows, and they may occur together in a complex mosaic in a large wetland. Marshes that have been disturbed are frequently invaded by weedy species such as purple loosestrife (*Lythrum salicaria*), European common reed (*Phragmites australis*), and water chestnut (*Trapa natans*). These areas are better classified as purple loosestrife marsh, common reed marsh, and one of the water chestnut bed cultural communities respectively. Deep emergent marsh vegetation may develop in excavations that contain standing water (*e.g.*, roadside ditches, gravel pits) and are also considered cultural communities (*e.g.*, impounded marsh).

Distribution: throughout New York State.

Rank: G5 S5 *Revised:* 2001

Examples: Lake Champlain South Basin, Washington County; Lake Lila, Hamilton County; Chippewa Creek Marsh, St. Lawrence County; Upper and Lower Lakes, St. Lawrence County; Big Bay Swamp, Oswego County.

Sources: Bray 1915; Cowardin *et al.* 1979; Gilman 1976; NYNHP field surveys.

2. Shallow emergent marsh: a marsh meadow community that occurs on mineral soil or deep muck soils (rather than true peat), that are permanently saturated and seasonally flooded. This marsh is better drained than a deep emergent marsh; water depths may range from 15 cm to 1 m (6 in to 3.3 ft) during flood stages, but the water level usually drops by mid to late summer and the substrate is exposed during an average year. This is a very broadly defined type that includes several distinct variants and many intermediates. Shallow emergent marshes are very common and quite variable. They may be codominated by a mixture of species, or have a single dominant species. It is likely that an individual occurrence of shallow emergent marsh will not include all of the species listed below.

Most abundant herbaceous plants include cattails (*Typha latifolia, T. angustifolia, T. x glauca*), sedges (*Carex* spp.), marsh fern (*Thelypteris palustris*), manna grasses (*Glyceria pallida, G. canadensis*), spikerushes (*Eleocharis palustris, E. obtusa*), bulrushes (*Scirpus cyperinus, S. atrovirens, Schoenoplectus tabernaemontani*), three- way sedge (*Dulichium arundinaceum*), sweetflag (*Acorus americanus*), tall meadow-rue (*Thalictrum pubescens*), marsh St. John's-wort (*Triadenum virginicum*), arrowhead (*Sagittaria latifolia*), goldenrods (*Solidago rugosa, S. gigantea*), spotted joe-pye-weed (*Eutrochium maculatum*), boneset (*Eupatorium perfoliatum*), smartweeds (*Persicaria amphibia, P. hydropiperoides*), marsh bedstraw (*Galium palustre*), jewelweed (*Impatiens capensis*), loosestrifes *(Lysimachia thyrsiflora, L. terrestris, L. ciliata*). Native reed canary grass (*Phalaris arundinacea*) may occur in low abundance in undisturbed marshes, but frequently becomes abundant in disturbed marshes. Bluejoint grass (*Calamagrostis canadensis*) may be common, but it is more characteristic of sedge meadow. Marshes that have been disturbed are frequently invaded by weedy species such as purple loosestrife (*Lythrum salicaria*) and European common reed (*Phragmites australis*). These areas are better classified as purple loosestrife marsh and common reed marsh respectively.

Sedges (*Carex* spp.) may be abundant in shallow emergent marshes, but are not usually dominant. Marshes must have less than 50% cover of peat and tussock-forming sedges, such as tussock sedge (*Carex stricta*); otherwise it may be classified as a sedge meadow. Characteristic shallow emergent marsh sedges include *Carex stricta, C. lacustris, C. lurida, C. hystericina, C. alata, C. vulpinoidea, C. comosa, C. utriculata, C. scoparia, C. gynandra, C. stipata,* and *C. crinita.*

Other plants characteristic of shallow emergent marshes (most frequent listed first) include blue flag iris (*Iris versicolor*), sensitive fern (*Onoclea sensibilis*), common skullcap (*Scutellaria galericulata*), begger-ticks (*Bidens* spp.), water-horehounds (*Lycopus uniflorus, L. americanus*), bur-reeds (*Sparganium americanum, S. eurycarpum*), swamp milkweed (*Asclepias incarnata*), water-hemlock (*Cicuta bulbifera*), asters (*Doellingeria umbellata* var. *umbellata*, *Symphyotrichum puniceum* var. *puniceum*), marsh bellflower (*Campanula aparinoides*), water purslane (*Ludwigia palustris*), royal and cinnamon ferns (*Osmunda regalis, O. cinnamomea*), marsh cinquefoil (*Comarum palustre*), rushes (*Juncus effusus, J. canadensis*), arrowleaf (*Peltandra virginica*), purple-stem angelica (*Angelica atropurpurea*), water docks (*Rumex orbiculatus, R. verticillatus*), turtlehead (*Chelone glabra*), water-parsnip (*Sium suave*), and cardinal flower (*Lobelia cardinalis*).

Shallow emergent marshes may have scattered shrubs including speckled alder (*Alnus incana* ssp.

rugosa), water-willow (*Decodon verticillatus*), shrubby dogwoods (*Cornus amomum, C. sericea*), willows (*Salix* spp.), meadow-sweet (*Spiraea alba* var. *latifolia*), and buttonbush (*Cephalanthus occidentalis*). Areas with greater than 50% shrub cover are classified as shrub swamps.

Characteristic mosses include *Calliergonella cuspidata* and *Campylium* spp.

Characteristic amphibians that breed in in shallow emergent marshes include frogs such as northern spring peeper (*Pseudacris crucifer*), green frog (*Rana clamitans melanota*), American toad (*Bufo americanus*), and wood frog (*Rana sylvatica*) (Hunsinger 1999). Characteristic birds with varying abundance include red-winged blackbird (*Agelaius phoeniceus*), marsh wren (*Cistothorus palustris*), swamp sparrow (*Melospiza georgiana*), Virginia rail (*Rallus limicola*), and common yellowthroat (*Geothlypis trichas*) (Levine 1998, P. Novak *pers. comm.*).

Shallow emergent marshes typically occur in lake basins and along streams often intergrading with deep emergent marshes, shrub swamps, and sedge meadows, and they may occur together in a complex mosaic in a large wetland. It appears that hydroperiod may be an important factor in determining shallow emergent marsh species composition (*e.g.*, permanently saturated and seasonally flooded vs. saturated and temporarily inunudated). Marshes with drier hydroperiods are sometimes called "wet meadows" (P. Rutledge *pers. comm.*). These wet meadows are often found in agricultural or cleared land and may be dominated by sedges (*Carex* spp.) and soft rush (*Juncus effusus*). More documentation and research is needed to distinguish the different types of shallow emergent marshes in New York.

Distribution: throughout New York State.

Rank: G5 S5 *Revised:* 2001

Examples: South Branch Grass River Colton, St. Lawrence County; West Branch Oswagatchie River Diana, Lewis County; East Branch Fish Creek, Lewis County; Jordan River, St. Lawrence/Franklin Counties; Lakeview Marshes, Jefferson County.

Sources: Bray 1915; Gilman 1976; Hotchkiss 1932; Hunsinger 1999; Levine 1998; Metzler and Tiner 1992; Tiner 1985; NYNHP field surveys.

3. Shrub swamp: a mostly inland wetland dominated by tall shrubs that occurs along the shore of a lake or river, in a wet depression or valley not associated with lakes, or as a transition zone between a marsh, fen, or bog and a swamp or upland community. The substrate is usually mineral soil or muck. A few examples may have a shallow layer of sphagnous peat.This is a very broadly defined type that includes several distinct communities and many intermediates. Shrub swamps are very common and quite variable. They may be codominated by a mixture of species, or have a single dominant shrub species.

In northern New York many shrub swamps are dominated by alder (*Alnus incana* ssp. *rugosa*); these swamps are widely recognized as *alder thickets.* A swamp dominated by red osier dogwood (*Cornus sericea*), silky dogwood (*C. amomum*), and willows (*Salix* spp.) may be called a *shrub carr*. Along the shores of some lakes and ponds there is a distinct zone dominated by water-willow (*Decodon verticillatus*) and/or buttonbush (*Cephalanthus occidentalis*) which can sometimes fill a shallow basin.

Characteristic shrubs that are common in these and other types of shrub swamps include meadow-sweet (*Spiraea alba* var. *alba* and *S. alba* var. *latifolia*), hardhack (*Spiraea tomentosa*), gray dogwood (*Cornus racemosa*), swamp azalea (*Rhododendron viscosum*), highbush blueberry (*Vaccinium corymbosum*), male-berry (*Lyonia ligustrina*), smooth alder (*Alnus serrulata*), spicebush (*Lindera benzoin*), willows (*Salix bebbiana, S. discolor, S. lucida, S. petiolaris*), wild raisin (*Viburnum nudum* var. *cassinoides*), and arrowwood (*Viburnum dentatum* var. *lucidum*). Scattered young trees may be present, such as red maple (*Acer rubrum*), American elm (*Ulmus americana*), and green ash (*Fraxinus pennsylvanica*).

Characteristic birds with varying abundance include common yellowthroat (*Geothlypis trichas*), American bittern (*Botaurus lentiginosus*), alder flycatcher (*Empidonax alnorum*), willow flycatcher (*Empidonax trallii*), and Lincoln's sparrow (*Passerella lincolnii*) (Levine 1998).

It appears that hydroperiod may be an important factor in determining shrub swamp species composition (*e.g.*, permanently inundated vs. seasonally inundated) (P. Rutledge *pers. comm.*). More documentation and research is needed to distinguish the different types of shrub swamps in New York.

Distribution: throughout New York State.

Rank: G5 S5 *Revised:* 2001

Examples: West Branch Oswagatchie River Town of Diana, Lewis County; West Branch Sacandaga River, Hamilton County; Jordan River, St. Lawrence/Franklin Counties; Shingle Shanty Brook, Hamilton County; East Branch Fish Creek, Lewis County.

Sources: Bray 1915; Levine 1998; McVaugh 1958; Metzler and Tiner 1992; Shanks 1966; Tiner 1985; NYNHP field surveys.

4. Cobble shore wet meadow: a community that occurs on the cobble shores of lakes and streams where the substrate is moist from seepage or intermittent flooding. The substrate is typically a mixture of cobbles (exposed at the surface) and sand, but can also include calcareous clay. They are likely to be scoured by floods or winter ice floes, but there is apparently no significant accumulation of pack ice. The substrate is typically periodically exposed and submerged with fluctuating water levels. Vegetation may be sparse and is predominately hydrophytic.

Characteristic species include water-plantain (*Alisma plantago-aquatica*), beggar-ticks (*Bidens frondosa*), spikerushes (*Eleocharis* spp.), common horsetail (*Equisetum arvense*), boneset (*Eupatorium perfoliatum*), silverweed (*Argentina anserina*), creeping spearwort (*Ranunculus flammula* var. *reptans*), freshwater cordgrass (*Spartina pectinata*), and three-square (*Schoenoplectus americanus*). Where seepage water is calcareous, characteristic species include sedges (*Carex aurea, C. flava, C. granularis, C. viridula*), variegated horsetail (*Equisetum variegatum*), Kalm's lobelia (*Lobelia kalmii*), marsh fern (*Thelypteris palustris*), rushes (*Juncus nodosus, J. alpinus, J. pelocarpus*), and mosses such as *Campylium stellatum* and *Drepanocladus* spp.

Distribution: apparently restricted to shores of Lake Champlain and the St. Lawrence River. Probably also occurs along Lake Ontario and possibly on a few large inland lakes such as the Finger Lakes, and other rivers such as the Saranac River.

Rank: G3? S2 *Revised:* 2010

Examples: Valcour Island, Essex County; Barnhart Island, St. Lawrence County.

Source: NYNHP field surveys.

5. Inland calcareous lake shore: the gravelly, sandy, or muddy shore of an inland lake or pond with calcareous water and seasonally fluctuating water levels. The average annual water levels are within 20 cm of surface. The substrate is either saturated or flooded and hydric. The soil is calcareous to circumneutral (pH is typically greater than 5.5). Vegetative cover may be sparse to unvegetated; the dominant species are hydrophytic herbs. This community is likely scoured by waves and ice.

Dominant species on the Great Lakes Plain include freshwater cordgrass (*Spartina pectinata*) and various bulrushes (*Schoenoplectus acutus, S. tabernaemontani*). Other characteristic species on the Great Lakes Plain include spikerush (*Eleocharis palustris*), water plantains (*Alisma plantago-aquatica, A. gramineum*), water stargrass (*Heteranthera dubia*), white water-crowfoot (*Ranunculus longirostris*), and lake-cress (*Armoracia aquatica*).

Dominant species in the Adirondacks include sedges (*Carex cryptolepis, C. lasiocarpa*) and Canadian burnet (*Sanguisorba canadensis*). Other characteristic species in the Adirondacks include sedges (*Carex viridula, C. flava*), royal fern (*Osmunda regalis*), beakrush (*Rhynchospora capitellata*), creeping spearwort (*Ranunculus flammula* var. *reptans*), sweet gale (*Myrica gale*), alder-leaf buckthorn (*Rhamnus alnifolia*), and red osier dogwood (*Cornus sericea*).

Species that may occur in both regional variants include pikerushes (*Eleocharis acicularis*) and Canada rush (*Juncus canadensis*). More data on this community are needed.

Distribution: restricted to calcareous areas throughout upstate New York, north of the Coastal Lowlands ecozone and concentrated on the Great Lakes Plain.

Rank: G4? S3 *Revised:* 2010

Examples: Song Lake, Cortland County; Ausable Delta, Clinton County; Harris Lake, Essex County; Eastern Lake Ontario, Oswego/Jefferson Counties.

Source: NYNHP field surveys.

6. Inland non-calcareous lake shore: the gravelly, sandy or muddy shore of an inland lake or pond with seasonally fluctuating water levels where the water is not calcareous. The average annual water levels are within 20 cm of surface. The substrate is either saturated or flooded and hydric. The soil is non-calcareous (pH is typically less than 6.5). Vegetative cover may be sparse; the dominant species are hydrophytic herbs. This community is likely scoured by waves and ice.

Characteristic species include smartweed (*Persicaria pensylvanica*), water lobelia (*Lobelia dortmanna*), cyperus (*Cyperus squarrosus*), sedge (*Fimbristylis autumnalis*), spikerush (*Eleocharis obtusa*), jointed rush (*Juncus articulatus*), mud-hyssop (*Gratiola neglecta*), and marsh purslane (*Ludwigia palustris*).

Dominant species in the Adirondacks include flat

sedge (*Cyperus dentatus*), Pickering's reedgrass (*Calamagrostis pickeringii*), and water-horehounds (*Lycopus* spp.). Other characteristic species in the Adirondacks include sweet gale (*Myrica gale*), rattlesnake grass (*Glyceria canadensis*), and dwarf St. John's-wort (*Hypericum mutilum*).

More data on this community are needed.

Distribution: throughout New York, comcentrated in upstate New York.

Rank: G4G5 S4 *Revised:* 2010

Examples: Oneida Lake, Oneida County; Lake Neahtawanta, Oswego County; Polliwog Pond, Franklin County.

Source: NYNHP field surveys.

7. Coastal plain pond shore: the gently sloping shore of a coastal plain pond with seasonally and annually fluctuating water levels. The substrate is sandy, gravelly, or mucky. Vegetative cover at any point varies seasonally and annually with the water levels. In dry years when water levels are low and the substrate is exposed, there is a dense growth of annual sedges, grasses, and herbs. Submerged and floating-leaved aquatic plants, such as fragrant waterlily (*Nymphaea odorata*) and pondweeds (*Potamogeton* spp.), may become "stranded" on the exposed shore. In wet years when the water level is high and the substrate is flooded, vegetation is sparse, and only a few emergents and floating-leaved aquatics are apparent. A description of the aquatic component is included under the coastal plain pond community. The vegetation of this pond shore community can change dramatically from one year to the next depending on fluctuations in groundwater levels.

Coastal plain pond shores on Long Island can be divided into four distinct zones following the proposed classification by Zaremba and Lamont (1993):

1. The *upper wetland shrub thicket* zone is treated as either pine barrens shrub swamp or the coastal variant of highbush blueberry bog thicket. This zone may also grade into red maple-blackgum swamp, coastal plain Atlantic white cedar swamp, or, in pond shores with steeper slopes, pitch pine-oak forest.

2. The *upper, low herbaceous fringe* zone is a narrow band of vegetation with peaty substrate mixed with sand. The dominant plants of this zone are peat moss (*Sphagnum* spp.), yellow-eyed grass (*Xyris difformis*), narrow-leaved goldenrod (*Euthamia caroliniana*), bluejoint grass (*Calamagrostis canadensis*), clubmosses (*Lycopodiella inundata, L. appressa*). Other plants of this zone include fascicled false foxglove (*Agalinis fasciculata*), Walter's sedge (*Carex striata*), sundews (*Drosera intermedia, D. filiformis*), creeping St. John's-wort (*Hypericum adpressum*), slender blue-flag *(Iris prismatica*), redroot (*Lachnanthes caroliniana*), Nuttall's lobelia (*Lobelia nuttallii*), water-horehound (*Lycopus amplectens*), panic grasses (*Dichanthelium meridional, D. wrightianum, Panicum verrucosum*), and large cranberry (*Vaccinium macrocarpon*). Occasionally, scattered seedlings of Atlantic white cedar (*Chamaecyparis thyoides*), red maple (*Acer rubrum*), and blackgum (*Nyssa sylvatica*) may be found in this zone.

3. The *sandy exposed pond bottom* zone is often very sandy and dominated by annual species. This zone may be extremely wide at ponds with very gradual pond bottom slopes. The dominant plants of this zone are beakrushes (*Rhynchospora capitellata*, *R. nitens*) and nutrush (*Scleria reticularis*). Other species of this zone include yellow-eyed grass (*Xyris difformis*), Canadian St. John's-wort (*Hypericum canadense*), rushes (*Juncus pelocarpus, J. canadensis*), rose coreopsis (*Coreopsis rosea*), spikerushes (*Eleocharis melanocarpa, E. tuberculosa*), umbrella-grass (*Fuirena pumila*), ludwigia (*Ludwigia sphaerocarpa*), bald-rush (*Rhynchospora scirpoides*), white beakrush (*Rhynchospora alba*), Virginia meadow-beauty (*Rhexia virginica*), marsh St. John's-wort (*Triadenum virginicum*), bladderwort (*Utricularia subulata*).

4. The *organic exposed pond bottom* zone is more frequently flooded than the sandy zone, hence has a greater accumulation of organics. The dominant plants of this zone can be extremely variable from year to year depending on the degree of flooding. In high water years, annual species that cannot germinate underwater are usually absent and submerged and floating-leaved aquatic plants are more abundant. In contrast, annual species tend to flourish in low water years and the aquatic species become less prevalent. The dominant plants of this zone are bald-rush (*Rhynchospora scirpoides*[l]), pipewort (*Eriocaulon aquaticum*[h]), spikerushes (*Eleocharis obtusa*[l], *E. olivacea*[l]), and gratiola (*Gratiola aurea*). Other species of this zone include twigrush (*Cladium mariscoides*), Robbin's spikerush (*Eleocharis robbinsii*), bayonet rush (*Juncus militaris*), mermaid-weed (*Proserpinaca pectinata*), beaked rushes (*Rhynchospora macrostachya, R. inundata)*, quill-leaf arrowhead (*Sagittaria teres*[h]), bladderworts (*Utricularia juncea*[l], *U. striata, U. purpurea*[h]), yellow-eyed grasses (*Xyris smalliana, X. torta*).

[h] = more abundant in high water years
[l] = more abundant in low water years

Characteristic coastal plain pond shore fauna include eastern painted turtle (*Chrysemys picta picta*), muskrat (*Ondatra zibethica*), various dragonflies and damselflies, and chain pickerel (*Esox niger*). Rare faunaof some coastal plain ponds and pond shores include bluets (*Enallagma recurvatum, E. laterale, E. pictum*), eastern mudminnow (*Umbra pygmaea*), tiger salamander (*Ambystoma tigrinum*), and banded sunfish (*Enneacanthus obesus*).

The primary ecological process in coastal plain pond shores is a periodic cycle of flooding and draw down. Hydrology of the ponds is controlled by a several year cycle of draw down and flooding tightly linked with local rainfall amounts and, in some ponds, local groundwater levels (Schneider 1992). The amount of groundwater influx for a given pond or pond system appears to be influenced by landscape position. For example, pond shores in proximity to topographical highs, such as kames and morainal hills, appear to have increased amounts of groundwater flow versus ponds in more level topography (Schneider 1992). Ponds positioned at higher elevations draw down faster than neighboring ponds at lower elevations. Secondary disturbances include fire, which influences vegetation at the pond shore shrub margin and may effect the amount of organic material in the pond substrate (Zaremba and Lamont 1993).

Because of the characteristic zones of vegetation that dominate a pond shore in any given year, ponds may have a number of different vegetation assemblages based on the extent of draw down, position within the pond shore, and overall composition of vegetation within a specific pond (Graham and Henry 1933, Zaremba and Lamont 1993, Schneider 1994). Coastal plain pond shores are a dynamic collection of vegetation and a well-zoned pond shore may display one or more vegetation associations in a single growing season. The vegetation associations that dominate New York pond shores probably should be recognized as stochastic, repeating vegetation "zones" that appear as a function of periodic fluctuation of hydrology (Zaremba and Lamont 1993, Schneider 1994).

The invasion of European common reed (*Phragmites australis*) is a serious threat to this community.

Distribution: restricted to the Coastal Lowlands ecozone on Long Island.

Rank: G3G4 S2 *Revised:* 2001

Examples: Peasy's Pond, Suffolk County; Crooked Pond and Long Pond, Suffolk County; House Pond and Division Pond, Suffolk County. The best examples are concentrated in three main areas on Long Island, the Peconic River Headwaters, Sears Bellows County Park, and the Long Pond Greenbelt.
Sources: Graham and Henry 1933; MacDonald and Edinger 2000; Parker 1946; Schneider 1992; Schneider 1994; Williams 2001; Zaremba and Lamont 1993; NYNHP field surveys.

8. Sinkhole wetland: a small wetland, with or without a pond, that occurs in a poorly drained sinkhole, typically underlain by limestone in a region of karst topography. The substrate may be dark muck that is rich in organic matter or deep, calcareous, gleyed clay. Water levels fluctuate seasonally, and the water is usually intermittent, basic and eutrophic. In some areas there are many sinkholes in a group that are hydrologically connected underground, even though they are clearly separate at the ground surface. A split into sinkhole wetland and sinkhole pond, the latter as a lacustrine community, may be warranted and is being evaluated.

Well-developed examples of this community may consist of about four physiognomic zones. The open water area is characterized by mostly submergent and some emergent aquatic plants, such as spikerush (*Eleocharis acicularis*), water-parsnip (*Sium suave*), water plantain (*Alisma plantago-aquatica*), and water purslane (*Ludwigia palustris*). Surrounding the open water is typically a zone of emergent aquatic plants; characteristic species in this zone include sedges (*Carex vulpinoidea, C. lacustris, C. canescens*), mannagrass (*Glyceria acutiflora*), woolgrass (*Scirpus cyperinus*), beakrush (*Rhynchospora capillacea*), bluejoint grass (*Calamagrostis canadensis*), and small beggar-ticks (*Bidens discoidea*). Some sinkhole wetlands are encircled by a ring of shrubs; characteristic shrubs are willows (*Salix sericea, S. lucida, S. nigra, S. petiolaris*). The outer zone may be forested, dominated by the characteristic tree species red maple (*Acer rubrum*), American elm (*Ulmus americana*), green ash (*Fraxinus pennsylvanica*), white ash (*F. americana*), bur oak (*Quercus macrocarpa*), and swamp white oak (*Q. bicolor*). Most examples have been altered by grazing and other forms of agricultural and only the emergent aquatic zone may remain.

Three broad scale topographic settings for sinkhole wetlands are suspected. Typical examples occur on broad flat calcareous lowland plains such as those on the Great Lakes Plain. Others occur on broad gently sloping valleys and hills sometimes associated with these plains and also in mountainous areas with calcareous bedrock. In addition, we suspect ther are three hydrologic variants. Typical examples occur as a string of small wetland pockets often interconnected via surface hydrology by an

intermittent stream. In other examples sinkholes are large and merge into a single continuous wetland with intruding upland fingers. A third variant has one or more wetland pockets connected via groundwater. Data on regional, topographic, and hydrological variants, as well as characteristic fauna, are needed.

Distribution: scattered on limestone bedrock north of the Coastal Lowland ecozone; documented only from the Eastern Ontario Plains subzone of the Great Lakes Plain ecozone, and the St. Lawrence Plains subzone of the St. Lawrence Valley ecozone.

Examples: Spile Bridge Road Wetlands, St. Lawrence County; Johnny Cake Road Sinkhole Wetlands, Jefferson County; Eastern Rensselaer Plateau Escarpment, Rensselaer County.

Rank: G3? S1 *Revised:* 2001

Sources: Walz *et al.* 2001; Williams 2001; NYNHP field surveys.

9. Maritime freshwater interdunal swales: wetlands that occur in low areas between dunes along the Atlantic coast; the low areas or swales are formed either by blowouts in the dunes that lower the soil surface to groundwater level. Soils are either sand or peaty sand; water levels fluctuate seasonally and annually, reflecting changes in groundwater levels. The dominant species are sedges and herbs; low shrubs are usually present, but they are never dominant. These wetlands may be quite small (less than 0.25 acre or 0.1 ha) and are generally linear in shape; species diversity is usually low. The composition may be quite variable between different interdunal swales.

Characteristic species with relatively high percent cover include large cranberry (*Vaccinium macrocarpon*), twig-rush (*Cladium mariscoides*), marsh fern (*Thelypteris palustris*), three-square (*Schoenoplectus pungens, S. americanus*), royal fern (*Osmunda regalis*), and peat mosses (*Sphagnum* spp.). Characteristic plants with low percent cover include Canada rush (*Juncus canadensis*), and marsh St. John's-wort (*Triadenum virginicum*), woolgrass (*Scirpus cyperinus*), highbush blueberry (*Vaccinium corymbosum*), mermaid-weed (*Proserpinaca pectinata*), and grass-leaved goldenrod (*Euthamia graminifolia*).

Other less frequently occurring plants with variable cover include poison ivy (*Toxicodendron radicans*), black chokeberry (*Aronia melanocarpa*), three three-way sedge (*Dulichium arundinaceum*), swamp rose (*Rosa palustris*), bayberry (*Myrica pensylvanica*), sweet gale (*M. gale*), rose-mallow (*Hibiscus moscheutos*), bladderwort (*Utricularia subulata*), switch grass (*Panicum virgatum*), beakrushes (*Rhynchospora alba, R. capitellata*), hardhack (*Spiraea tomentosa*), cube-seeded iris (*Iris prismatica*), Canadian St. John's-wort (*Hypericum canadense*), swamp loosestrife (*Lysimachia terrestris*), cinnamon fern (*Osmunda cinnamomea*), sundews (*Drosera intermedia, D. rotundifolia D. filiformis*), flat sedges (*Cyperus* spp.), stiff yellow flax (*Linum striatum*), purple false foxglove (*Agalinis purpurea*) and slender yellow-eyed grass (*Xyris torta*). The invasion of European common reed (*Phragmites australis*) is a serious threat to this community. Data on characteristic fauna are needed.

The name of this community was changed from "maritime interdunal swales" (Reschke 1990) to distinguish it from brackish interdunal swales. The term "maritime" is retained to distinguish it from interdunal swales in the Great Lakes region. Possible "Great Lakes interdunal swales" have been reported in Oswego County in the vicinity of Lakeview Wildlife Management Area (J. Herter *pers. comm.*). More data are needed in order to describe and confirm this type in New York.

Distribution: near the seacoast in the Coastal Lowlands ecozone.

Rank: G3G4 S2 *Revised:* 2009

Examples: Napeague Dunes, Suffolk County; Atlantic Double Dunes, Suffolk County; Walking Dunes, Suffolk County; Fire Island National Seashore, Suffolk County.

Sources: Johnson, A. F. 1985; NYNHP field surveys.

10. Pine barrens vernal pond: a seasonally fluctuating, groundwater-fed pond and associated wetland that typically occur in pine barrens. Examples are primarily known from inland pine barrens settings, such as the Albany Pine Bush, but may also occur on the coastal plain. Within the pine barren landscape, this community forms in low kettlehole depressions or in swales between forested dunes. The water is intermittent, typically vernally ponded, and circumneutral. The substrate is coarse sand, however, development of a shallow floating peat layer is common. These ponds and wetlands may be small.

Well-developed examples of this community may consist of about four physiognomic zones. Ponds are characterized by submergent aquatic plants such as pondweeds (*Potamogeton* spp.). Surrounding ponds are typically a zone of emergent aquatic plants dominated by graminoids and herbs. Sedges such as

Carex canescens, three-way sedge (*Dulichium arundinaceum*), and woolgrass (*Scirpus cyperinus*) and soft rush (*Juncus effusus*) may be dominant in this zone. Other herbs include tussock sedge (*Carex stricta*), marsh St. John's-wort (*Triadenum virginicum*), cinnamon fern (*Osmunda cinnamomea*), marsh fern (*Thelypteris palustris*), and Virginia chain fern (*Woodwardia virginica*). Characteristic mosses include peat mosses (*Sphagnum recurvum, S. fallax*).

Some sites are ringed by a zone of low shrubs. Characteristic shrubs include scattered highbush blueberry (*Vaccinium corymbosum*), winterberry (*Ilex verticillata*) and patches of leatherleaf (*Chamaedaphne calyculata*). Other shrubs include buttonbush (*Cephalanthus occidentalis*), black chokeberry (*Aronia melanocarpa*), black huckleberry (*Gaylussacia baccata*), mountain holly (*Nemopanthus mucronatus*), and meadow-sweet (*Spiraea alba* var. *latifolia*). Stunted trees may be present on hummocks within the wetland or surround the wetland; characteristic trees include red maple (*Acer rubrum*), gray birch (*Betula populifolia*), pitch pine (*Pinus rigida*), and quaking aspen (*Populus tremuloides*).

Amphibians that may be found in pine barrens vernal ponds include frogs such as eastern American toad (*Bufo americanus*), northern spring peeper (*Pseudacris crucifer*), green frog (*Rana clamitans melanota*), and wood frog (*Rana sylvatica*). Less frequently occurring amphibians include eastern spadefoot toad (*Scaphiopus holbrookii*), Fowler's toad (*Bufo fowleri*), and Jefferson salamander (*Ambystoma jeffersonianum*). Reptiles that may be found include spotted turtle (*Clemmys guttata*) and common snapping turtle (*Chelydra serpentina*) (Hunsinger 1999). Characteristic birds with varying abundance include red-winged blackbird (*Agelaius phoeniceus*) and common yellowthroat (*Geothlypis trichas*). These ponds are too small and ephemeral to support fish populations.

We are evaluating a split into pine barrens vernal wetland (or "pine barrens vernal pond shore") and "pine barrens vernal pond" (a lacustrine community). A proposed name change to "inland pine barrens vernal pond" may be appropriate, if no coastal plain examples are confirmed (P. Swain *pers. comm.*).

Distribution: known only from sandplains in the Great Lakes Plain and Hudson Valley ecozones and in the Western Adirondack Foothills subzone of the Adirondack ecozone.

Rank: G3G4 S2 *Revised:* 2001

Examples: Albany Pine Bush, Albany County; Rome Sand Plains, Oneida County; Wilton Wildlife Preserve and Park, Saratoga County; Chase Lake Sandplain, Lewis County.

Sources: Hunsinger 1999; Williams 2001; NYNHP field surveys.

11. Pine barrens shrub swamp: a shrub-dominated wetland that occurs in shallow depressions in the coastal plain, often as a linear transition zone between a coastal plain pond shore and either pitch pine-scrub oak barrens or pitch pine-oak forest.

Characteristic shrubs include highbush blueberry (*Vaccinium corymbosum*), inkberry (*Ilex glabra*), male-berry (*Lyonia ligustrina*), fetterbush (*Leucothoe racemosa*), sweet pepper-bush (*Clethra alnifolia*), leatherleaf (*Chamaedaphne calyculata*), dwarf huckleberry (*Gaylussacia dumosa*), and sheep laurel (*Kalmia angustifolia*). Other shrubs include staggerbush (*Lyonia mariana*), red chokeberry (*Aronia arbutifolia*), bayberry (*Myrica pensylvanica*), swamp azalea (*Rhododendron viscosum*), large cranberry (*Vaccinium macrocarpon*), and dangleberry (*Gaylussacia frondosa*).

The herb layer is sparse and characteristic herbs include Virginia chain fern (*Woodwardia virginica*), cinnamon fern (*Osmunda cinnamomea*), marsh fern (*Thelypteris palustris*), and tussock sedge (*Carex stricta*). Peat mosses (*Sphagnum* spp.) are characteristic in the groundlayer. Data on characteristic fauna are needed.

The largest and most diverse examples of pine barrens shrub swamp are located on the Roanoke Point and Ronkonkama moraines within fire prone forests. Most occur as small isolated segments, and large examples are rare. This community is linear in shape, often very thin (about 5-10 m), and typically less than 26 acres (10.5 ha) in size. The major ecological factors influencing this community include hydrology and fire. Pine barrens shrub swamps are best developed along the upper edges of coastal plain ponds that have variable hydrology, and are embedded in a fire prone forest, such as a pitch pine-oak forest.

Communities on Long Island with similar vegetation (*i.e.*, dominated by tall shrubs such as *Vaccinium corymbosum*, *Leucothoe racemosa*, *Clethra alnifolia*, and *Chamaedaphne calyculata*) with deep peat deposits (0.2-3 m) are treated as a coastal plain variety of highbush blueberry bog thicket. The two natural communities are separated by the fact that highbush blueberry bog thicket maintains a persistent hydrological regime, supports peat development, and often lacks "edge species" that are found in pine barrens shrub swamp, such as *Lyonia mariana*, *Ilex glabra*, and *Myrica pensylvanica*. Pine barrens shrub swamp is essentially an edge community positioned between

more persistent wetlands and a fire-prone upland. Consequently vegetation and soils reflect the constant tension between the contraction and expansion of adjacent wetlands and additional disturbances such as fire and frost. Peat develops only intermittently to a thin 5-10 centimeters layer, and vegetation consists of both wetland and upland species.

Distribution: restricted to the Central Lomg Island Pine Barrens in the Coastal Lowlands ecozone.

Rank: G5 S3 *Revised:* 2001

Examples: Peconic Headwater Wetlands, Suffolk County; Sears Bellows Wetlands, Suffolk County.

Sources: MacDonald and Edinger 2000; NYNHP field surveys.

B. OPEN PEATLANDS

This subsystem includes peatlands with less than 50% canopy cover of trees. The dominant vegetation may include shrubs, herbs, or mosses. Substrates range from coarse fibrous or woody peat, to fine-grained marl and organic muck. The peat layer is typically 40 to 50 cm deep, but can be as little as 20 cm deep in some examples (*e.g.*, sedge meadow, rich sloping fen, and alpine sliding fen). Peatlands are also classified based on the range of mineral richness of the water/peat and pH. For example, marl fens and rich fens are mineral rich (*e.g.*, high in calcium) and have a relatively high pH (greater than 6.0), whereas poor fens and bogs are mineral poor and have low pH (less than 5.0). Several plants in the following descriptions are indicaors of these environmental gradients while others grow in a wide range of conditions.

1. Inland salt marsh: a wetland that occurs on saline mudflats associated with inland salt springs. The mucky substrate is permanently saturated and seasonally flooded. Vegetation is sparse, with less than 50% cover. Species diversity is low.

Characteristic species are salt-tolerant plants including seaside bulrush (*Bolboschoenus maritimus* ssp. *paludosus*), seaside atriplex (*Atriplex patula*), salt marsh sand-spurry (*Spergularia marina*), creeping bent grass (*Agrostis stolonifera* var. *palustris*), salt-meadow grass (*Leptochloa fusca* ssp. *fascicularis*), dwarf spikerush (*Eleocharis parvula*), narrow-leaf cattail (*Typha angustifolia*), and non-native foxtail barley (*Hordeum jubatum*). These salt springs are rare, and they usually occur as relatively small patches within a deep or shallow emergent marsh. In some cases the surrounding marsh is dominated by purple loosestrife (*Lythrum salicaria*); since purple loosestrife is not very salt-tolerant, it usually does not grow in the inland salt marsh. However, the invasion of European common reed (*Phragmites australis*) is a more serious threat to this community. Data on characteristic fauna are needed.

Small areas of inland salt marsh are reported from saline wetlands that were artificially created. One example is a wetland bordering Wolf Creek below an old salt factory in Wyoming County; plants reported from this site include salt-meadow grass (*Spartina patens*), black grass (*Juncus gerardii*), and glasswort (*Salicornia depressa*).

Distribution: historically a rare community, many sites have been destroyed or degraded by salt extraction operations, filling, and development. Remnants are currently known from a few sites in the Drumlin and Erie-Ontario Plain subzones of the Great Lakes Plain ecozone.

Rank: G2 S1 *Revised:* 1990

Example: Carncross Salt Pond, Wayne County.

Sources: Catling and McKay 1981; Faust and Roberts 1983; Muenscher 1927; NYNHP field surveys.

2. Sedge meadow: a wet meadow community that has organic soils (muck or fibrous peat). Soils are permanently saturated and seasonally flooded; there is usually little peat accumulation in the substrate, but must have deep enough peat (usually at least 20 cm) to be treated as a peatland, otherwise it may be classified as a mineral soil wetland such as shallow emergent marsh. Peats are usually fibrous, not sphagnous, and are usually underlain by deep muck. The dominant herbs must be members of the sedge family (Cyperaceae), typically of the genus *Carex.*

Sedge meadows are dominated by peat and tussock-forming sedges such as tussock-sedge (*Carex stricta*), with at least 50% cover. They are often codominated by bluejoint grass (*Calamagrostis canadensis*) with less than 50% cover, and other sedges (*Carex utriculata, C. lacustris, C. vesicaria, C. canescens*). Other frequently occurring plants with low percent cover include marsh fern (*Thelypteris palustris*), marsh cinquefoil (*Comarum palustre*), sensitive fern (*Onoclea sensibilis*), manna grasses (*Glyceria* spp., including *G. canadensis*), swamp loosestrife (*Lysimachia terrestris*), hairgrass (*Agrostis scabra*), marsh St. John's-wort (*Triadenum virginicum*), water horsetail (*Equisetum fluviatile*), tall meadow-rue (*Thalictrum pubescens*), spike rushes (*Eleocharis acicularis, E. obtusa*), sweetflag

(*Acorus americanus*), spotted joe-pye-weed (*Eutrochium maculatum*), purple-stem angelica (*Angelica atropurpurea*), three-way sedge (*Dulichium arundinaceum*), and bulrushes (*Schoenoplectus* spp.). Sparse shrubs may be present, such as meadow-sweet (*Spiraea alba* var. *latifolia*), hardhack (*S. tomentosa*), leatherleaf (*Chamaedaphne calyculata*), sweet gale (*Myrica gale*), and speckled alder (*Alnus incana* ssp. *rugosa*). Data on characteristic fauna are needed.

Sedge meadows typically occur along streams and near the inlets and outlets of lakes and ponds; they also occur in lake basins as a zone near the upland edge of a shallow emergent marsh. A sedge meadow does not typically form a floating mat, instead it is covered with water during flooding. When water levels are low, there is little or no open water.

Distribution: moderately common on the Tug Hill Plateau and in the Adirondacks, and sparsely scattered throughout New York.

Rank: G5 S4 *Revised:* 2001

Examples: Dutchess Meadows, Dutchess County; West Branch Sacandaga River, Hamilton County; Poesten Kill Headwaters, Rensselaer County; Mad River Swamp, Lewis County.

Sources: Jeglum *et al.* 1974; McVaugh 1958; NYNHP field surveys.

3. Marl pond shore: the marly shore of an inland pond. In glaciated terrain, marl deposition occurs most often in depressions, lakes, or ponds in areas with morainic hills of coarse-textured outwash gravels. Marl pond shores typically occur on inactive lacustrine marl deposits in kettleholes. Marl is a white-colored precipitate that consists of calcium carbonate mixed with clay. More data are needed to determine if this community would be better classified as an open mineral soil wetland instead of peatland. Water levels may fluctuate seasonally; the substrate is usually saturated. Vegetation is sparse.

Characteristic species include tufted hairgrass (*Deschampsia cespitosa*), sedge (*Carex viridula*), spikerush (*Eleocharis palustris*), silverweed (*Argentina anserina*), boneset (*Eupatorium perfoliatum*), cardinal flower (*Lobelia cardinalis*), water-horehound (*Lycopus virginicus*), field mint (*Mentha arvensis*), and water smartweed (*Persicaria amphibia*). Data on characteristic fauna are needed.

Distribution: currently known only from the Finger Lakes Highlands subzone of the Appalachian Plateau ecozone, and from the Erie-Ontario Plain subzone of the Great Lakes Plain ecozone.
Rank: G3G4 S1 *Revised:* 1990

Example: Cortland Marl Ponds, Cortland County.

Sources: Seischab 1984; Tufts 1976; NYNHP field surveys.

4. Marl fen: a strongly minerotrophic wetland in which the substrate is a marl bed derived from either lacustrine marl deposits or actively accumulating marl that is exposed at the ground surface. Marl is a white-colored precipitate that consists of calcium carbonate mixed with clay. Marl fens have at least some exposed marl precipitate at the surface. The marl substrate is always saturated and may be either seasonally flooded or permanently flooded (*e.g.,* adjacent to seepage pools or streams) and has a very high pH, generally greater than 7.5. Vegetation is often sparse and stunted. Mosses colonize the marl, and may initiate hummock formation (Seischab 1984), but marl fens have lower bryophyte diversity than other rich fen types (Slack 1994). Marl fens may occur as small patches within a rich graminoid fen.

The dominant species in marl fens are graminoid. Characteristic herbaceous species include yellow sedge (*Carex flava*), spikerush (*Eleocharis rostellata*), twig-rush (*Cladium mariscoides*), beakrush (*Rhynchospora capillacea*), water-horehound (*Lycopus uniflorus*), grass-of-Parnassus (*Parnassia glauca*), pitcher-plant (*Sarracenia purpurea*), hard-stem bulrush (*Schoenoplectus acutus*), nutrush (*Scleria verticillata*), Ohio goldenrod (*Oligoneuron ohioense*), arrow-grass (*Triglochin maritimum*), variegated horsetail (*Equisetum variegatum*), jointed rush (*Juncus articulatus*), and Kalm's lobelia (*Lobelia kalmii*). Other herbaceous species found in marl fens include sedges (*Carex crawei*, *C. eburnea*) and wiry panicgrass (*Panicum flexile*). Shrubs found in marl fens include prostrate juniper (*Juniperus horizontalis*), shrubby cinquefoil (*Dasiphora fruticosa* ssp. *floribunda*), and northern white cedar (*Thuja occidentalis*). Shrubby cinquefoil and bristleleaf sedge (*Carex eburnea*) commonly occur on hummocks.

Characteristic nonvascular species include common stonewort (*Chara vulgaris*) and the thallose liverwort *Preissia quadrata*. Common stonewort occurs in marl pools and along stream banks. Bryophyte species can also include the mosses *Scorpidium revolvens, Campylium stellatum, Aulacomnium palustre, Bryum pseudotriquetrum, Calliergon giganteum, Calliergonella cuspidata, Cratoneuron filicinum, Scorpidium scorpioides,* the

thalloid liverwort *Aneura pinguis*, and the leafy liverwort *Plagiochila porelloides*.

Data on characteristic fauna are needed.

Distribution: known primarily from the Erie-Ontario Plain subzone of the Great Lakes Plain ecozone; also reported from the northern portion of the Hudson Valley ecozone.

Rank: G2G3 S1 *Revised:* 2001

Examples: Bergen Swamp, Genesee County; Junius Ponds – Lowery Pond, Seneca County.

Sources: Bernard *et al.* 1983; Godwin *et al.* 2000; Olivero 2001; Reschke *et al.* 1990; Seischab 1977, 1984; Seischab and Bernard 1985; Slack 1994; NYNHP field surveys.

5. Rich sloping fen: a small, gently sloping, minerotrophic wetland, with shallow peat deposits (usually at least 20 cm), that occurs in a shallow depression on a slope (1° or greater) composed of calcareous glacial deposits. Sloping fens are fed by small springs or groundwater seepage. Like other rich fens, their water sources have high concentrations of minerals and high pH values, generally from 6.0 to 7.8. Rich sloping fens are headwater wetlands with cold water constantly moving through them. They often have water flowing at the surface in small channels or rivulets. Rich sloping fens are often surrounded by upland forest and grade into other palustrine communities such as hemlock-hardwood swamp, shrub swamp, or shallow emergent marsh downslope. This community shares many species with other rich fens, but can be separated by having a measurable slope (*e.g.,* 1° to greater than 5°) and its position in the landscape.

The structure of rich sloping fens is variable; usually there are scattered trees and shrubs, and a nearly continuous groundlayer of herbs and bryophytes. They may be shrub-dominated or herb-dominated. Species diversity is usually very high and may include species from the surrounding forest.

Characteristic shrubs and small trees include red osier dogwood (*Cornus sericea*), willows (*Salix discolor, S. sericea, S. bebbiana*) dwarf raspberry (*Rubus pubescens*), northern gooseberry (*Ribes hirtellum*), alder-leaf buckthorn (*Rhamnus alnifolia*), arrowwood (*Viburnum dentatum* var. *lucidum*), highbush blueberry (*Vaccinium corymbosum*), red maple (*Acer rubrum*), eastern red cedar (*Juniperus virginiana*), and eastern hemlock (*Tsuga canadensis*). Other shrubs found in rich sloping fens include gray dogwood (*Cornus racemosa*), poison sumac (*Toxicodendron vernix*), and shrubby cinquefoil (*Dasiphora fruticosa* ssp. *floribunda*). Virgin's-bower (*Clematis virginiana*) is a characteristic vine.

Characteristic herbs include skunk-cabbage (*Symplocarpus foetidus*), marsh fern (*Thelypteris palustris*), spotted joe-pye-weed (*Eutrochium maculatum*), spreading goldenrod (*Solidago patula*), sedges (*Carex leptalea, C. flava, C. hystericina, C. interior, C. sterilis, C. stricta*), golden ragwort (*Packera aurea*), purple-stemmed aster (*Symphyotrichum puniceum* var. *puniceum*), cat-tails (*Typha latifolia* and *T. angustifolia*), swamp goldenrod (*Solidago uliginosa*), cotton-grass (*Eriophorum viridi-carinatum*), boneset (*Eupatorium perfoliatum*), flat-topped white aster (*Doellingeria umbellata* var. *umbellata*), purple avens (*Geum rivale*), tall meadow-rue (*Thalictrum pubescens*), common horsetail (*Equisetum arvense*), fowl mannagrass (*Glyceria striata*), field mint (*Mentha arvensis*), sundew (*Drosera rotundifolia*), water-horehound (*Lycopus americanus*), cinnamon fern (*Osmunda cinnamomea*), bulrush (*Scirpus atrovirens*), wild strawberry (*Fragaria virginiana*), water-horehound (*Lycopus uniflorus*), and grass-leaved goldenrod (*Euthamia graminifolia*). Other herbs found in rich sloping fens include the sedge *Carex prairea*, spike muhly (*Muhlenbergia glomerata*), turtle-heads (*Chelone glabra*), bog-candle (*Platanthera dilatata*), spreading globeflower (*Trollius laxus*), showy ladyslipper (*Cypripedium reginae*), fringed gentian (*Gentianopsis crinita*), and grass-of-Parnassus (*Parnassia glauca*).

Characteric bryophytes include the mosses *Calliergonella lindbergii, Hamatocaulis vernicosus, Helodium blandowii, Philonotis fontana,* several peat mosses (*Sphagnum centrale, S. fimbriatum, S. teres*), and the thalloid liverwort *Marchantia polymorpha*. Mosses that can become characteristically abundant in rich sloping fens include *Calliergonella cuspidata, Cratoneuron filicinum,* the peat moss *Sphagnum warnstorfii,* and the rare golden moss (*Tomentypnum nitens*). Additional rich sloping fen bryophytes common to other rich fen types include the mosses *Aulacomnium palustre, Bryum pseudotriquetrum, Calliergonella lindbergii, Campylium stellatum, Fissidens adianthoides, Scorpidium revolvens* and the thalloid liverwort *Aneura pinguis*.

A rare animal of some rich sloping fens is bog turtle (*Clemmys muhlenbergii*). Spotted turtle (*Clemmys guttata*) is characteristic of some rich sloping fens. Odonates, such as the brush-tipped emerald (*Somatochlora walshii*) and clamp-tipped emerald (*Somatochlora tenebrosa*) are characteristic of some rich sloping fens (J. Jaycox *pers. comm.*). More data on characteristic fauna are needed.

An open seep variant of this community with no peat, underlain by shale and clay has been reported (W. Broderick *pers. comm.*). More data on this and

other possible variants are needed.

Distribution: sparsely scattered throughout upstate New York north of the Coastal Lowlands ecozone, mostly in the Central Appalachians and Finger Lake Highlands subzones of the Appalachian Plateau ecozone, and the Taconic Highlands ecozone, but also in other parts of the state with calcareous glacial deposits.

Rank: G3 S1S2 *Revised:* 2001

Examples: Beaver Brook Fen Cortlandville, Cortland County; Dryden Slaterville Fir Swamp, Tompkins County; Dutchess Meadows, Dutchess County; Malloryville Swamp, Tompkins County; McLean Fen, Tompkins County; Ohio Fen, Livingston County.

Sources: Godwin *et al.* 2000; Motzkin 1994; Olivero 2001; Reschke *et al.* 1990; Slack 1994; NYNHP field surveys.

6. Rich graminoid fen: a strongly minerotrophic peatland in which the substrate is a predominantly graminoid peat that may or may not be underlain by marl. Rich fens are fed by waters that have high concentrations of minerals and high pH values, generally from 6.0 to 7.8. Rich graminoid fens are usually fed by water from highly calcareous springs or seepage.

The dominant species in rich graminoid fens are sedges, although grasses and rushes may be common. Shrubs may be present, but collectively they have less than 50% cover. Peat mosses (*Sphagnum* spp.) are either absent or a minor component, with only the most minerotrophic species present. Other mosses, especially those requiring highly minerotrophic conditions, may be common.

Characteristic herbs include spike muhly (*Muhlenbergia glomerata*), swamp goldenrod (*Solidago uliginosa*), sedges (*Carex flava, C. lasiocarpa, C. sterilis, C. aquatilis, C. prairea, C. hystericina*), bog-rush (*Cladium mariscoides*), grass-of-parnassus (*Parnassia glauca*), sundew (*Drosera rotundifolia*), marsh fern (*Thelypteris palustris*), white beakrush (*Rhynchospora alba*), common cat-tail (*Typha latifolia*), spikerush (*Eleocharis rostellata*), royal fern (*Osmunda regalis*), blue flag (*Iris versicolor*), and hard-stem bulrush (*Schoenoplectus acutus*). Other herbs found in rich graminoid fens include alpine bulrush (*Trichophorum alpinum*), flat-topped white aster (*Doellingeria umbellata* var. *umbellata*), cotton-grass (*Eriophorum viridi-carinatum*), boneset (*Eupatorium perfoliatum*), spotted joe-pye-weed (*Eutrochium maculatum*), buckbean (*Menyanthes trifoliata*), Ohio goldenrod (*Oligoneuron ohioense*), sedges (*Carex stricta, C. buxbaumii, C. pellita, C. leptalea*), spreading goldenrod (*Solidago patula*), fringed brome (*Bromus ciliatus*), marsh St. John's-wort (*Triadenum virginicum*), common horsetail (*Equisetum arvense*), marsh cinquefoil (*Comarum palustre*), field mint (*Mentha arvensis*), arrow-grasses (*Triglochin maritimum, T. palustre*), milfoil bladderwort (*Utricularia intermedia*), grass pink (*Calopogon tuberosus*), water-horehound (*Lycopus uniflorus*), rose pogonia (*Pogonia ophioglossoides*), golden ragwort (*Packera aurea*), fringed gentian (*Gentianopsis crinita*), and Kalm's lobelia (*Lobelia kalmii*).

Characteristic shrubs include shrubby cinquefoil (*Dasiphora fruticosa* ssp. *floribunda*), bayberry (*Myrica pensylvanica*), speckled alder (*Alnus incana* ssp. *rugosa*), poison sumac (*Toxicodendron vernix*), red maple (*Acer rubrum*), alder-leaf buckthorn (*Rhamnus alnifolia*), red osier dogwood (*Cornus sericea*), and hoary willow (*Salix candida*). Other shrubs found in rich graminoid fens include northern white cedar (*Thuja occidentalis*), dwarf raspberry (*Rubus pubescens*), tamarack (*Larix laricina*), sweet-gale (*Myrica gale*), and swamp fly honeysuckle (*Lonicera oblongifolia*).

Mosses that can become characteristically abundant in rich graminoid fens are *Campylium stellatum* and the rare scorpion feather moss (*Scorpidium scorpioides*). Other characteristic nonvascular species include the peat moss *Sphagnum centrale,* and the leafy liverworts *Calypogeia sphagnicola, Lepidozia reptans, Mylia anomala,* and *Plagiochila porelloides*. Additional rich graminoid fen bryophytes common to other rich fen types include the mosses *Aulacomnium palustre, Bryum pseudotriquetrum, Calliergonella cuspidata, Cratoneuron filicinum, Fissidens adianthoides, Scorpidium revolvens,* the peat moss *Sphagnum warnstorfii,* the rare golden moss (*Tomentypnum nitens*), and the thalloid liverwort *Aneura pinguis.* Sooty cupola moss (*Cinclidium stygium*) and pipe-cleaner moss (*Paludella squarrosa*) are two additional rare mosses that have only been found in rich graminoid fens in New York.

A rare animal of some rich graminoid fens is bog turtle (*Clemmys muhlenbergii*). Spotted turtle (*Clemmys guttata*) is characteristic of some rich graminoid fens. Odonates, such as brush-tipped emerald (*Somatochlora walshii*), are characteristic of some rich graminoid fens (J. Jaycox *pers. comm.*). Data on characteristic fauna are needed.

Distribution: Scattered throughout upstate New York north of the Coastal Lowlands in the Appalachian Plateau, Great Lakes Plain, Mohawk Valley, Hudson

Valley, Taconic Highlands, Tug Hill Plateau, St. Lawrence Valley, and Adirondacks ecozones.
Rank: G3 S1S2 *Revised:* 2001

Examples: Bergen Swamp, Genesee County; Hidden Lake, Herkimer County; Junius Ponds, Seneca County; Newcomb Swamp, Essex County; Quaker Pond Fen, Monroe County; Zurich Bog, Wayne County.

Sources: Andrus 1980; Godwin *et al.* 2000; Goodwin 1943; Motzkin 1994; Olivero 2001; Reschke *et al.* 1990; Seischab 1984; Shanks 1966; Slack 1994; NYNHP field surveys.

7. Rich shrub fen: a strongly minerotrophic peatland in which the substrate is a woody peat, which may or may not be underlain by marl or limestone bedrock. Rich fens are fed by waters that have high concentrations of minerals and high pH values, generally from 6.0 to 7.8.

The dominant species in rich shrub fens are shrubs, which form a canopy and overtop most herbs. Some rich shrub fens are dominated by low shrubs (under 4 ft or 1.2 m) that collectively have 80 to 90% cover in the community. Other rich shrub fens are dominated by taller shrubs (over 4 ft or 1.2 m) that collectively have 50 to 70% cover in the community with low shrubs and graminoids locally dominant in openings. The rich shrub fen community is somewhat broadly defined to include both the low shrub and taller shrub examples as well as regional variants distinguished by variations in their flora such as the lack of shrubby cinquefoil (*Dasiphora fruticosa* ssp. *floribunda*) in northern examples. More data could lead to the elevation of these variants to community types. In rich shrub fens, peat mosses (*Sphagnum* spp.) are either absent or a minor component, with only the most minerotrophic species present. Other mosses may be common.

Characteristic shrubs and small trees include red maple (*Acer rubrum*), red osier dogwood (*Cornus sericea*), speckled alder (*Alnus incana* ssp. *rugosa*), sweet-gale (*Myrica gale*), shrubby cinquefoil (*Dasiphora fruticosa* ssp. *floribunda*), swamp fly honeysuckle (*Lonicera oblongifolia*), black chokeberry (*Aronia melanocarpa*), alder-leaf buckthorn (*Rhamnus alnifolia*), and poison sumac (*Toxicodendron vernix*). Other shrubs small trees found in rich shrub fens include hoary willow (*Salix candida*), dwarf raspberry (*Rubus pubescens*), highbush blueberry (*Vaccinium corymbosum*), bog birch (*Betula pumila*), bayberry (*Myrica pensylvanica*), meadow-sweet (*Spiraea alba* var. *latifolia*), bog willow (*Salix pedicellaris*), tamarack (*Larix laricina*), and northern white cedar (*Thuja occidentalis*).

Characteristic herbs include marsh fern (*Thelypteris palustris*), royal fern (*Osmunda regalis*), sedges (*Carex stricta, C. interior*), common cat-tail (*Typha latifolia*), bluejoint grass (*Calamagrostis canadensis*), tall meadow-rue (*Thalictrum pubescens*), water horsetail (*Equisetum fluviatile*), and marsh St. John's-wort (*Triadenum virginicum*). Other herbs found in rich shrub fens include sedges (*Carex aquatilis, C. flava*) skunk-cabbage (*Symplocarpus foetidus*), flat-topped white aster (*Doellingeria umbellata* var. *umbellata*), spreading goldenrod (*Solidago patula*), blue flag (*Iris versicolor*), alpine bulrush (*Trichophorum alpinum*), and spike muhly (*Muhlenbergia glomerata*).

Characteristic nonvascular species include the mosses *Brachythecium oedipodium, Campylium polygamum, Eurhynchium pulchellum, Helodium blandowii, Scorpidium cossonii,* the rare scorpion feather moss (*Scorpidium scorpioides*), the peat moss *Sphagnum teres,* the leafy liverwort *Calypogeia sphagnicola,* and the thalloid liverworts *Pallavicinia lyellii* and *Pellia epiphylla*. The moss *Calliergon giganteum* becomes characteristically abundant in this community. Additional rich shrub fen bryophytes common to other rich fen types include the mosses *Aulacomnium palustre, Bryum pseudotriquetrum, Calliergonella cuspidata, Campylium stellatum, Cratoneuron filicinum, Fissidens adianthoides,* the peat moss *Sphagnum warnstorfii,* the rare golden moss (*Tomentypnum nitens*), and the thalloid liverwort *Aneura pinguis*.

A rare animal of some rich shrub fens is bog turtle (*Clemmys muhlenbergii*). Spotted turtle (*Clemmys guttata*) is characteristic of some rich shrub fens (J. Jaycox *pers. comm.*). Data on characteristic fauna are needed.

Distribution: scattered throughout upstate New York north of the Coastal Lowlands ecozone in the Appalachian Plateau, Great Lakes Plain, Mohawk Valley, Hudson Valley, Taconic Highlands, Tug Hill Plateau, St. Lawrence Valley, and Adirondacks ecozones.

Rank: G3G4 S1S2 *Revised:* 2001

Examples: Bear Swamp Sempronius, Cayuga County; Bonaparte Swamp, Lewis County; Great Swamp Pawling; Dutchess County; Lisbon Swamp, St. Lawrence County; Summit Lake Swamp, Otsego County.

Sources: Andrus 1980; Godwin *et al.* 2000; Johnson and Leopold 1994; Motzkin 1994; Olivero 2001; Reschke *et al.* 1990; Slack 1994; NYNHP field surveys.

8. Medium fen: a moderately minerotrophic peatland (intermediate between rich fens and poor fens) in which the substrate is a mixed peat composed of graminoids, mosses, and woody species. Medium fens are fed by waters that are moderately mineralized, with pH values generally ranging from 4.5 to 6.5. Medium fens often occur as a narrow transition zone between an aquatic community and either a swamp or an upland community along the edges of streams and lakes.

In medium fens, the herbaceous layer, dominated by the sedge *Carex lasiocarpa*, typically forms a canopy that overtops the low shrub layer. The physiognomy of medium fens may range from a dwarf shrubland to a perennial grassland, and be either shrub-dominated, herb dominated or have roughly equal amounts of shrubs and herbs.

The dominant species in medium fens are usually the sedge *Carex lasiocarpa* and sweet-gale (*Myrica gale*). In addition to sweet-gale, characteristic shrubs include leatherleaf (*Chamaedaphne calyculata*), bog rosemary (*Andromeda polifolia* var. *glaucophylla*), speckled alder (*Alnus incana* ssp. *rugosa*), large cranberry (*Vaccinium macrocarpon*), and young red maple (*Acer rubrum*). Other shrubs include black chokeberry (*Aronia melanocarpa*), bog willow (*Salix pedicellaris*), meadow-sweet (*Spiraea alba* var. *latifolia*), hardhack (*Spiraea tomentosa*), and swamp rose (*Rosa palustris*). Alder-leaf buckthorn (*Rhamnus alnifolia*), and poison sumac (*Toxicodendron vernix*) may be present with low percent cover.

In addition to the sedge *Carex lasiocarpa*, characteristic herbs include marsh St. John's-wort (*Triadenum virginicum*), pitcher-plant (*Sarracenia purpurea*), milfoil bladderwort (*Utricularia intermedia*), sundew (*Drosera rotundifolia*), white beakrush (*Rhynchospora alba*), marsh fern (*Thelypteris palustris*), arrowleaf (*Peltandra virginica*), rose pogonia (*Pogonia ophioglossoides*), grass pink (*Calopogon tuberosus*), swamp goldenrod (*Solidago uliginosa*), royal fern (*Osmunda regalis*), three-way sedge (*Dulichium arundinaceum*), buckbean (*Menyanthes trifoliata*), common cat-tail (*Typha latifolia*), and sundew (*Drosera intermedia*). Other herbs found in medium fens include blue flag (*Iris versicolor*), marsh cinquefoil (*Comarum palustre*), twig-rush (*Cladium mariscoides*), sedges (*Carex utriculata*, *C. leptalea*, *C. stricta*, *C. limosa*, *C. interior*), tufted loosestrife (*Lysimachia thyrsiflora*), alpine bulrush (*Trichophorum alpinum*), and narrow-leaf cat-tail (*Typha angustifolia*). A rare orchid of some medium fens is dragon's mouth (*Arethusa bulbosa*).

A characteristic moss is *Calliergonella cuspidata*. Other nonvascular plants found in medium fens include the mosses *Aulacomnium palustre*, *Bryum pseudotriquetrum*, *Calliergon giganteum*, *Campylium stellatum*, several peat mosses (*Sphagnum contortum*, *S. magellanicum*, *S. subsecundum*), and the thalloid liverwort *Aneura pinguis*. The major rich fen indicators scorpion feather moss (*Scorpidium scorpioides*) and *Scorpidium revolvens* are absent (Slack 1994).

A rare moth of some medium fens is bogbean buckmoth (*Hemileuca* sp.), which feeds on buckbean. A rare turtle of some medium fens is bog turtle (*Clemmys muhlenbergii*). Odonates, such as the brush-tipped emerald (*Somatochlora walshii*), are characteristic of some medium fens. More data on characteristic fauna are needed.

Medium fens along the Great Lakes in New York are similar to "shore fens" and "coastal fens" described by other Great Lakes states, such as Wisconsin (Eptein *et al.* 2002) and Michigan (Kost *et al.* 2007).

Distribution: sparsely scattered throughout upstate New York north of the Coastal Lowlands ecozone, mostly in the Great Lakes Plain, Tug Hill Plateau, St. Lawrence Valley, and Adirondacks ecozones.

Rank: G3G4 S2S3 *Revised:* 2001

Examples: Brennan Beach Fen, Oswego County; Deer Creek Marsh, Oswego County; Dunham Bay Marsh, Warren County; Fort Drum Mud Lake Fen, Lewis County; Long Pond, Oswego County; St. Mary's Pond, Oswego County; Newcomb Swamp, Essex County; South Pond Amboy, Oswego County; South Pond Fen, Oswego County.

Sources: Andrus 1980; Bailey and Bedford 1999; Epstein *et al.* 2002; Godwin *et al.* 2000; Johnson and Leopold 1994; Kost *et al.* 2007; Olivero 2001; Podniesinski 1994; Reschke *et al.* 1990; Slack 1994; NYNHP field surveys.

9. Inland poor fen: a weakly minerotrophic, flat peatland that occurs inland from the coastal plain in which the substrate is peat composed primarily of peat mosses (*Sphagnum* spp.) with admixtures of graminoid or woody peat. The dominant plants are peat mosses (*Sphagnum* spp.), with scattered sedges, shrubs, and stunted trees. Poor fens are fed by waters that are weakly mineralized, and have low pH values, generally between 3.5 and 5.0. This community typically develops where water moves through the peat mat, thus it often forms linear patches closely associated with open water.

Characteristic peat mosses include *Sphagnum angustifolium*, *S. cuspidatum*, *S. fallax*, *S. fuscum*, *S. magellanicum*, *S. papillosum*, *S. rubellum*, and *S.*

russowii.

Characteristic herbs include sedges (*Carex oligosperma, C. exilis, C. limosa, C. trisperma, C. utriculata, C. paupercula, C. canescens, C. michauxiana, C. parviflora*), white beakrush (*Rhynchospora alba*), cottongrasses (*Eriophorum vaginatum, E. virginicum*), round-leaf sundew (*Drosera rotundifolia*), rose pogonia (*Pogonia ophioglossoides*), grass pink (*Calopogon tuberosus*), and pitcher-plant (*Sarracenia purpurea*). *Carex lasiocarpa* may be present, but not dominant as in medium fens. A rare orchid of some inland poor fens is dragon's mouth (*Arethusa bulbosa*).

Shrubs and dwarf shrubs are patchy and usually have less than 50% cover (*i.e.*, not dominated by shrubs as in dwarf shrub bog). The taller sedges often overtop the short shrubs. Cranberries (*Vaccinium oxycoccos, V. macrocarpon*) are often dominant. Other characteristic shrubs include bog laurel (*Kalmia polifolia*), sheep laurel (*K. angustifolia*), sweet-gale (*Myrica gale*), black chokeberry (*Aronia melanocarpa*), leatherleaf (*Chamaedaphne calyculata*), bog rosemary (*Andromeda polifolia* var. *glaucophylla*), and Labrador tea (*Rhododendron groenlandicum*). Scattered stunted trees such as tamarack (*Larix laricina*), black spruce (*Picea mariana*), and red maple (*Acer rubrum*) may be present. Many of our "kettlehole bogs" are inland poor fens, according to this classification, since they are weakly minerotrophic. Poor fens often include hummocks that are essentially ombrotrophic islands within a weakly minerotrophic peatland.

This community shares many chararacteristics and species with coastal plain poor fen, but can be distinguished by its geographic location off the coastal plain along with having more northern or boreal indicator species (e.g., *Kalmia polifolia, Andromeda polifolia* var. *glaucophylla, Rhododendron groenlandicum, Larix laricina, Picea mariana*).

Distribution: throughout upstate New York north of the Coastal Lowlands ecozone.

Rank: G4 S3 *Revised:* 2001

Examples: Massawepie Mire, St. Lawrence County; Willis Brook Bog, Franklin County; Kildare Peatlands St. Lawrence County; Cranberry Vly, Rensselaer County; Brayton Marsh/Harris Bay Marsh, Warren County.

Sources: Andrus 1980; Damman and French 1987; Slack 1994; NYNHP field surveys.

10. Alpine sliding fen: a shallow peatland that develops on gentle to steep slopes (5° to 35°) on the brow of alpine or subalpine cliffs, or at the top and along the sides of steep, exposed bedrock slide areas. Water in the fen is primarily derived from runoff and seeps at higher elevation. Portions of alpine sliding fens presumably become supersaturated from major rain events and slide down the steep slope followed by the slow process of peat accumulation and revegetation (Sperduto and Cogbill 1999). The peat sliding process appears to be cyclical over long periods, ranging from relatively small events occurring once in several decades, to large and catastrophic events occurring once in several centuries at a given site. Peat slides often expose the underlying bedrock.

The short shrub layer includes leatherleaf (*Chamaedaphne calyculata*), small cranberry (*Vaccinium oxycoccus*), bog bilberry (*V. uliginosum*), bog laurel (*Kalmia polifolia*), and green alder (*Alnus viridis*). Other small trees and shrubs include tamarack (*Larix laricina*) and Labrador tea (*Rhododendron groenlandicum*).

Characteristic herbs include Pickering's reedgrass (*Calamagrostis pickeringii*), alpine bulrush (*Trichophorum cespitosum*), closed gentian (*Gentiana linearis*), round-leaved sundew (*Drosera rotundifolia*), and Bigelow's sedge (*Carex bigelowii*). Other low-growing herbs include creeping snowberry (*Gaultheria hispidula*) and mountain fir clubmoss (*Huperzia appalachiana*).

Characteristic peat mosses include *Sphagnum compactum, S. angustifolium, S. fallax, S. russowii, S. papillosum, S. pylaesii,* and *S. magellanicum.* A rare peat moss of some sliding fens is *Sphagnum lindbergii* (Andrus 1980). Mosses in the genus *Andreaea* and the leafy liverwort *Scapania nemorea* may also be present. Various crustose lichens grow on the open bedrock areas. The sliding fen can be distinguished from the relatively more common inland poor fen by having more alpine flora, a much steeper slope, high elevation mountain setting, and peat sliding process. Microhabitats include herb-dominated patches, shrub clusters, moss carpets, plus wet and dry exposed bedrock. Data from more examples are needed to refine the description.

Distribution: restricted to the Adirondack High Peaks subzone of the Adirondack ecozone.

Rank: G3G4 S1S2 *Revised:* 2005

Examples: Algonquin Mountain, Essex County; Whiteface Mountain, Essex County; Gothics, Essex County.

Sources: Andrus 1980; Sperduto and Cogbill 1999;

Sperduto *et al.* 2000; Sperduto and Nichols 2000; Sperduto 2000; NYNHP field surveys.

11. Coastal plain poor fen: a weakly minerotrophic peatland that occurs on the coastal plain, in which the substrate is peat composed primarily of peat mosses (*Sphagnum* spp.), with admixtures of graminoid and woody peat.

The dominant plants are peat mosses (*Sphagnum* spp.), with scattered sedges, shrubs, and stunted trees. Poor fens are fed by waters that are weakly mineralized, with low pH values, generally between 4.0 and 5.5 (Andrus 1980). *Sphagnum henryense* is a characteristic peat moss; additional species include *S. bartlettianum, S. fallax, S. flavicomans, S. magellanicum, S. papillosum, S. recurvum,* and *S. torreyanum*.

Characteristic shrubs include hardhack (*Spiraea tomentosa*), leatherleaf (*Chamaedaphne calyculata*), large cranberry (*Vaccinium macrocarpon*) water-willow (*Decodon verticillatus*), sweet gale (*Myrica gale*), and dwarf huckleberry (*Gaylussacia dumosa*). Small patches within the fen may be dominated by dwarf shrubs and may be classified as dwarf shrub bog.

Characteristic herbs include twig-rush (*Cladium mariscoides*), sedges (*Carex utriculata, C. lasiocarpa, C. striata, C. exilis*), beakrushes (*Rhynchospora alba, R. fusca*), rushes (*Juncus canadensis, J. pelocarpus*), cottongrass (*Eriophorum virginicum*), sundews (*Drosera intermedia, D. rotundifolia*), marsh St. John's-wort (*Triadenum virginicum*), bladderworts (*Utricularia striata, U. purpurea*), knotted spikerush (*Eleocharis equisetoides*), swamp loosestrife (*Lysimachia terrestris*), rose pogonia (*Pogonia ophioglossoides*), grass pink (*Calopogon tuberosus*), meadow beauty (*Rhexia virginica*), white water-lily (*Nymphaea odorata*). Sedges and rushes often overtop short shrubs by mid to late summer. Scattered stunted trees such as Atlantic white cedar (*Chamaecyparis thyoides*) and red maple (*Acer rubrum*) may also be present.

Fauna observed in coastal plain poor fens include common snipe (*Gallinago gallinago*), great blue heron (*Ardea herodias*), green frog (*Rana clamitans melanota*), bull frog (*Rana catesbeiana*), and spotted turtle (*Clemmys guttata*).

On Long Island, coastal plain poor fens occur from the Nissequogue River and the central south shore to Montauk Point. They are best developed on the Roanoke Point Moraine outwash plain and the Ronkonkoma Moraine. Coastal plain poor fen appears to form best in small "delta-like" areas of organic deposits near the small stream outlets of coastal plain pond basins. Major ecological factors influencing this community include groundwater discharge combined with one or more of the following hydrological influences: coastal plain pond shore draw down, stream flow, or an abbreviated freshwater tide. Fire regime may influence poor fens situated within fire prone landscapes. Coastal plain poor fen vegetation appears to form readily behind stream impoundments.

This community shares many chararacteristics and species with inland poor fen, but can be distinguished by its geographic location on the coastal plain on moraine or outwash sand along with having more coastal plain indicator species (e.g., *Chamaecyparis thyoides, Carex striata, Rhexia virginica*).

Distribution: restricted to the Coastal Lowlands ecozone.

Rank: G3? S1 *Revised:* 2001

Examples: Jones Pond, Suffolk County; Cranberry Bog, Suffolk County; Fresh Pond, Suffolk County; Quogue Wetland, Suffolk County; Bow Drive Marsh, Suffolk County.

Sources: Andrus 1980; MacDonald and Edinger 2000; Slack 1994; NYNHP field surveys.

12. Sea level fen: a small patch, sedge-dominated fen community that occurs at the upper edge of salt marsh complexes just above sea level where there is adjoining freshwater seepage. These fens are fed by acidic and oligotrophic freshwater seepage which mixes with salt or brackish water during unusually during high tides and storm surges. This fen is classified as a palustrine community, rather than an estuarine, community, because the primary hydrological influence is fresh groundwater seepage. Although there may be a few halophytes present, the fen is typically dominated by freshwater vegetation. The fen is herb dominated but can have trees and shrubs at low percent cover. There is usually nearly 100% cover of herbaceous plants with high species diversity. Soils are those of a peatland with deep sedgy peat underlain by deep sand or gravel. The soil pore salinity is moderate at 2-5 ppt.

Dominant plants include spikerush (*Eleocharis rostellata*), twig-rush (*Cladium mariscoides*), and three-square (*Schoenoplectus pungens*). Other characteristic species include marsh straw sedge (*Carex hormathodes*), slender blue flag (*Iris prismatica*), Canada rush (*Juncus canadensis*), white beakrush (*Rhynchospora alba*), Canadian burnet (*Sanguisorba canadensis*), wild germander (*Teucrium canadense*), poison ivy (*Toxicodendron*

radicans), and large cranberry (*Vaccinium macrocarpon*).

Typical trees and shrubs include scattered individuals of red cedar (*Juniperus virginiana*), pitch pine (*Pinus rigida*), bayberry (*Myrica pensylvanica*), groundsel-tree (*Baccharis halimifolia*) and salt marsh-elder (*Iva frutescens*). The invasion of European common reed (*Phragmites australis*) is a serious threat to this community.

Distribution: restricted to the upper estuarine portion of Coastal Lowlands ecozone. Most common in the Peconic Bay Estuary region, but also known from the mainland fringe of the south shore of Long Island.

Rank: G1G2 S1 *Revised:* 2001

Examples: Northwest Creek, Suffolk County; Little Northwest Creek, Suffolk County; Hubbard Creek Marsh, Suffolk County; Napeague Meadow, Suffolk County; Heckscher State Park, Suffolk County.

Sources: Ludwig 1995; MacDonald and Edinger 2000; NYNHP field surveys.

13. Perched bog: a flat ombrotrophic to minerotrophic peatland that occurs in shallow depressions in rock outcrops where there is a perched water table typically within a rocky barrens community. Vegetation is dominated by peat mosses (*Sphagnum* spp.) and ericaceous shrubs, and the substrate is a shallow peat (less than 0.5 m to 1.0 m deep) overlying bedrock. Water in a perched bog is usually very acid (pH less than 5.0), has low amounts of dissolved minerals, and is especially low in calcium ions. Species diversity is usually low.

Characteristic species include leatherleaf (*Chamaedaphne calyculata*), sheep laurel (*Kalmia angustifolia*), hardhack (*Spiraea tomentosa*), large cranberry (*Vaccinium macrocarpon*), woolgrass (*Scirpus cyperinus*), sedges (*Carex* spp.), and several peat mosses (*Sphagnum fuscum, S. rubellum, S. capillifolium,* and *S. magellanicum*), More data on this community are needed, especially for characteristic fauna.

Distribution: known only from the Lake Champlain Transition subzone of the Lake Champlain ecozone and the Shawangunk Hills subzone of the Hudson Valley ecozone.

Rank: G3G4 S1S2 *Revised:* 1990

Examples: Altona Flat Rock, Clinton County; Sam's Point, Ulster County.

Sources: Andrus 1980; Damman and French 1987; NYNHP field surveys.

14. Patterned peatland: a large peatland with a gentle slope or divide in which the vegetation consists of a mosaic of high and low areas (relative to water levels) that are called strings and flarks, respectively. The strings and flarks occur as narrow or broad bands of vegetation that extend perpendicular to the direction of water flow across the slope of the peatland, and are arrayed in a parallel or mottled manner. The strings or hummocks (high, relatively dry areas) are usually ombrotrophic or weakly minerotrophic, and the flarks or hollows (low, relatively wet areas) are more minerotrophic than the strings. Patterning in peatlands may occur regardless of the ombrotrophic or minerotrophic nature of the peatland; there are many types of patterns that can occur. In New York, the most pronounced patterning occurs on two bogs that are primarily ombrotrophic and are slightly raised at the center. These bogs have a subtle ladderform pattern of slightly raised linear hummocks (strings) and broad, shallow hollows (flarks) along one of the slopes, as well as several small ponds. In this peatland, the dominant peat moss is *Sphagnum rubellum*; this moss forms a nearly pure carpet in some areas of the bog, and it is common on the strings. Other common peat mosses include *Sphagnum cuspidatum, S. angustifolium,* and *S. majus* in flarks.

Characteristic herbs of the strings and flarks include sedges (*Carex oligosperma, C. exilis*) and Pickering's reed bent-grass (*Calamagrostis pickeringii*). Characteristic herbs mostly of the flarks with low percent cover include white beakrush (*Rhynchospora alba*), sedge (*Carex trisperma*), pitcher-plant (*Sarracenia purpurea*), cottongrass (*Eriophorum vaginatum*), and pod-grass (*Scheuchzeria palustris*). Characteristic herbs mostly of the strings with low percent cover include sedges (*Carex pauciflora, C. magellanica ssp. irrigua*), alpine bulrush (*Trichophorum alpinum*), and white fringed orchid (*Platanthera blephariglottis*),

Characteristic dwarf shrubs mostly on the strings include bog rosemary (*Andromeda polifolia* var. *glaucophylla*), leatherleaf (*Chamaedaphne calyculata*), bog laurel (*Kalmia polifolia*), black chokeberry (*Aronia melanocarpa*), and sheep laurel (*Kalmia angustifolia*). Other shrubs with low percent cover include small cranberry (*Vaccinium oxycoccos*), Labrador tea (*Rhododendron groenlandicum*), and lowbush blueberry (*Vaccinium angustifolium*).

Black spruce (*Picea mariana*) and tamarack (*Larix laricina*) on the bog mat are stunted and usually widely spaced on hummocks or strings.

Characteristic birds with varying abundance include yellow palm warbler (*Dendroica palmatum hypochrysea)*, Lincoln's sparrow (*Melospiza lincolnii*), and Nashville warbler (*Vermivora ruficapilla*). Data on other characteristic fauna are needed.

Distribution: restricted to the Western Adirondack Foothills subzone of the Adirondacks ecozone.

Rank: G3G4 S1 *Revised:* 2014

Examples: Spring Pond Bog, Franklin County; Bay Pond Bog, Franklin County.

Sources: Worley 1982; NYNHP field surveys.

15. Dwarf shrub bog: an ombrotrophic or weakly minerotrophic peatland dominated by low-growing, evergreen, ericaceous shrubs and peat mosses (*Sphagnum* spp.). The surface of the peatland is typically a mosaic of hummock/hollow microtopography. The hummocks tend to have a higher abundance of shrubs than the hollows; these bogs have more than 50% cover of low-growing shrubs. Water is usually nutrient-poor and acidic.

The dominant shrub is often leatherleaf (*Chamaedaphne calyculata*), which may have more than 50% cover. Shrubs are typically taller than the herb layer which is usually graminoid, and generally the shrub heights are 1 m or less. Other prominent shrubs and herbs are sheep laurel (*Kalmia angustifolia*), bog laurel (*K. polifolia*), Labrador tea (*Rhododendron groenlandicum*), cranberries (*Vaccinium oxycoccos, V. macrocarpon*), the sedge *Carex trisperma,* and tawny cottongrass (*Eriophorum virginicum*).

Other characteristic but less abundant plants are round-leaf sundew (*Drosera rotundifolia*), pitcher plant (*Sarracenia purpurea*), bog rosemary (*Andromeda polifolia* var. *glaucophylla*), huckleberry (*Gaylussacia baccata*), black chokeberry (*Aronia melanocarpa*), highbush blueberry (*Vaccinium corymbosum*), water-willow (*Decodon verticillatus*), meadow-sweet (*Spiraea alba* var. *latifolia*), hardhack (*Spiraea tomentosa*), marsh St. John's-wort (*Triadenum virginicum*), sedges (*Carex canescens, C. pauciflora*), Virginia chain fern (*Woodwardia virginica*), and white beakrush (*Rhynchospora alba*). Scattered stunted trees may be present, including black spruce (*Picea mariana*), tamarack (*Larix laricina*), and red maple (*Acer rubrum*).

Characteristic peat mosses that form a nearly continuous carpet under the shrubs include *Sphagnum magellanicum, S. rubellum, S. fallax, S. fuscum, S. papillosum,* and *S. angustifolium.*

Characteristic birds with varying abundance include yellow palm warbler (*Dendroica palmatum hypochrysea)*, Lincoln's sparrow (*Melospiza lincolnii*), and Nashville warbler (*Vermivora ruficapilla*).

A dwarf shrub bog may form a floating mat around a bog lake or along the banks of an acidic stream; it may also occur as a large or small mat completely filling a basin. A dwarf shrub bog may grade into a highbush blueberry bog thicket, inland poor fen, or a black spruce-tamarack bog.

Distribution: throughout upstate New York north of the Coastal Lowlands ecozone; most common in the Adirondack ecozone.

Rank: G4 S3 *Revised:* 2001

Examples: Bay Pond Bog, Franklin County; Bloomingdale Bog, Franklin County; Massawepie Mire, St. Lawrence County; Sunday Swamp, Lewis County; Rome Sand Plains, Oneida County; Little Cedar Pond; Orange County.

Sources: Andrus 1980; Bray 1921; Damman and French 1987; Johnson, C. W. 1985; Karlin and Andrus 1986; Karlin and Lynn 1988; Sperduto and Cogbill 1999; Sperduto *et al.* 2000; Sperduto and Nichols 2000; Sperduto 2000; NYNHP field surveys.

16. Highbush blueberry bog thicket: an ombrotrophic or weakly minerotrophic peatland dominated by tall, deciduous, ericaceous shrubs and peat mosses (*Sphagnum* spp.); the water is typically nutrient-poor and acidic.

The dominant shrub is usually highbush blueberry (*Vaccinium corymbosum*). At least three regional variants are recognized in New York. The first is found throughout central and western New York and is calcareous to circuneutral, the second is primarily a northern variant, and the third is a southern variant with more coastal plain species.

Species characteristic of all three varieties, and typical of the central and western New York examples, include highbush blueberry (*Vaccinium corymbosum*), winterberry (*Ilex verticillata*), cinnamon fern (*Osmunda cinnamomea*), marsh fern (*Thelypteris palustris*), and peat mosses (*Sphagnum* spp.). Stunted trees may be present at a low density and with less than 50% cover; red maple (*Acer rubrum*) occurs in many bog thickets as stunted individuals in small clusters or as dead snags. Other characteristic shrubs and herbs include black huckleberry (*Gaylussacia baccata*), false Solomon's-seal (*Maianthemum trifolium*), and pitcher plant (*Sarracenia purpurea*).

Additional characteristic species in northern examples include mountain holly (*Nemopanthus mucronatus*) which may be codominant, sedge (*Carex trisperma*), and wild calla (*Calla palustris*). Scattered small trees include tamarack (*Larix laricina*), black spruce (*Picea mariana*), and white pine (*Pinus strobus*).

The southern New York variant of this community (Long Island and Lower Hudson Valley) contains substantially fewer northern taxa and numerous coastal plain species, such as swamp azalea (*Rhododendron viscosum*) which may become codominant, red chokeberry (*Aronia arbutifolia*), male-berry (*Lyonia ligustrina*), fetterbush (*Leucothoe racemosa*), sweet pepperbush (*Clethra alnifolia*), water-willow (*Decodon verticillatus*), buttonbush (*Cephalanthus occidentalis*), marsh St. John's-wort (*Triadenum virginicum*), sedges (*Carex trisperma, C. striata*), three way sedge (*Dulichium arundinaceum*), and Virginia chain fern (*Woodwardia virginica*). Scattered small trees may include pitch pine (*Pinus rigida*) or Atlantic white cedar (*Chamaecyparis thyoides*).

Characteristic peat mosses for all variants include *Sphagnum magellanicum*, *S. centrale*, *S. capillifolium*, and *S. fimbriatum*.

Characteristic fauna include common yellowthroat (*Geothlypis trichas*), swamp sparrow (*Melospiza georgiana*), song sparrow (*Melospiza melodia*), meadow jumping mouse (*Zapus hudsonius*), masked shrew (*Sorex cinereus*), southern red-backed vole (*Clethrionomys gapperi*), and green frog (*Rana clamitans*).

See pine barrens shrub swamp for a community with similar shrub species, but with shallow peat (less than 20 cm deep) that is typically found at the upper margins of coastal plain pond shores within a pitch pine barrens.

Distribution: throughout New York State.

Rank: G4 S3 *Revised:* 2001

Examples: Brayton Marsh, Warren County; Sears Bellows Wetlands, Suffolk County; Protection Bog, Erie County; Harriman State Park, Rockland County.

Sources: Damman and French 1987; MacDonald and Edinger 2000; NYNHP field surveys.

C. FORESTED MINERAL SOIL WETLANDS

This subsystem includes seasonally flooded forests, and permanently flooded or saturated swamps. These forests and swamps typically have at least 50% canopy cover of trees. For the purposes of this classification, a tree is defined as a woody plant usually having one principal stem or trunk, a definite crown shape, and characteristically reaching a mature height of at least 5 m (16 ft) (Driscoll *et al.* 1984).

1. Floodplain forest: typically a hardwood forest that occurs on mineral soils on low terraces of river floodplains and river deltas. These sites are characterized by their flood regime; low areas are annually flooded in spring and high areas are flooded irregularly. Some sites may be quite dry by late summer whereas other sites may be flooded again in late summer or early autumn (these floods are caused by heavy precipitation associated with tropical storms). This is a broadly defined community; floodplain forests are quite variable and may be very diverse.

Characteristic trees include silver maple (*Acer saccharinum*), ashes (*Fraxinus pennsylvanica, F. nigra, F. americana*), cottonwood (*Populus deltoides*), red maple (*Acer rubrum*), box elder (*Acer negundo*), elms (*Ulmus americana, U. rubra*), hickories (*Carya cordiformis, C. ovata, C. laciniosa*), butternut and black walnut (*Juglans cinerea, J. nigra*), sycamore (*Platanus occidentalis*), oaks (*Quercus bicolor, Q. palustris*), and river birch (*Betula nigra*). Other trees include hackberry (*Celtis occidentalis*), tulip tree (*Liriodendron tulipifera*), basswood (*Tilia americana*), and sugar maple (*Acer saccharum*). Introduced trees, such as white willow (*Salix alba*) and black locust (*Robinia pseudo-acacia*), have become established in some floodplain forests. Multiple trunked silver maples are typical in this setting as an adaptation to flooding.

Characteristic shrubs include spicebush (*Lindera benzoin*), American hornbeam (*Carpinus caroliniana*), bladdernut (*Staphylea trifoliata*), speckled alder (*Alnus incana* ssp. *rugosa*), shrubby dogwoods *(Cornus sericea, C. racemosa, C. amomum*), viburnums (*Viburnum nudum* var. *cassinoides, V. prunifolium, V. dentatum, V. lentago*), and sapling canopy trees. Invasive non-native shrubs that may be locally abundant include shrub honeysuckles (*Lonicera tatarica, L. morrowii*), and multiflora rose (*Rosa multiflora*). Other shrubs include meadowsweet (*Spiraea alba* var. *latifolia*), and winterberry (*Ilex verticillata*).

Characteristic vines include poison ivy (*Toxicodendron radicans*), wild grapes (*Vitis* spp., including *V. riparia*), Virginia creeper (*Parthenocissus quinquefolia, P. vitacea*), virgin's bower (*Clematis virginiana*), and less frequently, moonseed (*Menispermum canadense*). Vines may become dense in the tree canopy (*i.e.*, liana) and/or dominate the groundcover.

Characteristic herbs include sensitive fern (*Onoclea sensibilis*), jewelweeds (*Impatiens capensis, I. pallida*), ostrich fern (*Matteuccia struthiopteris*), white snakeroot (*Ageratina altissima* var. *altissima*), wood nettle (*Laportea canadensis*), false nettle (*Boehmeria cylindrica*), goldenrods (*Solidago* spp., *S. gigantea, S. canadensis*), lizard's tail (*Saururus cernuus*), and jumpseed (*Persicaria virginiana*). Invasive non-native herbs that may be locally abundant include moneywort (*Lysimachia nummularia*), garlic mustard (*Alliaria petiolata*), dame's-rocket (*Hesperis matronalis*), European stinging nettle (*Urtica dioica* ssp. *dioica*), and stilt grass (*Microstegium vimineum*). Other herbs include skunk cabbage (*Symplocarpus foetidus*), enchanter's nightshade (*Circaea lutetiana* ssp. *canadensis*), bluejoint grass (*Calamagrostis canadensis*), white avens (*Geum canadense*), clearweed (*Pilea pumila*), jack-in-the-pulpit (*Arisaema triphyllum*), cutgrasses (*Leersia oryzoides, L. virginica*), American stinging nettle (*Urtica dioica* ssp. *gracilis*), sedges *(Carex lacustris, C. intumescens, C. lupulina, C. stricta*), and many others.

The composition of the forest apparently changes in relation to flood frequency and elevation of floodplain terraces along larger rivers. Neighboring states recognize several floodplain forest variants based on dominant plants, flood regime, and topographic position (Fike 1999, Kearsley 1999, Podniesinski and Wagner 2002, Sorenson and Lapin *et al.* 1998). The composition of floodplain forests in New York State has not been studied in sufficient detail to characterize compositional variations and how they correlate with flood regime and terrace elevation. Data on characteristic fauna are needed.

Distribution: throughout upstate New York, primarily north of the Coastal Lowlands ecozone.

Rank: G3G4 S2S3 *Revised:* 2001

Examples: Raquette River, Franklin County; Howland Island, Cayuga County; Catskill Creek, Greene County; Doyles Islands, Delaware County; South Bay Creek Wetlands, Washington County.

Sources: Barrett and Enser 1997; Bechtel and Sperduto 1998; Fike 1999; Gordon 1937; Kearsley 1999; Metzler and Damman 1985; Nichols *et al.* 2000; Podniesinski and Wagner 2002; Sorenson and Lapin *et al.* 1998; Veneman and Tiner 1990; NYNHP field surveys.

2. Red maple-hardwood swamp: a hardwood swamp that occurs in poorly drained depressions or basins, usually on inorganic soil, but occasionally on muck or shallow peat, that is typically acidic to circumneutral. This is a broadly defined community with several regional and edaphic variants. The hydrology varies from permanently saturated to the surface to seasonally flooded/wet with hummocks and hollows. In any one stand red maple (*Acer rubrum*) is either the only canopy dominant, or it is codominant with one or more hardwoods including ashes (*Fraxinus pennsylvanica*, *F. nigra*, and *F. americana*), elms (*Ulmus americana* and *U. rubra*), and yellow birch (*Betula alleghaniensis*). Other trees with low percent cover include butternut (*Juglans cinerea*), bitternut hickory (*Carya cordiformis*), blackgum (*Nyssa sylvatica*), American hornbeam (*Carpinus caroliniana*), swamp white oak (*Quercus bicolor*), and white pine (*Pinus strobus*). The trunks of maples are typically single-trunked unlike those of floodplain forests with multiple trunks.

The shrub layer is usually well-developed and may be quite dense. Characteristic shrubs are winterberry (*Ilex verticillata*), spicebush (*Lindera benzoin*), alders (*Alnus incana* ssp. *rugosa* and *A. serrulata*), viburnums (*Viburnum dentatum* var. *lucidum*, *V. nudum* var. *cassinoides*), highbush blueberry (*Vaccinium corymbosum*), common elderberry (*Sambucus nigra* ssp. *canadensis*), and various shrubby dogwoods (*Cornus sericea*, *C. racemosa*, and *C. amomum*). Swamp azalea (*Rhododendron viscosum*) is more common in southern examples, and poison sumac (*Toxicodendron vernix*) and black ash are more common in mineral-rich examples with slightly higher pH.

The herbaceous layer may be quite diverse and is often dominated by ferns, including sensitive fern (*Onoclea sensibilis*), cinnamon fern (*Osmunda cinnamomea*), royal fern (*O. regalis*), and marsh fern (*Thelypteris palustris*), with much lesser amounts of crested wood fern (*Dryopteris cristata*), and spinulose wood fern (*Dryopteris carthusiana*). Characteristic herbs include skunk cabbage (*Symplocarpus foetidus*), white hellebore (*Veratrum viride*), sedges (*Carex stricta*, *C. lacustris*, and *C. intumescens*), jewelweed (*Impatiens capensis*), false nettle (*Boehmeria cylindrica*), arrow arum (*Peltandra virginica*), tall meadow rue (*Thalictrum pubescens*), and marsh marigold (*Caltha palustris*). Open patches within the swamp may contain other herbs characteristic of shallow emergent marsh.

Examples of wetland fauna that occur in the glaciated northeast red maple-hardwood swamps include wood duck (*Aix sponosa*), American black duck (*Anas rubripes*), northern waterthrush (*Seiurus noveboracensis*), beaver (*Castor canadensis*), river otter (*Lutra canadensis*), and mink (*Mustela vison*). These swamps provide breeding habitat for many wetland-dependent species, such as northern spring peeper (*Pseudacris crucifer crucifer*), American toad (*Bufo americanus americanus*), wood frog (*Rana sylvatica*), and spotted salamander (*Ambystoma maculatum*) (Golet *et al.* 1993). More data on characteristic fauna, especially invertebrates, are needed.

More data are needed on reported variants of this community, such as forested seeps, successional hardwood swamp, red maple-white pine swamp on sandy soils, and red maple-tussock sedge swamp with shallow peat.

Distribution: throughout New York State, most common on the Great Lakes Plain, in the Hudson Valley, and the High Allegheny Plateau.

Rank: G5 S4S5 *Revised:* 2001

Examples: Great Swamp Pawling, Dutchess County; Deer Creek Marsh, Oswego County; Toad Harbor Swamp; Oswego County; Orange Lake, Orange and Ulster County; Joralemon Woods, Albany County.

Sources: Cain and Penfound 1939; Golet *et al.* 1993; McVaugh 1958; NYNHP field surveys.

3. Red maple-blackgum swamp: a maritime, coastal, or inland hardwood swamp that occurs in poorly drained depressions, sometimes in a narrow band between a stream and upland. Coastal plain examples have a shallow layer of acidic, well decomposed peat over saturated sandy loam or loamy sand. Inland examples usually occur on an acidic silt loam. Hummock-hollow microtopography is evident.

Red maple (*Acer rubrum*) and blackgum (*Nyssa sylvatica*) are often codominant, or blackgum (*Nyssa sylvatica*) may be the dominant tree. Pitch pine (*Pinus rigida*) may occur on drier hummock islands in pine barrens settings. Yellow birch (*Betula alleghaniensis*) may be codominant in inland examples.

The shrub layer is usually well developed. Characteristic shrubs are sweet pepperbush (*Clethra alnifolia*), highbush blueberry (*Vaccinium corymbosum*), swamp azalea (*Rhododendron viscosum*), fetterbush (*Leucothoe racemosa*), dangleberry (*Gaylussacia frondosa*), and on the coastal plain, inkberry (*Ilex glabra*). Vines such as common greenbrier (*Smilax rotundifolia*), sawbrier (*Smilax glauca*), Virginia creeper (*Parthenocissus quinquefolia*), and poison ivy (*Toxicodendron radicans*) are present in the understory. The herbaceous layer is not particularly diverse,

characterized by cinnamon fern (*Osmunda cinnamomea*), skunk cabbage (*Symplocarpus foetidus*), and on the coastal plain by netted chain fern (*Woodwardia areolata*). The nonvascular layer may or may not be well developed.

Characteristic nonvascular species are peat mosses (*Sphagnum* spp.) with *S. girgensohnii* occurring in more inland examples.

More data may support the future recognition of inland and coastal plain variants of this community. Data on characteristic fauna are needed.

Distribution: across the Coastal Lowlands, Hudson Valley, Taconic Highlands, Hudson Highlands, and possibly Manhattan Hills ecozones.

Rank: G3G4 S2 *Revised:* 2001

Examples: Connetquot River Watershed, Suffolk County; Lower Peconic River, Suffolk County; Carmans River, Suffolk County; Shawangunk Mountains, Sullivan County; Lincoln Mountain State Forest, Saratoga County.

Sources: Breden 1989; Cain and Penfound 1939; Golet *et al.* 1993; Greller 1977; McCormick 1979; NYNHP field surveys.

4. Red maple-sweetgum swamp: a hardwood swamp that occurs on somewhat poorly drained seasonally wet flats, usually on somewhat acidic gleyed to mottled clay loam or sandy loam. Red maple-sweetgum swamps often occur as a mosaic with upland forest communities.

Sweetgum (*Liquidambar styraciflua*) is often the dominant tree or may be codominant with red maple (*Acer rubrum*). Other codominant trees include pin oak (*Quercus palustris*) and blackgum (*Nyssa sylvatica*). Other trees occurring at lower densities include swamp white oak (*Quercus bicolor*), red oak (*Quercus rubra*), black ash (*Fraxinus nigra*), and swamp cottonwood (*Populus heterophylla*). Willow oak (*Quercus phellos*) and sweet-bay (*Magnolia virginiana*) are often present in larger occurrences where they may occur at very low density. Trees often have buttressed trunks and exposed roots from hydrological influences.

The shrub layer is usually fairly well-developed. Characteristic shrubs are sweet pepperbush (*Clethra alnifolia*), swamp azalea (*Rhododendron viscosum*), arrowwood (*Viburnum dentatum* var. *lucidum*), spicebush (*Lindera benzoin*), highbush blueberry (*Vaccinium corymbosum*), black chokeberry (*Aronia melanocarpa*) and possibly fetterbush (*Leucothoe racemosa*). Vines such as common greenbrier (*Smilax rotundifolia*), sawbrier (*S. glauca*), wild grapes (*Vitis* spp.), Virginia creeper (*Parthenocissus quinquefolia*), and poison ivy (*Toxicodendron radicans*) are present at low amounts in the understory.

The herbaceous layer is often dominated by ferns, including netted chain fern (*Woodwardia areolata*), cinnamon fern (*Osmunda cinnamomea*), and sensitive fern (*Onoclea sensibilis*). Characteristic herbs include lizard's-tail (*Saururus cernuus*), Canada mayflower (*Maianthemum canadense*), jumpseed (*Persicaria virginiana*), skunk cabbage (*Symplocarpus foetidus*) and jewelweed (*Impatiens capensis*). State-reported southern red oak (*Quercus falcata*) and state-extirpated mistletoe (*Phoradendron flavescens*) occur in this community south of New York and may have been historically present in this community in New York. Some occurrences of this community are now severely degraded.

Data on characteristic fauna are needed.

Distribution: probably restricted to Manhattan Hills ecozone and western part of Coastal Lowlands ecozone (Bray 1915). At least one example in the Triassic Lowlands ecozone. Known examples range from Hylan Boulevard and Bedell Avenue in the Tottenville portion of Staten Island (southernmost point in New York) north to Quaker Ridge Woods Scarsdale, Westchester County. Most occurrences are apparently concentrated in Richmond County. The community may occur or was historically present in very small patches farther east in Queens, Kings and Nassau Counties. Also likely to have been present historically in Bronx and New York Counties.

Rank: G4G5 S1S2 *Revised:* 2001

Examples: Magnolia Swamp, Richmond County; Tallman Mountain, Rockland County.

Sources: Braun 1950; Bray 1915; Breden 1989; Golet *et al.* 1993; Greller 1977; Robichaud and Buell 1973; Stevens 1992; NYNHP field surveys.

5. Red maple-swamp white oak swamp: a hardwood swamp typically found in small, isolated basins on sandy soils that are underlain by a clay layer. The swamp floods seasonally and draws down in most years exposing a leaf litter substrate. The swamp is codominated by red maple (*Acer rubrum*) and oaks, such as swamp white oak (*Quercus bicolor*) and/or pin oak (*Q. palustris*). Typically, swamp white oak is either dominant or codominant with red maple along with several other canopy trees with lower abundance, such as blackgum (*Nyssa sylvatica*), green ash (*Fraxinus pennsylvanica*), swamp cottonwood (*Populus heterophylla*), and elms

(*Ulmus americana, U. rubra*). Pin oak can be an associate canopy tree or replace swamp white oak as the codominant. Trees from the surrounding uplands can occur in low abundance within the swamp on drier hummocks, such as pignut hickory (*Carya glabra*) and American beech (*Fagus grandifolia*).

Characteristic shrubs include winterberry (*Ilex verticillata*), highbush blueberry (*Vaccinium corymbosum*), buttonbush (*Cephalanthus occidentalis*), and arrowwood (*Viburnum dentatum*). Associated shrubs with low abundance include sweet pepperbush (*Clethra alnifolia*) and spicebush (*Lindera benzoin*). Multiflora rose (*Rosa multiflora*) is an invasive shrub in some examples.

Characteristic vines with low abundance include poison ivy (*Toxicodendron radicans*), greenbrier (*Smilax rotundifolia*), and wild grapes (*Vitis* spp.).

Herb cover is typically sparse. Characteristic herbs include various sedges (*Carex* spp.), such as *C. crinita C. grayi C. lupulina,* and *C. tuckermanii.* Other characteristic herbs include ferns, such as cinnamon fern (*Osmunda cinnamomea*), royal fern (*Osmunda regalis*), marsh fern (*Thelypteris palustris*), netted chain fern (*Woodwardia areolata*). Associated herbs with low abundance include lady fern (*Athyrium filix-femina*), sweet woodreed (*Cinna arundinacea*), spinulose wood fern (*Dryopteris carthusiana*), soft rush (*Juncus effusus*), marsh seedbox (*Ludwigia palustris*), northern bugleweed (*Lycopus uniflorus*), and blunt-leaved sandwort (*Moehringia lateriflora*).

The unvegetated layer is dominated by leaf litter that typically covers about three-quarters of the swamp basin.

Swamp white oak dominated or codominated swamps on hilltops, or on steps in slopes, over bedrock rather than sandy soil are classified as perched swamp white oak swamps.

Rank: G3G4 S2 *Revised:* 2014

Examples: Saratoga Spa State Park, Saratoga County; North Fork Preserve, Suffolk County; Arshamomaque Wetland, Suffolk County.

Sources: NYNHP field surveys.

6. Silver maple-ash swamp: a hardwood basin swamp that typically occurs in poorly-drained depressions or along the borders of large lakes, and less frequently in poorly drained soils along rivers. These sites are characterized by uniformly wet conditions with minimal seasonal fluctuations in water levels.

The dominant trees are usually silver maple (*Acer saccharinum*) and green ash (*Fraxinus pennsylvanica*). American elm (*Ulmus americana*) is often present and probably was a codominant prior to the onset of Dutch elm disease and elm yellows. Other trees include black ash (*Fraxinus nigra*), white ash (*F. americana*), swamp white oak (*Quercus bicolor*), red maple (*Acer rubrum*), and occasionally the silver maple-red maple hybrid "Freeman's maple" (*Acer x freemanii*). The trunks of maples are typically single-trunked unlike those of floodplain forests with multiple trunks. Many of the canopy trees occur in the subcanopy along with American hornbeam (*Carpinus caroliniana*).

Characteristic shrubs include prickly ash (*Zanthoxylum americanum*), winterberry (*Ilex verticillata*), spicebush (*Lindera benzoin*), various shrubby dogwoods *(Cornus racemosa, C. amomum,* and *C. sericea*), various viburnums (*Viburnum dentatum* var. *lucidum, V. lentago,* and V. *nudum* var. *cassinoides*), speckled alder (*Alnus incana* ssp. *rugosa*), gooseberries (*Ribes* spp.), and sapling canopy trees. Characteristic vines include Virginia creeper (*Parthenocissus quinquefolia*) and poison ivy (*Toxicodendron radicans*).

Characteristic herbs include sensitive fern (*Onoclea sensibilis*), skunk cabbage (*Symplocarpus foetidus*), false nettle (*Boehmeria cylindrica*), wood-nettle (*Laportea canadensis*), cinnamon fern (*Osmunda cinnamomea*), royal fern (*O. regalis*), marsh fern (*Thelypteris palustris*), jewelweed (*Impatiens capensis*), manna grasses (*Glyceria striata, G. grandis*), and various sedges (*Carex lupulina, C. crinita, C. bromoides,* and *C. lacustris*). Other herbs in wetter examples include arrow arum (*Peltandra virginica*), arrowheads (*Sagittaria* spp.), wild calla (*Calla palustris*), cattail (*Typha latifolia*), tufted loosestrife (*Lysimachia thyrsiflora*), water smartweed (*Persicaria amphibia*), and duckweeds (*Lemna* spp.). A few examples are dominated by reed canary grass (*Phalaris arundinacea*) and/or lizard's tail (*Saururus cernuus*). A rare sedge of some silver maple-ash swamps is false hop sedge (*Carex lupuliformis*).

Silver maple-ash swamps are often underlain by calcareous bedrock and may contain a few calciphilic species, such as northern white cedar (*Thuja occidentalis*) and alder-leaf buckthorn (*Rhamnus alnifolia*). Most ash-elm dominated swamps with little or no maple are tentatively included here. Another variant tentatively called "maple-ash-oak swamp" with hydrophytic oaks (*Quercus bicolor, Q. palustris,* and *Q. macrocarpon*) is reported from western New York (P. Rutledge *pers. comm.*). More data on these variants are needed.

In central New York, silver maple-ash swamps may include areas that function as vernal pools that provide breeding habitat for amphibians, such as blue-spotted salamander (*Ambystoma laterale*) and

Jefferson's salamander (*Ambystoma jeffersonianum*) (N. Quenzar Jr. *pers. comm.*). A characteristic mammal is beaver (*Castor canadensis*). More data on characteristic fauna are needed.

Distribution: in lowlands of central and western New York in the Appalachian Plateau and Great Lakes Plain ecozones, the St. Lawrence and Lake Champlain Valley ecozones, and the northernmost part of the Central Hudson subzone of the Hudson Valley ecozone.

Rank: G4 S3 *Revised:* 2001

Examples: Kings Bay Wetlands, Clinton County; Beaver Creek Swamp, St. Lawrence County; Black Creek Swamp, Monroe County; Cicero Swamp, Onondaga County; Conesus Wetlands, Livingston County.

Sources: Huenneke 1982; NYNHP field surveys.

7. Vernal pool: an aquatic community of small, shallow depressions that are intermittently to ephemerally flooded. These small depressions typically occur within an upland forest, but may be surrounded by a narrow fringe of red maple-hardwood swamp that quickly transitions to upland forest. The pools generally lack trees, but are classified here as forested wetlands because of their position in the forested landscape. Vernal pools are typically flooded in spring or after a heavy rainfall, but usually dry during summer. Many vernal pools are filled again in autumn. The uppermost substrate is typically dense leaf litter over hydric soils. The leaf litter is the predominant source of food energy and organic matter in the pool, and derived from the surrounding forest (*i.e.,* these are allochthonous pools). The substrate under the leaf litter is known to vary from deep sands to loam to sandstone pavement. Vernal pools typically occupy a confined basin (*i.e.,* a standing waterbody without a flowing outlet), but may have an intermittent stream flowing out of it during high water. Several hydrologic types of vernal pools have been identified including marsh pools, floodplain basins, in-stream basins, and swamp pools (Barbour 1999). In this classification, these types are treated as embedded microhabitats within related communities (*e.g.,* shallow emergent marsh, floodplain forest, intermittent stream, and various swamp communities).

This community includes a diverse group of invertebrates and amphibians that depend upon temporary pools as breeding habitat. Since vernal pools cannot support fish populations, there is no threat of fish predation on amphibian eggs or invertebrate larvae. Characteristic vernal pool fauna include species of amphibians, reptiles, crustaceans, mollusks, annelids, and insects. Vernal pool species can be categorized as either *obligate* (species that depend upon vernal pool habitat for reproduction), or *facultative* (species that are often found in vernal pools, but are not dependent on them and can successfully reproduce elsewhere) (Commonwealth of Massachusetts, Division of Fisheries & Wildlife 2001, Colburn 1997, 2004).

Obligate vernal pool amphibians include spotted salamander (*Ambystoma maculatum*), blue-spotted salamander (*Ambystoma laterale*), Jefferson's salamander (*Ambystoma jeffersonianum*), marbled salamander (*Ambystoma opacum*) and wood frog (*Rana sylvatica*). Vernal pools on Long Island are important breeding habitat for tiger salamander (*Ambystoma tigrinum*). Fairy shrimp (Anostraca) are obligate vernal pool crustaceans, with *Eubranchipus* spp. being the most common.

Facultative vernal pool amphibians include four-toed salamander (*Hemidactylium scutatum*), red-spotted newt (*Notophthalmus viridescens*), northern spring peeper (*Pseudacris crucifer*), gray tree frog (*Hyla versicolor*), green frog (*Rana clamitans*), American toad (*Bufo americanus americanus*), and Fowler's toad (*Bufo woodhousii fowleri*). Facultative vernal pool reptiles include painted turtle (*Chrysemys picta*), spotted turtle (*Clemmys guttata*), and snapping turtle (*Chelydra serpentina*). Facultative vernal pool mollusks include freshwater fingernail clams (*Sphaerium* spp., *Musculium* spp.), pea clams (*Pisidium* spp.), and amphibious snails (*Physa* spp., *Lymnaea* spp., and *Helisoma* spp.). Facultative vernal pool insects include water scorpions (Nepidae, *Nepa* sp.), predacious diving beetles (Dytiscidae), whirligig beetles (Gyrinidae), dobsonflies (Corydalidae), caddisflies (Trichoptera), dragonflies (Anisoptera), damselflies (Zygoptera), mosquitoes (Culicidae), springtails (Collembola) and water striders (*Gerris* spp.). Leeches (Hirudinea) are a facultative vernal pool annelid.

Plants are predominantly hydrophytic, typically with a combination of obligate and facultative wetland species. Floating and submergent plants may be common, but emergent plants should be sparse or lacking. Characteristic vascular plants may include mannagrasses (*Glyceria* spp.), spikerush (*Eleocharis acicularis*), water purslane (*Ludwigia palustris*), naiad (*Najas* spp.), duckweed (*Lemna minor*), and water-hemlock (*Cicuta maculata*). Characteristic bryophytes may include *Brachythecium rivulare*, *Calliergon* spp., and peat mosses (*Sphagnum* spp.). Rare plants of some examples on the coastal plain and Hudson Highlands include featherfoil (*Hottonia inflata*) and false hop sedge (*Carex lupuliformis*) in the Hudson Valley. A few trees, such as red maple

(*Acer rubrum*), blackgum (*Nyssa sylvatica*), and swamp white oak (*Quercus bicolor*) may occur along the margin of some pools before transitioning to one of the upland forest communities.

Five to seven ecoregional variants (including Northern Appalachian, Great Lakes, Lower New England, Allegheny Plateau and North Atlantic Coast types) are suspected to differ in characteristic and dominant vascular plants, amphibians and invertebrates, as well as water chemistry, water temperature, substrate type, and surrounding forest type. More data on regional variants are needed.

Distribution: throughout New York State.

Rank: G4 S3S4 *Revised:* 2001

Examples: Urbana State Forest, Steuben County; Minnewaska State Park, Ulster County; Mohonk Preserve, Ulster County; Peebles Island State Park, Saratoga County; Muttontown Preserve, Nassau County; Saratoga National Historic Park, Saratoga County.

Sources: Barbour 1999; Colburn 1997, 2004; Commonwealth of Massachusetts, Division of Fisheries & Wildlife 2001; Huth and Smiley 1981; Swain and Kearsley 2000; Williams 2001; NYNHP field surveys.

8. Perched swamp white oak swamp: a hardwood to mixed swamp that occurs in shallow depressions located either on flat hillside steps or flat hilltops where the water table is locally perched above the surrounding groundwater level. The water level fluctuates seasonally; the swamp may be flooded in spring and nearly dry by late summer. The substrate ranges from poorly drained mineral soil to muck over bedrock.

The dominant tree is swamp white oak (*Quercus bicolor*), which may form a nearly pure, open canopy stand in areas that are permanently saturated along with red maple (*Acer rubrum*), green ash (*Fraxinus pennsylvanica*), and American elm (*Ulmus americana*). In better-drained areas and along the margin, where the soil is seasonally dry, trees more typical of upland habitat may be found, such as scarlet oak (*Quercus coccinea*), white oak (*Q. alba*), white pine (*Pinus strobus*), American beech (*Fagus grandifolia*), and pitch pine (*P. rigida*).

The understory is fairly open. Characteristic shrubs include saplings of canopy trees, with scattered ericaceous shrubs including black huckleberry (*Gaylussacia baccata*), highbush blueberry (*Vaccinium corymbosum*), lowbush blueberry (*V. angustifolium*), and pink azalea (*Rhododendron periclymenoides*). Other shrubs include winterberry (*Ilex verticillata*) and arrowwood (*Viburnum dentatum* var. *lucidum*). Poison ivy (*Toxicodendron radicans*) is a characteristic vine.

The groundcover may be sparse, with scattered patches of peat mosses (*Sphagnum* spp.) where the canopy cover is closed. In areas with an open canopy and wet soils, peat mosses may form extensive carpets. Characteristic herbs include marsh fern (*Thelypteris palustris*), cinnamon fern (*Osmunda cinnamomea*), royal fern (*O. regalis*), sensitive fern (*Onoclea sensibilis*), Tuckerman's sedge (*Carex tuckermanii*), Gray's sedge (*Carex grayi*), sedge (*Carex stipata*), woolgrass (*Scirpus cyperinus*), and mannagrass (*Glyceria striata*).

Swamp white oak dominated or codominated swamps on sandy soils that are underlain by a clay layer are classified red maple-swamp white oak swamps. Data on characteristic fauna are needed.

Distribution: not well known; reported from the Finger Lakes Highlands subzone of the Appalachian Plateau ecozone.

Rank: G3G4 S1S2 *Revised:* 2014

Examples: South Hill Swamp, Tompkins County; Blueberry Patch Swamp, Schuyler County.

Sources: Tufts 1976; NYNHP field surveys.

9. Hemlock-hardwood swamp: a mixed swamp that occurs on mineral soils and deep muck in depressions which receive groundwater discharge, typically in areas with acidic substrate. These swamps usually have a fairly closed canopy (70 to 90% cover), sparse shrub layer, and low species diversity.

The tree canopy is typically dominated by eastern hemlock (*Tsuga canadensis*), and codominated by yellow birch (*Betula alleghaniensis*) and red maple (*Acer rubrum*). Other less frequently occurring trees include white pine (*Pinus strobus*), blackgum (*Nyssa sylvatica*), and green ash (*Fraxinus pennsylvanica*).

Characteristic shrubs include saplings of canopy trees plus highbush blueberry (*Vaccinium corymbosum*) often dominant, with great rhododendron (*Rhododenron maximum*) and sweet pepperbush (*Clethra alnifolia*) becoming more common in Lower Hudson Valley examples. Other less frequently occurring shrubs include various viburnums (*Viburnum nudum* var. *cassinoides, V. lentago,* and *V. lantanoides*), winterberry (*Ilex verticillata*), and mountain holly (*Nemopanthus mucronatus*).

Characteristic herbs are cinnamon fern

(*Osmunda cinnamomea*) and sensitive fern (*Onoclea sensibilis*). Groundcover may also be fairly sparse. Other less frequently occurring herbs include sedges (*Carex trisperma, C. folliculata,* and *C. bromoides*), goldthread (*Coptis trifolia*), Canada mayflower (*Maianthemum canadense*), common wood-sorrel (*Oxalis montana*), foamflower (*Tiarella cordifolia*), and wild sarsaparilla (*Aralia nudicaulis*).

Peat mosses (*Sphagnum* spp.) may be dominant or characteristic bryophyte forming a thin carpet over muck, but typically not developing deep peat.

This is a common and widespread swamp community. Some occurrences are very small (1 to 2 acres or 0.4 to 0.8 ha). Water levels in these swamps typically fluctuate seasonally; they may be flooded in spring and relatively dry by late summer. See rich hemlock-hardwood peat swamp for example with greater peat development and abundance of mineral-rich indicator plants.

Distribution: throughout most of upstate New York, north of the Coastal Lowlands ecozone; probably absent from the Adirondacks High Peaks subzone.

Rank: G4G5 S4 *Revised:* 2001

Examples: Tamarack Swamp Town of Boylston, Oswego County; Pacama Vly, Ulster County; Bear Swamp Town of Sempronius, Cayuga County; Hariman State Park, Rockland County; Happy Valley Wildlife Management Area, Oswego County.

Sources: Bray 1915; McVaugh 1958; NYNHP field surveys.

10. Spruce-fir swamp: a conifer or sometimes mixed swamp that occurs on acidic muck to shallow peat. This community typically occurs in a drainage basin, in some cases filling the basin, but also can occur at the edge of a lake or pond, or along gentle slopes of islands where there is some nutrient input from groundwater discharge or subsurface flow. In the Adirondacks and the Tug Hill these swamps are often found in drainage basins occasionally flooded by beaver (*Castor canadensis*).

These swamps are usually dense, with a fairly closed canopy (80 to 90% cover). The dominant trees are usually red spruce (*Picea rubens*) and balsam fir (*Abies balsamea*); either one may be dominant in a stand or they may be codominant. In the Catskills, balsam fir may be absent with red maple (*Acer rubrum*) becoming codominant. In the Adirondacks, black spruce (*Picea mariana*) or white spruce (*P. glauca*) may replace red spruce as a dominant tree. Other trees with low percent cover include yellow birch (*Betula alleghaniensis*), white pine (*Pinus strobus*), black ash (*Fraxinus nigra*), tamarack (*Larix laricina*), northern white cedar (*Thuja occidentalis*), and eastern hemlock (*Tsuga canadensis*).

The shrub layer is often sparse; characteristic and dominant shrubs include mountain holly (*Nemopanthus mucronatus*) along with sapling canopy trees. Other less frequently occurring shrubs include alders (*Alnus viridis* ssp. *crispa, A. incana* ssp. *rugosa*), blueberries (*Vaccinium corymbosum, V. myrtilloides*), wild raisin (*Viburnum nudum* var. *cassinoides*), mountain ash (*Sorbus americana*), and winterberry (*Ilex verticillata*).

Characteristic herbs are cinnamon fern (*Osmunda cinnamomea*), sedges (*Carex trisperma, C. folliculata*), goldthread (*Coptis trifolia*), bunchberry (*Cornus canadensis*), starflower (*Trientalis borealis*), common wood-sorrel (*Oxalis montana*), creeping snowberry (*Gaultheria hispidula*), and dewdrop (*Dalibarda repens*).

The nonvascular layer is often dominated by peat mosses, including *Sphagnum girgensohnii, S. centrale,* and *S. angustifolium*. Other characteristic bryophytes include the leafy liverwort *Bazzania trilobata* and big red stem moss (*Pleurozium schreberi*).

Spruce-fir swamps occur in lowlands where they may grade into either spruce flats or balsam flats (upland forests). A spruce-fir swamp is distinguished from spruce flats by the lower elevation of the swamp, wetland soils, presence in the swamp of patches of peat mosses (*Sphagnum* spp.), and the absence of black cherry (*Prunus serotina*), a characteristic species of spruce flats and balsam flats.

Data on characteristic fauna are needed.

Distribution: mostly found in the Adirondacks, Tug Hill Plateau, and Catskills, but also in Rensselaer Hill section of the Taconic Highland ecozone and extending south into the Appalachian Plateau ecozone.

Rank: G3G4 S3 *Revised:* 2001

Examples: Black Pond Swamp, Franklin County; Marion River, Hamilton County; Blue Swamp, Lewis County; Page Swamp, Lewis County; Brandy Brook, Ulster County; Poesten Kill Headwaters, Rensselaer County; Mad River Swamp, Lewis County; Whetstone Creek Swamp, Lewis County.

Sources: Braun 1950; Zon 1914; NYNHP field surveys.

D. FORESTED PEATLANDS

This subsystem includes peatlands with at least 50% canopy cover of trees. Substrates range from coarse woody or fibrous peat to fine-grained marl and organic muck.

1. Inland Atlantic white cedar swamp: a conifer or mixed swamp that occurs on organic soils (usually peat) in poorly drained depressions and along pond edges in southeastern New York and northern New Jersey.

The characteristic tree is Atlantic white cedar (*Chamaecyparis thyoides*); the canopy cover of *Chamaecyparis* in these swamps is quite variable, ranging from nearly pure stands to as little as 30% of the canopy. In mixed stands the codominants are typically red maple (*Acer rubrum*), blackgum (*Nyssa sylvatica*), and eastern hemlock (*Tsuga canadensis*).

Characteristic small trees and shrubs are winterberry (*Ilex verticillata*), highbush blueberry (*Vaccinium corymbosum*), smooth winterberry (*Ilex laevigata*), rosebay (*Rhododendron maximum*), swamp azalea (*Rhododendron viscosum*), sweet pepperbush (*Clethra alnifolia*), mountain holly (*Nemopanthus mucronatus*), and red chokeberry (*Aronia arbutifolia*).

In a dense stand of *Chamaecyparis*, the groundcover is predominantly bryophytes, including several peat mosses (*Sphagnum* spp.), and at least one characteristic thalloid liverwort, *Pallavicinia lyellii*. In mixed stands with a more open canopy some characteristic herbs are cinnamon fern (*Osmunda cinnamomea*), interrupted fern (*O. claytoniana*), royal fern (*O. regalis*), skunk cabbage (*Symplocarpus foetidus*), wild calla (*Calla palustris*), and starflower (*Trientalis borealis*). Data on characteristic fauna are needed.

Distribution: known only from the Hudson Highlands ecozone, the Central Hudson subzone of the Hudson Valley ecozone, and the Mongaup Hills subzone of the Appalachian Plateau ecozone.

Rank: G2G3 S1 *Revised:* 2001

Examples: Little Cedar Bog, Orange County; Bellvale Mountain, Orange County.

Sources: Eyre 1980; Karlin 1997; Laderman 1989; Lynn 1984; NYNHP field surveys.

2. Coastal plain Atlantic white cedar swamp: a conifer or mixed swamp that occurs on organic soils along streams and in poorly drained depressions of the coastal plain of New England, Long Island, New Jersey, and southward.

Atlantic white cedar (*Chamaecyparis thyoides*) makes up over 50% of the canopy cover. In mixed stands in New York, red maple (*Acer rubrum*) is the codominant tree. Other less frequently occurring trees include blackgum (*Nyssa sylvatica*) and pitch pine (*Pinus rigida*) on higher hummock islands within the swamp.

Characteristic shrubs include canopy trees along with sweet pepperbush (*Clethra alnifolia*), highbush blueberry (*Vaccinium corymbosum*), swamp azalea (*Rhododendron viscosum*), inkberry (*Ilex glabra*), dangleberry (*Gaylussacia frondosa*), black huckleberry (*G. baccata*), sheep laurel (*Kalmia angustifolia*), and bayberry (*Myrica pensylvanica*), and black chokeberry (*Aronia melanocarpa*).

Characteristic herbs, typically found in sunny openings in the swamp, include cinnamon fern (*Osmunda cinnamomea*), marsh fern (*Thelypteris palustris*), wintergreen (*Gaultheria procumbens*), pitcher plant (*Sarracenia purpurea*), sundews (*Drosera intermedia, D. rotundifolia*), bladderworts (*Utricularia* spp.) marsh St. John's-wort (*Triadenum virginicum*), Virginia chain fern (*Woodwardia virginica*), and Walter's sedge (*Carex striata*). Massachusetts fern (*Thelypteris simulata*) and two sedges (*Carex atlantica, C. collinsii*) are characteristic of these swamps in New England; these species occur in New York but they have not recently been reported from New York *Chamaecyparis* swamps.

The bryophyte layer is dominated by several peat mosses (*Sphagnum* spp.).

A rare butterfly of some Atlantic white cedar swamps is Hessel's hairstreak (*Mitoura hesseli*), which feeds on Atlantic white cedar. Data on characteristic fauna are needed.

Distribution: restricted to the Coastal Lowlands ecozone.

Rank: G3G4 S1 *Revised:* 2001

Example: Cranberry Bog County Park, Suffolk County.

Sources: Bicknell 1908; Ehrenfeld & Schneider 1991; Eyre 1980; Laderman 1987; Laderman 1989; Motzkin *et al.* 1993; Motzkin 1991; Schroeder and Taras 1985; Zampella *et al.* 1999; NYNHP field surveys.

3. Red maple-tamarack peat swamp: a mixed swamp that occurs on organic soils (peat or muck) in poorly drained depressions. These swamps are often spring fed or enriched by seepage of minerotrophic

groundwater resulting in a stable water table and continually saturated soil. Soils are often rich in calcium.

The dominant trees are red maple (*Acer rubrum*) and tamarack (*Larix laricina*). These species usually form an open canopy (50 to 70% cover) with numerous small openings dominated by shrubs or sedges. Other less frequently occurring trees include black spruce (*Picea mariana*), white pine (*Pinus strobus*), black ash (*Fraxinus nigra*), American hornbeam (*Carpinus caroliniana*), and northern white cedar (*Thuja occidentalis*).

Characteristic shrubs are alders (*Alnus incana* ssp. *rugosa*, *A. serrulata*), winterberry (*Ilex verticillata*), various shrubby dogwoods, especially red osier dogwood (*Cornus sericea*), willows (*Salix* spp.), highbush blueberry (*Vaccinium corymbosum*), dwarf raspberry (*Rubus pubescens*), along with many rich shrub fen species such as swamp birch (*Betula pumila*), alder-leaf buckthorn (*Rhamnus alnifolia*), poison sumac (*Toxicodendron vernix*), swamp fly honeysuckle (*Lonicera oblongifolia*), and shrubby cinquefoil (*Dasiphora fruticosa* ssp. *floribunda*). Other less frequently occurring shrubs include black chokeberry (*Aronia melanocarpa*) and mountain holly (*Nemopanthus mucronatus*).

The herb layer is often very diverse and usually includes calcium-rich indicator species. Characteristic herbs include sedges (*Carex trisperma, C. interior, C. stricta, C. lacustris, C. leptalea*), royal fern (*Osmunda regalis*), cinnamon fern (*O. cinnamomea*), marsh fern (*Thelypteris palustris*), crested wood fern (*Dryopteris cristata*), skunk cabbage (*Symplocarpus foetidus*), purple avens (*Geum rivale*), marsh marigold (*Caltha palustris*), and water horehound (*Lycopus uniflorus*). Other less frequently occurring herbs include cattail (*Typha latifolia*), goldthread (*Coptis trifolia*), flat-topped white aster (*Doellingeria umbellata* var. *umbellata*), fowl manna grass (*Glyceria striata*), water horsetail (*Equisetum fluviatile*), buckbean (*Menyanthes trifoliata*), starflower (*Trientalis borealis*), goldenrods (*Solidago patula, S. uliginosa*), golden ragwort (*Packera aurea*), and marsh cinquefoil (*Comarum palustre*).

The bryophyte layer is dominated by several peat mosses, including *Sphagnum magellanicum, S. angustifolium,* and *S. subtile.*

Data on characteristic fauna are needed. These swamps are closely related to and often grade into rich shrub fens and rich graminoid fens.

Distribution: scattered throughout upstate New York, north of the Coastal Lowlands ecozone; most common in the Great Lakes and St Lawrence Valley ecozones.

Rank: G3G4 S2S3 *Revised:* 2001

Examples: Deer Creek Marsh, Oswego County; Pacama Vly, Ulster County; Perch River Swamp, Jefferson County; Lisbon Swamp, St. Lawrence County; Drowned Lands Swamp, Columbia County; Brennen Beach Fen, Oswego County.

Sources: McVaugh 1958; NYNHP field surveys.

4. Pitch pine-blueberry peat swamp: a conifer swamp that occurs in shallow depressions in sand plains where peat has accumulated over a poorly drained sandy soil. This soil has a horizon cemented by iron oxide (Ortstein layer); the cemented horizon impedes drainage, causing seasonal flooding.

The dominant tree is pitch pine (*Pinus rigida*). Gray birch (*Betula populifolia*) and red maple (*Acer rubrum*) are present at a low density. The canopy is open, with about 50 to 60 percent cover.

There is a dense shrub layer dominated by highbush blueberry (*Vaccinium corymbosum*), with small amounts of sheep laurel (*Kalmia angustifolia*), velvetleaf blueberry (*Vaccinium myrtilloides*), wild raisin (*Viburnum nudum* var. *cassinoides*), and black chokeberry (*Aronia melanocarpa*).

The groundcover is a hummocky carpet of peat mosses (*Sphagnum* spp.) with scattered herbs including wintergreen (*Gaultheria procumbens*), bracken fern (*Pteridium aquilinum* var. *latiusculum*), bunchberry (*Cornus canadensis*), Canada mayflower (*Maianthemum canadense*), swamp dewberry (*Rubus hispidus*), and bulrushes (*Schoenoplectus* spp.). More data on this community are needed.

Distribution: known only from the Erie-Ontario Plain subzone of the Great Lakes Plain ecozone. Examples were sought, but not found on Long Island (MacDonald and Edinger 2000). Communities with similar composition called "pitch pine lowlands" have been described from the New Jersey Pine Barrens (Robichaud and Anderson 1994, Breden et al. 2001).

Rank: G3? S1 *Revised:* 2001

Example: Huckleberry Swamp in the Rome Sand Plains, Oneida County.

Sources: Breden 1989; Leimanis 1993; MacDonald and Edinger 2000; NYNHP field surveys.

5. Northern white cedar swamp: a conifer or mixed swamp that occurs on organic soils in cool, poorly drained depressions in central and northern New

York, and along lakes and streams in the northern half of the state. These swamps are often spring fed or enriched by seepage of cold, minerotrophic groundwater, resulting in a stable water table and continually saturated soils. Soils are often rich in calcium. At some sites these soils have developed above a marl substrate.

The dominant tree is northern white cedar (*Thuja occidentalis*), which makes up more than 30% of the canopy cover. *Thuja* may form nearly pure stands, or it may be mixed with other conifers and hardwoods, including red maple (*Acer rubrum*), eastern hemlock (*Tsuga canadensis*), balsam fir (*Abies balsamea*), tamarack (*Larix laricina*), yellow birch (*Betula alleghaniensis*), white pine (*Pinus strobus*), spruces (*Picea mariana, P. rubens, P. glauca*), and black ash (*Fraxinus nigra*) which is a good indicator for this community when present.

The shrub layer is usually sparse; characteristic species are northern white cedar (*Thuja occidentalis*), dwarf raspberry (*Rubus pubescens*), red osier dogwood (*Cornus sericea*), swamp fly honeysuckle (*Lonicera oblongifolia*), speckled alder (*Alnus incana* ssp. *rugosa*), and highbush blueberry (*Vaccinium corymbosum*). The groundlayer is typically diverse, with many bryophytes and boreal herbs. There are typically many hummocks formed by decaying downed trees or tip-up mounds.

Characteristic herbs on the hummocks include sedges (*Carex leptalea, C. eburnea*), oak fern (*Gymnocarpium dryopteris*), goldthread (*Coptis trifolia*), starflower (*Trientalis borealis*), bunchberry (*Cornus canadensis*), miterwort (*Mitella nuda*), Canada mayflower (*Maianthemum canadense*), blue bead lily (*Clintonia borealis*), snowberry (*Gaultheria hispidula*), partridge berry (*Mitchella repens*), and dwarf scouring rush (*Equisetum scirpoides*) which is a good indicator for this community when present.

Characteristic herbs of hollows between the hummocks are the sedge *Carex intumescens*, sensitive fern (*Onoclea sensibilis*), marsh fern (*Thelypteris palustris*), cinnamon fern (*Osmunda cinnamomea*), royal fern (*O. regalis*), crested wood fern (*Dryopteris cristata*), showy lady's-slipper (*Cypripedium reginae*), yellow lady's-slipper (*Cypripedium parviflorum* var. *pubescens*), and golden ragwort (*Packera aurea*).

Characteristic bryophytes are several peat mosses (*Sphagnum* spp.), feather mosses such as stair-step moss (*Hylocomium splendens*) and knight's plume moss (*Ptilium crista-castrensis*), and leafy liverworts such as *Bazzania trilobata* and *Trichocolea tomentella*.

Characteristic birds with varying abundance include northern waterthrush (*Seiurus noveboracensis*), winter wren (*Troglodytes troglodytes*), white-throated sparrow (*Zonotrichia albicollis*), and golden-crowned kinglet (*Regulus satrapa*).

Flooding by beaver is common and the community may oscillate between a tall shrubland and forest over long cycles of beaver flooding and abandonment.

Distribution: scattered across upstate New York, extending north from the Appalachian Plateau ecozone.

Rank: G4 S2S3 *Revised:* 1990

Examples: Bergen Swamp, Genesee County; Toad Harbor Swamp, Oswego County; Marion River, Hamilton County; Carley Swamp, Lewis County; Dunham Bay Marsh, Warren County; Ninemile Swamp, Madison/Oneida Counties; Nelson Swamp, Madison County; Summit Lake Swamp, Otsego County.

Sources: Anderson and Leopold 2002; Seischab 1984; Shanks 1966; Sorenson and Engstrom *et al.* 1998; Sperduto and Engstrom 1998; NYNHP field surveys.

6. Rich hemlock-hardwood peat swamp: a mixed swamp that occurs on organic soils (peat or muck) in central New York in depressions or concave slopes which receive groundwater discharge, typically in areas where the groundwater flows through calcareous gravels of glacial deposits. These swamps usually have a fairly open canopy (50 to 70% cover), scattered shrubs, and a diverse groundlayer with sedges, mosses, and forbs.

The characteristic canopy trees are eastern hemlock (*Tsuga canadensis*), which usually has at least 20% cover, red maple (*Acer rubrum*), yellow birch (*Betula alleghaniensis*), black ash (*Fraxinus nigra*), tamarack (*Larix laricina*), white pine (*Pinus strobus*), smooth serviceberry (*Amelanchier laevis*), balsam fir (*Abies balsamea*), and northern white cedar (*Thuja occidentalis*). In any one swamp there may be very few (if any) stems of *Abies* or *Thuja*. If these trees are dominant, then see spruce-fir swamp or northern white cedar swamp descriptions for comparison. Less mineral-rich examples on more acidic muck or mineral soil are classified as hemlock-hardwood swamp.

In the Cayuga Lake area, some rich hemlock-hardwood peat swamps are locally known as "fir tree swamps," even if there are only a few balsam fir present, because these are the only places locally where native balsam fir can be found.

Characteristic shrubs and vines are alder-leaf buckthorn (*Rhamnus alnifolia*), highbush blueberry

(*Vaccinium corymbosum*), red osier dogwood (*Cornus sericea*), northern gooseberry (*Ribes hirtellum*), wild raisin (*Viburnum nudum* var. *cassinoides*), virgin's bower (*Clematis virginiana*), and dwarf raspberry (*Rubus pubescens*).

Characteristic herbs include sedges (*Carex bromoides*, *C. interior*, *C. scabrata*), manna grass (*Glyceria striata*), cinnamon fern (*Osmunda cinnamomea*), royal fern (*O. regalis*), sensitive fern (*Onoclea sensibilis*), marsh marigold (*Caltha palustris*), golden ragwort (*Packera aurea*), meadow-rue (*Thalictrum pubescens*), miterwort (*Mitella nuda*), starry Solomon's seal (*Maianthemum stellatum*), spreading goldenrod (*Solidago patula*), white hellebore (*Veratrum viride*), swamp thistle (*Cirsium muticum*), purple avens (*Geum rivale*), globeflower (*Trollius laxus* ssp. *laxus*), and swamp saxifrage (*Saxifraga pensylvanica*).

Characteristic mosses include peat mosses (*Sphagnum russowii, S. warnstorfii,* and *S. centrale*), *Aulacomnium palustre*, and *Campylium stellatum*. Data on characteristic fauna are needed.

Distribution: scattered throughout upsate New York, north of the Hudson Highlands; most common in the Central Appalachians and Finger Lake Highlands subzones of the Appalachian Plateau ecozone; very sparse in the Adirondacks ecozone.

Rank: G3G4 S2S3 *Revised:* 1990

Examples: Bear Swamp Sempronius, Cayuga County; Perkins Swamp, Chautauqua County; Alder Bottom Wetlands, Chautauqua County; Malloryville Swamp, Tompkins County; Michigan Hollow Swamp, Tompkins County; Brayton Marsh, Warren County.

Sources: Tufts 1976; NYNHP field surveys.

7. Black spruce-tamarack bog: a conifer forest or woodland that occurs on acidic peatlands in cool, poorly drained depressions.

The characteristic trees are black spruce (*Picea mariana*) and tamarack (*Larix laricina*); in any one stand, either tree may be dominant, or they may be codominant. Canopy cover is quite variable, ranging from open canopy woodlands with as little as 20% cover of evenly spaced canopy trees to closed canopy forests with 80 to 90% cover.

In the more open canopy stands there is usually a well-developed shrub layer characterized by several shrubs typical of bogs: leatherleaf (*Chamaedaphne calyculata*), sheep laurel (*Kalmia angustifolia*), highbush blueberry (*Vaccinium corymbosum*), Labrador tea (*Rhododendron groenlandicum*), mountain holly (*Nemopanthus mucronatus*), and wild raisin (*Viburnum nudum* var. *cassinoides*). In closed canopy stands the shrub layer is usually sparse; however the species composition is similar. The dominant groundcover consists of several peat mosses, including *Sphagnum fimbriatum, S. girgensohnii,* and *S. magellanicum*, with scattered sedges and forbs.

Characteristic herbs are the sedge *Carex trisperma*, cotton grass (*Eriophorum* spp.), pitcher plant (*Sarracenia purpurea*), bunchberry (*Cornus canadensis*), and cinnamon fern (*Osmunda cinnamomea*). In shady areas where the canopy is dense, goldthread (*Coptis trifolia*) and creeping snowberry (*Gaultheria hispidula*) may be found. Vascular plant diversity is usually low in these forested peatlands; however the bryophyte and epiphytic lichen flora may be relatively diverse.

Characteristic birds with varying abundance include purple finch (*Carpodacus purpureus*), blackpoll warbler (*Dendroica striata*), Nashville warbler (*Vermivora ruficapilla*), Lincoln's sparrow (*Melospiza lincolnii*), golden-crowned kinglet (*Regulus satrapa*), black-backed woodpecker (*Picoides arcticus*), white-throated sparrow (*Zonotrichia albicollis*), olive-sided flycatcher (*Contopus cooperi*), gray jay (*Perisoreus canadensis*), yellow palm warbler (*Dendroica palmatum hypochrysea*), and dark-eyed junco (*Junco hyemalis*). Rare birds of some black spruce-tamarack bogs include three-toed woodpecker (*Picoides tridactylus*) and spruce grouse (*Falcipennis canadensis*).

A black spruce-tamarack bog may grade into and form a mosaic with dwarf shrub bog, inland poor fen, and spruce-fir swamp. As the peat substrate thins and the wetland transitions to terrestrial communities, the black spruce-tamarack bog may grade into spruce flats.

Distribution: scattered throughout upstate New York; more common to the north in the Adirondacks ecozone.

*Rank:*G4G5 S3 *Revised:* 2001

Examples: Kildare Peatlands, Franklin and St. Lawrence Counties; Cicero Swamp, Oneida County; Massawepie Mire, St. Lawrence County; Bay Pond Bog, Franklin County; Spring Pond Bog, Franklin County; Sunday Swamp, Lewis County; Round Lake, Hamilton County; Rome Sand Plains, Oneida County.

Sources: Bray 1921; Shanks 1966; NYNHP field surveys.

C. PALUSTRINE CULTURAL

This subsystem includes communities that are either created and maintained by human activities, or are modified by human influence to such a degree that the physical conformation of the substrate, the hydrology, or the biological composition of the resident community is substantially different from the character of the substrate, hydrology, or community as it existed prior to human influence.

1. Reverted drained muckland: a wetland with muck soils that has been drained and cultivated (*e.g.*, for vegetable crops), and subsequently allowed to flood and thereby revert to a wetland.

Distribution: throughout upstate New York, north of the Coastal Lowlands ecozone.

Rank: unranked cultural *Revised:* 1990

2. Impounded marsh: a marsh (with less than 50% cover of trees) in which the water levels have been artificially manipulated or modified, often for the purpose of improving waterfowl habitat. Purple loosestrife (*Lythrum salicaria*) may become dominant when water levels are low. Vegetation often consists of species planted to improve waterfowl habitat, such as proso millet (*Panicum miliaceum*), foxtail millet (*Setaria italica*), sorghum (*Sorghum bicolor*), reed canary grass (*Phalaris arundinacea*), and buckwheat (*Fagopyrum esculentum*).

Distribution: throughout upstate New York, north of the Coastal Lowlands ecozone.

Rank: unranked cultural *Revised:* 1990

Source: Giles 1969.

3. Impounded swamp: a swamp (with at least 50% cover of trees) where the water levels have been artificially manipulated or modified, often for the purpose of improving waterfowl habitat. Red maple (*Acer rubrum*) is a characteristic tree. Often there are many standing dead tree trunks. Purple loosestrife (*Lythrum salicaria*) and duckweed (*Lemna minor*) may become dominant in the understory.

Distribution: throughout upstate New York, north of the Coastal Lowlands ecozone.

Rank: unranked cultural *Revised:* 1990

4. Common reed marsh: a marsh that has been disturbed by draining, filling, road salts, etc. in which European common reed (*Phragmites australis*) has become dominant. In extreme examples, common reed forms monotypic stands. This community is common along highways and railroads. Common reed marsh may form a mosaic with, or grade into, purple loosestrife marsh, or occur as a patch within other palustrine communities. Although remnant native plants may be present, the abundance of common reed makes it impossible to classify the marsh as one of the palustrine natural communities. See estuarine common reed marsh for tidal settings, and dredge spoil wetland for common reed in dredge spoil areas.

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 2004

5. Purple loosestrife marsh: a marsh that has been disturbed by draining, filling, road salts, etc. in which purple loosestrife (*Lythrum salicaria*) has become dominant. In extreme examples, purple loosestife forms monotypic stands. This community is common along highways and railroads. Purple loosestrife marsh may form a mosaic with, or grade into, European common reed (*Phragmites australis*) marsh, or occur as a patch within other palustrine communities. Although remnant native plants may be present, the abundance of purple loosestrife makes it impossible to classify the marsh as one of the palustrine natural communities. See impounded marsh for purple loosestrife in that setting.

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 2004

6. Dredge spoil wetland: a wetland in which the substrate consists of dredge spoils; European common reed (*Phragmites australis*) is a characteristic species. See common reed marsh for non-dredge spoil settings.

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 1990

7. Mine spoil wetland: a sparsely vegetated wetland in which the substrate consists of mine spoils.

Distribution: scattered throughout upstate New York, north of the Coastal Lowlands ecozone.

Rank: unranked cultural *Revised:* 1990

8. Water recharge basin: the aquatic community of a constructed depression near a road or development that receives runoff from paved surfaces and allows the water to percolate through to the groundwater, thereby recharging the groundwater. These basins are intermittently flooded during periods of heavy precipitation. On Long Island some of these are important as breeding habitat for amphibians such as tiger salamander (*Ambystoma tigrinum*).

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 1990

F. PALUSTRINE REFERENCES

Anderson, K. L. and D. J. Leopold. 2002. The role of canopy gaps in maintaining vascular plant diversity at a forested wetland in New York State. Journal of the Torrey Botanical Society 129(3):238-250.

Andrus, R. E. 1980. Sphagnaceae (Peat Moss Family) of New York State. Contributions to a Flora of New York State III. New York State Museum Bull. No. 422, Albany, NY.

Bailey, K. and B. L. Bedford. 1999. Response of fen vegetation to variation in hydrochemical inputs. Unpublished report. Dept. of Natural Resources, Cornell University, Ithaca, NY.

Barbour, S. 1999. Northern Shawangunks Vernal Pools Inventory. Final Report to the Shawangunk Biodiversity Partnership. Unpublished report. Eastern New York Chapter of The Nature Conservancy. Troy, NY.

Barrett, N. and R. Enser. 1997. Alluvial plant communities within the Wood-Pawcatuck major basin, Rhode Island. Unpublished report. Rhode Island Natural Heritage Program, Providence, R. I.

Bechtel, D. A. and D. D. Sperduto. 1998. Floodplain forest natural communities along major rivers in New Hampshire. Unpublished report submitted to the Environmental Protection Agency prepared by New Hamphire Natural Heritage Program, Concord, NH.

Bedford, B. L. 1999. Patterns in nutrient availability and plant diversity of temperate North American wetlands. Ecology. 80(7): 2151-2169.

Bedford, B. L. 2001. An obsession with fens. Central and Western New York Chapter Newsletter. Spring 2001: 3-4.

Bedford, B. L, D. J. Leopold, and D. Siegel. 1999. Conservation and management of New York fens: plant diversity, nutrient availability, and landscape controls. Mellon Proposal submitted to The Nature Conservancy. Ithaca, NY.

Bernard, J. M., F. K. Seischab, and H. G. Gauch, Jr. 1983. Gradient analysis of the vegetation of the Byron-Bergen Swamp, a rich fen in western New York. Vegetatio 53: 85-91.

Bicknell, E. P. 1908. The white cedar in western Long Island. Torreya 8(2):27-28.

Braun, E. L. 1950. Deciduous forests of Eastern North America. MacMillan Publ. Co. Inc., New York, NY.

Bray, W. L. 1915. The development of the vegetation of New York State. New York State Coll. of Forestry, Tech. Publ. No. 3, Syracuse, NY.

Bray, W. L. 1921. History of forest development on an undrained sand plain in the Adirondacks. New York State Coll. of Forestry, Tech. Publ. No. 13, Syracuse, NY.

Breden, T. F. 1989. A preliminary natural community classifcation for New Jersey. Natural Heritage Program, New Jersey Department of Environmental Protection, Division of Parks and Forestry, Office of Natural Lands Management, Trenton, NJ.

Breden, T.F., Y. Alger, K. Strakosch Walz, and A.G. Windisch. 2001. Classification of Vegetation Communities of New Jersey: Second Iteration. Association for Biodiversity Information and New Jersey Natural Heritage Program, Office of Natural Lands Management, Division of Parks and Forestry, NJ Department of Environmental Protection. Trenton, NJ.

Cain, S. A. and W. T. Penfound. 1939. Aceretum rubri: the red maple swamp forest of central Long Island. Am. Midl. Nat. 19: 390-416.

Catling, P. M. and S. M. McKay. 1981. A review of the occurrence of halophytes in the eastern Great Lakes region. Mich. Bot. 20: 167-179.

Colburn, E. A. 1997. A citizens step-by-step guide to protecting vernal pools. Seventh edition. Massachusetts Audubon Society, Lincoln, MA.

Colburn, E.A. 2004. Vernal Pools: Natural History and Conservation. The McDonald and Woodward Publishing Company, Blacksburg, VA.

Commonwealth of Massachusetts, Division of Fisheries & Wildlife. 2001. Guidelines for the certification of vernal pools: Vernal pool fact sheet. January 1, 2001. Commonwealth of Massachusetts, Division of Fisheries & Wildlife, Boston, MA.

Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. Office of Biological Services, Fish and Wildlife Service, US Dept. of Interior, Washington, DC

Crum, H. A. 1992. A Focus on Peatlands and Peat Mosses. The University of Michigan Press, Ann Arbor, MI.

Damman, A. W. H. and T. W. French. 1987. The ecology of peat bogs of the glaciated Northeastern United States: a community profile. US Fish and Wildlife Service. Biol. Rep. 85(7.16).

Driscoll, R. S., D. L. Merkel, D. L. Radloff, D. E. Snyder, and J. S. Hagihara. 1984. An ecological land classification framework for the United States. Miscellaneous Publ. 1439, US Dept. of Agriculture, Washington DC

Ehrenfeld, J. G. & J. P. Schneider 1991. *Chamaecyparis thyoides* wetlands and suburbanization: effects on hydrology, water quality and plant community composition. Journal of Applied Ecology. 28: 467-490.

Epstein E., E. Judziewicz, and E. Spencer. 2002. Recognized Natural Communities – Working Document. Wisconsin Natural Heritage Inventory, Madison, MI.
http://dnr.wi.gov/org/land/er/communities/pdfs/communities.pdf

Eyre, F. H., ed. 1980. Forest cover types of the United States and Canada. Society of American Foresters, Washington, DC

Faust, M. E. and N. R. Roberts. 1983. The salt plants of Onondaga Lake, Onondaga County, New York. Bartonia 49: 20-26.

Fike, J. 1999. Terrestrial & Palustrine Plant Communities of Pennsylvania. Pennsylvania Natural Diversity Inventory, Harrisburg, PA.

Giles, R. H., ed. 1969. Wildlife Management Techniques. The Wildlife Society, Washington, DC

Gilman, B. A. 1976. Wetland plant communities along the eastern shoreline of Lake Ontario. M. S. thesis, SUNY College of Environmental Science and Forestry, Syracuse, NY.

Godwin, K. S., J. P. Shallenberger, D. J. Leopold, and B. L. Beford. 2000. Linking landscape parameters to local hydrogeologic gradients and plant species occurrence in New York fens: A hydrogeologic setting (HGS) framework. Unpublished draft manuscript. December 20, 2000.

Golet, F. C., A. J. K. Calhoun, W. R. DeRagon. D. J. Lowry, and A. J. Gold. 1993. Ecology of red maple swamps in the glaciated Northeast: a community profile. US Fish and Wildlife Service. Biological Services Program FWS/OBS-84/09.

Goodwin, R. H. 1943. The flora of Mendon Ponds County Park. Proc. Rochester Acad. Science 8: 233-298.

Gordon, R. B. 1937. The primeval forest types of southwestern New York. NYS Mus. Bull. No. 321, Albany, NY.

Graham, H. W. and L. K. Henry. 1933. Plant succession at the borders of a kettlehole lake. Bull. Torrey Bot. Club 60: 301-315.

Greller, A. M. 1977. A classification of mature forests on Long Island, New York. Bull. Torrey Bot. Club 104: 376-382.

Harris, A. G., S. C. McMurray, P. W. C. Uhlig, J. K. Jeglum, R. F. Foster, and G. D. Racey. 1996. Field Guide to the Wetland Ecosystem Classification for Northwestern Ontario. Ont. Min. Natur. Resour., Northwest Sci. & Technol. Thunder Bay, Ontario. Field Guide FG-01.

Heinselman, M. L. 1970. Landscape evolution, peatland types, and the environment in the Lake Agassiz Peatlands Natural Area, Minnesota. Ecol. Monogr. 40: 235-261.

Hotchkiss, N. 1932. A botanical survey of the Tug Hill plateau. NYS Mus. Bull. No. 287, Albany, NY.

Huenneke, L. F. 1982. Wetland forests of Tompkins County, New York. Bull. Torrey Bot. Club 109: 51-63.

Hunsinger, K. C. 1999. A survey of the amphibians & reptiles of the Albany Pine Bush. M. S. Thesis submitted to the University at Albany, State University of New York, Albany, NY.

Huth, P. and D. Smiley. 1981. Shawangunk Vernal Pool Report. Daniel Smiley Research Center. Mohonk Preserve, Inc. New Paltz, NY.

Jeglum, J. K., A. N. Boissonneau, and V. F. Haavisto. 1974. Toward a wetland classification for Ontario. Information report O-X-215 for the Great Lakes Forest Research Centre, Sault Ste. Marie, Ontario.

Johnson, A. M. and D. J. Leopold. 1994. Vascular plant species richness and rarity across a minerotrophic gradient in wetlands of St. Lawrence County, New York, USA. Biodiversity Conserv. 3:606-627.

Johnson, A. F. 1985. A guide to the plant communities of the Napeague Dunes. Publ. by the author, Southampton, NY.

Johnson, C. W. 1985. Bogs of the northeast. University Press of New England, Hanover, N. H.

Karlin, E. F. 1997. The Drowned Lands' last stand: an inland Atlantic white cedar peat swamp in Orange County, New York. Journal of the Torrey Botanical Society 124(1):89-97.

Karlin, E. F. and R. E. Andrus. 1986. *Sphagnum* vegetation of the low-shrub bogs of northern New Jersey and adjacent New York. Bull. Torrey Bot. Club 113: 281-287.

Karlin E. F. and L. M. Lynn. 1988. Dwarf-shrub bogs of the southern Catskill Mountain region of New York State: geographic changes in the flora of peatlands in northern New Jersey and southern New York. Bull. Torrey Bot. Club 115: 209-217.

Kearsley, J. B. 1999. Inventory and vegetation classification of floodplain forest communities in Massachusetts. Rhodora 101:105-135.

Kost, M.A., D.A. Albert, J.G. Cohen, B.S. Slaughter, R.K. Schillo, C.R. Weber, and K.A. Chapman. 2007. Natural Communities of Michigan: Classification and Description. Michigan Natural Features Inventory, Report Number 2007-21, Lansing, MI. 314 pp.

Laderman, A. D., ed. 1987. Atlantic white cedar wetlands. Westview Press, Boulder, CO.

Laderman, A. D. 1989. The ecology of the Atlantic white cedar wetlands: a community profile. US Fish Wildlife Service. Biol. Rep. 85(7.21).

Leimanis, A. 1993. Vegetation and fire history of the Rome SandPlains. The Nature Conservancy Central and Western New York Chapter, Rochester, NY.

Leopold, D. J., J. P. Shallenberger, K. S. Godwin. 2000. Patterns of plant diversity in eastern North American fens. Unpublished draft manuscript. December 22, 2000.

Levine, E. (*editor*), 1998. Bull's birds of New York. Cornell University Press, Ithaca, NY.

Ludwig, J. C. 1995. An overview of sea-level fens. Unpublished report. Virginia Division of Natural Heritage, Richmond, VA.

Lynn, L. M. 1984. The vegetation of Little Cedar Bog, southeastern New York. Bull. Torrey Bot. Club 111: 90-95.

Lynn, L. M. and E. F. Karlin. 1985. The vegetation of the low-shrub bogs of northern New Jersey and adjacent New York: ecosystems at their southern limit. Bull. Torrey Bot. Club 112: 436-444.

MacDonald, D. and G. J. Edinger. 2000. Identification of reference wetlands on Long Island, New York. Final report for US Environmental Protection Agency. New York Natural Heritage Program, Latham, NY.

Massachusetts Natural Heritage & Endangered Species Program. 2001. Guidelines for the certification of vernal pool habitat: Fact sheet and certification criteria. Massachusetts Division of Fisheries and Wildlife, Westborough, MA.

McCormick, J. 1979. The vegetation of the New Jersey Pine Barrens. In Pine Barrens: Ecosystem and Landscape, Formann, R. T. T (ed.) Academic Press, NY.

McVaugh, R. 1958. Flora of Columbia County area, New York. NYS Mus. and Sci. Service, Bull. No. 360, Albany, NY.

Metzler, K. J. and A. W. H. Damman. 1985. Vegetation patterns in the Connecticut River flood plain in relation to frequency and duration of flooding. Le Naturaliste Canadien 112:535-547.

Metzler, K. J. and R. W. Tiner. 1992. Wetlands of Connecticut. Connecticut Geological & Natural History Survey, Report of Investigations No. 13. Department of Environmental Protection, Hartford, CT.

Motzkin, G. 1991. Atlantic white cedar wetlands of Massachusetts. Research Bulletin Number 731. Massachusetts Agricultural Experiment Station. Amherst, MA.

Motzkin, G., W. A. Patterson, and E. R. Drake. 1993. Fire history and vegetation dynamics of a *Chamaecyparis thyoides* wetland on Cape Cod, Massachusetts. Journal of Ecology 81:391-402.

Motzkin, G. 1994. Calcareous fens of western New England and adjacent New York State. Rhodora 96(885): 44-68.

Muenscher, W. C. 1927. *Spartina patens* and other saline plants in the Genesee Valley of western New York. Rhodora 29: 138-139.

Nichols, W. F., D. D. Sperduto, D. A. Bechtel, and K. F. Crowley. 2000. Floodplain forest natural communities along minor rivers and large streams in New Hampshire. New Hampshire Natural Heritage Inventory, Concord, NH.

Olivero, A. 2001. Classification and mapping of New York's calcareous fen communities. Unpublished report. New York Natural Heritage Program, Albany, NY.

Podniesinski, G. and J. Wagner. 2002. Classification, assessment and protection of forested floodplain wetlands of the Susquehanna drainage. Western Pennsylvania Conservancy, Pittsburgh, PA and The Nature Conservancy Pennsylvania Science Office, Middletown, PA.

Parker, D. 1946. Plant succession at Long Pond, Long Island, New York. Butler Univ. Bot. Studies 7:74-88.

Podniesinski, G. 1994. An ecological model for the fens of the Deer Creek Marsh complex. Unpublished report prepared for The Nature Conservancy. SUNY College of Environmental Science and Forestry, Syracuse, NY. April 28, 1994.

Reschke, C., B. Bedford, N. Slack, and F. R. Wesley. 1990. Fen Vegetation of New York State. A poster presented on July 31, 1990 at the Ecological Society of America Annual Meeting, Snowbird, Utah.

Robichaud-Collins, Beryl and Karl H. Anderson. 1994. Plant Communities of New Jersey: A study in landscape diversity. Rutgers University Press, New Brunswick, NJ.

Schneider, R. 1992. Examination of the role of hydrology and geochemistry in maintaining rare plant communities of coastal plain ponds. A final report to The Nature Conservancy. Dept. of Ecology & Systematics, Cornell University, Ithaca, NY.

Schneider, R. 1994. The role of hydrologic regime in maintaining rare plant communities of New York's coastal plain pondshores. Biological Conservation 68:253-260.

Schroeder, J. G. and M. A. Taras. 1985. Atlantic white cedar: an American wood. Forest Service Bulletin FS-225. United States Department of Agriculture. Washington, DC

Seischab, F. K. 1977. Plant community development in the Byron-Bergen Swamp: a rheotrophic mire in Genesee County, New York. Ph. D. thesis, SUNY College of Environmental Science and Forestry, Syracuse, NY.

Seischab, F. K. 1984. Plant community development in the Byron-Bergen Swamp: marl-bed vegetation. Can. J. Bot. 62: 1006-1017.

Seischab, F. K., and J. M. Bernard. 1985. Early plant succession on marl beds in the Byron-Bergen Swamp. Bartonia 51: 58-64.

Shanks, R. E. 1966. An ecological survey of the vegetation of Monroe County, New York. Proc. Rochester Acad. Sci. 11: 108-252.

Slack, N. G. 1994. Can one tell the mire type from the bryophytes alone? J. Hattori Bot. Lab. 75:149-159.

Sorenson, E., B. Engstrom, M. Lapin, R. Popp, and S. Parren. 1998. Northern white cedar swamps and red maple-northern white cedar swamps of Vermont: some sites of ecological significance. Vermont Nongame and Natural Heritage Program, Waterbury, VT.

Sorenson, E., M. Lapin, B. Engstrom, and R. Popp. 1998. Floodplain forests of Vermont: Some sites of ecological significance. Unpublished report submitted to the US Environmental Protection Agency, Vermont Nongame and Natural Heritage Program, Waterbury, VT.

Sperduto, D. D. 2000. A classification of wetland natural communities in New Hampshire. New Hampshire Natural Heritage Inventory, Concord, NH.

Sperduto, D. D. and B. Engstrom. 1998. Northern white cedar swamps of New Hampshire. New Hampshire Natural Heritage Inventory, Concord, NH.

Sperduto, D. D. and C. V. Cogbill. 1999. Alpine and subalpine vegetation of the White Mountains, New Hampshire. New Hampshire Natural Heritage Inventory, Concord, NH.

Sperduto, D. D. and W. F. Nichols. 2000. Exemplary bogs and fens of New Hampshire. New Hampshire Natural Heritage Inventory, Concord, NH.

Sperduto, D. D., W. F. Nichols, and N. Cleavitt. 2000. Bogs and fens of New Hampshire. New Hampshire Natural Heritage Inventory, Concord, NH.

Stevens, G. 1992. Assessment of wetland delineation of the Great Sweet-gum Swamp Site, Village of Scarsdale, NY. Unpublished report. Hudsonia Ltd., Annandale, NY.

Swain, P. C. and J. B. Kearsley. 2000. Classification of the Natural Communities of Massachusetts. Draft July 2000. Natural Heritage & Endangered Species Program, Massachusetts Division of Fisheries and Wildlife, Westborough, MA.

Thompson, E. H. and E. R. Sorensen. 2000. Wetland, woodland, wildland: A guide to the natural communities of Vermont. Vermont Department of Fish and Wildlife and The Nature Conservancy. University Press of New England, Hanover, NH.

Tiner, Ralph W., Jr. 1985. Wetlands of New Jersey. *In:* National wetlands inventory. US Department of the Interior, Fish and Wildlife Service, Newton Corner, MA:

Tufts, C. E. 1976. A preliminary inventory of some unique natural areas in Tompkins County, New York. M. S. thesis, Cornell Univ., Ithaca.

Veneman, P. L. M. and R. W. Tiner. 1990. Soil-vegetation correlations in the Connecticut River floodplain of western Massachusetts. Biological report 90(6). US Fish and Wildlife Service, Washington, DC

Walz, K. S., R. J. Canace, J. Boyle, R. Witte, M. S. Serfes, W. Honachefsky, J. Kurtz, and R. Dutko. 2001. Identification and protection of reference wetland natural communities in New Jersey: Calcareous sinkhole ponds of the Kittatinny Valley. New Jersey Department of Environmental Protection, Division of Parks and Forestry, Office of Natural Lands Management, Natural Heritage Program, Trenton, NJ.

Warner, B. G. and C. D. A. Rubec (eds.) 1997. The Canadian Wetland Classification. Second Edition. Wetlands Research Centre, University of Waterloo, Waterloo, Ontario, Canada.

Williams, D. D. 2001. The Ecology of Temporary Waters. The Blackburn Press, Caldwell, NJ.

Worley, I. A. 1982. The natural significance and protection priority of New York's largest open peatlands. Unpublished report of August 27, 1982 for the Adirondack Nature Conservancy. Botany Department, University of Vermont.

Zampella, R. A., K. J. Laidig, R. G. Lathrop, and J. A. Bognar. 1999. Size-class structure and hardwood recruitment in Atlantic white cedar swamps of the New Jersey pinelands. Journal of the Torrey Botanical Society 126(3):268-275.

Zaremba, R. and E. E. Lamont. 1993. The status of the coastal plain pondshore community in New York. Bull. Torrey Bot. Club 120:180-187.

Zon, R. 1914. Balsam fir. Bull US Dept. Agriculture No. 55: 1-68.

VI. TERRESTRIAL SYSTEM

The terrestrial system consists of upland habitats. These habitats have well-drained soils that are dry to mesic (never hydric), and vegetative cover that is never predominantly hydrophytic, even if the soil surface is occasionally or seasonally flooded or saturated. In other words, this is a broadly defined system that includes everything except aquatic, wetland, and subterranean communities.

A. OPEN UPLANDS

This subsystem includes upland communities with less than 25% canopy cover of trees; the dominant species in these communities are shrubs, herbs, or cryptogammic plants (mosses, lichens, etc.). Three distinctive physiognomic types are included in this subsystem. Grasslands include communities that are dominated by grasses and sedges; they may include scattered shrubs (never more than 50% cover of shrubs), and scattered trees (usually less than one tree per acre, or 3 trees per hectare). Meadows include communities with forbs, grasses, sedges, and shrubs codominant; they may include scattered trees. Shrublands include communities that are dominated by shrubs (more than 50% cover of shrubs); they may include scattered trees.

1. Sand beach: a sparsely vegetated community that occurs on unstable sandy shores of large freshwater lakes, where the shore is formed and continually modified by wave action and wind erosion.

Characteristic species usually present at very low percent cover include various grasses such as beachgrass (*Ammophila breviligulata*, *A. champlainensis*), freshwater cordgrass (*Spartina pectinata*), common hairgrass (*Avenella flexuosa*), Canada wild-rye (*Elymus canadensis*), reed canary-grass (*Phalaris arundinacea*), Pickering's reedgrass (*Calamagrostis pickeringii*), poverty-grass *(Danthonia spicata*), sand dropseed (*Sporobolus cryptandrus*), switch grass (*Panicum virgatum*) and other panic grasses (*Panicum* spp.). Other species present at low percent cover include common cocklebur (*Xanthium strumarium*), beach pea (*Lathyrus japonicus* var. *maritimus*), sea-rocket (*Cakile edentula* ssp. *lacustris*), silverweed (*Argentina anserina*), tall wormwood (*Artemisia campestris* ssp. *caudata*), cyperus (*Cyperus* spp., *C. dentatus*), beggar-ticks (*Bidens* spp.), and knotweeds (*Persicaria* spp.).

Sand beaches provide feeding areas for migratory birds and nesting habitat for shorebirds. Characteristic insects are tiger beetles (*Cicindela* spp.). Morte data on characteristic fauna are needed.

Distribution: throughout New York State.

Rank: G5 S3 *Revised:* 2001

Examples: Ausable Delta, Clinton County; Southwick Beach State Park, Jefferson County.

Sources: Bonanno 1998; NYNHP field surveys.

2. Great Lakes dunes: a community dominated by grasses and shrubs that occurs on active and stabilized sand dunes along the shores of the Great Lakes. The composition and structure of the community is variable depending on stability of the dunes, the amount of sand deposition and erosion, and distance from the lake. Unstable dunes are sparsely vegetated, whereas the vegetation of stable dunes is more dense, and can eventually become forested. Great Lake dunes can be divided into six physiographic zones: 1) beach (see sand beach), 2) foredune front, 3) foredune back and swale, 4) secondary dunes, 5) last lee face of high dune, and 6) last lee face of low dune. Each of these zones may develop any one to several vegetation associations or "community types" (Bonanno 1992). The species listed below are not necessarily restricted to a specific vegetation association. For example, beachgrass (*Ammophila breviligulata*, *A. champlainensis*) and riverbank grape (*Vitis riparia*) may occur in more than one of the listed associations, but their abundance will vary accordingly.

The first and largest vegetation association is dominated by beachgrass (*Ammophila breviligulata*, *A. champlainensis*) and tall wormwood (*Artemisia campestris* ssp. *caudata*). Other characteristic species with low percent cover include cottonwood (*Populus deltoides*), sand dune willow (*Salix cordata*), sand dropseed (*Sporobolus cryptandrus*), beach pea (*Lathyrus japonicus* var. *maritimus*), and riverbank grape (*Vitis riparia*). In more natural settings this association usually occurs on the more active parts of the beach, foredune, and swale zones.

The second association is dominated by poison ivy (*Toxicodendron radicans*), riverbank grape (*Vitis riparia*), and cottonwood (*Populus deltoides*). Other characteristic shrubs and vines with low percent cover include red osier dogwood (*Cornus sericea*), silky dogwood (*C. amomum*), sand cherry (*Prunus pumila* var. *pumila*), sand dune willow (*Salix cordata*), poison ivy (*Toxicodendron radicans*), and bittersweet (*Celastrus scandens*). Other characteristic herbs with low percent cover include beachgrass (*Ammophila breviligulata*, *A. champlainensis*), tall wormwood (*Artemisia campestris* ssp. *caudata*), Canada wild-rye (*Elymus canadensis*), spotted knapweed (*Centaurea stoebe* ssp. *micranthos*), starry

Solomon's seal (*Maianthemum stellata*), jointweed (*Polygonella articulata*), seaside spurge (*Euphorbia polygonifolia*), and common hairgrass (*Avenella flexuosa*). In more natural settings this association occurs mostly on the moderately stabilized dune crests and occasionally in swales and on secondary dunes. This association may be split out as a new community (*e.g.*, "Great Lakes dune shrubland") in future versions of this classification.

The third association is an open forest canopy dominated by red oak (*Quercus rubra*) and red maple (*Acer rubrum*). Other characteristic species of the forested dunes include sugar maple (*Acer saccharum*), striped maple (*Acer pensylvanicum*), serviceberries (*Amelanchier* spp.), American beech (*Fagus grandifolia*), black cherry (*Prunus serotina*), chokecherry (*Prunus virginiana*), blackberry (*Rubus allegheniensis*), red raspberry (*Rubus idaeus*), nannyberry (*Viburnum lentago*), arrowwood (*V. dentatum* var. *lucidum*), wild sarsaparilla (*Aralia nudicaulis*), and wreath goldenrod (*Solidago caesia*). In more natural settings this association occurs on very stabilized secondary dunes and the leeward side of the last high dune. This association may be split out as a new community (*e.g.,* "Great Lakes dune woodland") in future versions of this classification.

A fourth association dominated by speckled alder (*Alnus incana* ssp. *rugosa*) that is often found in wet dune swales is tentatively included under shrub swamp. Palustrine "Great Lakes interdunal swales" have been reported in Oswego County in the vicinity of Lakeview Wildlife Management Area (J. Herter *pers. comm.*). More data are needed in order to describe and confirm this type in New York. More data on the physiognomic variants of this community are needed.

Distribution: primarily on the eastern shore of Lake Ontario, in the Eastern Ontario Plain subzone of the Great Lakes Plain ecozone, but also on Lake Erie and Lake Champlain.

Rank: G3G4 S1S2 *Revised:* 2001

Examples: Southwick Beach, Jefferson County; El Dorado Beach, Jefferson County; Lakeview Wildlife Management Area, Jefferson County; Deer Creek Dunes, Oswego County.

Sources: Bonanno 1992, Bonanno *et al.* 1998; NYNHP field surveys.

3. Maritime beach: a community with extremely sparse vegetation that occurs on unstable sand, gravel, or cobble ocean shores above mean high tide, where the shore is modified by storm waves and wind erosion. The upper margin of a maritime beach often grades into the base of a primary maritime dune, or other maritime community, such as maritime shrubland or one of the maritime forests.

Characteristic species include beachgrass (*Ammophila breviligulata*), sea-rocket (*Cakile edentula* ssp. *edentula*), seaside atriplex (*Atriplex patula*), seabeach atriplex (*A. arenaria*), seabeach sandwort (*Honckenya peploides*), salsola (*Salsola kali*), seaside spurge (*Chamaesyce polygonifolia*), seabeach knotweed (*Polygonum glaucum*), and seabeach amaranth (*Amaranthus pumilus*)

Maritime beaches and dunes provide important nesting habitat for birds such as piping plover (*Charadrius melodus*), least tern (*Sterna antillarum*), and common tern (*S. hirundo*).

Distribution: along the seacoast of the Coastal Lowlands ecozone.

Rank: G5 S3S4 *Revised:* 1990

Examples: Fire Island National Seashore, Suffolk County; Napeague Beach, Suffolk County; Orient Beach, Suffolk County.

Sources: Art 1976; Johnson 1985; NYNHP field surveys.

4. Maritime dunes: a community dominated by grasses and low shrubs that occurs on active and stabilized dunes along the Atlantic coast. This community consists of a mosaic of vegetation patches. This mosaic reflects past natural disturbances such as sand deposition, erosion, and dune migration. The composition and structure of the vegetation is variable depending on stability of the dunes, amounts of sand deposition and erosion, and distance from the ocean.

Characteristic species of the active dunes, where sand movement is greastest, include beachgrass (*Ammophila breviligulata*), dusty-miller (*Artemisia stelleriana*), beach pea (*Lathyrus japonicus* var. *maritimus*), sedge (*Carex silicea*), seaside goldenrod (*Solidago sempervirens*), and sand-rose (*Rosa rugosa*).

Characteristic species of stabilized dunes include beach heather (*Hudsonia tomentosa*), bearberry (*Arctostaphylos uva-ursi*), beachgrass (*Ammophila breviligulata*), cyperus (*Cyperus polystachyos* var. *macrostachyus*), seaside goldenrod, beach pinweed (*Lechea maritima*), jointweed (*Polygonella articulata*), common evening-primrose (*Oenothera biennis*), sand-rose (*Rosa rugosa*), bayberry (*Myrica pensylvanica*), beach-plum (*Prunus maritima*), poison ivy (*Toxicodendron radicans*), and the lichens

Cladonia submitis and *Cetraria arenaria*. Shrubs are typically under 1 m tall. Extensive taller shrub areas may be better classified as maritime shrubland.

Seabeach amaranth (*Amaranthus pumilus*) is a federally threatened plant that is found on open sand at the base of the foredune of some maritime dunes. A few stunted pitch pines (*Pinus rigida*) or post oaks (*Quercus stellata*) may be present in the dunes.

Maritime dunes and beaches provide important nesting habitat for birds such as piping plover (*Charadrius melodus*), least tern (*Sterna antillarum*), and common tern (*S. hirundo*).

Distribution: along the seacoast of the Coastal Lowlands ecozone.

Rank: G4 S3 *Revised:* 2001

Examples: Napeague Dunes, Suffolk County; Fire Island National Seashore, Suffolk County.

Sources: Andrle and Carroll 1988; Art 1976; Hancock 1995; Johnson 1985; Leatherman 1979; Robichaud-Collins and Anderson 1994; Zaremba 1990; NYNHP field surveys.

5. Maritime shrubland: a shrubland community that occurs on dry seaside bluffs and sheltered back dunes that are exposed to onshore winds and salt spray. This community typically occurs as a tall shrubland (2-3 m), but may include areas with shrub canopy from 1 to 5 m tall. The community typically occurs on very gently rolling topography and may include moist shallow depressions. These low areas may imperceptibly grade into shrub swamp if soils are sufficiently wet. Trees are usually sparse or absent (ideally less than 25% cover).

Characteristic shrubs and sapling trees include serviceberry (*Amelanchier canadensis*), bayberry (*Myrica pensylvanica*), black cherry (*Prunus serotina*), southern arrowwood (*Viburnum dentatum* var. *venosum*), and shining sumac (*Rhus copallinum*). Other shrubs and stunted trees include beach-plum (*Prunus maritima*), sand-rose (*Rosa rugosa*), wild rose (*R. virginiana*), eastern red cedar (*Juniperus virginiana*), American holly (*Ilex opaca*), black oak (*Quercus velutina*), and sassafras (*Sassafras albidum*). Small amounts of highbush blueberry (*Vaccinium corymbosum*), sweet pepperbush (*Clethra alnifolia*), red maple (*Acer rubrum*), and black chokeberry (*Aronia melanocarpa*) are found in moister low areas, often grading to small patches of shrub swamp. Morrow's honeysuckle (*Lonicera morrowii*) is a common invasive shrub in this community

Characteristic vines include poison ivy (*Toxicodendron radicans*), Virginia creeper (*Parthenocissus quiquefolia*), and common greenbrier (*Smilax rotundifolia*). Oriental bittersweet (*Celastrus orbiculatus*) and Japanese honeysuckle (*Lonicera japonica*) are common invasive vines in this community.

The herb layer is very sparse and may contain a few scatttered grass-leaved goldenrod (*Euthamia graminifolia*), wild indigo (*Baptisia tinctoria*), white-topped aster (*Sericocarpus asteroides*), and little bluestem (*Schizachyrium scoparium*).

Maritime shublands may form a patchy mosaic and grade into other maritime communities. For example, if trees become more prevalent it may grade into one of the maritime forest communities, such as successional maritime forest. If a severe storm reduces shrub cover and deposits sand into the community it may be converted to a maritime dune. This community shares many shrub species with maritime dunes, but typically lacks the maritime dune herb species and has very little bare substrate visible between shrubs. More data on possible landscape variants are needed (*e.g.*, maritime shrublands on morainal headland vs. outwash barrier dune).

Characteristic birds with varying abundance include include black-crowned night-heron (*Nycticorax nycticorax*), fish crow (*Corvus ossifragus*), and migratory songbirds (especially in fall) (Levine 1998).

Distribution: along the seacoast of the Coastal Lowlands ecozone.

Rank: G4 S4 *Revised:* 2001

Examples: Montauk Point, Suffolk County; Fire Island, Suffolk County.

Sources: Clark 1986; Levine 1998; Robichaud-Collins and Anderson 1994; Taylor 1923; Thompson 1997; NYNHP field surveys.

6. Maritime heathland: a dwarf shrubland community that occurs on rolling outwash plains and moraine of the glaciated portion of the coastal plain, near the ocean and within the influence of onshore winds and salt spray. Typical examples of this community are dominated by low heath or heath-like shrubs that collectively have greater than 50% cover. A few examples may be sparsely vegetated by the same heath shrubs. This community intergrades with maritime grassland, and the two communities may occur together in a mosaic.

Characteristic shrubs include bearberry (*Arctostaphylos uva-ursi*), beach heather (*Hudsonia tomentosa*), lowbush blueberry (*Vaccinium*

angustifolium), black huckleberry (*Gaylussacia baccata*), bayberry (*Myrica pensylvanica*), and beach-plum (*Prunus maritima*). Golden heather (*Hudsonia ericoides*) may be a possible indicator for this community when present (R. Zaremba *pers. comm.*).

Grasses and forbs are present, but they do not form a turf; characteristic species include common hairgrass (*Avenella flexuosa*), little bluestem (*Schizachyrium scoparium*), Pennsylvania sedge (*Carex pensylvancica*), rush (*Juncus greenei*), bushy aster (*Symphyotrichum dumosum*), stiff-leaf aster (*Ionactis linariifolius*), flax-leaf white-topped aster (*Sericocarpus linifolius*), bushy rockrose (*Helianthemum dumosum*), and New England blazing star (*Liatris scariosa* var. *novae-angliae*).

More data are needed to clearly separate this community from interdunal areas dominated by beach heather (*Hudsonia tomentosa*) and bearberry (*Arctostaphylos uva-ursi*) that are classified as maritime dunes. A characteristic bird in winter is the yellow-rumped warbler (*Dendroica coronata*).

Distribution: along the seacoast of the Coastal Lowlands ecozone, in eastern Long Island.

Rank: G3 S1 *Revised:* 1990

Examples: Montauk Mountain, Suffolk County; East Hampton Heathland, Suffolk County; Napeague Dunes, Suffolk County.

Sources: Dunwiddie *et al.* 1996; Thompson 1997; NYNHP field surveys.

7. Maritime grassland: a grassland community that occurs on rolling outwash plains of the glaciated portion of the coastal plain, near the ocean and within the influence of offshore winds and salt spray. This community is dominated by grasses that usually form a turf; the grasses collectively have greater than 50% cover. Low heath shrubs may be present, with less than 50% cover.

The dominant grasses are little bluestem (*Schizachyrium scoparium*), common hairgrass (*Avenella flexuosa*), and poverty-grass (*Danthonia spicata*).

Other characteristic species include Pennsylvania sedge (*Carex pensylvanica*), rush (*Juncus greenei*), Indian grass (*Sorghastrum nutans*), Atlantic golden aster (*Pityopsis falcata*), bushy rockrose (*Helianthemum dumosum*), hoary frostweed (*H. propinquum*), grass-leaved goldenrod (*Euthamia graminifolia*), white-topped aster (*Sericocarpus asteroides*), pussy's-toes (*Antennaria plantaginifolia*), bitter milkwort (*Polygala polygama*), hyssop-leaved boneset (*Eupatorium hyssopifolium*), bayberry (*Myrica pensylvanica*), shining sumac (*Rhus copallinum*), and northern dewberry (*Rubus flagellaris*). A rare plant of some maritime grasslands is New England blazing star (*Liatris scariosa* var. *novae-angliae*) (T. Weldy *pers. comm.*). A characteristic lichen is reindeer lichen (*Cladonia rangiferina*).

Distribution: along the seacoast of the Coastal Lowlands ecozone, in eastern Long Island.

Rank: G2 S1 *Revised:* 1990

Examples: Conscience Point, Suffolk County; Shinnecock Hills, Suffolk County; Sayville Grasslands, Suffolk County.

Sources: Taylor 1923; Dunwiddie *et al.* 1996; Thompson 1997; NYNHP field surveys.

8. Hempstead Plains grassland: a tall grassland community that occurs on rolling outwash plains in west-central Long Island. This community occurs inland, beyond the influence of offshore winds and salt spray. Historically this community covered about approximately 38,000 acres (15,400 ha) of western Long Island; less than 30 acres (12 ha) remain today, and most of these are severely degraded.

This community was dominated by species characteristic of midwestern tallgrass prairie: big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), Indian grass (*Sorghastrum nutans*), and switchgrass (*Panicum virgatum*). These species are present in today's remnants, but they are not always dominant.

Other characteristic species that still occur in this community include rush (*Juncus greenei*), wild indigo (*Baptisia tinctoria*), Canada cinquefoil (*Potentilla canadensis*), gray goldenrod (*Solidago nemoralis*), early goldenrod (*Solidago juncea*), butterfly-weed (*Asclepias tuberosa*), stargrass (*Hypoxis hirsuta*), fringed violet (*Viola sagittata*), bird's-foot violet (*V. pedata*), stiff-leaf aster (*Ionactis linariifolius*), hyssop-leaved boneset (*Eupatorium hyssopifolium*), and northern dewberry (*Rubus flagellaris*).

Characteristic birds with varying abundance include vesper sparrow (*Pooecetes gramineus*), savannah sparrow (*Passerculus sandwichensis*), grasshopper sparrow (*Ammodramus savannarum*), and bobolink (*Dolichonyx oryzivorus*).

Distribution: known only from the Coastal Lowlands ecozone, in western Long Island.

Rank: G1Q S1 *Revised:* 1990

Example: Mitchel Field, Nassau County.

Sources: Cain *et al.* 1937; Harper 1911, 1912; Seyfert 1973; NYNHP field surveys.

9. Riverside ice meadow: a meadow community that occurs on gently sloping cobble shores and rock outcrops along large rivers in areas where winter ice floes are pushed up onto the shore, forming an ice pack that remains until late spring. The ice scours the meadow, cutting back woody plants. The late-melting ice pack, which is up to 2.4 m (8 ft) deep in late April or early May (in the southern Adirondacks), creates a cool microclimate in late spring, and shortens the growing season. The ice pack deposits organic matter that has accumulated in the ice during the winter, apparently enriching the sandy soils of the cobble and rocky shores. Within this community there is a gradient of two to three vegetation zones that vary with elevation above the river and soil moisture.

Along the river there is often a narrow zone of seepy, wet meadow; characteristic species of this riverside seep include sweet-gale (*Myrica gale*), twig-rush (*Cladium mariscoides*), Canadian burnet (*Sanguisorba canadensis*), heartleaf willow (*Salix eriocephala*), silky dogwood (*Cornus amomum*), three-way sedge (*Dulichium arundinaceum*), slender spikerush (*Eleocharis elliptica* var. *elliptica*), beakrush (*Rhynchospora capitellata*), large cranberry (*Vaccinium macrocarpon*), Kalm's lobelia (*Lobelia kalmii*), false asphodel (*Tofieldia glutinosa*), and rose pogonia (*Pogonia ophioglossoides*).

Where the cobble shores are broad and the soil is coarse and dry, there is a zone of grassy meadow. The meadow is dominanted by widely scattered clump-forming grasses, such as big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), and Indian grass (*Sorghastrum nutans*); in at least one location, nutrush (*Scleria triglomerata*) is codominant. Characteristic species of the dry meadow include sweet-fern (*Comptonia peregrina*), woodland sunflower (*Helianthus divaricatus*), meadow-sweet (*Spiraea alba* var. *latifolia*), sand-cherry (*Prunus pumila* var. *depressa*), butterfly-weed (*Asclepias tuberosa*), wild rose (*Rosa virginiana*), frostweed (*Helianthemum canadense*), and bush-clover (*Lespedeza capitata*).

Farthest from the river there may be a shrubby zone that includes some tree saplings and seedlings. Characteristic species of the shrubby zone include hazelnut (*Corylus americana*), virgin's-bower (*Clematis virginiana*), bush honeysuckle (*Diervilla lonicera*), ostrich fern (*Matteuccia struthiopteris*), interrupted fern (*Osmunda claytoniana*), red raspberry (*Rubus idaeus*), deer-tongue grass (*Panicum clandestinum*), and flat-topped white aster (*Doellingeria umbellata* var. *umbellata*). Data on characteristic fauna are needed.

Similar grasslands on other rivers in the state, such as the Delaware River and Hudson River, that lack the seepy wet meadow and shrubby zones and are more densely vegetated by tall grasses are classified as floodplain grasslands.

Distribution: along upper reaches of large rivers, reported from the Hudson River in the Adirondacks ecozone, and St. Regis River in the St. Lawrence Plains subzone.

Rank: G2G3 S1 *Revised:* 2014

Examples: South of The Glen, Warren County; Sacandaga River Hope, Hamilton County.

Source: NYNHP field surveys.

10. Floodplain grassland: a somewhat densely vegetated, tall grassland community that occurs on the floodplains along the upper reaches of larger confined rivers. This community occurs on relatively stable sand/gravel or cobble substrate that is often visible between the clump forming grasses. These floodplain shores and islands are typically broad and the soil is coarse and dry. These grasslands are subject to flooding and ice scour, but ice floes usually do not persist into spring as in riverside ice meadows.

The dominant grasses are big bluestem (*Andropogon gerardii*), Indian grass (*Sorghastrum nutans*), and switch grass (*Panicum virgatum*). Other grasses with lower percent cover include little bluestem (*Schizachyrium scoparium*), reed canary grass (*Phalaris arundinacea*), deer tongue grass (*Dichanthelium clandestinum*), and freshwater cordgrass (*Spartina pectinata*). By late summer these grasses usually cover from 30% to ideally 50% or more of this community. Other characteristic herbs include goldenrods (*Solidago juncea, S. gigantea, S. rugosa, S. canadensis, S. nemoralis, Euthamia graminifolia*), false indigo (*Baptisia tinctoria*), marsh fern (*Thelypteris palustris*), frostweed (*Helianthemum canadense*), bushclover (*Lespedeza capitata*), starry Solomon's-seal (*Maianthemum stellatum*), American germander (*Teucrium canadense*), spreading dogbane (*Apocynum androsaemifolium*), St. John's-wort (*Hypericum mutilum*), butterflyweed (*Asclepias tuberosa*), hairy-fruited sedge (*Carex trichocarpa*), giant St. John's-wort (*Hypericum ascyron*), and wool grass (*Scirpus cyperinus*).

Scattered young trees and shrubs may be present at low percent cover, including cottonwood (*Populus deltoids*), sycamore (*Platanus occidentalis*), gray dogwood (*Cornus foemina*), river birch (*Betula nigra*), indigo bush (*Amorpha fruticosa*), scrub oak (*Quercus ilicifolia*), pasture rose (*Rosa carolina*), sand cherry (*Prunus pumila* var. *depressa*), low bush blueberries (*Vaccinium pallidum. V. angustifolium*), black huckleberry (*Gaylussacia baccata*), black locust (*Robinia pseudoacacia*), ninebark (*Physocarpus opulifolius*), meadowsweet (*Spiraea alba* var. *latifolia*), and staggerbush (*Lyonia ligustrina*). This association dominated by woody plants may be split out as a new community (*e.g.*, "floodplain shrubland") in future versions of this classification.

Vines that may be present in the groundlayer include poison ivy (*Toxicodendron radicans*) and Virginia creeper (*Parthenocissus quinquefolia*).

Non-native invasive plants that may be found in this community include Japanese knotweed (*Fallopia japonica*), knapweed (*Centaurea stoebe* ssp. *micranthos*), and Cypress spurge (*Euphorpia cyparissias*).

Distribution: occurs as discontinuous patches along the upper reaches of large rivers throughout upstate New York, north of the Coastal Lowland ecozone.

Rank: G3G4 S3 *Revised:* 2014

Examples: Upper Delaware River (Cherry Island), Sullivan/Delaware Counties; Hudson River (Peebles Island), Albany/Saratoga Counties; Neversink River (Cuddebackville Dam), Orange County; Lower Shawangunk Kill, Ulster County.

Sources: Fike 1999; NYNHP field surveys.

11. Riverside sand/gravel bar: a meadow community that occurs on sand and gravel bars deposited within, or adjacent to, a river channel. The community may be very sparsely vegetated, depending on the rates of deposition and erosion of the sand or gravel. Flood events may remove sand and gravel layers converting patches to cobble shore.

Characteristic species include sandbar willow (*Salix exigua*), sand-cherry (*Prunus pumila*), dogbane (*Apocynum cannabinum*), switchgrass (*Panicum virgatum*), and poison ivy (*Toxicodendron radicans*). Japanese knotweed (*Fallopia japonica*) may become invasive on riverside sand/gravel bars.

More data on this community are needed.

Distribution: throughout New York State.

Rank: G5 S3S4 *Revised:* 2004

Examples: Ausable River, Clinton County; Deer River Gorge, Lewis County; Upper Schroon River, Essex County; Cattaraugus Creek, Cattaragus and Erie Counties.

Source: NYNHP field surveys.

12. Shoreline outcrop: a community that occurs along the shores of lakes and streams on outcrops of non-calcareous rocks such as anorthosite, granite, quartzite, sandstone, gneiss, or schist. The shoreline is exposed to wave action and ice scour. The vegetation is sparse; most plants are rooted in rock crevices.

Characteristic species include lowbush blueberries (*Vaccinium angustifolium, V. pallidum*), black huckleberry (*Gaylussacia baccata*), poverty-grass (*Danthonia spicata*), and common hairgrass (*Avenella flexuosa*). Crustose and foliose lichens may be common on the rocks. More data on this community are needed.

Distribution: throughout upstate New York, north of the Coastal Lowlands ecozone.

Rank: G5 S3S4 *Revised:* 2001

Examples: Lake Lila, Hamilton County; Twin Hill, Essex County.

Source: NYNHP field surveys.

13. Calcareous shoreline outcrop: a community that occurs along the shores of lakes and streams on outcrops of calcareous rocks such as limestone and dolomite. The vegetation is sparse, most plants are rooted in rock crevices. Mosses and lichens may be common on the rocks.

Characteristic species include wild columbine (*Aquilegia canadensis*), sedges (*Carex eburnea, C. granularis*), silky dogwood (*Cornus amomum*), red osier dogwood (*Cornus sericea*), and meadow-rue (*Thalictrum* spp.). Characteristic bryophytes include *Tortella tortuosa* and *Syntrichia ruralis*. More data on this community are needed.

Distribution: throughout upstate New York north of the Coastal Lowlands ecozone, at sites where the bedrock is calcareous.

Rank: G3G4 S2 *Revised:* 1990

Examples: Valcour Island, Clinton County; Hudson

River Gorge, Essex and Hamilton Counties.

Source: NYNHP field surveys.

14. Cobble shore: a community that occurs on the well-drained cobble shores of lakes and streams. These shores are usually associated with high-energy waters (such as high-gradient streams), and they are likely to be scoured by floods or winter ice floes. This community includes both active and stable shores. Active cobble shores have loose cobbles that are moved by waves or river currents; these shores are sparsely vegetated, and they have comparatively few species. Stable cobble shores have cobbles embedded in sand or peat, usually with vegetation rooted between the cobbles, and are generally more diverse than active cobble shores. Flood events may deposit thick layers of sand and gravel converting patches to riverside sand/gravel bar.

Characteristic species include Indian grass (*Sorghastrum nutans*), big bluestem (*Andropogon gerardii*), dogbane (*Apocynum androsaemifolium*), deer-tongue grass (*Panicum clandestinum*), grass-leaved goldenrod (*Euthamia graminifolia*), beggar-ticks (*Bidens frondosa*), silverweed (*Argentina anserina*), and bluejoint grass (*Calamagrostis canadensis*). Japanese knotweed (*Fallopia japonica*) may become invasive on cobble shores. More data on this community are needed.

Distribution: scattered throughout upstate New York, north of the Coastal Lowlands ecozone.

Rank: G4G5 S4 *Revised:* 1990

Examples: South of the Glen, Warren County; Schuyler Island, Essex County; Doyles Islands, Delaware County.

Source: NYNHP field surveys.

Alvar Communities

Alvar ecosystems are grasslands, shrublands, woodlands, and sparsely vegetated rock barrens that develop on flat limestone or dolostone where soils are very shallow. Almost all of North America's alvars occur within the Great Lake basin, primarily in an arc from northern Lake Michigan across northern Lake Huron and along the southern edge of the Canadian Shield to include eastern Ontario and northwestern New York.

Communities in this classification that may be considered part of the alvar ecosystem include wet alvar grassland, dry alvar grassland, alvar pavement grassland, alvar shrubland, and alvar woodland. Alvar woodland is treated under the Barrens and Woodlands Subsystem. The following four alvar community descriptions, and the alvar woodland described later, are primarily adapted from the Conserving Great Lakes Alvars Final Technical Report of the International Alvar Conservation Initiative (Reschke *et al.* 1999). Changes to the community names, descriptions, and diagnostic characteristics were made in order to reflect species that occur in New York and to be consistent with the nomenclature and format used in this classification.

15. Wet alvar grassland: a grassland community that occurs on very shallow, organic soils that cover limestone or dolostone bedrock. Average soil depths in this grassland community are less than 10 cm. This community has a characteristic soil moisture regime of alternating wet and dry seasons; many of them have flooded or saturated soils in early spring and late fall, combined with summer drought in most years.

The dominant grasses and sedges are tufted hairgrass (*Deschampsia cespitosa*), Crawe's sedge (*Carex crawei*), prairie dropseed (*Sporobolus heterolepis*), and flat-stemmed spikerush (*Eleocharis elliptica* var. *elliptica*). Other characteristic grasses and herbs include balsam ragwort (*Packera paupercula*), small rush grass (*Sporobolus neglectus*), sheathed rush grass (*S. vaginiflorus*), false pennyroyal (*Trichostema brachiatum*), and wild chives (*Allium schoenoprasum*).

Typically there are several turf and weft mosses forming a patchy mat at the base of grasses and forbs; typical mosses are *Bryum pseudo-triquetrum*, *Abietinella abietinum*, *Tortella tortuosa*, and *Drepanocladus* spp.

There are usually very few shrubs in this grassland community (usually less than 1% cover). Wet alvar grasslands occur in small to large patches. They usually occur in a patchy landscape mosaic with other alvar communities, including alvar pavement grassland and alvar shrubland. In these landscape mosaics, the wet alvar grassland usually occupies the lowest, wettest positions; the actual elevation differences may be very subtle, with differences of less than 10 or 15 cm.

This community description is adapted from, and most similar to, the "tufted hairgrass wet alvar grassland" described by the International Alvar Conservation Initiative (Reschke *et al.* 1999).

Other characteristic species in New York examples include sedges (*Carex molesta*, *C. castanea*, *C. vulpinoidea*, *C. granularis*), slender wheatgrass (*Elymus trachycaulum*), brome grass (*Bromus kalmii*), spike muhly (*Muhlenbergia*

glomerata), golden Alexanders (*Zizia aurea*), white camas (*Zigadenus elegans* ssp. *glaucus*), Indian paintbrush (*Castilleja coccinea*), and prairie-smoke (*Geum triflorum*) (NY Natural Heritage).

Distribution: known only from a few outcrops of Chaumont limestone in Jefferson County, in the Eastern Ontario Plain subzone.

Rank: G2 S1 *Revised:* 2010

Examples: Three Mile Creek Road Barrens, Jefferson County; Chaumont Barrens, Jefferson County; Lucky Star Alvar, Jefferson County.
Sources: Catling *et al.* 1975; Reschke and Gilman 1988; Slack *et al.* 1988; Gilman 1998; Reschke *et al.* 1999; Stanton 1997; NYNHP field surveys.

16. Dry alvar grassland: a grassland community that occurs on very shallow, organic soils that cover limestone or dolostone bedrock. This community has a characteristic soil moisture regime of summer drought in most years. This grassland seems to occur on well-drained soils that are rarely, if ever, saturated or flooded; this interpretation is based on soil texture (soil moisture regime of this type has not been studied).

This dry grassland is dominated by poverty grass (*Danthonia spicata*), Canada bluegrass (*Poa compressa*), and sometimes little bluestem (*Schizachyrium scoparium*).

There is less than 10% cover of trees and less than 25% cover of shrubs. There is usually about 50% cover of herbs and up to about 50% cover of nonvascular plants (mosses, lichens, and algae) growing on exposed limestone or dolostone pavement areas that occur as patches within the grassland. Poverty grass dry alvar grassland usually occurs in small to large patches. This community may occur in a patchy landscape mosaic with other alvar communities, most commonly alvar shrubland and alvar pavement grassland. Soils of poverty grass dry alvar grasslands are very shallow loams (usually less than 10 cm deep) over limestone or dolostone bedrock. These grasslands are sometimes disturbed by grazing, which introduces non-native species and pasture grasses such as timothy (*Phleum pratense*).

This community description is adapted from, and most similar to, the "poverty grass dry alvar grassland" described by the International Alvar Conservation Initiative (Reschke *et al.* 1999).

Distribution: known only from a few outcrops of Chaumont limestone in Jefferson County, in the Eastern Ontario Plain subzone.

Rank: G2? S1 *Revised:* 2010

Examples: Sam Adams Road Woods, Jefferson County; Limerick Cedars, Jefferson County; Chaumont Barrens, Jefferson County; Three Mile Creek Road Barrens, Jefferson County; Lucky Star Alvar, Jefferson County.

Sources: Catling *et al.* 1975; Reschke and Gilman 1988; Slack *et al.* 1988; Gilman 1998; Reschke *et al.* 1999; Stanton 1997; NYNHP field surveys.

17. Alvar pavement grassland: a community comprised of two vegetation associations; the first is a mosaic of pavement and grassland areas dominated by characteristic native species; the second consists of exposed, flat limestone or dolostone pavement that is sparsely vegetated with a mosaic of mossy patches and exposed bedrock that is covered with crustose and foliose lichens.

The mosaic pavement and grassland association is dominated by small rush grass (*Sporobolus neglectus*), sheathed rush grass (*S. vaginiflorus*), Philadelphia panic grass (*Panicum philadelphicum*), Canada bluegrass (*Poa compressa*), upland white aster (*Oligoneuron album*), poverty grass (*Danthonia spicata*), false pennyroyal (*Trichostema brachiatum*), balsam ragwort (*Packera paupercula*), Crawe's sedge (*Carex crawei*), and wiry panic grass (*Panicum flexile*).

There is usually less than 10% cover of shrubs. There may be nearly equal cover of grassy vegetation, and exposed rock covered with nonvascular plants. Lichens and mosses are common on "pavement" rock outcrops that occur as patches within this mosaic. Alvar pavement grasslands usually occur in small to large patches. This community typically occurs in a landscape mosaic with other alvar communities; the most common associated communities are wet alvar grassland, alvar shrubland, and dry alvar grassland.

Soils of alvar pavement grasslands are very shallow (usually less than 10 cm deep) over limestone or dolostone bedrock. At some sites there is a distinctive soil moisture regime of alternating wet and dry seasons: they are often saturated in early spring and late fall and subject to severe summer drought in most years (except unusually wet years). Due to the very shallow soils, and often saturated conditions during freeze-thaw cycles in early and late winter, needle ice often forms in the soils, causing frost-heaving of the shallow soils.

The second association consists of exposed, flat limestone or dolostone pavement that is sparsely vegetated with a mosaic of mossy patches and exposed bedrock that is covered with crustose and

foliose lichens. In the mossy patches, characteristic mosses are *Tortella tortuosa, Tortula ruralis* and other *Tortella* spp. and a characteristic lichen is cup lichen (*Cladonia pocillum*). On exposed pavement patches, characteristic lichens are blackthread lichen (*Placynthium nigrum)* and silver skin lichen (*Dermatocarpon* cf *miniatum*).

Very small herbs (under 15 cm tall) grow in the mossy patches on the pavement, including Virginia saxifrage (*Saxifraga virginiensis*), hairy beardtongue (*Penstemon hirsutus*), Norwegian cinquefoil (*Potentilla norvegica*), false pennyroyal (*Trichostema brachiatum*), Virginia strawberry (*Fragaria virginiana*), Michaux's stitchwort (*Minuartia michauxii* var. *michauxii*), and longleaf summer bluet (*Houstonia longifolia*). Some taller herbs and low shrubs grow primarily in rock crevices that crisscross the pavement, including gray goldenrod (*Solidago nemoralis*), snowberry (*Symphoricarpos albus*), riverbank grape (*Vitis riparia*), red columbine (*Aquilegia canadensis*), and tall hawkweed (*Hieracium piloselloides*). There is usually less than 15% cover of herbs.

A few trees and shrubs are usually rooted in deep crevices of the pavement; characteristic trees and shrubs that occur sparsely include eastern white cedar (*Thuja occidentalis),* common juniper (*Juniperus communis*), white birch (*Betula papyrifera*), eastern red cedar *(Juniperus virginiana),* butternut (*Juglans cinerea*), and white pine (*Picea glauca*).

There is less than 10% total cover of trees, and less than 10% total cover of shrubs. There is a lot of exposed bedrock and much of it is covered with lichens and mosses (average cover of lichens and mosses is about 55%).

Alvar nonvascular pavements usually occur in small to large patches. They usually occur in a patchy landscape mosaic with other alvar communities, including wet alvar grassland, and alvar shrubland. Soils of alvar nonvascular pavement are either lacking or very shallow (usually less than 10 cm deep in crevices) over limestone or dolostone bedrock. This community typically has a soil moisture regime characterized by severe summer drought as well as high summer temperatures.

This community description is adapted from, and is a combination of, the "annual alvar pavement-grassland" and "alvar nonvascular pavement" communities described by the International Alvar Conservation Initiative (Reschke *et al.* 1999). See calcareous pavement woodland for a description of a similar community in a non-alvar setting.

Distribution: known only from a few outcrops of Chaumont limestone in Jefferson County, in the Eastern Ontario Plain subzone.

Rank: G3 S2 *Revised:* 2010

Examples: Limerick Cedars, Jefferson County; Lucky Star Alvar, Jefferson County; Three Mile Creek Road Barrens, Jefferson County; Chaumont Barrens, Jefferson County.

Sources: Catling *et al.* 1975; Reschke and Gilman 1988; Slack *et al.* 1988; Gilman 1998; Reschke *et al.* 1999; Stanton 1997; NYNHP field surveys.

18. Alvar shrubland: a shrubland community that has over 25% cover of dwarf, short, and tall shrubs (less than 0.5 to 5 m); the average is about 43% cover of shrubs, with less than 10% of that being tall shrubs. Characteristic tall shrubs (2 to 5 m tall) are scrub forms of trees such as eastern red cedar (*Juniperus virginiana*), northern white cedar (*Thuja occidentalis*), and bur oak (*Quercus macrocarpa*). Tree forms (over 5 m tall) of these species may be present, but trees have less than 10% cover in the community. Other less common trees (over 5 m tall) that may be present include shagbark hickory (*Carya ovata*), rock elm (*Ulmus thomasii*), and white ash (*Fraxinus americana*).

Characteristic short shrubs (0.5 to 2 m tall) include common juniper (*Juniperus communis*), gray dogwood (*Cornus foemina* ssp. *racemosa*), fragrant sumac (*Rhus aromatica*), chokecherry (*Prunus virginiana*), and downy arrow-wood (*Viburnum rafinesquianum*). Some dwarf shrubs (under 0.5 m tall) are usually present, including bearberry (*Arctostaphylos uva-ursi*) and snowberry (*Symphoricarpos albus*). Characteristic vines include poison ivy (*Toxicodendron radicans*) and riverbank grape (*Vitis riparia*).

The herb layer forms a dry, grassy meadow between the shrubs; average cover of herbs is about 23%. The most abundant herbs are poverty grass (*Danthonia spicata*), upland white aster (*Oligoneuron album*), and hidden sedge (*Carex umbellata*).

Less than 50% of the ground surface is exposed limestone bedrock, which is usually covered with lichens, mosses, and algae. There are often deep crevices or grikes in the limestone pavement; trees and shrubs are often rooted in the grikes. Alvar shrubland occurs in small to large patches; some of the larger patches form a small-scale matrix within which smaller openings of alvar grasslands and pavements may occur. They often occur in a patchy landscape mosaic with other alvar communities, including wet alvar grassland, alvar pavement grassland, alvar nonvascular pavement, and poverty grass dry alvar grassland. Soils of alvar shrublands are very shallow (usually less than 0.3 m deep) over

limestone bedrock. The soil moisture regime typically includes summer drought in most years (except unusually wet years).

This community description is adapted from, and most similar to, the "juniper alvar shrubland" described by the International Alvar Conservation Initiative (Reschke *et al.* 1999).

Distribution: known only from a few outcrops of Chaumont limestone in Jefferson County, in the Eastern Ontario Plain subzone.

Rank: G3 S2S3 *Revised:* 2010

Examples: Lucky Star Alvar, Jefferson County; Chaumont Barrens, Jefferson County; Three Mile Creek Road Barrens, Jefferson County; Limerick Cedars, Jefferson County; Ashland Flats Wildlife Management Area, Jefferson County.

Sources: Catling *et al.* 1975; Reschke and Gilman 1988; Slack *et al.* 1988; Gilman 1998; Reschke *et al.* 1999; Stanton 1997; NYNHP field surveys.

19. Open alpine community: an open community consisting of a mosaic of sedge/dwarf shrub meadows, dwarf heath shrublands, small boggy depressions, and exposed bedrock covered with lichens and mosses. The open alpine community occurs above timberline (about 4,900 ft or 1,620 m) on the higher mountain summits and exposed ledges of the Adirondacks. The flora includes arctic-alpine species that are restricted (in New York) to these areas, as well as boreal species that occur in forests and bogs at lower elevations. The soils are thin and organic, primarily composed of peat derived from peat mosses (*Sphagnum* spp.) or black muck. The soils are often saturated because they can be recharged by atmospheric moisture. This community was formerly called "alpine meadow" in Reschke (1990).

The open alpine community can be divided into three distinct vegetation associations following the proposed classification by Howard (2009):

1. The *alpine sedge/dwarf shrub meadows* association is characterized by high densities of deer's hair sedge (*Trichophorum caespitosum*), Bigelow's sedge (*Carex bigelowii*), and three-toothed cinquefoil (*Sibbaldiopsis tridentata*). Other indicator species include diapensia (*Diapensia lapponica*), small cranberry (*Vaccinium oxycoccus*), mountain fir-clubmoss (*Huperzia appressa*), mountain sandwort (*Minuartia groenlandica*), alpine goldenrod (*Solidago leiocarpa*), and northern bentgrass (*Agrostis mertensii*). Bilberrry (*Vaccinium uliginosum*) is common in this association as in the others, but here it tends to be shorter and more compact. Depending on the immediate moisture regime, mosses such as hair cap mosses (*Polytrichum strictum*, *P. juniperinum*), or the peat moss *Sphagnum pylaesii* may be present. Other species that may be present include bluejoint grass (*Calamagrostis canadensis*), alpine sweetgrass (*Hierochloe alpina*), common hairgrass (*Avenella flexuosa*), mountain woodrush (*Luzula parviflora*), arctic rush (*Juncus trifidus*), bunchberry (*Cornus canadensis*), and dwarf rattlesnake-root (*Prenanthes nana*).

2. The *alpine heath* association is characterized by a near continuous cover of low shrubs, including bog bilberry (*Vaccinium uliginosum*), black crowberry (*Empetrum nigrum*), Labrador tea (*Rhododendron groenlandicum*), and high-mountain blueberry (*Vaccinium boreale*), which may be growing underneath the other shrubs. This community is commonly bordered by alpine krummholz and so small patches of balsam fir (*Abies balsamea*), black spruce (*Picea mariana*), red spruce (*Picea rubens*), and heart-leaf paper birch (*Betula cordifolia*) are also common. Growing underneath the shrubs are fruticose lichens such as *Cladonia stygia, C. rangiferina, C. gracilis* ssp. *gracilis*, *C. stellaris*, and *Cetraria laevigata.* Foliose lichens such as *Parmelia sulcata* commonly grow as epiphytes on shrub stems. Bryophytes such as red stem moss (*Pleurozium schreberi*), *Hypnum imponens*, and the liverwort *Ptilidium ciliare* are also common underneath the dwarf shrubs.

3. The *alpine snowbank* association includes areas where ice and snow are deposited unevenly in the alpine zone and the locations with particularly heavy snow buildup or that are particularly sheltered so that snow lingers into late spring garner a different vegetation response. Shrubs are common and include northern meadow-sweet (*Spiraea septentrionalis*), dwarf bilberry (*Vaccinium cespitosum*), velvetleaf blueberry (*Vaccinium myrtilloides*), green alder (*Alnus viridis* ssp. *crispa)*, dwarf birch (*Betula glandulosa*), and skunk currant (*Ribes glandulosum*) as indicator species. Bog bilberry (*Vaccinium uliginosum*) is also present in many transects. Herbs are also common in this association and typically well mixed with the woody species. More importantly, herbaceous species from the other alpine types and from lower elevations are present in this association. Deer's hair sedge (*Trichophorum caespitosum*) for example can be found in this association, along with bunchberry (*Cornus canadensis*), blue bead-lily (*Clintonia borealis*), Canada mayflower (*Maianthemum canadense*), goldthread (*Coptis trifolia*), white hellebore (*Veratrum viride*), common hairgrass (*Avenella flexuosa*), and Pickering's reedgrass (*Calamagrostis*

pickeringii). The typically dense graminoids create a thicker duff layer with the result that lichens and bryophytes are less frequent in this community.

Characteristic species of the small boggy depressions include peat mosses (*Sphagnum capillifolium*, *S. fuscum*), cottongrass (*Eriophorum vaginatum*), bog laurel (*Kalmia polifolia*), and small cranberry (*Vaccinium oxycoccos*). Larger examples are are recognized as "alpine bogs" in other northeast state classifications (Sperduto and Cogbill 1999, Sperduto 2000, Thompson and Sorenson 2000). Rock outcrops that are relatively undisturbed by trampling are covered with arctic-alpine lichens such as map lichen (*Rhizocarpon geographicum*) and may have scattered cushions of diapensia.

Characteristic birds of the open alpine community with varying abundance include dark-eyed junco (*Junco hyemalis*) and white-throated sparrow (*Zonotrichia albicollis*).

This community is very sensitive to trampling because of the thin, often saturated soils and the very slow growth rate of the vegetation in the stressful alpine environment. Every effort should be made to minimize off-trail trampling by the many hikers who climb to these meadows in the High Peaks.

Distribution: restricted to the Adirondack High Peaks subzone of the Adirondacks ecozone.

Rank: G3G4 S1 *Revised:* 2009

Examples: MacIntyre Range (includes Algonquin Peak, Wright Peak, Boundary Peak, and Iroquois Peak) Essex County; Haystack Mountains, Essex County; Mount Skylight, Essex County; Mount Marcy, Essex County.

Sources: DiNunzio 1972; Howard 2009; LeBlanc 1981; Slack and Bell 1993, 1995; Sperduto and Cogbill 1999; NYNHP field surveys.

20. Cliff community: a community that occurs on vertical exposures of resistant, non-calcareous bedrock (such as quartzite, sandstone, or schist) or consolidated material; these cliffs often include ledges and small areas of talus. There is minimal soil development, and vegetation is usually sparse. Different types of cliffs may be distinguished based on exposure and moisture; these variations are not well-documented in New York, therefore the assemblages associated with these variations (sunny, shaded, moist, or dry areas) are combined in one community.

Characteristic species include rock polypody (*Polypodium virginianum*), marginal wood fern (*Dryopteris marginalis*), common hairgrass (*Avenella flexuosa*), mountain laurel (*Kalmia latifolia*), and eastern hemlock (*Tsuga canadensis*).

Bryophytes that are characteristic of acidic cliffs include the mosses *Andreaea rothii*, *Dicranum fulvum*, *Dicranum montanum*, white cushion moss (*Leucobryum glaucum*), *Plagiothecium laetum*, *Pohlia nutans*, *Pylaisiadelpha tenuirostris*, and the leafy liverworts *Blepharostoma trichophyllum*, *Jamesoniella autumnalis*, and *Scapania nemorea*. The rare two-ranked moss (*Pseudotaxiphyllum distichaceum*) and the uncommon leafy liverwort *Herbertus aduncus* ssp. *tenuis* are also known from acidic cliff communities.

A characteristic bird that nests on cliffs is the common raven (*Corvus corax*). More data on this community are needed.

Distribution: throughout upstate New York north of the Coastal Lowlands ecozone, where bedrock is not calcareous.

Rank: G5 S4 *Revised:* 1990

Examples: Wallface Mountain, Essex County; Poke O Moonshine Mountain, Essex County; Catskill Escarpment, Greene County; Smiley Cliff, Ulster County; Palisades Orangetown, Rockland County.

Sources: Cleavitt et al. 2005, 2006, 2009; Larson *et al.* 2000; Lougee 2000; Mellor 1995; NYNHP field surveys.

21. Calcareous cliff community: a community that occurs on vertical exposures of resistant, calcareous bedrock (such as limestone or dolomite) or consolidated material; these cliffs often include ledges and small areas of talus. There is minimal soil development, and vegetation is usually sparse. Different types of calcareous cliffs may be distinguished based on exposure and moisture; these variations are not well-documented in New York, therefore the assemblages associated with these variations (sunny, shaded, moist, or dry areas) are combined in one community.

Characteristic small trees and shrubs include eastern red cedar (*Juniperus virginiana*), hop hornbeam (*Ostrya virginiana*), round-leaf dogwood (*Cornus rugosa*), Canada yew (*Taxus canadensis*), black cherry (*Prunus serotina*), downy arrow-wood (*Viburnum rafinesquianum*), and northern white cedar (*Thuja occidentalis*).

Characteristic herbs growing in cracks and on ledges include bulblet fern (*Cystopteris bulbifera*), bristleleaf sedge (*Carex eburnea*), herb robert (*Geranium robertianum*), zig-zag goldenrod (*Solidago flexicaulis*), harebell (*Campanula*

rotundifolia), purple cliff brake (*Pellaea atropurpurea*), early saxifrage (*Saxifraga virginiensis*), and wild columbine (*Aquilegia canadensis*).

Characteristic calcareous cliff mosses include *Anomodon attenuatus, A. rostratus, A. viticulosus, Encalypta procera, Fissidens bryoides, Gymnostomum aeruginosum, Myurella siberica,* and *Tortella tortuosa*. The rare small mousetail moss (*Myurella julacea*), false willow moss (*Platydictya jungermannioides*), and chalk dwarf moss (*Seligeria calcarea*) are known from calcareous cliff communities.

Distribution: throughout upstate New York, north of the Coastal Lowlands ecozone, where bedrock is calcareous.

Rank: G4 S3 *Revised:* 2001

Examples: The Diameter, Washington County; Helderberg Escarpment, Albany County; Deer Leap, Warren County; Rogers Rock and Slide, Essex and Warren Counties.

Sources: Cleavitt et al. 2005, 2006, 2009; Larson *et al.* 2000; NYNHP field surveys.

22. Shale cliff and talus community: a community that occurs on nearly vertical exposures of shale bedrock and includes ledges and small areas of talus. Talus areas are composed of small fragments that are unstable and steeply sloping; the unstable nature of the shale results in uneven slopes and many rock crevices. There is minimal soil development, and vegetation is usually sparse. Different types of shale cliffs may be distinguished based on exposure and moisture; these variations are not well-documented in New York, therefore the assemblages associated with these variations (sunny, shaded, moist, or dry areas) are combined in one community.

Characteristic species include blunt-lobed woodsia (*Woodsia obtusa*), rusty woodsia (*W. ilvensis*), penstemon (*Penstemon hirsutus*), herb robert (*Geranium robertianum*), cyperus (*Cyperus filiculmis*), little bluestem (*Schizachyrium scoparium*), panic grass (*Panicum linearifolium*), Pennsylvania sedge (*Carex pensylvanica*), golden sedge (*C. aurea*), ox-tongue (*Picris* spp.), and eastern red cedar (*Juniperus virginiana*).

Characteristic bryophyte species on calcareous shale and mudstone cliffs can include the mosses *Bryum pseudotriquetrum, Campylium chrysophyllum, Encalypta procera, Fissidens bryoides, Gymnostomum aeruginosum, Mnium marginatum, Myurella siberica,* and the leafy liverwort *Cololejeunea biddlecomiae*.

A characteristic invertebrate is the silvery blue butterfly (*Glaucopsyche lygdamus lygdamus*), which feeds on wood-vetch (*Vicia caroliniana*). More data on this community are needed.

Distribution: scattered throughout upstate New York, north of the Coastal Lowlands ecozone, where bedrock is shale.

Rank: G4 S3 *Revised:* 1990

Examples: Chautauqua Gorge, Chautauqua County; Lorraine Gulf, Jefferson County; Cattaraugus Creek Zoar Valley, Cattaraugus and Erie Counties; Neversink Guymard Cliffs, Orange County; Whetstone Gulf, Lewis County.

Sources: Cleavitt et al. 2005, 2006, 2009; Hotchkiss 1932; Larson *et al.* 2000; NYNHP field surveys.

23. Maritime bluff: a sparsely vegetated community that occurs on vertical exposures of unconsolidated material, such as small stone, gravel, sand, and clay, that is exposed to maritime forces, such as water, ice, or wind. There are very few woody species present because of the unstable substrate. Most abundant species are usually annual and early succesional herbs. These bluffs are adjacent to maritime and marine communities and are actively eroded by the oceanic forces.

The maritime bluff is comprised of areas of unvegetated, near vertical morainal sand cliffs, and less steep (about 45°) areas of slumped bluff-face at the base of the bluff that support beach grass (*Ammophila breviligulata*), seaside goldenrod (*Soligago sempervirens*), and bayberry (*Myrica pensylvanica*). More data are needed for this community.

Distribution: known from Coastal Lowland ecozone.

Rank: G4 S2S3 *Revised:* 2005

Examples: Montauk Peninsula (south shore), Suffolk County.

Sources: Larson *et al.* 2000; NYNHP field surveys.

24. Great Lakes bluff: a sparsely vegetated community that occurs on vertical exposures of unconsolidated material, such as small stone, gravel, sand, and clay (e.g., drumlins), that is exposed to Great Lakes erosional forces, such as water, ice, or wind. There are very few woody species present because of the unstable substrate. Most abundant

species are usually annual and early succesional herbs. Great Lakes bluffs are adjacent to, and are exposed to erosional forces of, one of the Great Lakes.

More data are needed for this community.

Distribution: known from the drumlins region of the Great Lakes Plain ecozone.

Rank: G4 S2S3 *Revised:* 2005

Examples: Chimney Bluffs State Park, Wayne County; Fair Haven Beach State Park, Cayuga County.

Sources: Office of Parks, Recreation and Historic Preservation 1988; NYNHP field surveys.

25. Riverside/lakeside bluff: a sparsely vegetated community that occurs on vertical exposures of unconsolidated material, such as small stone, gravel, sand, and clay, that is exposed to erosional forces from rivers or lakes (excluding Great Lakes), such as water, ice, or wind. There are very few woody species present because of the unstable substrate. Most abundant species are usually annual and early succesional herbs. More data are needed for this community.

Distribution: not well known; likely occurring along many of the confined rivers throughout the state.

Rank: G4 S2S3 *Revised:* 2005

Examples: Chautauqua Gorge, Chautauqua County.

Sources: NYNHP field surveys.

26. Rocky summit grassland: a grassland community that occurs on rocky summits and exposed rocky slopes of hills. Woody plants are sparse and may be scattered near the margin of the community. Small trees and shrubs at low percent cover include eastern red cedar (*Juniperus virginiana*), shagbark hickory (*Carya ovata*), and red oak (*Quercus rubra*).

Characteristic and dominant grasses include little bluestem (*Schizachyrium scoparium*), tufted hairgrasss (*Avenella flexuosa*), poverty-grass (*Danthonia spicata, D. compressa*), and Indian grass (*Sorghastrum nutans*). Other grasses and sedges include Pennsylvania sedge (*Carex pensylvanica*), big bluestem (*Andropogon gerardii*), sweet vernal grass (*Anthoxanthum odoratum*), and deer-tongue grass (*Panicum clandestinum*).

Other herbs include ebony spleenwort (*Asplenium platyneuron*), dittany (*Cunila origanoides*), fragrant goldenrod (*Solidago odora*), bush-clover (*Lespedeza violacea*), Greene's rush (*Juncus greenei*), and whorled loosestrife (*Lysimachia quadrifolia*). Characteristic nonvascular species include lichens and mosses on scattered rock outcrops.

Distribution: not well known; currently reported from the Hudson Valley, Hudson Highlands, Triassic Lowlands ecozones.

Rank: G3G4 S3 *Revised:* 2001

Examples: Rocky Peak Ridge, Essex County; Bigelow Mountain, Essex County; Cranberry Mountain, Orange Countgy; Sugarloaf Mountain, Orange County.

Source: NYNHP field surveys.

27. Successional fern meadow: a meadow dominated by ferns that occurs on sites that have been cleared (for logging, farming, etc.) or otherwise opened by disturbance (*e.g.*, fire).

Characteristic ferns that may be dominant include bracken fern (*Pteridium aquilinum* var. *latiusculum*) and hay-scented fern (*Dennstaedtia punctilobula*); lowbush blueberries (*Vaccinium angustifolium, V. pallidum*) are common associates. This community may be relatively short-lived; it gradually succeeds to a blueberry heath or a forest community. More data on this community are needed.

Distribution: throughout upstate New York, north of the Coastal Lowlands ecozone.

Rank: G4 S3S4 *Revised:* 1990

Examples: Brandon Burn, Franklin County; Sarartoga National Historical Park, Sarartoga County.

Sources: NYNHP field surveys.

28. Successional blueberry heath: a shrubland dominated by ericaceous shrubs that occurs on sites with acidic soils that have been cleared (for logging, farming, etc.) or otherwise disturbed.

Characteristic species include blueberries (*Vaccinium corymbosum, V. pallidum, V. myrtilloides, V. stamineum*), black huckleberry

(*Gaylussacia baccata*), wintergreen (*Gaultheria procumbens*), trailing arbutus (*Epigaea repens*), poverty-grass (*Danthonia spicata*), and common hairgrass (*Avenella flexuosa*). This community may be relatively short-lived; it gradually succeeds to a forest community. More data on this community are needed.

Distribution: throughout New York State.

Rank: G4 S4 *Revised:* 2001
Examples: Brandon Burn, Franklin County; Finger Lakes National Forest, Schuyler County.

Source: NYNHP field surveys.

29. Successional northern sandplain grassland: a meadow community that occurs on open sandplains that have been cleared and plowed (for farming or development), and then abandoned. This community is usually dominated by a low, dry turf of sedges and grasses less than 30 cm (12 inches) tall, and includes patches of open sand and patches of soil covered with mosses and lichens.

These grasslands are dominated grasses and sedges, such as little bluestem (*Schizachyrium scoparium*), hairgrass (*Avenella flexuosa*), Pennsylvania sedge (*Carex pensylvanica*), common poverty grass (*Danthonia spicata*), panicgrasses (*Dichanthelium acuminatum* ssp. *columbianum, D. linearifolium, D. depauperatum*), and other sedges (*Carex rugosperma, C. lucorum*). Characteristic herbs with low percent cover include bracken fern (*Pteridium aquilinum* var. *latiusculum*), stiff-leaf aster (*Ionactis linariifolius*), butterflyweed (*Asclepias tuberosa*), round-head bushclover (*Lespedeza capitata*), whorled loosestrife (*Lysimachia quadrifolia*), and pale bluets (*Houstonia longifolia*).

They have relatively few other herbs, but include small amounts of characteristic sandplain species, such as bitter milkwort (*Polygala polygama*), panic grass (*Dichanthelium xanthophysum*), common milkweed (*Asclepias syriaca*), jointweed (*Polygonella articulata*), and Houghton umbrella-sedge (*Cyperus houghtonii*). Wild lupine (*Lupinus perennis*), horsemint (*Monarda punctata*), and Great Plains flatsedge (*Cyperus lupulinus* ssp. *macilentus*) are good indicator species in eastern New York examples.

These grasslands consist primarily of native species, although in some areas near roads they are invaded by non-native weeds such as spotted knapweed (*Centaurea stoebe* ssp. *micranthos*) and St. Johns-wort (*Hypericum perforatum*). There are essentially no non-native grasses, and thus they are very different from abandoned pastures and old fields on heavier soils.

The nonvascular layer may be well developed. Characteristic bryophytes include mosses such as haircap moss (*Polytrichum juniperinum, P. piliferum*) and lichens (*Cladonia arbuscula* ssp. *mitis, C. cristatella, C. rangiferina*).

Shrubs such as sweet-fern (*Comptonia peregrina*) may be present, but collectively they have less than 50% cover in the community. This community may succeed into pitch pine-scrub oak barrens at some sites.

These grasslands provide important habitat for grassland birds. Characteristic birds with varying abundance include grasshopper sparrow (*Ammodramus savannarum*), savannah sparrow (*Passerculus sandwichensis*), and vesper sparrow (*Pooecetes gramineus*). A rare bird that breeds in some successional northern sandplain grasslands is the upland sandpiper (*Bartramia longicauda*).

Characteristic butterflies include meadow fritillary (*Boloria bellona*) and black swallowtail (*Papilo polyxenes asterius*). Some of these grasslands probably originate from anthropogenic disturbances such as trampling by vehicles. It is also possible that fire is an important part of the disturbance regime. Ecoregional variants of sandplain grassland within the state may be recognized and are included here until further inventory warrants separation. This is a relatively short-lived community that succeeds to a shrubland, woodland, or forest community, but can be maintained as an open grassland via fire and/or mechanical removal of woody plants.

Distribution: on sandy soils throughout New York State.

Rank: G4? S3 *Revised:* 2014

Examples: Brandon Burn, Franklin County; Fort Drum, Jefferson County; Wilton Wildlife Preserve and Park, Saratoga County.

Source: NYNHP field surveys.

30. Successional old field: a meadow dominated by forbs and grasses that occurs on sites that have been cleared and plowed (for farming or development), and then abandoned. Fields that are mowed at an interval (*e.g.*, less than once per year) that favors the reproduction of characteristic successional old field species are included here.

Characteristic herbs include goldenrods (*Solidago altissima, S. nemoralis, S. rugosa, S. juncea, S. canadensis*, and *Euthamia graminifolia*), bluegrasses (*Poa pratensis, P. compressa*), timothy (*Phleum pratense*), quackgrass (*Elymus repens*),

smooth brome (*Bromus inermis*), sweet vernal grass (*Anthoxanthum odoratum*), orchard grass (*Dactylis glomerata*), common chickweed (*Cerastium arvense*), common evening primrose (*Oenothera biennis*), old-field cinquefoil (*Potentilla simplex*), calico aster (*Sympyotrichum lateriflorum* var. *lateriflorum*), New England aster (*Sympyotrichum novae-angliae*), wild strawberry (*Fragaria virginiana*), Queen-Anne's-lace (*Daucus carota*), ragweed (*Ambrosia artemisiifolia*), hawkweeds (*Hieracium* spp.), dandelion (*Taraxacum officinale*), and ox-tongue (*Picris hieracioides*). Little bluestem (*Schizachyrium scoparium*) may be present in some examples, but is more characteristic of successional northern sandplain grassland.

Shrubs may be present, but collectively they have less than 50% cover in the community. Characteristic shrubs include gray dogwood (*Cornus racemosa*), silky dogwood (*C. amomum*), arrowwood (*Viburnum dentatum* var. *lucidum*), raspberries (*Rubus* spp.), sumac (*Rhus typhina, R. glabra*), and eastern red cedar (*Juniperus virginiana*).

Characteristic butterflies include black swallowtail (*Papilio polyxenes*), orange sulphur (*Colias eurytheme*), eastern tailed blue (*Everes comyntas*), and copper (*Lycaena phlaeas*). Charactertistic birds include field sparrow (*Spizella pusilla*), savannah sparrow (*Passerculus sandwichensis*), and American goldfinch (*Carduelis tristis*). Characteristic mammals include meadow vole (*Microtus pennsylvanicus*) and woodchuck (*Marmota monax*) (D. Küntsler *pers. comm.*).

This is a relatively short-lived community that succeeds to a shrubland, woodland, or forest community.

Distribution: throughout New York State.

Rank: G5 S5 *Revised:* 1990

Examples: Chippewa Creek Plains, St. Lawrence County; Finger Lakes National Forest, Schuyler County; Saratoga National Historical Park, Saratoga County.

Sources: Mellinger and McNaughton 1975; NYNHP field surveys.

31. Successional shrubland: a shrubland that occurs on sites that have been cleared (for farming, logging, development, etc.) or otherwise disturbed. This community has at least 50% cover of shrubs.

Characteristic shrubs include gray dogwood (*Cornus racemosa*), eastern red cedar (*Juniperus virginiana*), raspberries (*Rubus* spp.), serviceberries (*Amelanchier* spp.), choke-cherry (*Prunus virginiana*), wild plum (*Prunus americana*), sumac (*Rhus glabra, R. typhina*), nanny-berry (*Viburnum lentago*), and arrowwood (*Viburnum dentatum* var. *lucidum*). Non-native invasive shrubs include hawthornes (*Crataegus* spp.), multiflora rose (*Rosa multiflora*), Russian and autumn olive (*Elaeagnus angustifolia, E. umbellata*), buckthorns (*Rhamnus cathartica, Frangula alnus*), and shubby honeysuckles (*Lonicera tatarica, L. morrowii, L. maacckii*).

Characteristic birds with varying abundance include gray catbird (*Dumetella caroliniensis*), brown thrasher (*Toxostoma rufum*), blue-winged warbler (*Vermivora pinus*), golden-winged warbler (*V. chrysotera*), chestnut-sided warbler (*Dendroica pensylvanica*), yellow-breasted chat (*Icteria virens*), eastern towhee (*Pipilo erythrophthalmus*), field sparrow (*Spizella pusilla*), song sparrow (*Melospiza melodia*), and indigo bunting (*Passerina cyanea*) (Levine 1998).

Distribution: throughout New York State.

Rank: G5 S5 *Revised:* 2001

Examples: Chippewa Creek Plains, St. Lawrence County; Finger Lakes National Forest, Schuyler County.

Sources: NYNHP field surveys.

B. BARRENS AND WOODLANDS

This subsystem includes upland communities that are structurally intermediate between forests and open canopy uplands. Several physiognomic types are included in this subsystem. Savannas are communities with a sparse canopy of trees (25 to 60% cover), and a groundlayer that is predominantly either grassy or shrubby (these will be called, respectively, grass-savanna and shrub-savanna). Woodlands include communities with a canopy of stunted or dwarf trees (less than 16 ft or 4.9 m tall), and wooded communities occurring on shallow soils over bedrock with numerous rock outcrops. The term "barrens" is commonly applied to both savannas and woodlands (*e.g.*, pine barrens).

1. Serpentine barrens: a grass-savanna community that occurs on shallow soils over outcrops of serpentine bedrock. Serpentine bedrock has a high concentration of heavy metals including magnesium which inhibit plant growth. The appearance and composition of vegetation on serpentine soils is often striking because it represents an abrupt change from surrounding vegetation on non-serpentine soils. In New York this community is restricted to Staten Island, where the remnants are relatively disturbed. The best examples of this community occur in southeastern Pennsylvania and northeastern Maryland.

On Staten Island, the open grassland areas are dominated by little bluestem (*Schizachyrium scoparium*), panic grasses (*Panicum virgatum* and *P. philadelphicum*), Indian grass (*Sorghastrum nutans*), and poverty-grass (*Danthonia spicata*). Characteristic forbs in the grassy areas are heath aster (*Sympyotrichum pilosum*), calico aster (*Sympyotrichum lateriflorum* var. *lateriflorum*), small white snakeroot (*Eupatorium pilosum*) old-field cinquefoil (*Potentilla simplex*), slender knotweed (*Polygonum tenue*) and green milkweed (*Asclepias viridiflora*).

Trees and shrubs are scattered in the barrens; usually there is roughly 20 to 40% cover of trees and 15 to 30% cover of shrubs. On Staten Island, the characteristic woody plants are gray birch (*Betula populifolia*), black oak (*Quercus velutina*), sassafras (*Sassafras albidum*), quaking aspen (*Populus tremuloides*), bayberry (*Myrica pensylvanica*), shining sumac (*Rhus copallinum*), sawbrier (*Smilax glauca*), arrowwood (*Viburnum dentatum* var. *lucidum*), and blueberries (*Vaccinium corymbosum*, *V. pallidum*). A characteristic butterfly is the arogos skipper (*Atrytone arogos arogos*).

The remnant serpentine barrens of Staten Island are currently lacking many of the species that characterize the serpentine barrens of Pennsylvania and Maryland, such as Virginia pine (*Pinus virginiana*), blackjack oak (*Querus marilandica* var. *marilandica*), fameflower (*Talinum teretifolium*), and chickweed (*Cerastium arvense* var. *villosissimum*).

Distribution: Restricted to the Manhattan Hills ecozone.

Rank: G2 S1 *Revised:* 1990

Examples: Heyerdahl Hill, Richmond County; Seaview, Richmond County.

Sources: Brooks 1987; Reed 1986; NYNHP field surveys.

2. Dwarf pine plains: a woodland community dominated by dwarf individuals of pitch pine (*Pinus rigida*) and scrub oak (*Quercus ilicifolia*) that occurs on nearly level outwash sand and gravel plains in eastern Long Island. This community is "fire dependent" meaning that frequent fires are necessary to maintain the species composition. The soils are infertile, coarse textured sands that are excessively well-drained. The canopy of dwarf pitch pines and scrub oaks is generally from 1.2 to 2.4 m (4 to 8 ft) tall, and it may form a dense thicket. The community includes very few species of vascular plants.

The majority of the biomass in the community consists of seven woody plant species: pitch pine, scrub oak, black huckleberry (*Gaylussacia baccata*), lowbush blueberry (*Vaccinium pallidum*), golden heather (*Hudsonia ericoides*), bearberry (*Arctostaphylos uva-ursi*), and wintergreen (*Gaultheria procumbens*). The huckleberries and blueberries form a low shrub canopy under the pines and oaks.

In areas of dwarf pine plains that appear to have never been cleared by humans (based on old aerial photos going back to 1930), there are very few lichens or herbs (M. Jordan *pers. comm.*). Artificially cleared areas may include foliose and fruticose lichens such as *Cetraria arenaria*, several reindeer lichens (*Cladonia mitis*, *C. stellaris*, *C. submitis*), British soldier lichen (*Cladonia cristatella*), *Punctelia rudecta*, *Parmelia saxatilis*, and dog-lichen (*Peltigera canina*). These sandy openings may include a few low herbs such as frostweed (*Helianthemum canadense*), cow-wheat (*Melampyrum lineare*), jointweed (*Polygonella articulata*), stiff-leaf aster (*Ionactis linariifolius*), flat sedge (*Cyperus houghtonii*), and orange-grass (*Hypericum gentianoides*). There are also reports of grassy openings and areas of frost pockets that occur in the lower elevation gullies with Pennsylvania sedge (*Carex pensylvanica*), golden heather, and

bearberry.

This community is a favored nesting area for prairie warbler (*Dendroica discolor*) and brown thrasher (*Toxostoma rufum*); pine warbler (*Dendroica pinus*), ovenbird (*Seiurus aurocapillus*), and northern harrier (*Circus cyaneus*) are also characteristic birds.

This community also provides prime habitat for the coastal barrens buckmoth (*Hemileuca maia* ssp. 5); the largest and most dense population of buckmoths in New York occurs in the dwarf pine plains.

This community combined pitch pine-oak-heath woodland and pitch pine-oak forest with embedded, small patch wetlands makes up the broadly defined ecosystem known as the Central Long Island Pine Barrens.

Distribution: restricted to the Coastal Lowlands ecozone.

Rank: G1G2 S1 *Revised:* 2011

Example: Dwarf Pine Barrens, Suffolk County.

Sources: Jordan 1998; Kerlinger and Doremus 1981; Olsvig 1980; Olsvig *et al.* 1979; NYNHP field surveys.

3. Dwarf pine ridges: a woodland community dominated by dwarf individuals of pitch pine (*Pinus rigida*) and black huckleberry (*Gaylussacia baccata*), which occurs on flat-topped summits of rocky ridges. The bedrock is a white quartzite conglomerate; soils are very thin, and they are rich in organic matter from litter that has accumulated on the bedrock.

Characteristic woody plants associated with the dwarf pines in the tall shrub "canopy" are wild raisin (*Viburnum nudum* var. *cassinoides*), black chokeberry (*Aronia melanocarpa*), and stunted gray birch (*Betula populifolia*). There is also a low shrub stratum with lowbush blueberries (*Vaccinium angustifolium, V. pallidum*), sweet-fern (*Comptonia peregrina*), and sheep laurel (*Kalmia angustifolia*).

Characteristic groundlayer species are wintergreen (*Gaultheria procumbens*), bunchberry (*Cornus canadensis*), Canada mayflower (*Maianthemum canadense*), moccasin flower (*Cypripedium acaule*), and cow-wheat (*Melampyrum lineare*). There are also openings with clustered sedge (*Carex cumulata*).

Invertebrates such as toothed apharetra (*Apharetra dentata*) and northern barrens tiger beetle (*Cicindela patruela patruela*) also occur in this community. More data on characteristic fauna are needed.

The dwarf pine ridges community grades into the pitch pine-oak-heath rocky summit community, which occurs on the top and upper slopes of ridges. The dwarf pine ridges are distinguished primarily by the height of the canopy pines: stands with pines less than 4.9 m (16 ft) tall are classified as dwarf pine ridges.

Distribution: restricted to the Shawangunk Hills subzone of the Hudson Valley ecozone.

Rank: G1G2 S1 *Revised:* 1990

Example: Sam's Point, Ulster County.

Sources: Olsvig 1980; Thompson 1996; NYNHP field surveys.

4. Maritime pitch pine dune woodland: a maritime woodland that occurs on stabilized dunes and back-barrier sand flats. The substrate is wind and wave deposited sand that is usually excessively well-drained and nutrient poor although the site may have a shallow depth to groundwater. The litter layer is shallow. The community is subject to high winds, sand-blasting, salt spray, and shifting substrate.

Trees are somewhat stunted (10-12 m high) and salt pruned. The canopy is sparse with some openings. Pitch pine (*Pinus rigida*) is the dominant tree and may have lower branches that grow out horizontally like aprons. Black oak (*Quercus velutina*), white oak (*Quercus alba*) and post oak (*Quercus stellata*) may also occur and can be codominant with pitch pine in more developed examples.

The shrub layer is usually well developed. Characteristic shrubs are bearberry (*Arctostaphylos uva-ursi*), black huckleberry (*Gaylussacia baccata*), highbush blueberry (*Vaccinium corymbosum*), beach heather (*Hudsonia tomentosa*), bayberry (*Myrica pensylvanica*), and scrub oak (*Quercus ilicifolia*). The vine layer is often well developed. Characteristic vines are common greenbrier (*Smilax rotundifolia*) and poison ivy (*Toxicodendron radicans*).

The herbaceous layer is dominated by hairgrass (*Avenella flexuosa*). Other characteristic herbaceous species include Pennsylvania sedge (*Carex pensylvanica*), little bluestem (*Schizachyrium scoparium*), starflower (*Trientalis borealis*), panic grass (*Panicum* spp.), jointweed (*Polygonella articulata*), blunt-leaved sandwort (*Moehringia lateriflora*), and pine barren sandwort (*Minuartia caroliniana*).

The nonvascular layer is often well developed. Characteristic bryophytes and fungi include reindeer lichens (*Cladonia arbuscula, C. rangiferina*), cup lichen (*Cladonia uncialis*), the barometer earthstar

fungus (Astraeus hygrometricus), and mosses such as white cushion moss (*Leucobryum glaucum*), hair cap moss (*Polytrichum juniperinum*), and *Tortella tortuosa.* More data on characteristic animals are needed.

Distribution: restricted to the Coastal Lowlands ecozone.

Rank: G2G3 S1 *Revised:* 2001

Examples: Napeague Woods, Suffolk County; Walking Dunes, Suffolk County; Fire Island National Seashore, Suffolk County.

Sources: Johnson 1981, 1985; Collins and Anderson 1994; Thompson 1997; NYNHP field surveys.

5. Pitch pine-scrub oak barrens: a shrub-savanna community that occurs on well-drained, sandy soils that have developed on sand dunes (primarily glacial lacustrine dunes), glacial till, and outwash plains. This community is adapted to and maintained by periodic fires; natural frequency of fires ranges from 6 to 15 years.

Pitch pine (*Pinus rigida*) is the dominant tree; the percent cover of pitch pine is variable, ranging from 20 to 60%. The shrub layer dominants are scrub oaks (*Quercus ilicifolia* and *Q. prinoides*), which often form dense thickets. Beneath this tall shrub canopy is a low shrub layer primarily composed of sweet-fern (*Comptonia peregrina*), lowbush blueberries (*Vaccinium angustifolium*, *V. pallidum*), black huckleberry (*Gaylussacia baccata*), and scattered New Jersey tea (*Ceanothus americanus*). These scrub oak thickets cover 60 to 80 percent of the community; pitch pines are scattered through the shrub thicket, occurring as emergent trees within an extensive shrubland.

Within the shrub thickets are small patches of grassland dominated by the following prairie grasses: big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), and Indian grass (*Sorghastrum nutans*). These grassy areas are usually found near ant mounds, along trails, and in some of the low areas between dunes where the water table may be very close to the soil surface. This community can be rich in species. Characteristic forbs include bush-clovers (*Lespedeza capitata, L. hirta, L. procumbens*, and *L. stuevii*), pinweed (*Lechea villosa*), milkwort (*Polygala nuttallii*), goat's-rue (*Tephrosia virginiana*), horse mint (*Monarda punctata*), bracken fern (*Pteridium aquilinum* var. *latiusculum*), and wild lupine (*Lupinus perennis*). *Ceratodon purpureus* is a common moss in pitch pine-scrub oak barrens (N. Slack *pers. comm.*). Larger grassland areas with less than 50% cover of shrubs may be classified as successional northern sandplain grassland. Pitch pine-scrub oak barrens are distinguished from pitch pine-oak-heath woodland in having openings dominated by grasses and forbs. Pitch pine-oak-heath woodland is characterized by openings dominated by heaths.

Rare Lepidoptera of some northern Hudson Valley pitch pine-scrub oak barrens include Karner blue butterfly (*Lycaeides melissa samuelis*), frosted elfin (*Callophrys irus*), and inland barrens buckmoth (*Hemileuca maia maia*). The coastal barrens buckmoth (*Hemileuca maia* ssp. 5) is a rare lepidopteran of pitch pine-scrub oak barrens on Long Island.

Characteristic birds with varying abundance include eastern towhee (*Pipilo erythrophthalmus*), brown thrasher (*Toxostoma rufum*), pine warbler (*Dendroica pinus*), prairie warbler (*D. discolor*), ovenbird (*Seiurus aurocapillus*), common yellowthroat (*Geothlypis trichas*), field sparrow (*Spizella pusilla*), chipping sparrow (*S. passerina*), and gray catbird (*Dumetella carolinensis*) (Levine 1998, Drennan 1981).

Two regional variants of this community type occur in New York. One is found in coastal areas and the other is found further inland. A wet variant may also occur within the typical dry community type. This community combined with pitch pine-oak forest with embedded, small patch wetlands makes up the broadly defined ecosystem known as the inland pine barrens.

Distribution: probably limited to the Coastal Lowlands ecozone and the Central Hudson subzone of the Hudson Valley ecozone; small examples are reported from the Appalachian Plateau ecozone.

Rank: G2 S1 *Revised:* 2001

Examples: Albany Pine Bush, Albany County; Edgewood Oak Brush Plains, Suffolk County.

Sources: Cryan and Turner 1981; Drennan 1981; Forman 1979; Kerlinger and Doremus 1981; Levine 1998; Olsvig 1980; NYNHP field surveys.

6. Pitch pine-oak-heath woodland: a pine barren community that occurs on well-drained, infertile, sandy soils in eastern Long Island (and possibly on sandy or rocky soils in upstate New York). The structure of this community is intermediate between a shrub-savanna and a woodland.

Pitch pine (*Pinus rigida*) and white oak (*Quercus alba*) are the most abundant trees, and these form an

open canopy with 30 to 60% cover. Scarlet oak (*Quercus coccinea*) and black oak (*Q. velutina*) may also occur in the canopy.

The shrub layer is dominated by scrub oaks (*Quercus ilicifolia, Q. prinoides*), and includes a few heath shrubs such as huckleberry (*Gaylussacia baccata*) and lowbush blueberry (*Vaccinium pallidum*). Blackjack oak (*Querus marilandica* var. *marilandica*) may also occur in low percentages.

The density of the shrub layer is inversely related to the tree canopy cover; where the trees are sparse, the shrubs form a dense thicket, and where the trees form a more closed canopy, the shrub layer may be relatively sparse. Stunted, multiple-stemmed white oaks may be present in the shrub layer if the site has burned regularly.

Characteristic species of the groundcover include bearberry (*Arctostaphylos uva-ursi*), Pennsylvania sedge (*Carex pensylvanica*), golden heather (*Hudsonia ericoides*), beach heather (*Hudsonia ericoides*), and pinweed (*Lechea villosa*).

Like other closely related pine barren communities, the woodland provides habitat for coastal barrens buckmoth (*Hemileuca maia* ssp. 5) and prairie warbler (*Dendroica discolor*). Pitch pine-oak-heath woodland is distinguished from pitch pine-scrub oak barrens in having openings dominated by heaths. Pitch pine-scrub oak barrens are characterized by openings dominated by grasses and forbs.

This community is adapted to periodic fires; the fire frequency has not been documented, but it probably burns less frequently than pitch pine-scrub oak barrens (*i.e.* more than 15 years between fires). This community may have a fairly low species richness; it is more diverse than dwarf pine plains, but less diverse than pitch pine-scrub oak barrens. This community combined dwarf pine plains and pitch pine-oak forest with embedded, small patch wetlands makes up the broadly defined ecosystem known as the Central Long Island Pine Barrens.

Distribution: probably restricted to the Coastal Lowlands ecozone.

Rank: G3G4 S2S3 *Revised:* 1990

Examples: Rocky Point Pine Barrens, Suffolk County; Dwarf Pine Barrens, Suffolk County.

Source: NYNHP field surveys.

7. Post oak-blackjack oak barrens: open barrens on upper slopes and low ridges of late cretaceous dunes characterized by the presence of stunted individuals of post oak (*Quercus stellata*), scarlet oak (*Q. coccinea*), and blackjack oak (*Q. marilandica* var. *marilandica*). Other trees at low cover include white oak (*Q. alba*), black oak *(Q. velutina*), sassafras *(Sassafras albidum*), American chestnut (*Castanea dentata*), gray birch (*Betula populifolia*), red maple (*Acer rubrum*), pitch pine (*Pinus rigida*), blackgum (*Nyssa sylvatica*) and persimmon (*Diospyros virginiana*). There is a sparse heath and grass groundcover growing in very dry, deep, exposed sand overlying a clay subsoil.

The shrub layer includes sapling canopy trees along with blueberries (*Vaccinium corymbosum, V. pallidum*), and black huckleberry (*Gaylussacia baccata*). Characteristic vines are carrion-flower (*Smilax herbacea*) and sawbrier (*S. glauca*).

The herb layer has low percent cover of old field toadflax (*Linaria canadensis*), bracken fern (*Pteridium aquilinum* var. *latiusculum*), bastard toadflax (*Comandra umbellata*), switch grass (*Panicum virgatum*), little bluestem (*Schizachyrium scoparium*), gray goldenrod (*Solidago nemoralis*), and wild indigo (*Baptisia tinctoria*). More data on characteristic animals are needed.

This community may be adapted to periodic fires; the fire frequency has not been documented.

Distribution: restricted to the Manhattan Hills ecozone.

Rank: G2G3 S1 *Revised:* 2001

Examples: Clay Pit Ponds State Park, Richmond County; Bethel Church Barrens, Richmond County.

Source: NYNHP field surveys.

8. Pitch pine-heath barrens: a shrub-savanna community that occurs on well-drained, sandy or rocky soils. This community is a mosaic of forested islands, woodland, dwarf heathland, and grassy patches.

The most abundant tree is pitch pine (*Pinus rigida*); in some stands there is an admixture of one or more species including big tooth aspen (*Populus grandidentata*), white pine (*Pinus strobus*), red pine (*P. resinosa*) or jack pine (*P. banksiana*). The percent cover of trees is variable, ranging from 30 to 60%.

The shrub layer is dominated by heath shrubs such as black huckleberry (*Gaylussacia baccata*), blueberries (*Vaccinium angustifolium, V. pallidum, V. myrtilloides*), and sheep-laurel (*Kalmia angustifolia*), as well as sweet-fern (*Comptonia peregrina*) and prairie redroot (*Ceanothus herbaceus*). This shrub layer may be quite diverse.

Characteristic groundlayer species include wintergreen (*Gaultheria procumbens*), wild sarsaparilla (*Aralia nudicaulis*), Canada mayflower

(*Maianthemum canadense*), cow-wheat (*Melampyrum lineare*), wild strawberry (*Fragaria virginiana*), moccasin flower (*Cypripedium acaule*), Pennsylvania sedge (*Carex pensylvanica*), Houghton's umbrella sedge (*Cyperus houghtonii*), northern jointweed (*Polygonella articulata*) and bracken fern (*Pteridium aquilinum* var. *latiusculum*). Characteristic birds with varying abundance include include ovenbird (*Seiurus aurocapillus*), common yellowthroat (*Geothlypis trichas*), chestnut-sided warbler (*Dendroica pensylvanica*), hermit thrush (*Catharus guttatus*), and wood thrush (*Hylocichla mustelina*). Rare moths in this community include pine pinion moth (*Lithophane lepida lepida*) and Thaxter's pinion (*L. thaxteri*).

This community is distinguished from pitch pine-scrub oak barrens by the dominance in the shrub layer of heath shrubs rather than scrub oaks (*Quercus ilicifolia* and *Q. prinoides*). Scrub oaks may be present, but they are never abundant or dominant in the shrub layer of pitch pine-heath barrens.

Distribution: apparently restricted to sandplains in northern and north-central New York, from the Erie-Ontario Plain subzone, the Champlain transition subzone, the western Adirondack subzone and the Champlain Valley subzone.

Rank: G4 S1S2 *Revised:* 1990

Examples: Clintonville Pine Barrens, Clinton County; Rome Sand Plains, Oneida County.

Source: NYNHP field surveys.

9. Boreal heath barrens: a dwarf shrubland or shrub-savanna dominated by heath or heath-like shrubs. Boreal heath barrens typically occur on nearly level outwash plains of the Adirondacks, in frost pockets lying in valleys, and in small kettleholes. Soils are sandy, dry, and poor in nutrients. Boreal heath barrens may become seasonally flooded because the soils have a discontinuous subsurface layer of podzolized soil (an ortstein), which impedes water drainage.

The dominant shrubs are blueberries (*Vaccinium myrtilloides, V. angustifolium, V. pallidum*), black chokeberry (*Aronia melanocarpa*), meadow-sweet (*Spiraea alba* var. *latifolia*), and mountain fly honeysuckle (*Lonicera villosa*).

Other characteristic plants include ricegrasses (*Oryzopsis asperifolia, Piptatherum canadensis, P. pungens*), swamp dewberry (*Rubus hispidus*), Canada goldenrod (*Solidago canadensis*), grass-leaved goldenrod (*Euthamia graminifolia*), yellow trout-lily (*Erythronium* americanum), northern tree clubmoss (*Dendrolycopodium dendroideum*), and running-pine (*Diphasiastrum digitatum*). Reindeer lichens (*Cladonia rangiferina, C. stellaris*) and cup lichen (*Cladonia pyxidata*) are also characteristic. Bryophytes include big red stem moss (*Pleurozium schreberi*), hair cap moss (*Polytrichum commune*), and *Dicranum* spp.

Trees may be scattered through the barrens, or they may be confined to the edges of open shrublands. Characteristic trees are black spruce (*Picea mariana*), white pine (*Pinus strobus*), black cherry (*Prunus serotina*), and tamarack (*Larix laricina*). Characteristic animals include snowshoe hare (*Lepus americanus*), raptors, field sparrow (*Spizella pusilla*), cedar waxwing (*Bombycilla cedrorum*), American goldfinch (*Spinus tristis*), and white-throated sparrow (*Zonotrichia albicollis*). The community often consists of a mosaic of two or more associations including woodland islands, dwarf heathland, meadow-sweet thickets, moss patches, lichen patches, grassy patches on plains, and forb-dominated frost pockets in kettleholes.

Distribution: probably limited to the Western Adirondack Foothills and Central Adirondacks subzones of the Adirondacks ecozone.

Rank: G3G4 S1 *Revised:* 1990

Examples: Oswegatchie Plains, St. Lawrence County; Chase Lake Sandplain, Lewis County; Moose River Sandplain, Lewis County.

Sources: Bray 1915; Bray 1921; Curran 1974; Faber-Langendoen *et al.* 2000; NYNHP field surveys.

10. Sandstone pavement barrens: an open canopy woodland that occurs on very shallow acidic soils (dysic lithic borofolist) over sandstone bedrock; this community is best developed where the bedrock is nearly level, thus forming a pavement. It is best developed on former shoreline of the Great Lakes. The best developed examples are found on Potsdam Sandstone in Clinton County. Large examples often include wetlands, such as perched bogs and inland poor fens.

Fire is the most important ecological process for the maintenance of healthy sandstone pavement barren communities (Stergas and Adams 1989, Hawver 1993). Other disturbances that have influenced these barrens include blow downs, ice storms and subsequent restoration cutting. Physiognomic variants such as exposed bedrock, open heath shrubs, sparse woodland, and closed canopy forest reflect the disturbance history of a given site.

In New York the dominant tree is jack pine (*Pinus banksiana*). Other associated pines include pitch pine (*Pinus rigida*), white pine (*P. strobus*), and red pine (*P. resinosa*). Other characteristic trees include red maple (*Acer rubrum*), paper birch (*Betula papyrifera*), gray birch (*B. populifolia*), and red oak (*Quercus rubra*).

The shrub layer is dominated by black huckleberry (*Gaylussacia baccata*) and lowbush blueberry (*Vaccinium angustifolium*). Other important shrubs are black chokeberry (*Aronia melanocarpa*), sheep laurel (*Kalmia angustifolia*), sweet-fern (*Comptonia peregrina*) and bearberry (*Arctostaphylos uva-ursi*).

The groundcover includes many lichens and mosses, which may form a continuous cover in some areas. Characteristic lichens include several reindeer lichens (*Cladonia mitis, C. rangiferina, C. stellaris*), and cup lichen (*Cladonia uncialis*). Characteristic mosses include hair cap moss (*Polytrichum juniperinum*) and big red stem moss (*Pleurozium schreberi*). Herbs grow throughout this groundcover and include bracken fern (*Pteridium aquilinum* var. *latiusculum*), wintergreen (*Gaultheria procumbens*), cow-wheat (*Melampyrum lineare*), poverty-grass (*Danthonia spicata*), and common hairgrass (*Avenella flexuosa*).

Breeding season bird species showing preference for jack pine barrens in New York include eastern towhee (*Pipilo erythrophthalmus*), dark-eyed junco (*Junco hyemalis*), chipping sparrow (*Spizella passerina*), white-throated sparrow (*Zonotrichia albicollis*), blue-headed vireo (*Vireo solitarius*), Nashville warbler (*Vermivora ruficapilla*), and common nighthawk (*Chordeiles minor*) (Gifford 1994). More data on characteristic fauna are needed.

Distribution: restricted to the north and east portions of the Adirondack ecozone. Most common and best developed in the Champlain Transition subzones of Clinton County.

Rank: G2 S1 *Revised:* 2004

Examples: Altona Flat Rock, Clinton County; Gadway Road Flat Rock, Clinton County; Buzzards Barren, St. Lawrence County; Wellesley Island, Jefferson County.

Sources: Adams and Franzi 1994; Franzi and Adams 1999; Gifford 1994; Hawver 1993; Stergas and Adams 1989; Yorks and Adams 2003; NYNHP field surveys.

11. Oak openings: a grass-savanna community that occurs on well-drained soils. In New York, these savannas originally occurred as openings within extensive oak-hickory forests. They were restricted to excessively well-drained sites such as on knobs or hilltops with shallow soil over dolomite outcrops, sandy to gravelly soils of kames and eskers, or gravelly glacial deltas and terraces. The best remnants occur on dolomite knobs.

Characteristic trees in New York occurrences are chinquapin oak (*Quercus muhlenbergii*), white oak (*Q. alba*), black oak (*Q. velutina*), and bur oak (*Q. macrocarpa*); these oaks typically occur as open-grown trees with broadly spreading canopies.

The oaks are sparsely distributed amidst a grassy groundlayer dominated by Indian grass (*Sorghastrum nutans*), little bluestem (*Schizachyrium scoparium*), and big bluestem (*Andropogon gerardii*). Characteristic forbs in the grassy groundlayer include thimbleweed (*Anemone cylindrica*), butterfly-weed (*Asclepias tuberosa*), tick-trefoils (*Desmodium glabellum, D. paniculatum*), wild bergamot (*Monarda fistulosa*), everlasting (*Antennaria* spp.), heath aster (*Sympyotrichum pilosum*), early goldenrod (*Solidago juncea*), and black-eyed-Susan (*Rudbeckia hirta* var. *pulcherrima*). Shrubs are scattered through the grassy area, and they may be locally dominant under the shade of larger trees.

Characteristic shrubs include gray dogwood (*Cornus racemosa*), which typically grows in small clones, and northern dewberry (*Rubus flagellaris*). Data on characteristic fauna are needed.

Distribution: known only from the Erie-Ontario Plain subzone of the Great Lakes Plain ecozone.

Rank: G2 S1 *Revised:* 1990

Example: Rush Oak Openings, Monroe County.

Sources: Shanks 1966; NYNHP field surveys.

12. Calcareous pavement woodland: an open canopy woodland that occurs on very shallow soils over flat, striated outcrops of calcareous bedrock (limestone and dolomite). This community includes patches of sparsely vegetated rock rubble in between dense cedar clumps or grassy open areas (A. Johnson *pers. comm.*). This woodland is not typically found in an alvar ecosystem, but is often associated with limestone woodlands. This community is more open and has larger areas of exposed bedrock than limestone woodland. The concept for this community includes the non-alvar variants of "calcareous pavement barrens" originally described by Reschke (1990).

The tree canopy layer is sparse and often grows in clumps. Characteristic trees include northern white cedar (*Thuja occidentalis*), eastern red cedar (*Juniperus virginiana*), hop hornbeam (*Ostrya virginiana*), bur oak (*Quercus macrocarpa*), white ash (*Fraxinus americana*), red maple (*Acer rubrum*), and white pine (*Pinus strobus*).

Many of the shrubs occur in dense thickets; they are rooted either in rock crevices or in shallow soil over bedrock. Characteristic shrubs include seedlings and saplings of trees listed above plus shrubby dogwoods (*Cornus racemosa, C. amomum*), common juniper (*Juniperus communis*), fragrant sumac (*Rhus aromatica*), and prickly ash (*Zanthoxylum americanum*). Invasive non-native shrubs that may be locally abundant include buckthorn (*Rhamnus cathartica*), shrub honeysuckles (*Lonicera tatarica, L. morrowii*), common barberry (*Berberis vulgaris*), and hawthorn (*Crataegus* spp.).

Characteristic herbs include a mix of native and non-native species including Canada bluegrass (*Poa compressa*), poverty-grass (*Danthonia spicata*), gray goldenrod (*Solidago nemoralis*), panic grasses (*Panicum, flexile, Dichanthelium acuminatum*), prairie fleabane (*Erigeron strigosus* var. *strigosus*), American pennyroyal (*Hedeoma pulegioides*), balsam ragwort (*Packera paupercula*), Queen-Anne's-lace (*Daucus carota*), hawkweeds (*Hieracium* spp.), clovers (*Trifolium* spp.), ebony sedge (*Carex eburnea*), upland white aster (*Oligoneuron album*), herb robert (*Geranium robertianum*), and wild strawberry (*Fragaria virginiana*).

Fruticose and foliose lichens are locally common in the grassy areas, including reindeer lichens (*Cladonia* spp.) and cup lichen (*Cladonia pocillum*). Characteristic mosses include hair cap moss (*Polytrichum* spp.) and *Tortella tortuosa*.

See wet alvar grassland, dry alvar grassland, alvar pavement grassland, alvar shrubland, and alvar woodland for descriptions of similar communities in an alvar setting.

Distribution: scattered throughout upstate New York north of the Coastal Lowlands ecozone, at sites where the bedrock is limestone including the St. Lawrence Valley and Lake Champlain ecozones, the Helderberg Highlands in the Appalachian Plateau ecozone, and the Great Lakes ecozone.

Rank: G3G4 S2S3 *Revised:* 2010

Examples: Waddington Cedar Rock Flats, St. Lawrence County; Crown Point, Essex County; Chazy Barrens, Clinton County.

Sources: A. Johnson *pers. comm.*; L. Harper *pers. comm.*; NYNHP field surveys.

13. Calcareous red cedar barrens: a small-patch community with dry, south-facing to southwest-facing slopes of calcareous bedrock supporting stunted, sparse woodlands with small grassland openings characterized by little blue stem (*Schizachyrium scoparium*) and side-oats grama (*Bouteloua curtipendula*).

Red cedar (*Juniperus virginiana*) is usually present as a stunted, sparse canopy. Other possible woody associates may include white ash (*Fraxinus americana*), yellow oak (*Quercus muhlenbergii*), chinquapin oak (*Quercus prinoides*), paper birch (*Betula papyrifera*), basswood (*Tilia americana*), and hop hornbeam (*Ostrya virginiana*).

Shrubs are sparse but when present may include hackberry (*Celtis occidentalis*) or hazelnuts (*Corylus americana, C. cornuta*), and alternate-leaved dogwood (*Cornus alternifolia*).

The herbaceous composition is quite variable among occurrences but often includes such species as bristle-leaf sedge (*Carex eburnea*), thimbleweeds (*Anemone virginiana, A. cylindrica*), silver-rod (*Solidago bicolor*), switch-grass (*Panicum virgatum*), Pennsylvania sedge (*Carex pensylvanica*), bush-clovers (*Lespedeza* spp.), green milkweed (*Asclepias viridiflora*), whorled milkweed (*Asclepias verticillata*), creeping muhly (*Muhlenbergia sobolifera*), Indian grass (*Sorghastrum nutans*), false gromwells (*Onosmodium* spp.), ragworts (*Senecio aureus, S. obovatus*), purple cliff brake (*Pellaea atropurpurea*), dropseed (*Sporobolus asper*), mountain-mints (*Pycnanthemum virginianum, P. incanum*), and horse-gentian (*Triosteum aurantiacum*).

This community appears to be associated with Stockbridge Marble in eastern NY and western CT, and Franklin Marble in northern NJ.

Rank: G1G2 S1 *Revised:* 2003

Examples: Nellie Hill, Dutchess County.

Sources: Edinger 2003; NYNHP field surveys.

14. Alpine krummholz: a dwarf woodland or tall shrubland dominated by balsam fir (*Abies balsamea*) that occurs at or near the summits of the high peaks of the Adirondacks at elevations of 3,500 to 4,900 ft (1,067 to 1,494 m). Approximately 85% of the canopy consists of balsam fir; common associates include mountain paper birch (*Betula cordifolia*) and black spruce (*Picea mariana*). Less common are red

spruce (*Picea rubens*), common juniper (*Juniperus communis*), tamarack (*Larix laricina*), American mountain ash (Sorbus americana), and northern white cedar (*Thuja occidentalis*). The stunted trees form dense stands; at the uppermost elevations below timberline the tree species are typically under 1.5 m (5 ft) tall, with branches extending to the ground (*i.e.*, there is no self-pruning of lower branches), and an average dbh of 7.6 cm (3 in). Other low shrubs include bog bilberry (*Vaccinium uliginosum*), dwarf blueberry (*Vaccinium caespitosum*), velvetleaf blueberry (*Vaccinium myrtilloides*), and Labrador tea (*Rhododendron groenlandicum*).

The groundlayer is densely shaded; the groundcover consists of a thick carpet of mosses, with scattered lichens and herbs.

The dominant bryophytes include peat moss (*Sphagnum capillifolium*), big red stem moss (*Pleurozium schreberi*), broom moss (*Dicranum scoparium*), hair cap mosses (*Polytrichum juniperinum, P. strictum*), *Paraleucobryum longifolium*, and the leafy liverwort *Ptilidium ciliare*. Reindeer lichen (*Cladonia rangiferina*) and *Cetraria laevigata* are the most common lichens.

Characteristic herbs include bunchberry (*Cornus canadensis*), large-leaf goldenrod (*Solidago macrophylla*), common wood-sorrel (*Oxalis montana*), goldthread (*Coptis trifolia*), blue bead-lily (*Clintonia borealis*), mountain fir clubmoss (*Huperzia appalachiana*), three-toothed cinquefoil (*Sibbaldiopsis tridentata*), and Canada mayflower (*Maianthemum canadense*).

Characteristic birds with varying abundance include blackpoll warbler (*Dendroica striata*), white-throated sparrow (*Zonotrichia albicollis*), and dark-eyed junco (*Junco hyemalis*). A rare bird of some alpine krummholz communities is Bicknell's Thrush (*Catharus bicknelli*).

Distribution: restricted to the Adirondack High Peak subzone of the Adirondack ecozone in Essex County.

Rank: G3G4 S2 *Revised:* 2004

Examples: MacIntyre Range (includes Algonquin Peak and Wright Peak) Essex County; Mount Skylight, Essex County; Haystack Mountains, Essex County; Mount Marcy, Essex County; Whiteface Mountain, Essex County.

Sources: Slack and Bell 1993, 1995; Sperduto and Cogbill 1999; NYNHP field surveys.

15. Limestone woodland: a conifer or hardwood dominated woodland that occurs on shallow soils over limestone bedrock, and usually includes numerous small rock outcrops. Typical examples have pure calcareous bedrock such as limestone, dolomite, calcite, or marble. Other examples may have hybrid bedrock types such as amphibolites or Potsdam sandstone. The tree canopy may be open or closed. There are usually several codominant trees, although one species may become dominant in any one stand.

Characteristic canopy trees in some stands are primarily conifers such as northern white cedar (*Thuja occidentalis*), white pine (*Pinus strobus*), white spruce (*Picea glauca*), and balsam fir (*Abies balsamea*). In other stands the characteristic canopy trees are primarily hardwoods such as hop hornbeam (*Ostrya virginiana*), sugar maple (*Acer saccharum*), shagbark hickory (*Carya ovata*), bitternut hickory (*C. cordiformis*), white oak (*Quercus alba*), bur oak (*Q. macrocarpa*), red oak (*Q. rubra*), chinkapin oak (*Q. muhlenbergii*), basswood (*Tilia americana*), and common hackberry (*Celtis occidentalis*). There are also stands that include mixtures of these conifers and hardwoods. More data are needed on these variations in canopy composition and related changes in understory composition.

The shrub layer is variable, becoming more dense where the canopy is open and soils are deeper. Characteristic shrubs include gray dogwood (*Cornus racemosa*), wild honeysuckle (*Lonicera dioica*), alder-leaf buckthorn (*Rhamnus alnifolia*), prickly gooseberry (*Ribes cynosbati*), raspberries (*Rubus idaeus, R. occidentalis*), bladdernut (*Staphylea trifolia*), serviceberries (*Amelanchier* spp.), poison ivy (*Toxicodendron radicans*), and purple clematis (*Clematis occidentalis*).

The groundlayer may be quite diverse, with many grasses, sedges, and forbs. Characteristic herbs include sedges (*Carex eburnea, C. pensylvanica, C. platyphylla*), marginal wood fern (*Dryopteris marginalis*), rattlesnake fern (*Botrychium virginianum*), bracken fern (*Pteridium aquilinum* var. *latiusculum*), barren strawberry (*Waldsteinia fragarioides*), big-leaf aster (*Eurybia macrophylla*), wild strawberry (*Fragaria virginiana*), black snakeroot (*Sanicula marilandica*), herb robert (*Geranium robertianum*), Canada mayflower (*Maianthemum canadense*), false Solomon's-seal (*Maianthemum racemosum*), early meadow-rue (*Thalictrum dioicum*), white trillium (*Trillium grandiflorum*), and wreath goldenrod (*Solidago caesia*). Rare, indicator plants include pink wintergreen (*Pyrola asarifolia*) and ram's-head lady's-slipper (*Cypripedium arietinum*). Shaded rock surfaces and crevices often support ferns such as rock polypody (*Polypodium virginianum*) and maidenhair spleenwort (*Asplenium trichomanes*).

See calcareous pavement woodland for examples with a more open tree canopy and larger patches of

flat bedrock outcrops. See alvar woodland for mixed conifer woodlands in alvar settings. More data on regional variants and characteristic fauna are needed.

Distribution: scattered throughout upstate New York north of the Coastal Lowlands ecozone, at sites where the bedrock is limestone. This community is most common in the Great Lakes Plain and Lake Champlain Valley.

Rank: G3G4 S2S3 *Revised:* 1990

Examples: Valcour Island, Clinton County; Split Rock Mountain, Essex County; Oatka Creek Slopes, Genesee County; Rush Oak Opening, Monroe County; Willsboro Bay Shore, Essex County.

Sources: NYNHP field surveys.

16. Alvar woodland: a mixed conifer woodland that occurs on shallow soils over limestone bedrock in alvar settings, and usually includes numerous rock outcrops. The woodland tree canopy consists of a variable mixture of eastern red cedar (*Juniperus virginiana*), northern white cedar (*Thuja occidentalis*), bur oak (*Quercus macrocarpa*), white ash (*Fraxinus americana*), paper birch (*Betula papyrifera*), white pine (*Pinus strobus*), shagbark hickory (*Carya ovata*), hop hornbeam (*Ostrya virginiana*), white spruce (*Picea glauca*), balsam fir (*Abies balasamea*), basswood (*Tilia americana*), American elm (*Ulmus americana*), rock elm (*U. thomasii*), and pin-cherry (*Prunus pensylvanica*). Jack pine (*Pinus banksiana*) is characteristic of alvar woodlands outside of New York.

The understory of this is a mosaic of shrubby patches, exposed pavement, and grassy patches. The most abundant shrub is common juniper (*Juniperus communis*); other characteristic shrubs include buffaloberry (*Shepherdia canadensis*) and bearberry (*Arctostaphylos uva-ursi*).

Characteristic herbs include false pennyroyal (*Trichostema brachiatum*), Crawe's sedge (*Carex crawei*), balsam ragwort (*Packera paupercula*), ebony sedge (*Carex eburnea*), and sheathed rush grass (*Sporobolus vaginiflorus*).

Areas of exposed limestone or dolostone pavement are common, usually with a cover of mosses such as *Tortella* spp. and *Schistidium* spp., lichens such as reindeer lichen (*Cladonia rangiferina*) and dog-lichen (*Peltigera canina*), and rock surface algae (*Gloeocapsa alpina*).

This community is related to alvar shrubland and may represent a later successional stage of that community. This woodland often forms a mosaic with other alvar communities and may include patches of alvar shrubland, dry alvar grassland, and alvar pavement grassland.

This community description is adapted from the "mixed conifer/common juniper alvar woodland" described by the International Alvar Conservation Initiative (Reschke *et al.* 1999).

Distribution: known only from a few outcrops of Chaumont limestone in Jefferson County, in the Eastern Ontario Plain subzone.

Rank: G2? S2 *Revised:* 2010

Examples: Chaumont Barrens, Jefferson County; Lucky Star Alvar, Jefferson County; Three Mile Creek Road Barrens, Jefferson County.

Sources: Gilman 1998; Reschke *et al.* 1999; NYNHP field surveys.

17. Ice cave talus community: a community that occurs on rocks and soil at the base of talus slopes where cold air is emitted. The emission of cold air results from air circulation among the rocks of the talus slope where winter ice remains through the summer. The air is cooled by the ice deep in the talus, and settles; gravity eventually forces the air out along the face of rocks at the base of the slope (Core 1968). Mist typically concentrates in this community during the spring.

The vegetation is distinctive because it includes species characteristic of climates much cooler or moister than the climate of the area where the ice caves occur. Species found at higher elevations and/or latitudes are often seen at these talus sites. For example, at the ice caves of the Shawangunks in southeastern New York, there are northern species such as black spruce (*Picea mariana*), red spruce (*P. rubens*), balsam fir (*Abies balsamea*), eastern hemlock (*Tsuga canadensis*), mountain ash (*Sorbus americana*, *S. decora*), creeping snowberry (*Gaultheria hispidula*) and bunchberry (*Cornus canadensis*). The surrounding communities are mostly pine barrens and oak forests.

Bryophytes and lichens are typically abundant. Some rare and uncommon bryophytes have been collected from these talus slopes. A leafy liverwort (*Mylia taylorii*) has been found from the Shawangunks. In Wilmington Notch in the Adirondacks, a leafy liverwort (*Anastrophyllum saxicola*), a short-pointed lantern moss (*Cyrtomnium hymenophylloides*), and the cup lichen *Cladonia metacorallifera* have also been found.

A characteristic mammal is the rock vole (*Microtus chrotorrhinus*).

In the midwest, similar cold air producing talus slopes have been called "algific talus slopes," and they are the habitat of a rare species of snail. In New York, these communities need to be surveyed; special attention should be paid to their invertebrate fauna.

Distribution: apparently limited to the Adirondacks ecozone where it is most common and the Shawangunk Hills subzone of the Hudson Valley ecozone. This community may also be present in the Catskill Peaks.

Rank: G3? S1S2 *Revised:* 1990

Examples: Shingle Gully, Ulster County; Moss Lake Mountain, Herkimer County; Indian Pass, Essex County; Sam's Point, Ulster County.

Sources: Core 1968; comments by Norton Miller (of the New York State Museum Biological Survey); NYNHP field surveys.

18. Calcareous talus slope woodland: An open or closed canopy community dominated by calciphilic plants that occurs on talus slopes composed of calcareous to circumneutral bedrock such as limestone, dolomite, or amphibolite. The soils are usually moist and loamy with a pH greater than 5.5; there may be numerous rock outcrops.

Characteristic trees include sugar maple (*Acer saccharum*), mountain maple (*A. spicatum*), white ash (*Fraxinus americana*), hop hornbeam (*Ostrya virginiana*), eastern red cedar (*Juniperus virginiana*), northern white cedar (*Thuja occidentalis*), basswood (*Tilia americana*), slippery elm (*Ulmus rubra*), common hackberry (*Celtis occidentalis*), and butternut (*Juglans cinerea*).

Shrubs may be abundant if the canopy is open; characteristic shrubs include round-leaf dogwood (*Cornus rugosa*), downy arrowwood (*Viburnum rafinesquianum*), prickly ash (*Zanthoxylum americanum*), red osier dogwood (*Cornus sericea*), and bladdernut (*Staphylea trifolia*). Common vines include bittersweet (*Celastrus scandens*), Virginia creeper (*Parthenocissus quinquefolia*), climbing fumitory (*Adlumia fungosa*), and grape vines including (*Vitis aestivalis*).

Herbaceous vegetation may be quite diverse; characteristic species include bulblet fern (*Cystopteris bulbifera*), lady fern (*Athyrium filix-femina* var. *asplenioides*), oak fern (*Gymnocarpium dryopteris*), bottlebrush grass (*Elymus hystrix*), herb robert (*Geranium robertianum*), Solomon's-seal (*Polygonatum pubescens*), wild ginger (*Asarum canadense*), white baneberry (*Actaea pachypoda*), early meadow-rue (*Thalictrum dioicum*), bloodroot (*Sanguinaria canadensis*), wreath goldenrod (*Solidago caesia*), blue cohosh (*Caulophyllum thalictroides*), lyre-leaved rock cress (*Arabidopsis lyrata*), white wood aster (*Eurybia divaricata*), and ricegrass (*Oryzopsis racemosa*). Rock outcrops may have ferns such as walking fern (*Asplenium rhizophyllum*) and maidenhair spleenwort (*Asplenium trichomanes*). Bryophytes on wet forested talus can include stair-step moss (*Hylocomium splendens*).

Physiognomic variants range from northern white cedar-dominated, to hardwood-dominated forest, to non-vegetated talus. More data are needed to split out these variants.

Characteristic fauna include many species of snakes including black rat snake (*Elaphe alleganiensis*), smooth green snake (*Opheodrys vernalis*), northern ringneck snake (*Diadophis punctatus*), and northern redbelly snake (*Storeria occiptomaculata*). A rare reptile of some calcareous talus slope woodlands is the timber rattlesnake (*Crotalus horridus*). Five lined skink (*Eumeces fasciatus*) and many species of dragonflies and lycanid butterflies have also been seen. Other denning species such as the porcupine (*Erethizon dorsatum*) may also be found here.

Distribution: throughout upstate New York north of the Coastal Lowlands ecozone, at sites where the bedrock is calcareous.

Rank: G3G4 S3 *Revised:* 2001

Examples: Warner Hill, Washington County; The Diameter, Washington County; Deer Leap, Warren County; Clarence Escarpment, Erie County.

Sources: McVaugh 1958; Zenkert 1934; NYNHP field surveys.

19. Acidic talus slope woodland: An open to closed canopy woodland that occurs on talus slopes composed of non-calcareous bedrock such as granite, quartzite, or schist.

Characteristic trees include chestnut oak (*Quercus montana*), red oak (*Q. rubra*), white oak (*Q. alba*), white pine (*Pinus strobus*), paper birch (*Betula papyrifera*), yellow birch (*Betula alleghaniensis*), black birch (*B. lenta*), and mountain paper birch (*B. cordifolia*). Other trees include sugar maple (*Acer saccharum*), white ash *(Fraxinus americana*), and basswood (*Tilia americana*). Striped maple (*Acer pensylvanicum*) and mountain maple (*A. spicatum*) are common subcanopy trees. Red pine (*P. resinosa*) may occur in more northern examples, and tulip tree (*Liriodendron tulipifera*) may occur in more southern examples.

Characteristic shrubs include red elderberry (*Sambucus racemosa* ssp. *racemosa*), serviceberries (*Amelanchier* spp.), maple-leaved viburnum (*Viburnum acerifolium*), and brambles (*Rubus* spp.)

Characteristic groundlayer species include many ferns such as rock polypody (*Polypodium virginianum*), Christmas fern (*Polystichum acrostichoides*), marginal wood fern *(Dryopteris marginalis*), and rusty woodsia (*Woodsia ilvensis*). Other common herbs include wild sarsaparilla (*Aralia nudicaulis*). Crustose lichens are abundant on the talus.

Rare snakes of some acidic talus slope woodlands include include copperhead (*Agkistrodon contortrix*) and timber rattlesnake (*Crotalus horridus*).

Regional variants are known. Species characteristic of the Hudson River Valley may include witch hazel (*Hamamelis virginiana*), mountain laurel (*Kalmia latifolia*), scrub oak (*Quercus ilicifolia*), black huckleberry (*Gaylussacia baccata*), lowbush blueberry (*Vaccinium pallidum*), and Pennsylvania sedge (*Carex pensylvanica*).

Distribution: scattered throughout upstate New York, north of the Coastal Lowlands ecozone.

Rank: G4? S3 *Revised:* 2004

Examples: Black Rock Forest, Orange County; The Trapps, Ulster County; Catamount Mountain, Warren County; Chapel Pond Valley, Essex County; West Point Bull Hill, Orange County.

Sources: McVaugh 1958; NYNHP field surveys.

20. Shale talus slope woodland: an open to closed canopy woodland that occurs on talus slopes composed of shale. These slopes are rather unstable, and they are usually very well-drained, so the soils are shallow and dry. The canopy cover is usually less than 50%, due to the instability of the substrate.

Characteristic trees include chestnut oak (*Quercus montana*), pignut hickory (*Carya glabra*), red oak (*Quercus rubra*), white oak (*Q. alba*), white pine (*Pinus strobus*), white ash (*Fraxinus americana*), and eastern red cedar (*Juniperus virginiana*).

Characteristic shrubs and herbs include smooth sumac (*Rhus glabra*), scrub oak (*Quercus prinoides*), poison ivy (*Toxicodendron radicans*), penstemon (*Penstemon hirsutus*), everlasting (*Antennaria plantaginifolia*), and Pennsylvania sedge (*Carex pensylvanica*). More data on this community are needed.

Distribution: scattered throughout upstate New York, north of the Coastal Lowlands ecozone.

Rank: G3G4 S3 *Revised:* 1990

Examples: Chemung Shale Slope, Chemung County; Potic Mountain, Greene County; Whetstone Gulf, Lewis County; Chautauqua Gorge, Chautauqua County.

Sources: McVaugh 1958; NYNHP field surveys.

Summit Communities

The following five summit communities, and the rocky summit grassland community described earlier, typically occur on ridgetops and upper slopes, but can also occur midslope. They are typically variable in physiognomy with much clustering of woody and herbaceous vegetation and occurrences should be evaluated over broad areas. Included physiognomic types are often numerous: woodland, dwarf woodland, tall shrubland, dwarf heathland, herbaceous patches, and rock outcrops. Trees are often stunted/dwarfed, or contorted. Extreme fluctuations in the dominant species within an occurrence over time is possible. Ecological processes that influence the distribution of these patches and determines dominant species include fire regime, wind events, ice damage, heat stress, and erosion on steep slopes.

21. Pitch pine-oak-heath rocky summit: a community that occurs on warm, dry, rocky ridgetops and summits where the bedrock is non-calcareous (such as quartzite, sandstone, or schist), and the soils are more or less acidic. The vegetation may be sparse or patchy, with numerous rock outcrops. This community is broadly defined and includes examples that may lack pines and are dominated by scrub oak and/or heath shrubs apparently related to fire regime. Oak-heath summits without pitch pine are more common in the Hudson Highlands (S. Barbour *pers. comm.*). This community is often surrounded by chestnut oak forest.

Characteristic species include pitch pine (*Pinus rigida*), chestnut oak (*Quercus montana*), red oak (*Q. rubra*), and scarlet oak (*Q. coccinea*). Other trees may include black cherry (*Prunus serotina*), red maple (*Acer rubrum*), gray birch (*Betula populifolia*), choke-cherry (*Prunus virginiana*), serviceberry (*Amelanchier arborea*), white pine (*Pinus strobus*), and a few blackgum (*Nyssa sylvatica*).

Characteristic shrubs include scrub oak (*Qurcus ilicifolia*), common juniper (*Juniperus communis*), lowbush blueberries (*Vaccinium angustifolium, V. pallidum*), sweet-fern (*Comptonia peregrina*), and

black huckleberry (*Gaylussacia baccata*). Other shrubs include highbush blueberry (*Vaccinium corymbosum*), sheep laurel (*Kalmia angustifolia*), mountain laurel (*Kalmia latifolia*), chokeberry (*Aronia* spp.), and deerberry (*Vaccinium stamineum*).

Characteristic herbs include Pennsylvania sedge (*Carex pensylvanica*), poverty-grass (*Danthonia spicata*), common hairgrass (*Avenella flexuosa*), three-toothed cinquefoil (*Sibbaldiopsis tridentata*), and cow-wheat (*Melampyrum lineare*). Other herbs include bracken fern (*Pteridium aquilinum* var. *latiusculum*), wintergreen (*Gaultheria procumbens*), little bluestem (*Schizachyrium scoparium*), and pink corydalis (*Corydalis sempervirens*)

Characteristic lichens include various crustose, foliose, and fruticose lichens, such as *Cetraria arenaria,* reindeer lichens (*Cladonia* spp.), and cup lichens (*Cladonia* spp.). Characteristic mosses include hair cap moss (*Polytrichum* spp.) and white cushion moss (*Leucobryum glaucum*).

Examples dominated by white pine (*Pinus strobus*) or other oaks (*e.g., Quercus rubra* and *Q. montana*) are tentatively included here until further evaluation warrants the recognition of new community types (*e.g.,* "white pine rocky summit" and "red oak rocky summit").

Distribution: common in the Hudson Valley ecozone, also occurs in the Appalachian Plateau ecozone, and along the St. Lawrence River in the St. Lawrence Plains subzone.

Rank: G4 S3S4 *Revised:* 2001

Examples: Shawangunk Mountains, Ulster County; Schunnemunk Mountain, Orange County; Bellvale Mountain, Orange County; Prospect Mountain, Warren County.

Sources: McVaugh 1958; Olsvig 1980; NYNHP field surveys.

22. Red pine rocky summit: a community that occurs on cool, dry, rocky ridgetops and summits where the bedrock is non-calcareous (such as anorthosite, quartzite, or sandstone), and the soils are more or less acidic. Red pine (*Pinus resinosa*) is typically dominant, but may also be codominant with red oak (*Quercus rubra*) and/or white pine (*Pinus strobus*). Other trees include red maple (*Acer rubrum*), paper birch (*Betula papyrifera*), serviceberry (*Amelanchier arborea*), and red spruce (*Picea rubens*).

Characteristic shrubs include lowbush blueberries (*Vaccinium angustifolium, V. pallidum*) chokeberry (*Aronia melanocarpa*), common juniper (*Juniperus communis*), and bearberry (*Arctostaphylos uva-ursi*).

Characteristic herbs include tufted hairgrass (*Avenella flexuosa*), poverty-grass (*Danthonia spicata*), bracken fern (*Pteridium aquilinum* var. *latiusculum*), three-toothed cinquefoil (*Sibbaldiopsis tridentata*), Pennsylvania sedge (*Carex pensylvanica*), Canada mayflower (*Maianthemum canadense*), trailing arbutus (*Epigaea repens*), and wintergreen (*Gaultheria procumbens*).

Rock outcrops are dominated by various crustose, foliose, and fruticose lichens. Characteristic mosses include haircap moss (*Polytrichum juniperinum*) and *Hedwigia ciliata*.

Data on characteristic fauna are needed.

Distribution: primarily in the Adirondack Mountains and possibly in the Catskill Mountains (M. Corey *pers. comm.*).

Rank: G4 S3 *Revised:* 2011

Examples: Crane and Huckleberry Mountains, Warren County; Whiteface Mountain, Essex County; Peaked Hills, Essex County; Buck Mountain, Washington County.

Sources: NYNHP field surveys.

23. Spruce-fir rocky summit: a community that occurs on cool, dry, rocky ridgetops and summits where the bedrock is non-calcareous (such as anorthosite, quartzite, or sandstone), and the soils are more or less acidic. The vegetation may be sparse or patchy, with numerous rock outcrops and rock slides. The species have predominantly boreal distributions.

Characteristic trees include red spruce (*Picea rubens*), balsam fir (*Abies balsamea*), mountain ash (*Sorbus americana, S. decora*), and mountain paper birch (*Betula cordifolia*). Eastern hemlock (*Tsuga canadensis*) may be an associate in examples in the Catskill Mountains. The shrub layer includes sapling canopy trees along with blueberries (*Vaccinium angustifolium, V. myrtilloides*).

Characteristic herbs include harebell (*Campanula rotundifolia*), three-toothed cinquefoil (*Sibbaldiopsis tridentata*), mountain goldenrod (*Solidago simplex* var. *monticola*), large-leaf goldenrod (*S. macrophylla*), common hairgrass (*Avenella flexuosa*), bunchberry (*Cornus canadensis*), whorled aster (*Oclemena acuminata*), and small ricegrass (*Oryzopsis pungens*). There are usually many mosses and crustose lichens growing on rock outcrops. More data on this community are needed.

Distribution: primarily in the Adirondack and Catskill Mountains.

Rank: G4 S3 *Revised:* 2001

Examples: East Dix Mountain, Essex County; Pitchoff Mountain, Essex County; Giant Mountain, Essex County; Catskill Escarpment, Greene County.

Source: NYNHP field surveys.

24. Red cedar rocky summit: a community that occurs on warm, dry, rocky ridgetops and summits where the bedrock is calcareous (such as limestone or dolomite, but also marble, amphibolite, and calcsilicate rock), and the soils are more or less calcareous. The vegetation may be sparse or patchy, with numerous lichen covered rock outcrops. This community is often surrounded by Appalachian oak-hickory forest.

Characteristic trees include eastern red cedar (*Juniperus virginiana*), red oak (*Quercus rubra*), shagbark hickory (*Carya ovata*), white ash (*Fraxinus americana*), hop hornbeam (*Ostrya virginiana*), and serviceberries (*Amelanchier* spp.). In many examples many dead or dying red cedars may be evident, which is often associated with severe heat stress characteristic of this community.

Characteristic shrubs include sapling canopy trees along with common juniper (*Juniperus communis*), downy arrow-wood (*Viburnum rafinesquianum*), prickly ash (*Zanthoxylum americanum*), fragrant sumac (*Rhus aromatica*), and snowberry (*Symphoricarpos albus*). Other shrubs with low percent cover include lowbush blueberries (*Vaccinium pallidum, V. angustifolium*) and scrub oak (*Quercus ilicifolia*).

The herb layer can be quite diverse. Characteristic herbs include little bluestem (*Schizachyrium scoparium*), bristleleaf sedge (*Carex eburnea*), tufted hairgrass (*Avenella flexuosa*), buttercups (*Ranunculus fascicularis, R. micranthus*) maidenhair spleenwort (*Asplenium trichomanes*), upland white aster (*Oligoneuron album*), rockcresses (*Boechera missouriensis, Arabidopsis lyrata*), Douglas knotweed (*Polygonum douglasii*), bluets (*Houstonia caerulea*), and dittany (*Cunila origanoides*).

Other herbs include Pennsylvania sedge (*Carex pensylvanica*), rock polypody (*Polypodium virginianum*), marginal wood fern (*Dryopteris marginalis*), and everlasting (*Antennaria plantaginifolia*). Larger grass dominated areas (*e.g.*, greater than 0.5 acres or 0.2 ha) with little or no woody vegetation may be better classified as rocky summit grassland.

Nonvascular species include reindeer lichens such as *Cladonia stellaris* and cup lichens, including *Cladonia furcata*. Mosses include hair cap moss (*Polytrichum* spp.), *Hypnum cupressiforme, Anomodon attenuatus,* and *Hedwigia ciliata.*

Data on characteristic fauna are needed.

Distribution: throughout upstate New York, north of the Coastal Lowlands ecozone, where bedrock is calcareous; more common in the southern part of this range.

Rank: G3G4 S3 *Revised:* 2001

Examples: Neversink Glade, Orange County; Split Rock Mountain, Essex County; Tongue Mountain, Warren County; Black Rock Forest, Orange County.

Source: NYNHP field surveys.

25. Northern white cedar rocky summit: a community that occurs on cool, dry, rocky ridgetops and summits where the bedrock is calcareous (such as limestone or dolomite), and the soils are more or less calcareous. The vegetation may be sparse or patchy, with numerous rock outcrops. The species have predominantly boreal distributions. This community is often surrounded by other calcareous communities, such as limestone woodland, calcareous talus slope woodland, and calcareous cliff community.

Characteristic species include northern white cedar (*Thuja occidentalis*), American basswood (*Tilia americana*), and hop hornbeam (*Ostrya virginiana*). Other trees at low percent cover include sugar maple (*Acer saccharum*), American beech (*Fagus grandifolia*), and red pine (*Pinus resinosa*).

Characteristic herbs include upland white aster (*Oligoneuron album*), bristleleaf sedge (*Carex eburnea*), wild columbine (*Aquilegia canadensis*), bulblet fern (*Cystopteris bulbifera*), and oatgrass (*Trisetum triflorum*). More data on this community are needed.

Distribution: in upstate New York north of the Hudson Highlands ecozone, where bedrock is calcareous; more common in the northern part of this range.

Rank: G3G4 S2 *Revised:* 1990

Examples: Valcour Island, Clinton County; Hudson River Gorge, Hamilton and Essex Counties; Little Nose, Montgomery County.

Source: Larson *et al.* 2000; NYNHP field surveys.

26. Successional red cedar woodland: a woodland community that commonly occurs on abandoned agricultural fields and pastures, usually at elevations less than 1,000 ft (305 m).

The dominant tree is eastern red cedar (*Juniperus virginiana*), which may occur widely spaced in young stands and may be rather dense in more mature stands. Smaller numbers of gray birch (*Betula populifolia*), hawthorn (*Crataegus* spp.), buckthorn (*Rhamnus cathartica*), and other early successional hardwoods may be present. On slopes along the Finger Lakes, red cedar is commonly found mixed with white ash (*Fraxinus americana*) and black walnut (*Juglans nigra*).

Shrubs and groundlayer vegetation are similar to a successional old field; in some stands the groundcover consists of a nearly pure stand of non-native bluegrasses such as *Poa compressa* and *P. pratensis*.

A characteristic bird is the prairie warbler (*Dendroica discolor*). More data on characteristic fauna are needed.

Distribution: restricted to calcareous areas throughout upstate New York State.

Rank: G5 S5 *Revised:* 1990

Examples: Champlain Valley Essex, Essex County; Crown Point, Essex County; Beaver Brook Valley, Essex County; NY State Thruway at Cauterskill, Greene County.

Source: NYNHP field surveys.

C. FORESTED UPLANDS

This subsystem includes upland communities with more than 60% canopy cover of trees (greater than 5 m tall); these communities occur on substrates with less than 50% rock outcrop or shallow soil over bedrock.

Maritime Forests

The following four maritime forests, the successional maritime forest described later in this section, and the other "maritime" communities in this classification are generally in immediate proximity to marine and estuarine communities. These communities are heavily influenced by coastal processes including strong salt spray, high winds and dune deposition, shifting sand and overwash processes. Maritime forests generally contain stunted "salt pruned" trees with contorted branches and wilted leaves plus usually have a dense vine layer. Communities often occur as narrow bands under 50 meters wide. Greller (1977) referred to maritime forests as "strand forests" (*i.e.,* linear forests that develop on relatively narrow peninsulas and barrier islands).

1. Maritime oak forest: an oak-dominated forest that borders salt marshes or occurs on exposed bluffs and sand spits within about 200 meters of the seacoast. The trees may be somewhat stunted and flat-topped because the canopies are pruned by salt spray and exposed to winds.

The forest is usually dominated by two or more species of oaks. Characteristic canopy trees include post oak (*Quercus stellata*), black oak (*Q. velutina*), scarlet oak (*Q. coccinea*) and white oak (*Q. alba*). A small number of eastern red cedar (*Juniperus virginiana*) may be present.

The understory usually contains a dense shrub thicket dominated by bayberry (*Myrica pensylvanica*) and black huckleberry (*Gaylussacia baccata*), with saplings of black cherry (*Prunus serotina*) as a common associate. In most stands the small trees and shrubs are covered with a dense vine thicket of common greenbrier (*Smilax rotundifolia*). The presence of greenbrier is not well understood. It is likely a result of natural disturbances, such as exposure to salt spray and wind-throw. However, other disturbances such as insect infestations, heavy browsing by white-tailed deer, clear-cutting, and fires may produce a similar effect. Other vines are common including poison ivy (*Toxicodendron radicans*), wild grapes (*Vitis* spp.), and Virginia creeper (*Parthenocissus quinquefolia*). The sparse groundlayer under this shrub and vine thicket is dominated by common hairgrass (*Avenella flexuosa*).

Several variants of this community are known. The typical post oak-greenbrier forest variant, experiencing the most extreme degree of salt spray, is most widespread. A post oak-basswood variant on windswept sands forming dunes on top of morainal bluffs is reported along Long Island Sound (Lamont 1997). A white oak-black oak-scarlet oak-mockernut hickory (*Carya alba*) variant lacking post oak is known from morainal bluffs on the north shore on Montauk Peninsula at Hither Hills (A. Olivero *pers. comm.*).

Data on characteristic fauna are needed.

Distribution: apparently restricted to eastern Long Island and islands in Block Island Sound, in the Coastal Lowlands ecozone.

Rank: G3G4 S2S3 *Revised:* 2001

Examples: Mashomack Preserve, Suffolk County; Barcelona Neck, Suffolk County; Jessup's Neck, Suffolk County.

Sources: Greller 1977; Lamont 1997; Rosza and Metzler 1982; Taylor 1923; NYNHP field surveys.

2. Maritime beech forest: a deciduous forest that occurs near the seacoast on north-facing, exposed bluffs and the back portions of rolling dunes in well-drained, fine sands. The dominant tree is American beech (*Fagus grandifolia*); black oak (*Quercus velutina*) and red maple (*Acer rubrum*) may be present at a low density. Occurrences are often associated with coastal oak-beech forest. Wind and salt spray cause the trees to be stunted (average height 4-15 m) and multiple-stemmed with contorted branches, especially on the exposed bluffs. Trees are notably taller on the more protected dunes. Shrub and herb layers are not well developed.

Some examples may have a well-developed vine layer that includes common greenbrier (*Smilax rotundifolia*), wild grapes (*Vitis* spp.), poison ivy (*Toxicodendron radicans*), and Virginia creeper (*Parthenocissus quinquefolia*) (B. Carr *pers. comm.*).

Characteristic herbs are wild sarsaparilla (*Aralia nudicaulis*), and beech drops (*Epifagus virginiana*). The nonvascular layer may or may not be well developed.

Data on characteristic fauna are needed.

Distribution: currently known only from the town of Riverhead, Suffolk County. Historically, may have occurred along the north-facing coastal bluffs of Long Island, in the Coastal Lowland ecozone of Suffolk County.

Rank: G2 S1 *Revised:* 2001

Examples: Friars Head Forest, Suffolk County; Roanoke Point, Suffolk County.

Sources: Good and Good 1970; Greller 1977; Grossman *et al.* 1994; Lamont 1998; NYNHP field surveys.

3. Maritime holly forest: a broadleaf evergreen maritime strand forest that occurs in low areas on the back portions of maritime dunes. The dunes protect these areas from overwash and salt spray enough to allow forest formation. In New York State this forest is best developed and probably restricted to the barrier islands off the south shore of Long Island. The trees are usually stunted and flat-topped because the canopies are pruned by salt spray and exposed to winds; the canopy of a mature stand may be only 5 to 7 m (16 to 23 ft) tall.

The dominant tree is holly (*Ilex opaca*). Other characteristic trees at lower abundance include sassafras (*Sassafras albidum*), serviceberry (*Amelanchier canadensis*), post oak (*Quercus stellata*) and black oak (*Quercus velutina*).

Vines such as Virginia creeper (*Parthenocissus quinquefolia*), poison ivy (*Toxicodendron radicans*), common greenbrier (*Smilax rotundifolia*), sawbrier (*S. glauca*), and wild grapes (*Vitis* spp.) are common in the understory, and they often grow up into the canopy.

Shrubs such as highbush blueberry (*Vaccinium corymbosum*), bayberry (*Myrica pensylvanica*) and black huckleberry (*Gaylussacia baccata*) are common in the understory, especially at the margins of the forest.

Characteristic groundlayer herbs include wild sarsaparilla (*Aralia nudicaulis*), starry Solomon's seal (*Maianthemum stellata*), and Canada mayflower (*Maianthemum canadense*). There may be small, damp depressions that are somewhat boggy; species found in these depressions include blackgum (*Nyssa sylvatica*), serviceberry, highbush blueberry, and chokeberry (*Aronia melanocarpa*). Data on characteristic fauna are needed.

Distribution: restricted to southern fringe of Coastal Lowlands ecozone, concentrated on maritime dunes of barrier islands. Known and suspected examples limited to Fire Island. Very unlikely to be found elsewhere.

Rank: G1G2 S1 *Revised:* 2001

Examples: Sunken Forest, Suffolk County.

Sources: Art 1976; Greller 1977; Sneddon *et al.* 1998; NYNHP field surveys.

4. Maritime red cedar forest: a conifer forest that occurs on dry sites near the ocean. Eastern red cedar (*Juniperus virginiana*) is the dominant tree, often forming nearly pure stands. Red cedar is usually present in all tree and shrub layers. Other characteristic trees include post oak (*Quercus stellata*) and black cherry (*Prunus serotina*).

Characteristic shrubs and vines include bayberry (*Myrica pensylvanica*), groundsel-tree (*Baccharis halimifolia*), poison ivy (*Toxicodendron radicans*), and Virginia creeper (*Parthenocissus quinquefolia*).

Characteristic herbs include eastern prickly pear (*Opuntia humifusa*), common hairgrass (*Avenella flexuosa*), little bluestem (*Schizachyrium scoparium*), switch grass (*Panicum virgatum*), and seaside goldenrod (*Solidago sempervirens*).

A characteristic butterfly is olive hairstreak (*Mitoura grynea*) (D. Küntsler *pers. comm.*). More data on characteristic fauna are needed.

Distribution: known only from the Coastal Lowlands ecozone.

Rank: G3G4 S1 *Revised:* 1990

Example: Orient Point, Suffolk County.

Sources: Conard 1935; Greller 1977; Latham 1935; Robichaud-Collins and Anderson 1994; NYNHP field surveys.

Coastal Forests

The following five coastal forests are non-maritime forests within the coastal plain (*i.e.*, generally not in immediate proximity to marine communities). At most, the forests are lightly influenced by coastal processes, including minor salt spray associated with severe storms (*e.g.*, hurricanes), and lack dune deposition, shifting and overwash processes. Forests generally contain trees of normal stature with uncontorted branches and unwilted leaves. Coastal forests usually have a sparse vine layer.

5. Coastal oak-heath forest: a large patch to matrix hardwood forest of low diversity that typically occurs on dry, well-drained, sandy soils of glacial outwash plains or moraines of the coastal plain.

The forest is usually codominated by two or more species of oaks: scarlet oak (*Quercus coccinea*), white oak (*Q. alba*) and black oak (*Q. velutina*). Chestnut oak (*Quercus montana*) is also a common associate. Pitch pine (*Pinus rigida*), sassafras (*Sassafras albidum*), and other tree species typically have very low cover in the canopy. American chestnut (*Castanea dentata*) may have been a common associate in these forests prior to the chestnut blight; chestnut sprouts are still found in some stands.

The shrub layer is well-developed typically with a low nearly continuous cover of dwarf heaths such as lowbush blueberries (*Vaccinium pallidum, V. angustifolium*) and black huckleberry (*Gaylussacia baccata*).

The herbaceous layer is very sparse; characteristic species are bracken fern (*Pteridium aquilinum* var. *latiusculum*), wintergreen (*Gaultheria procumbens*), and Pennsylvania sedge (*Carex pensylvanica*). Herb diversity is greatest in natural and artificial openings with species such as frostweed (*Helianthemum canadense*), false-foxglove (*Aureolaria* spp.), bearberry (*Arctostaphylos uva-ursi*), goat's-rue (*Tephrosia virginiana*), bush-clovers (*Lespedeza* spp.), and pinweeds (*Lechea* spp.).

This community can occur with several types of barrens and woodland communities as part of the broadly defined ecosystem known as the Pine Barrens.

Data on characteristic fauna are needed.

Distribution: restricted to the interior portions of the Coastal Lowlands ecozone, concentrated on outwash plains; possibly knolls and mid to upper slopes of moraines. Known examples range from Hither Hills and Montauk Mountain; and west probably to the morainal hills of northwestern Suffolk County. Numerous examples occur in the central portion of this range (the periphery of the Long Island Pine Barrens) south of the Ronkonkoma Moraine (Greller 1977). Occurrences are more sparse in the eastern and western portions of the range. The community range possibly extends westward into eastern Nassau County on the end moraine of western Long Island and has been reported from a narrow strip of outwash on the north shore of Long Island.

Rank: G4 S3 *Revised:* 2001

Examples: Long Pond Greenbelt, Hither Hills State Park, Barcelona Neck, Bethpage State Park, Suffolk County.

Sources: Brodo 1968; Greller 1977; Sneddon *et al.* 1998; NYNHP field surveys.

6. Coastal oak-hickory forest: a hardwood forest with oaks (*Quercus* spp.) and hickories (*Carya* spp.) codominant that occurs in dry, well-drained, loamy sand of knolls, upper slopes, or south-facing slopes of glacial moraines of the coastal plain. The forest is usually codominated by two or more species of oaks, usually white oak (*Q. alba*), black oak (*Quercus velutina*) and chestnut oak (*Q. montana*). Scarlet oak (*Quercus coccinea*) is also a common associate. Mixed with the oaks are one or more of the following hickories: pignut (*Carya glabra*), mockernut (*C. alba*), and sweet pignut (*C. ovalis*). These hickories can range from nearly pure stands to as little as about 25% cover. There is typically a subcanopy stratum of small trees and tall shrubs including flowering dogwood (*Cornus florida*) and highbush blueberry (*Vaccinium corymbosum*). The shrub layer and groundlayer flora may be diverse. Common low shrubs include maple-leaf viburnum (*Viburnum acerifolium*), lowbush blueberries (*Vaccinium angustifolium, V. pallidum*) and black huckleberry (*Gaylussacia baccata*).

Characteristic groundlayer herbs are Swan's sedge (*Carex swanii*), panic grass (*Panicum dichotomum*), poverty grass (*Danthonia spicata*),

cow-wheat (*Melampyrum lineare*), spotted wintergreen (*Chimaphila maculata*), rattlesnake weed (*Hieracium venosum*), white wood aster (*Eurybia divaricata*), false Solomon's seal *(Maianthemum racemosum*), Pennsylvania sedge (*Carex pensylvanica*), and silver-rod (*Solidago bicolor*). Other herbs include Solomon's-seal (*Polygonatum biflorum*) and Canada mayflower (*Maianthemum canadense*) (David Küntsler *pers. comm.*)

Data on characteristic fauna are needed.

Distribution: restricted to the interior portions of the Coastal Lowlands ecozone, concentrated on knolls and mid to upper slopes of the moraines. Known examples range from Mashomack west to the morainal hills of northwestern Suffolk County. Numerous examples occur in the western portion of this range while occurrences are sparse in the eastern portion. The community range possibly extends westward into northeastern Nassau County and on the end moraine of western Long Island (Greller 1977).

Rank: G4 S3 *Revised:* 2001

Examples: Mashomack, Wildwood State Park, Caleb Smith State Park, Suffolk County.

Sources: Greller 1977; Greller *et al.* 1982; Rosza and Metzer 1982; Sneddon *et al.* 1998, NYNHP field surveys.

7. Coastal oak-beech forest: a hardwood forest with oaks (*Quercus* spp.) and American beech (*Fagus grandifolia*) codominant that occurs in dry, well-drained, loamy sand of morainal coves of the coastal plain. Some occurrences are associated with maritime beech forest. American beech can range from nearly pure stands to as little as about 25% cover. The forest is usually codominated by two or more species of oaks, usually black oak (*Quercus velutina*) and white oak (*Q. alba*). Scarlet oak (*Q. coccinea*) and chestnut oak (*Q. montana*) are common associates. Red oak (*Q. rubra*) may be present at low density, and is a key indicator species along with sugar maple (*Acer saccharum*) and paper birch (*Betula papyrifera*).

There are relatively few shrubs and herbs. Characteristic groundlayer species are Swan's sedge (*Carex swanii*), Canada mayflower (*Maianthemum canadense*), white wood aster (*Eurybia divaricata*), beech-drops (*Epifagus virginiana*), and false Solomon's seal *(Maianthemum racemosum*). Typically there is also an abundance of tree seedlings, especially of American beech; beech and oak saplings are often the most abundant "shrubs" and small trees.

Data on characteristic fauna are needed.

Distribution: restricted to interior portions of the Coastal Lowlands ecozone, concentrated on north-facing slopes on the moraines. Known examples range from Montauk Point (Brodo 1968) west to the Big Woods along the south shore of Long Island and from Route 48 Southold to Camp Baiting Hollow along the north shore of Long Island. Numerous examples occur in the Riverhead portion of the north shore. The community is also reported from necks of Long Island Sound (Greller 1977). It may occur in small patches farther west on Long Island to western Suffolk, Nassau and eastern Queens Counties (Greller 1977). The community was also apparently reported from New York City by Harper (1917) and Brodo (1968).

Rank: G4 S3 *Revised:* 2001

Examples: Mashomack, Friars Head, Wildwood State Park, Suffolk County.

Sources: Brodo 1968; Greller 1977; Rosza and Metzler 1982; Sneddon *et al.* 1998; Taylor 1923; NYNHP field surveys.

8. Coastal oak-laurel forest: a large patch, low diversity hardwood forest with broadleaf canopy and evergreen subcanopy that typically occurs on dry, well-drained, sandy and gravelly soils of morainal hills of the coastal plain. This forest is similar to the chestnut oak forest of the Appalachian Mountains; it is distinguished by lower abundance of chestnut oak (*Quercus montana*) and absence of red oak (*Q. rubra*), probably correlated with the difference between the sand and gravel of glacial moraines versus the bedrock of mountains.

The dominant tree is typically scarlet oak (*Q. coccinea*). Common associates are white oak (*Q. alba*), black oak (*Q. velutina*), and chestnut oak.

The shrub layer is well-developed typically with a tall, often nearly continuous cover of mountain laurel (*Kalmia latifolia*). Other characteristic shrubs include black huckleberry (*Gaylussacia baccata*) and lowbush blueberry (*Vaccinium pallidum*).

The herbaceous layer is very sparse; characteristic species are bracken fern (*Pteridium aquilinum* var. *latiusculum*), wintergreen (*Gaultheria procumbens*), and Pennsylvania sedge (*Carex pensylvanica*).

This forest is often associated with coastal oak-heath forest forming a forest complex on morainal hills.

Distribution: restricted to interior portions of Coastal Lowlands ecozone, concentrated on knolls and mid to upper slopes of moraines. Known examples range

from Hither Hills west possibly to the morainal hill of northwestern Suffolk County. Several examples occur along the eastern half of the Ronkonkoma Moraine. The community range possibly extends westward into eastern Nassau County on the end moraine of western Long Island.

Data on characteristic fauna are needed.

Rank: G3G4 S3 *Revised:* 2001

Example: Hither Woods, Suffolk County.

Sources: Cain 1936; Greller 1977; Sneddon *et al.* 1998; Thompson 1997; NYNHP field surveys.

9. Coastal oak-holly forest: a mixed deciduous-evergreen broadleaf forest that occurs on somewhat moist and moderately well drained silt and sandy loams in low areas on morainal plateaus. The elevation afforded by the raised plateau protects these areas from overwash and salt spray. In New York State this forest is best developed on the narrow peninsulas of eastern Long Island. The trees are usually not stunted, and are removed from the pruning effects of severe salt spray. The canopy of a mature stand is usually up to about 20 m (65 ft) tall.

The dominant canopy trees are black oak (*Quercus velutina*), blackgum (*Nyssa sylvatica*), red maple (*Acer rubrum*) and American beech (*Fagus grandifolia*). Holly (*Ilex opaca*) is abundant in the subcanopy and tall shrub layers. Other characteristic trees at lower density include sassafras (*Sassafras albidum*), serviceberry (*Amelanchier canadensis*), and white oak (*Quercus alba*).

Shrubs such as highbush blueberry (*Vaccinium corymbosum*), witch hazel (*Hamamelis virginiana*), mountain laurel (*Kalmia latifolia*) and arrowwood (*Viburnum dentatum* var. *lucidum*) are common in the understory. Vines such as Virginia creeper (*Parthenocissus quinquefolia*), poison ivy (*Toxicodendron radicans*), and common greenbrier (*Smilax rotundifolia*), sawbrier (*S. glauca*), and wild grapes (*Vitis* spp.) are at very low abundance in the understory, and usually do not grow up into the canopy.

Characteristic groundlayer herbs include New York fern (*Thelypteris noveboracensis*), star flower (*Trientalis borealis*) and Swan's sedge (*Carex swanii*). There may be small, damp depressions that are somewhat boggy; species found in these depressions include blackgum (*Nyssa sylvatica*), serviceberry, highbush blueberry, and chokeberry (*Aronia melanocarpa*).

Data on characteristic fauna are needed.

Distribution: restricted to eastern extreme of Coastal Lowlands ecozone, concentrated on Montauk Peninsula, a morainal plateau. Known and suspected examples limited to this peninsula, and very unlikely to be found elsewhere.

Rank: G2G3 S1 *Revised:* 2001

Example: Montauk Point, Suffolk County.

Sources: Greller 1977; Sneddon *et al.* 1998; Taylor 1923; NYNHP field surveys.

10. Pitch pine-oak forest: a mixed forest that typically occurs on well-drained, sandy soils of glacial outwash plains or moraines; it also occurs on thin, rocky soils of ridgetops.

The dominant trees are pitch pine (*Pinus rigida*) mixed with one or more of the following oaks: scarlet oak (*Quercus coccinea*), white oak (*Q. alba*), red oak (*Q. rubra*), or black oak (*Q. velutina*). The relative proportions of pines and oaks are quite variable within this community type. Examples can range from having widely spaced pines that are often emergent above the oak canopy to a nearly pure stand of pines with only a few widely spaced oak trees. The shrub layer is well-developed with scattered clumps of scrub oak (*Quercus ilicifolia*) and a nearly continuous cover of low heath shrubs such as lowbush blueberries (*Vaccinium pallidum, V. angustifolium*) and black huckleberry (*Gaylussacia baccata*).

The herbaceous layer is relatively sparse; characteristic species are bracken fern (*Pteridium aquilinum* var. *latiusculum*), wintergreen (*Gaultheria procumbens*), and Pennsylvania sedge (*Carex pensylvanica*).

Characteristic birds with varying abundance include eastern towhee (*Pipilo erythrophthalmus*), common yellowthroat (*Geothlypis trichas*), field sparrow (*Spizella pusilla*), prairie warbler (*Dendroica discolor*), pine warbler (*Dendroica pinus*), and blue jay (*Cyanocitta cristata*). More data on characteristic fauna are needed.

At least two potential regional variants are known or suspected: 1) the typical coastal variant on Long Island, and 2) the inland variant of upstate New York. More data on these regional variants are needed. This community combined with dwarf pine plains and pitch pine-oak-heath woodland with embedded, small patch wetlands make up the broadly defined ecosystem known as the Central Long Island Pine Barrens.

Distribution: known from the Coastal Lowlands and Hudson Valley ecozones.

Rank: G4G5 S4 *Revised:* 2001

Examples: Long Island Pine Barrens, Suffolk County; Albany Pine Bush, Albany County; Macomb Sandplain, Clinton County.

Sources: Bernard and Seischab 1995; Greller 1977; Kerlinger and Doremus 1981; Olsvig 1979; Reiners 1967; Seischab and Bernard 1996; NYNHP field surveys.

11. Appalachian oak-hickory forest: a hardwood forest that occurs on well-drained sites, usually on ridgetops, upper slopes, or south- and west-facing slopes. The soils are usually loams or sandy loams. This is a broadly defined forest community with several regional and edaphic variants.

The dominant trees include one or more of the following oaks: red oak (*Quercus rubra*), white oak (*Q. alba*), and black oak (*Q. velutina*). Mixed with the oaks, usually at lower densities, are one or more of the following hickories: pignut (*Carya glabra*), shagbark (*C. ovata*), and sweet pignut (*C. ovalis*). Common associates are white ash (*Fraxinus americana*), red maple (*Acer rubrum*), and hop hornbeam (*Ostrya virginiana*).

There is typically a subcanopy stratum of small trees and tall shrubs including flowering dogwood (*Cornus florida*), hop hornbeam, witch hazel (*Hamamelis virginiana*), serviceberry (*Amelanchier arborea*), and choke cherry (*Prunus virginiana*). Common low shrubs include maple-leaf viburnum (*Viburnum acerifolium*), lowbush blueberries (*Vaccinium angustifolium, V. pallidum*), red raspberry (*Rubus idaeus*), gray dogwood (*Cornus racemosa*), and beaked hazelnut (*Corylus cornuta*). The shrub layer and groundlayer flora may be diverse.

Characteristic groundlayer herbs are wild sarsaparilla (*Aralia nudicaulis*), false Solomon's seal *(Maianthemum racemosum*), Pennsylvania sedge (*Carex pensylvanica*), tick-trefoil (*Desmodium glutinosum, D. paniculatum*), black cohosh (*Cimicifuga racemosa*), rattlesnake root (*Prenanthes alba*), silver-rod (*Solidago bicolor*), mayapple (*Podophyllum peltatum*), and round-lobed hepatica (*Anemone americana*).

Characteristic birds of eastern oak-hickory forests, but not restricted to this type, include the following: 1) bark foragers such as northern flicker (*Colaptes auratus*), white-breasted nuthatch (*Sitta carolinensis*), downy woodpecker (*Picoides pubescens*), and hairy woodpecker (*P. villosus*); 2) active gleaners feeding in the tree canopy such as black-capped chickadee (*Poecile atricapillus*), tufted titmouse (*Baeolophus bicolor*), and red-eyed vireo (*Vireo olivaceus*); 3) pursuers feeding in tree canopy with a sit-and-wait hunting strategy such as flycatchers (*Empidonax* spp.) and scarlet tanagers (*Piranga olivacea*); 4) ground species associated with shrub and sapling layers such as thrushes (family Muscicapidae), eastern towhee (*Pipilo erythrophthalmus*), and ovenbird (*Seiurus aurocapillus*); and 5) species associated with dense growth of saplings and small trees, mostly warblers (Emberizidae) (Probst 1979). More data on characteristic fauna are needed.

Distribution: throughout upstate New York north of the Coastal Lowlands ecozone; most common south of the Adirondacks ecozone.

Rank: G4G5 S4 *Revised:* 1990

Examples: Alander Mountain, Taconic State Park, Columbia and Dutchess Counties; Tongue Mountain, Warren and Washington Counties; Fishkill Ridge, Dutchess and Putnam Counties; Round Hill, Clarence Fahnestock State Park, Putnam County; Bristol Hills, Stid Hill Multiple Use Area, Ontario County; Letchworth State Park, Livingston and Wyoming Counties; Sterling Forest State Park, Orange County.

Sources: Braun 1950; McIntosh 1972; Probst 1979; Ross 1958; NYNHP field surveys.

12. Allegheny oak forest: a hardwood forest that occurs on well-drained sites in the unglaciated portion of southwestern New York. This is a narrowly defined community distinguished by a more diverse flora, especially in the tree canopy and groundlayer, compared to other mid to high elevation oak communities in the state (*e.g.,* chestnut oak forest). These mixed oak forests are characteristic of the rounded ridgetops and upper south-facing slopes of the unglaciated Allegheny Plateau. In New York, they occur from 1,300 to 2,300 feet above sea level and grade into rich mesophytic forests that occur directly below them on west-facing, and east-facing slopes and sometimes on north-facing aspects.

Codominant trees are white oak (*Q. alba*), red oak (*Q. rubra*), chestnut oak (*Q. montana*), black oak (*Q. velutina*), and red maple (*Acer rubrum*). American chestnut (*Castanea dentata*) was a significant canopy codominant prior to the chestnut blight; chestnut sprouts are still very common in the understory. Other common canopy trees are pignut hickory (*Carya glabra*), black birch (*Betula lenta*), black cherry (*Prunus serotina*), and big-tooth aspen (*Populus grandidentata*).

The shrub-layer is a mixed heath with lowbush blueberries (*Vaccinium angustifolium, V. pallidum*),

black huckleberry (*Gaylussacia baccata*), maple-leaved viburnum (*Viburnum acerifolium*), and occasionally pink azalea (*Rhododendron periclymenoides)* and mountain laurel (*Kalmia latifolia*).

Common groundlayer herbs are bracken fern (*Pteridium aquilinum* var. *latiusculum*), Pennsylvania sedge (*Carex pensylvanica*), wintergreen (*Gaultheria procumbens*), wild sarsaparilla (*Aralia nudicaulis*), starflower (*Trientalis borealis*), barren strawberry (*Waldsteinia fragarioides*), flowering wintergreen (*Polygala paucifolia*), rough-leaved rice-grass (*Oryzopsis asperifolia*), white clintonia (*Clintonia umbellulata*), and rattlesnake weed (*Hieracium venosum*).

Allegheny oak forest can be distinguished from rich mesophytic forest by the presence of chestnut oak or the codominance of typically three to four oak species, negligible presence of sugar maple and Amercan beech, and a heath-dominated low shrub layer. It is distinguished from chestnut oak forest by codominance of four to five oak species, in contrast to dominance of chestnut oak or codominance of chestnut oak and red maple typical of chestnut oak forests.

Data on characteristic fauna are needed.

Distribution: known only from the Allegheny Hills subzone of the Appalachian Plateau ecozone.

Rank: G3G4 S2 *Revised:* 1990

Examples: Allegany State Park, Cattaraugus County; Robinson Run Hill, Cattaraugus County.

Sources: Eaton and Schrot 1987; Gordon 1937; NYNHP field surveys.

13. Chestnut oak forest: a hardwood forest that occurs on well-drained sites in glaciated portions of the Appalachians. This forest is similar to the Allegheny oak forest; it is distinguished by fewer canopy dominants and a less diverse shrub layer and groundlayer flora.

Dominant trees are typically chestnut oak (*Quercus montana*) and red oak (*Q. rubra*). Common associates are white oak (*Q. alba*), black oak (*Q. velutina*), and red maple (*Acer rubrum*). American chestnut (*Castanea dentata*) was a common associate in these forests prior to the chestnut blight; chestnut sprouts are still found in some stands.

The shrub layer is predominantly ericaceous; characteristic shrubs are black huckleberry (*Gaylussacia baccata*), mountain laurel (*Kalmia latifolia*), and lowbush blueberry (*Vaccinium pallidum*). Common groundlayer plants are Pennsylvania sedge (*Carex pensylvanica*), wild sarsaparilla (*Aralia nudicaulis*), wintergreen (*Gaultheria procumbens*), and white cushion moss (*Leucobryum glaucum*).

At least three edaphic variants with different understory dominants are known: 1) a tall shrub-dominated understory with 60-90% mountain laurel; 2) a short shrub-dominated understory with dense dwarf heaths, such as black huckleberry; and 3) an herb-dominated understory with Pennsylvania sedge. Chestnut oak forests may include small woodland patches (*i.e.*, tree canopy less than 60%) with similar floristic composition. These embedded woodlands are often associated with summits and rock outcrops. Larger embedded patches may be classified as one of the woodland or summit types in this classification.

Data on characteristic fauna are needed.

Distribution: most common on mid-elevation slopes of the Hudson Highlands ecozone, also occurs in the Manhattan Hills and Coastal Lowlands ecozones, and in the southeastern portion of the Appalachian Plateau ecozone. Reportedly occurs on the eastern slopes of the Catskill Mountains (M. Corey *pers. comm.*).

Rank: G5 S4 *Revised:* 2001

Examples: Hudson Highlands, Orange and Rockland Counties; Northern Shawangunk Mountains, Ulster County.

Sources: Braun 1950; Conard 1935; Eyre 1980; McIntosh 1972; McVaugh 1958; Ross 1958; NYNHP field surveys.

14. Oak-tulip tree forest: a mesophytic hardwood forest that occurs on moist, well-drained sites in southeastern New York. This community is similar to the "mixed mesophytic forest" described by Greller *et al.* (1978). The dominant trees include a mixture of five or more of the following: red oak (*Quercus rubra*), tulip tree (*Liriodendron tulipifera*), American beech (*Fagus grandifolia*), black birch (*Betula lenta*), red maple (*Acer rubrum*), scarlet oak (*Quercus coccinea*), black oak (*Q. velutina*), and white oak (*Q. alba*).

There is typically a subcanopy stratum of small trees and tall shrubs dominated by flowering dogwood (*Cornus florida*); common associates include witch-hazel (*Hamamelis virginiana*), sassafras (*Sassafras albidum*), red maple, and black cherry (*Prunus serotina*). Common low shrubs include maple-leaf viburnum (*Viburnum acerifolium*), northern blackberry (*Rubus allegheniensis*), and lowbush blueberries (*Vaccinium*

angustifolium, V. pallidum). Spicebush (*Lindera benzoin*) may be common in moister areas. A characteristic vine is Virginia creeper (*Parthenocissus quinquefolia*). The shrub layer and groundlayer flora may be diverse.

Characteristic groundlayer herbs are white wood aster (*Eurybia divaricata*), New York fern (*Thelypteris noveboracensis*), jack-in-the-pulpit (*Arisaema triphyllum*), wild geranium (*Geranium maculatum*), spring beauty (*Claytonia virginica*), Solomon's-seal (*Polygonatum biflorum*), and false Solomon's-seal *(Maianthemum racemosum*). Purple trillium (*Trillium erectum*) and wild ginger (*Asarum canadense*) may be present at low percent cover in less disturbed examples. Stilt grass (*Microstegium vimineum*) may become invasive in oak-tulip tree forests.

Data on characteristic fauna are needed.

Distribution: most common on the northern half of Long Island in the Coastal Lowlands ecozone, also occurs in the Manhattan Hills, Hudson Highlands, and Triassic Lowlands ecozones.

Rank: G4 S2S3 *Revised:* 2011

Examples: Black Rock Forest, Orange County; Breakneck-Scofield-Fishkill Ridge, Dutchess and Putnam Counties; Staten Island Greenbelt, Richmond County; Vanderbilt Mansion National Historic Site, Dutchess County; Van Cortlandt Park, Bronx County.

Sources: Braun 1950; Greller 1977; Greller *et al.* 1978; Rosza and Metzler 1982; NYNHP field surveys.

15. Appalachian oak-pine forest: a mixed forest that occurs on sandy soils, sandy ravines in pine barrens, or on slopes with rocky soils that are well-drained.

The canopy is dominated by a mixture of oaks and pines. The oaks include one or more of the following: black oak (*Quercus velutina*), chestnut oak (*Q. montana*), red oak (*Q. rubra*), white oak (*Q. alba*), and scarlet oak (*Q. coccinea*). The pines are either white pine (*Pinus strobus*) or pitch pine (*P. rigida*); in some stands both pines are present, but white pine should be greater than pitch pine. Red maple (*Acer rubrum*), eastern hemlock (*Tsuga canadensis*), American beech (*Fagus grandifolia*), and black cherry (*Prunus serotina*) are common associates occurring at low densities.

The tall shrub layer includes saplings of canopy trees plus witch hazel (*Hamamelis virginiana*), serviceberry (*Amelanchier arborea*), and hazelnuts (*Corylus americana, C. cornuta*). The short shrub layer is predominantly ericaceous, usually with lowbush blueberries (*Vaccinium angustifolium, V. pallidum*) and black huckleberry (*Gaylussacia baccata*), but also includes maple-leaf viburnum (*Viburnum acerifolium*) and tree canopy seedlings.

The groundlayer is relatively sparse, and comprised of Pennsylvania sedge (*Carex pensylvanica*), Canada mayflower (*Maianthemum canadense*), star flower (*Trientalis borealis*), wild sarsaparilla (*Aralia nudicaulis*), common hairgrass (*Avenella flexuosa*), partridge berry (*Mitchella repens*), bracken fern (*Pteridium aquilinum* var. *latiusculum*), woodferns (*Dryopteris intermedia, D. marginalis*), and wintergreen (*Gaultheria procumbens*).

Although Appalachian oak-pine forest currently includes white pine forests of the Coastal Lowlands, the latter may be distinctive enough to be designated as “coastal white pine-oak forest.” Appalachian oak-pine forest would be distinguished from a “coastal white pine-oak forest” by the presence of bedrock and large rocks (instead of sand and gravel), and by the presence and dominance of red oak instead of dominance by scarlet oak (*Quercus coccinea*) with red oak lacking. More data on the coastal variant and characteristic fauna are needed.

Distribution: occurs in the Appalachian Plateau, Hudson Valley, and Taconic Highlands ecozones.

Rank: G4G5 S4 *Revised:* 2011

Examples: Tongue Mountain, Warren County; Steege Hill, Chemung County; Catskill Escarpment, Greene County; Rome Sand Plains, Oneida County; Wilton Wildlife Preserve & Park, Saratoga County.

Sources: Braun 1950; McVaugh 1958; NYNHP field surveys.

16. Rich mesophytic forest: a hardwood or mixed forest that resembles the mixed mesophytic forests of the Allegheny Plateau south of New York (Braun 1950) but is less diverse. It occurs on mineral-rich, fine-textured, well-drained soils that are favorable for the dominance of a wide variety of tree species. A canopy with a relatively large number of codominant trees characterizes this forest. This community is distinct from the “mixed mesophytic forest” described by Greller *et al.* (1978) which is treated as oak-tulip tree forest in this classification.

Canopy codominants include five or more of the following species: red oak (*Quercus rubra*), red maple (*Acer rubrum*), white ash (*Fraxinus americana),* American beech (*Fagus grandifolia*),

sugar maple (*Acer saccharum)*, black cherry (*Prunus serotina*), cucumber tree (*Magnolia acuminata*), and black birch (*Betula lenta)*. American chestnut (*Castanea dentata*) was a characteristic tree before it was eliminated by chestnut blight. Less common in the canopy and subcanopy are tulip tree (*Liriodendron tulipifera*), white oak (*Quercus alba)*, white pine (*Pinus strobus*), basswood (*Tilia americana*), bitternut hickory (*Carya cordiformis*), black oak (*Quercus velutina*), hop hornbeam (*Ostrya virginiana*), and striped maple (*Acer pensylvanicum*).

This forest has a well-developed shrub layer with a variety of characteristic species including American hornbeam (*Carpinus caroliniana*), maple-leaf viburnum (*Viburnum acerifolium*), witch hazel (*Hamamelis virginiana*), pink azalea (*Rhododendron periclymenoides*), red elderberry (*Sambucus racemosa* ssp. *racemosa*), American fly-honeysuckle (*Lonicera canadensis*), round-leaved dogwood (*Cornus rugosa*), alternate-leaved dogwood (*C. alternifolia*), smooth serviceberry (*Amelanchier laevis*), and lowbush blueberry (*Vaccinium pallidum*).

The groundlayer is fairly rich in species. Characteristic herbs are interrupted fern (*Osmunda claytoniana*), yellow mandarin (*Disporum lanuginosum*), white baneberry (*Actaea pachypoda*), jack-in-the-pulpit (*Arisaema triphyllum*), early meadow rue (*Thalictrum dioicum*), tree clubmoss (*Dendrolycopodium obscurum*), partridge berry (*Mitchella repens*), round-leaf violet (*Viola rotundifolia*), black cohosh (*Cimicifuga racemosa*), stoneroot (*Collinsonia canadensis*), black snakeroot (*Sanicula marilandica*), large-leaf aster (*Eurybia macrophylla*), wreath goldenrod (*Solidago caesia*), and tall rattlesnake root (*Prenanthes trifoliolata*), blue bead lily (*Clintonia borealis*), white clintonia (*C. umbellulata*), and bearded short-husk (*Brachyelytrum erectum*).

In New York, rich mesophytic forests are best developed in the unglaciated portions of the Allegheny Plateau. In Cattaraugus County, this forest typically occurs at mid- to upper elevations between Allegheny oak forest on upper slopes and hemlock-northern hardwood forest on lower slopes and in ravines. The rich mesophytic forest can be distinguished from Allegheny oak forest by the lack of chestnut oak and lack of, or only very rarely present, black oak. The short shrub layer of Allegheny oak forest is typically dominated by heaths such as lowbush blueberry (*Vaccinium pallidum*), whereas the shrub layer of rich mesophytic forest is a mix of tree seedlings and saplings and tall shrub species such as red elderberry (*Sambucus racemosa* ssp. *racemosa*) and maple-leaved viburnum (*Viburnum acerifolium*). Rich mesophytic forest can be distinguished from maple-basswood rich mesic forest by having more red oak (*Quercus rubra*) and the presence of mineral-rich indicator species, such as Canada waterleaf (*Hydrophyllum canadense*), running strawberry bush (*Euonymus obovatus*), yellow mandarin (*Disporum lanuginosum*), and black cohosh (*Cimicifuga racemosa*). It can be distinguished from beech-maple mesic forest by the predominance of mineral-rich indicator herbs such as those listed above, and a soil pH range of about 4.5 to 5.0, in contrast to the generally more acidic soils of beech-maple mesic forest (pH about 4.0). Rich mesophytic forest soil typically contains more clay than other hardwood types, such as clay loam and silty clay loam.

Data on characteristic fauna are needed.

Distribution: known only from the western part of the Appalachian Plateau ecozone, primarily in the Allegheny Hills and Finger Lakes Highlands subzones.

Rank: G4 S2S3 *Revised:* 2001

Examples: Allegany State Park, Cattaraugus County; Zoar Valley, Cattaraugus County.

Sources: Braun 1950; Eaton and Schrot 1987; Gordon 1937; Greller *et al.* 1978; Shanks 1966; NYNHP field surveys.

17. Beech-maple mesic forest: a northern hardwood forest with sugar maple (*Acer saccharum*) and American beech (*Fagus grandifolia*) codominant. This is a broadly defined community type with several regional and edaphic variants. These forests occur on moist, well-drained, usually acid soils. Common associates are yellow birch (*Betula alleghaniensis*), white ash (*Fraxinus americana*), hop hornbeam (*Ostrya virginiana*), and red maple (*Acer rubrum*).

Characteristic small trees or tall shrubs are hobblebush (*Viburnum lantanoides*), American hornbeam (*Carpinus caroliniana*), striped maple (*Acer pensylvanicum*), witch hazel (*Hamamelis virginiana*), and alternate-leaved dogwood (*Cornus alternifolia*). Typically there is also an abundance of tree seedlings, especially of sugar maple; American beech and sugar maple saplings are often the most abundant “shrubs” and small trees. Eastern hemlock (*Tsuga canadensis*) may be present at a low density. In the Adirondacks a few red spruce (*Picea rubens*) may also be present.

Characteristic herbs are woodferns (*Dryopteris intermedia, D. carthusiana, D. marginalis*), Canada mayflower (*Maianthemum canadense*), Christmas fern (*Polystichum acrostichoides*), white wood aster (*Eurybia divaricata*), common wood-sorrel (*Oxalis*

montana), Pennsylvania sedge (*Carex pensylvanica*), jack-in-the-pulpit (*Arisaema triphyllum*), sarsaparilla (*Aralia nudicaulis*), shining fir clubmoss (*Huperzia lucidula*), bearded short-husk (*Brachyelytrum erectum*), white snakeroot (*Ageratina altissima* var. *altissima*), violets (*Viola* spp.), star flower (*Trientalis borealis*), partridge berry (*Mitchella repens*), Solomon's-seals (*Polygonatum pubescens, P. biflorum*), foam flower (*Tiarella cordifolia*), false Solomon's seal *(Maianthemum racemosum*), whorled aster (*Oclemena acuminata*), Indian cucumber-root (*Medeola virginiana*), wreath goldenrod (*Solidago caesia*), trilliums (*Trillium undulatum, T. erectum*), mayapple (*Podophyllum peltatum*), troutlily (*Erythronium americanum*), and sessile-leaved bellwort (*Uvularia sessilifolia*). In forests that have American beech as a codominant tree, beech-drops (*Epifagus virginiana*) are common. Hay-scented fern (*Dennstaedtia punctilobula*) may be common in canopy gaps. There are many spring ephemerals which bloom before the canopy trees leaf out.

Characteristic breeding birds in beech-maple forests include red-eyed vireo (*Vireo olivaceus*), ovenbird (*Seiurus aurocapillus*), black-throated blue warbler (*Dendroica caerulescens*), and black-throated green warbler (*Dendroica virens*) (Kendeigh 1946, Germaine *et al.* 1997). These birds are not restricted to this forest type. More data on characteristic fauna are needed.

Within extensive areas of beech-maple mesic forest, there are often associated small patches of hemlock-northern hardwood forest in steep ravines and gullies where eastern hemlock is locally dominant.

Distribution: throughout New York State.

Rank: G4 S4 *Revised:* 2001

Examples: Five Ponds Wilderness Area, Herkimer and Hamilton Counties; West Canada Lakes Wilderness Area, Herkimer and Hamilton Counties; Central Tug Hill Forest, Jefferson, Lewis, and Oswego Counties; Catskill Park (including Slide Mountain, Plateau Mountain, Westkill Mountain, Beaverkill Drainage), Delaware, Greene, Sullivan, and Ulster Counties.

Sources: Braun 1950; Eyre 1980; Germaine *et al.* 1997; Gordon 1937; Heimburger 1934; Holmes *et al.* 1986; Kendeigh 1946; Leopold *et al.* 1988; McIntosh 1972; Shanks 1966; NYNHP field surveys.

18. Maple-basswood rich mesic forest: a species-rich northern hardwood forest that typically occurs on well-drained, moist soils of circumneutral pH. Calcium-rich indicator herbs are predominant in the groundlayer and are usually correlated with calcareous bedrock, although bedrock does not have to be exposed. Where bedrock outcrops are lacking, surficial features such as seeps are often present.

The dominant trees are sugar maple (*Acer saccharum*), basswood (*Tilia americana*), and white ash (*Fraxinus americana*). Associate tree species can include hop hornbeam (*Ostrya virginiana*), yellow birch (*Betula alleghaniensis*), red oak (*Quercus rubra*), American beech (*Fagus grandifolia*), bitternut hickory (*Carya cordiformis*), shagbark hickory (*Carya ovata*), tulip tree (*Liriodendron tulipifera*), butternut (*Juglans cinerea*), and American hornbeam (*Carpinus caroliniana*).

Characteristic tall shrubs are alternate-leaved dogwood (*Cornus alternifolia*), mountain maple (*Acer spicatum*), and witch hazel (*Hamamelis virginiana*); the shrub layer is typically patchy and can be quite sparse in herb rich areas.

Spring ephemerals are usually abundant in the groundlayer. Characteristic species are wild leek (*Allium tricoccum*), troutlily (*Erythronium americanum*), dutchman's breeches (*Dicentra cucullaria*), squirrel-corn (*Dicentra canadensis*), purple trillium (*Trillium erectum),* nodding trillium (*Trillium cernuum*), spring beauty (*Claytonia virginica*), maidenhair fern (*Adiantum pedatum*), bulbet fern (*Cystopteris bulbifera*), Goldie’s fern (*Dryopteris goldiana*), lady fern (*Athyrium filix-femina* var. *aslplenioides*), silvery glade fern (*Deparia acrostichoides*), glade fern (*Diplazium pyncnocarpon*), blue cohosh (*Caulophyllum thalictroides*), herb robert (*Geranium robertianum*), wild ginger (*Asarum canadense*), early meadow-rue (*Thalictrum dioicum*), false Solomon's seal (*Maianthemum racemosum*), white baneberry (*Actaea pachypoda*), Virginia waterleaf (*Hydrophyllum virginianum*), two-leaf toothwort (*Cardamine diphylla*), bloodroot (*Sanguinaria canadensis*), foam flower (*Tiarella cordifolia*), mayapple (*Podophyllum peltatum*), and wide-leaved sedges (*Carex plantaginea, Carex platyphylla, C. albursina*).

Maple-basswood rich mesic forest can be distinguished from beech-maple mesic forest by the predominance of calcium-rich indicator plants in the herbaceous layer and the high species diversity of this layer, which often supports a variety of fern species and a strong component of spring ephemerals. A less less rich variant codominated by red oak and sugar maple is reported from the lower Hudson Valley (A. Finton, S. Barbour, J. Braden *pers. comm.*).

More data on the variant and characteristic fauna are needed.

Distribution: primarily known from the Great Lakes Plain ecozone.

Rank: G4 S3 *Revised:* 2001

Examples: Allegany State Park, Cattaraugus County; Pitcarin Forest, St. Lawrence and Lewis Counties; Great Gully, Cayuga County.

Sources: Braun 1950; Eaton and Schrot 1987; Eyre 1980; NYNHP field surveys.

19. Hemlock-northern hardwood forest: a mixed forest that typically occurs on middle to lower slopes of ravines, on cool, mid-elevation slopes, and on moist, well-drained sites at the margins of swamps.

In any one stand, eastern hemlock (*Tsuga canadensis*) is codominant with any one to three of the following: sugar maple (*Acer saccharum*), red maple (*A. rubrum*), yellow birch (*Betula alleghaniensis*), black birch (*B. lenta*), red oak (*Quercus rubra*), American beech (*Fagus grandifolia*), white ash (*Fraxinus americana*), chestnut oak (*Quercus montana*), white oak (*Q. alba*), white pine (*Pinus strobus*), Other trees may include hop hornbeam (*Ostrya virginiana*), black cherry (*Prunus serotina*), and basswood (*Tilia americana*). The relative cover of eastern hemlock is quite variable, ranging from nearly pure stands in some steep ravines to as little as 20% of the canopy cover. Striped maple (*Acer pensylvanicum*) is often prominent as a mid-story tree.

The shrub layer may be sparse and typically includes saplings of canopy trees. Characteristic shrubs are witch hazel (*Hamamelis virginiana*), hobblebush (*Viburnum lantanoides*), maple-leaf viburnum (*Viburnum acerifolium*), lowbush blueberry (*Vaccinium pallidum*), and raspberries (*Rubus* spp.). In some ravines, especially in the southern part of the state, rosebay (*Rhododendron maximum*) forms a dense subcanopy or tall shrub layer.

Canopy cover can be quite dense, resulting in low light intensities on the forest floor and hence a relatively sparse groundlayer. Characteristic groundlayer herbs include woodferns (*Dryopteris marginalis, D. intermedia D. campyloptera*), Christmas fern (*Polystichum acrostichoides*), Canada mayflower (*Maianthemum canadense*), white wood aster (*Eurybia divaricata*), sarsaparilla (*Aralia nudicaulis*), partridge berry (*Mitchella repens*), common wood-sorrel (*Oxalis montana*), jack-in-the-pulpit (*Arisaema triphyllum*), star flower (*Trientalis borealis*), lady fern (*Athyrium filix-femina* var. *asplenioides*), and Pennsylvania sedge (*Carex pensylvanica*). Other plants include Indian cucumber-root (*Medeola virginiana*), sessile-leaved bellwort (*Uvularia sessilifolia*), shining fir clubmoss (*Huperzia lucidula*), foamflower (*Tiarella cordifolia*), round-leaf violet (*Viola rotundifolia*), twisted stalk (*Streptopus roseus*), purple trillium (*Trillium erectum*), and white cushion moss (*Leucobryum glaucum*). In forests that have American beech as a codominant tree, beech-drops (*Epifagus virginiana*) is a common herb. Indian-pipe (*Monotropa uniflora*) and American pinesap (*M. hypopithys*) are occasionally found in low light examples. Hay-scented fern (*Dennstaedtia punctilobula*) and New York fern (*Thelypteris noveboracensis*) may be common in canopy gaps.

Birds frequently found in hemlock forests include Acadian flycatcher (*Empidonax virescens*), blue-headed vireo (*Vireo solitarius*), black-throated green warbler (*Dendroica virens*), and Blackburnian warbler (*Dendroica fusca*) (Ross *et al.* 2004). These birds are not restricted to this forest type. More data on characteristic fauna are needed.

This is a broadly defined and very widespread community, with many regional and edaphic variants. For example, in the Hudson Valley, eastern hemlock is sometimes codominant with red oak (Charney 1980) and is also the case in and central and western New York (D. Faber-Langendoen *pers. comm.*); in the Adirondacks, yellow birch and sugar maple are sometimes codominant, with a relatively small number of eastern hemlocks as well as a few red spruce (*Picea rubens*). More data on the shrub layer and groundlayer composition are needed before these regional variants can be distinguished as separate types.

Distribution: throughout New York State.

Rank: G4G5 S4 *Revised:* 2004

Examples: Ampersand Mountain, Franklin County; Five Ponds Wilderness Area, Herkimer and Hamilton Counties; Slide Mountain, Sullivan and Ulster Counties; Big Basin in Allegany State Park, Cattaraugus County; Western Rensselaer Plateau Escarpment, Rensselaer County.

Sources: Braun 1950; Charney 1980; Eyre 1980; Heimburger 1934; Leopold *et al.* 1988; McIntosh 1972; McVaugh 1958; Ross 1958; Ross *et al.* 2004; Shanks 1966; NYNHP field surveys.

20. Pine-northern hardwood forest: a mixed forest that occurs on gravelly outwash plains, delta sands, eskers, and dry lake sands in the Adirondacks. The dominant trees are white pine (*Pinus strobus*) and red pine (*P. resinosa*); these are mixed with scattered

paper birch (*Betula papyrifera*) and quaking aspen (*Populus tremuloides*). In some stands there is an admixture of other northern hardwoods and conifers such as yellow birch (*Betula alleghaniensis*), red maple (*Acer rubrum*), balsam fir (*Abies balsamea*), and red spruce (*Picea rubens*); these are never common in a pine-northern hardwood forest.

Characteristic shrubs are blueberries (*Vaccinium angustifolium, V. myrtilloides*), sheep laurel (*Kalmia angustifolia*), wild raisin (*Viburnum nudum* var. *cassinoides*), and serviceberry (*Amelanchier canadensis*).

Characteristic herbs are bracken fern (*Pteridium aquilinum* var. *latiusculum*), wintergreen (*Gaultheria procumbens*), trailing arbutus (*Epigaea repens*), cow-wheat (*Melampyrum lineare*), Canada mayflower (*Maianthemum canadense*), bunchberry (*Cornus canadensis*), star flower (*Trientalis borealis*), blue bead-lily (*Clintonia borealis*), painted trillium (*Trillium undulatum*), spreading ricegrass (*Oryzopsis asperifolia*), and Pennsylvania sedge (*Carex pensylvanica*). Mosses and lichens may be common to abundant, especially the mosses big red stem moss (*Pleurozium schreberi*), *Brachythecium* spp., and *Dicranum polysetum*.

Characteristic birds with varying abundance include pine warbler (*Dendroica pinus*) and pileated woodpecker (*Dryocopus pileatus*). More data on characteristic fauna are needed.

Distribution: throughout upstate New York, north of the Coastal Lowlands ecozone, more common to the north.

Rank: G4 S4 *Revised:* 1990

Examples: Five Ponds Wilderness Area, Herkimer and Hamilton Counties; Black Brook Forest, Clinton and Essex Counties; Pine Orchard, Hamilton County.

Sources: Eyre 1980; Heimburger 1934; Roman 1980; NYNHP field surveys.

21. Spruce flats: a mixed forest that occurs on moist sites along the borders of swamps and in low flats along lakes and streams in the Adirondacks. Soils are strongly podzolized, loamy to sandy, and seasonally moist, but not saturated and not peaty.

Typically, the dominant trees are red spruce (*Picea rubens*) and red maple (*Acer rubrum*) mixed with smaller numbers of yellow birch (*Betula alleghaniensis*), black cherry (*Prunus serotina*), and eastern hemlock (*Tsuga canadensis*). Spruce and yellow birch, or sometimes these and eastern hemlock, make up about 75% of the canopy cover. Smaller numbers of other northern hardwoods, such as American beech (*Fagus grandifolia*) may also be present. The shrub layer is sparse or patchy.

Characteristic shrubs are sheep laurel (*Kalmia angustifolia*), and blueberries (*Vaccinium angustifolium, V. myrtilloides*).

Typically the groundcover consists of a luxuriant carpet of mosses and herbs, with an abundance of feather mosses. Some common bryophytes are the mosses big red stem moss (*Pleurozium schreberi*), stair-step moss (*Hylocomium splendens*), knight's plume moss (*Ptilium crista-castrensis*), *Dicranum* spp., and the leafy liverwort *Bazzania trilobata*.

Characteristic herbs are creeping snowberry (*Gaultheria hispidula*), goldthread (*Coptis trifolia*), dewdrop (*Dalibarda repens*), bunchberry (*Cornus canadensis*), and Canada mayflower (*Maianthemum canadense*).

A characteristic bird is golden-crowned kinglet (*Regulus satrapa*). More data on characteristic fauna are needed.

A more restricted variant codominated by black spruce (*Picea mariana*) and tamarack (*Larix laricina*) and with only low abundance of red spruce is known from dry to moist, well-drained sandy outwash plains of the Adirondacks. White spruce (*P. glauca*) and Labrador tea (*Rhododendron groenlandicum*) may be characteristic of this variant. This variant apparently develops in association with boreal heath barrens in areas which experience fire or cold air accumulation.

Distribution: primarily known from the Adirondacks ecozone.

Rank: G4? S4 *Revised:* 2001

Examples: Five Ponds Wilderness Area, Herkimer and Hamilton Counties; West Canada Lakes Wilderness Area, Herkimer and Hamilton Counties; Moose River Plains, Hamilton County.

Sources: Braun 1950; Eyre 1980; Heimburger 1934; NYNHP field surveys.

22. Balsam flats: a conifer forest that occurs on moist, well-drained soils of low flats adjoining swamps, gentle low ridges, and knolls within swamps.

The dominant tree is balsam fir (*Abies balsamea*), which occurs either in pure stands or in mixed stands with red spruce (*Picea rubens*) or black spruce (*P. mariana*), and possibly a few yellow birch (*Betula alleghaniensis*), red maple (*Acer rubrum*), and black cherry (*Prunus serotina*).

The shrub layer is patchy and sparse; characteristic tall shrubs include hobblebush (*Viburnum lantanoides*), wild raisin (*V. nudum* var.

cassinoides), and mountain ash (*Sorbus americana, S. decora*). The groundlayer is typically a dense carpet of feather mosses, especially stair-step moss (*Hylocomium splendens*).

Characteristic herbs include common wood-sorrel (*Oxalis montana*), bunchberry (*Cornus canadensis*), creeping snowberry (*Gaultheria hispidula*), blue bead-lily (*Clintonia borealis*), wild sarsaparilla (*Aralia nudicaulis*), dewdrop (*Dalibarda repens*), spinulose wood fern (*Dryopteris carthusiana*), and lady fern (*Athyrium filix-femina* var. *asplenioides*). More data on this community are needed.

Distribution: known only from the Adirondacks ecozone.

Rank: G4 S3S4 *Revised:* 1990

Examples: Blue Ridge Wilderness Area, Hamilton County; Deer Pond Marsh, Franklin County; Cold Brook Plains, Essex County.

Sources: Eyre 1980; Zon 1914; NYNHP field surveys.

23. Spruce-northern hardwood forest: a mixed forest that occurs on lower mountain slopes and upper margins of flats on glacial till. This is a broadly defined community with several regional and edaphic variants; it is one of the most common forest types in the Adirondacks.

Codominant trees are red spruce (*Picea rubens*), sugar maple (*Acer saccharum*), American beech (*Fagus grandifolia*), yellow birch (*Betula alleghaniensis*), and red maple (*Acer rubrum*), with scattered balsam fir (*Abies balsamea*). Striped maple (*Acer pensylvanicum*) and mountain maple (*A. spicatum*) are common subcanopy trees.

Characteristic shrubs are hobblebush (*Viburnum lantanoides*), American fly honeysuckle (*Lonicera canadensis*), and Canada yew (*Taxus canadensis*).

Characteristic groundlayer plants are common wood-sorrel (*Oxalis montana*), common wood fern (*Dryopteris intermedia*), shining fir clubmoss (*Huperzia lucidula*), wild sarsaparilla (*Aralia nudicaulis*), blue bead-lily (*Clintonia borealis*), goldthread (*Coptis trifolia*), bunchberry (*Cornus canadensis*), Canada mayflower (*Maianthemum canadense*), Indian cucumber-root (*Medeola virginiana*), and twisted stalk (*Streptopus roseus*).

Characteristic birds with varying abundance include white-throated sparrow (*Zonotrichia albicollis*), golden-crowned kinglet (*Regulus satrapa*), pileated woodpecker (*Dryocopus pileatus*), and gray jay (*Perisoreus canadensis*) in the Adirondacks. More data on characteristic fauna are needed.

Distribution: primarily known from the Adirondacks and Tug Hill Plateau ecozones; also occurs in the Catskill Peaks subzone of the Appalachian Plateau ecozone.

Rank: G3G4 S3S4 *Revised:* 1990

Examples: Five Ponds Wilderness Area, Herkimer and Hamilton Counties; Slide Mountain, Ulster County; Kildare Forest, St. Lawrence County.

Sources: Braun 1950; Eyre 1980; Heimburger 1934; Irland 1993; Leopold *et al.* 1988; Roman 1980; Zon 1914; NYNHP field surveys.

24. Mountain spruce-fir forest: a conifer forest that occurs at high elevations in the Catskill and Adirondack mountains, usually at elevations ranging from 3,000 to 4,000 ft (about 900 to 1,200 m). This forest occurs on upper slopes that are somewhat protected from the prevailing westerly winds, usually at elevations above spruce-northern hardwood forests, and below mountain fir forests. Soils are strongly podzolized, and they tend to be highly organic.

The dominant trees are red spruce (*Picea rubens*) and balsam fir (*Abies balsamea*). Common associates are mountain paper birch (*Betula cordifolia*) and yellow birch (*B. alleghaniensis*). Subcanopy trees that are usually present at a low density include mountain ash (*Sorbus americana, S. decora*), mountain maple (*Acer spicatum*), pin cherry (*Prunus pensylvanica*) and striped maple (*Acer pensylvanicum*). The shrub layer may consist primarily of seedlings and saplings of canopy trees; other shrubs that are present in some stands include red elderberry (*Sambucus racemosa* ssp. *racemosa*), mountain holly (*Nemopanthus mucronatus*), American fly honeysuckle (*Lonicera canadensis*), and dwarf raspberry (*Rubus pubescens*). In the Catskills, hobblebush (*Viburnum lantanoides*) and mountain azalea (*Rhododendron prinophyllum*) are also common. Typically there is a dense layer of feather mosses and other bryophytes carpeting the forest floor; common bryophytes include the mosses big red stem moss (*Pleurozium schreberi*), knight's plume moss (*Ptilium crista-castrensis*), *Brotherella recurvans*, broom moss (*Dicranum scoparium*), *Hypnum pallescens*, stair-step moss (*Hylocomium splendens*), *Sanionia uncinata*, and the leafy liverwort *Bazzania trilobata*.

Characteristic herbs are common wood-sorrel (*Oxalis montana*), mountain wood fern (*Dryopteris*

campyloptera), blue bead-lily (*Clintonia borealis*), Canada mayflower (*Maianthemum canadense*), bunchberry (*Cornus canadensis*), large-leaf goldenrod (*Solidago macrophylla*), whorled aster (*Oclemena acuminata*), goldthread (*Coptis trifolia*), and shining fir clubmoss (*Huperzia lucidula*).

Characteristic birds with varying abundance include white-throated sparrow (*Zonotrichia albicollis*), winter wren (*Troglodytes troglodytes*), golden-crowned kinglet (*Regulus satrapa*), yellow-rumped warbler (*Dendroica coronata*), blackpoll warbler (*Dendroica striata*), Swainson's thrush (*Catharus ustulatus*), and yellow-bellied flycatcher (*Empidonax flaviventris*). A rare bird of some mountain spruce-fir forests is Bicknell's Thrush (*Catharus bicknelli*) (Rimmer *et al.* 2001).

A significant disturbance that is currently affecting mountain spruce-fir forests in the eastern US is spruce decline, a phenomenon that retards the growth of red spruce and eventually kills many trees. The causes of spruce decline have not been substantiated, but atmospheric deposition of pollutants (acid rain) is likely a contributing factor

Distribution: on high-elevation slopes of the Adirondack High Peaks and the Catskill Peaks.

Rank: G3 S2S3 *Revised:* 1990

Examples: Street Mountain, Essex County; Whiteface Mountain, Essex County; Phelps Brook, Essex County; Hunter Mountain, Greene County; Cornell Mountain, Ulster County.

Sources: Eyre 1980; Holway and Scott 1969; Leopold *et al.* 1988; McIntosh and Hurley 1964; McLaughlin *et al.* 1987; Nicholson 1965; Rimmer *et al.* 2001; Sabo 1980; Slack 1977; NYNHP field surveys.

25. Mountain fir forest: a conifer forest that occurs at high elevations in the Catskill and Adirondack mountains, usually at elevations ranging from 3,500 to 4,500 ft (about 1,100 to 1,400 m). This forest typically occurs on cool upper slopes that are exposed to wind, at elevations above spruce-northern hardwood forests, usually above mountain spruce-fir forest, and below alpine krummholz. Soils are typically thin (less than 20 in or 50 cm), and they tend to be highly organic and strongly acidic. The vegetation typically has a low species diversity; the tree layer is almost entirely balsam fir (*Abies balsamea*), with a small amount of mountain paper birch (*Betula cordifolia*) and occasional individuals of red spruce (*Picea rubens*) and mountain ash (*Sorbus americana, S. decora*).

The shrub layer is predominantly seedlings and saplings of balsam fir, with occasional individuals of green alder (*Alnus viridis* ssp. *crispa)* and Labrador tea (*Rhododendron groenlandicum*). Red raspberry (*Rubus idaeus*) and skunk currant (*Ribes glandulosum*) occur in recently disturbed areas.

Characteristic herbs are common wood-sorrel (*Oxalis montana*), blue bead-lily (*Clintonia borealis*), Canada mayflower (*Maianthemum canadense*), mountain wood fern (*Dryopteris campyloptera*), bunchberry (*Cornus canadensis*), large-leaf goldenrod (*Solidago macrophylla*), whorled aster (*Oclemena acuminata*), goldthread (*Coptis trifolia*), and bristly clubmoss (*Spinulum annotinum*). The forest floor is typically carpeted with mosses, including *Dicranum fuscescens,* broom moss (*Dicranum scoparium*), *Plagiothecium laetum,* big red stem moss (*Pleurozium schreberi*), *Polytrichastrum ohioense,* and *Sanionia uncinata.*

Characteristic birds with varying abundance include white-throated sparrow (*Zonotrichia albicollis*), winter wren (*Troglodytes troglodytes*), blackpoll warbler (*Dendroica striata*), yellow-bellied flycatcher (*Empidonax flaviventris*), magnolia warbler (*Dendroica magnolia*), purple finch (*Carpodacus purpureus*), and Nashville warbler (*Vermivora ruficapilla*). A rare bird of some mountain fir forests is Bicknell's Thrush (*Catharus bicknelli*) (Rimmer *et al.* 2001).

In certain areas mountain fir forests exhibit a distinctive pattern of disturbance and regrowth that is called "wave- regeneration" or "fir waves." From a distance the forest appears to be very patchy, with large areas of green canopy interspersed with roughly crescent-shaped bands of dead trees. The "waves" consist of "troughs" of dead and wind-thrown trees, grading downhill first into a zone of vigorous fir seedlings, then into a dense stand of fir saplings, and then to a "crest" of mature fir trees that border another band of standing dead and wind-thrown trees.

Distribution: on high-elevation slopes of the Adirondack High Peaks and Catskill Peaks.

Rank: G3 S2 *Revised:* 2001

Examples: High Peaks Wilderness Area, Essex County; Whiteface Mountain, Essex County; Slide Mountain, Ulster County; Blackhead Mountains, Greene County.

Sources: Marchand *et al.* 1986; McIntosh and Hurley 1964; Nicholson 1965; Rimmer *et al.* 2001; Slack 1977; Sprugel 1976, 1984; NYNHP field surveys.

Successional Forests

The following three successional forests, and the successional red cedar woodland described earlier, develop on sites that have been cleared (for farming, logging, etc.) or otherwise disturbed (by fire, ice scour, wind throw, flooding, etc.). Successional forests generally have the following characteristics: 1) dominated by light-requiring, wind-dispersed species that are well-adapted to establishment following disturbance, 2) lack the reproduction of the canopy species, 3) comprised of tree seedlings and saplings that are more shade-tolerant than the canopy species, 4) dominated by species characteristic of successional old fields in the shrub layer and groundlayer, or include species that occurred on or near the site prior to disturbance, 5) comprised of canopy trees with small diameter (generally less than 10 to 15 cm dbh), 6) comprised of canopy trees of young age (generally less than about 25 to 50 years old), 7) show evidence of recent logging (*e.g.*, presence of stumps, brush, and multi-trunked trees) and other human disturbances (*e.g.*, stonewalls), and 8) relatively low canopy height with poor tree diversity and poor development of multiple strata.

26. Successional northern hardwoods: a hardwood or mixed forest that occurs on sites that have been cleared or otherwise disturbed.

Characteristic trees and shrubs include any of the following: quaking aspen[n] (*Populus tremuloides*), big-tooth aspen[n] (*P. grandidentata*), balsam poplar[n] (*P. balsamifera*), paper birch[n] (*Betula papyrifera*), gray birch[n] (*B. populifolia*), pin cherry[n] (*Prunus pensylvanica*), black cherry (*P. serotina*), red maple (*Acer rubrum*), white pine (*Pinus strobus*), with lesser amounts of white ash (*Fraxinus americana*), green ash (*F. pennsylvanica*), and American elm (*Ulmus americana*). White pine dominated examples are known from upstate New York (*e.g.*, Saratoga County). This is a broadly defined community and several seral and regional variants are known.

[n] = northern indicators.

Characteristic birds with varying abundance include chestnut-sided warbler (*Dendroica pensylvanica*), Nashville warbler (*Vermivora ruficapilla*) in young forests with aspen and birch seedlings, and yellow-bellied sapsucker (*Sphyrapicus varius*) in mature aspen forests. More data on characteristic fauna are needed.

Distribution: throughout upstate New York north of the Coastal Lowlands ecozone.

Rank: G5 S5 *Revised:* 2001

Examples: Saratoga National Historical Site, Saratoga County; Mills Norrie State Park, Dutchess County; Albany Pine Bush, Albany County.

Sources: Mellinger and McNaughton 1975; NYNHP field surveys.

27. Successional southern hardwoods: a hardwood or mixed forest that occurs on sites that have been cleared or otherwise disturbed.

Characteristic trees and shrubs include any of the following: American elm[s] (*Ulmus americana*), slippery elm (*Ulmus rubra*), white ash[s] (*Fraxinus americana*), red maple[s] (*Acer rubrum*), box elder[s] (*Acer negundo*), silver maple (*Acersaccharinum*), sassafras[s] (*Sassafras albidum*), gray birch (*Betula populifolia*), hawthorns (*Crataegus* spp.), eastern red cedar (*Juniperus virginiana*), and choke-cherry[s] (*Prunus virginiana*). Certain introduced species are commonly found in successional forests, including black locust (*Robinia pseudo-acacia*), tree-of-heaven (*Ailanthus altissima*), and buckthorn (*Rhamnus cathartica*). Any of these may be dominant or codominant in a successional southern hardwood forest. This is a broadly defined community and several seral and regional variants are known.

[s] = southern indicators.

A characteristic bird is chestnut-sided warbler (*Dendroica pensylvanica*). More data on characteristic fauna are needed.

Distribution: primarily in the southern half of New York, south of the Adirondacks.

Rank: G5 S5 *Revised:* 2001

Examples: Nissequogue River Headwaters, Suffolk County; Wildwood State Park, Suffolk County.

Sources: Eyre 1980; NYNHP field surveys.

28. Successional maritime forest: a successional hardwood forest that occurs in low areas near the seacoast. This forest is a variable type that develops after vegetation has burned or land cleared (such as pastureland or farm fields). The trees may be somewhat stunted and flat-topped because the canopies are pruned by salt spray. The forest may be dominated by a single species, or there may be two or three codominants.

Characteristic canopy trees include black oak (*Quercus velutina*), post oak (*Quercus stellata*), serviceberry (*Amelanchier canadensis*), white oak (*Quercus alba*), black cherry (*Prunus serotina*), blackgum (*Nyssa sylvatica*), sassafras (*Sassafras*

albidum), and red maple (*Acer rubrum*). A small number of eastern red cedar (*Juniperus virginiana*) may be present.

Vines that are common in the understory and subcanopy include riverbank grape (*Vitis riparia*), poison ivy (*Toxicodendron radicans*), Virginia creeper (*Parthenocissus quinquefolia*), and greenbriers (*Smilax* spp.).

Shrub layer and groundlayer dominants are variable. Bayberry (*Myrica pensylvanica*) is a common shrub. Certain introduced species are commonly found in this forest, including black locust (*Robinia pseudoacacia*), privet (*Ligustrum* spp.), Asiatic bittersweet (*Celastrus orbiculatus*), Japanese honey suckle (*Lonicera japonica*), multiflora rose (*Rosa multiflora*), and wineberry (*Rubus phoenicolasius*). Any of these may be dominant or codominant in a successional maritime forest.

Characteristic birds with varying abundance include gray catbird (*Dumetella carolinensis*) and eastern towhee (*Pipilo erythrophthalmus*). More data on characteristic fauna are needed.

This forest represents an earlier seral stage of other maritime forests, such as maritime post oak forest, maritime holly forest, maritime red cedar forest, and probably others. Soil and moisture regime will usually determine which forest type succeeds from this community. A few disturbance-climax examples occur, maintained by severe and constant salt spray.

Distribution: in the Coastal Lowlands ecozone, in low areas near the coast of Long Island.

Rank: G4 S3S4 *Revised:* 2001

Examples: Montauk Point, Suffolk County; William Floyd Estate (Fire Island National Seashore), Suffolk County.

Sources: Clark 1986; Greller 1977; NYNHP field surveys.

D. TERRESTRIAL CULTURAL

This subsystem includes communities that are either created and maintained by human activities, or are modified by human influence to such a degree that the physical conformation of the substrate, or the biological composition of the resident community is substantially different from the character of the substrate or community as it existed prior to human influence.

1. Cropland/row crops: an agricultural field planted in row crops such as corn, potatoes, and soybeans. This community includes vegetable gardens in residential areas.

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 1990

2. Cropland/field crops: an agricultural field planted in field crops such as alfalfa, wheat, timothy, and oats. This community includes hayfields that are rotated to pasture. Characteristic birds with varying abundance include grasshopper sparrow (*Ammodramus savannarum*), vesper sparrow (*Pooecetes gramineus*), bobolink (*Dolichonys oryzivorous*), and mourning dove (*Zenaida macroura*). A rare bird that breeds in some croplands/field crops is the upland sandpiper (*Bartramia longicauda*).

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 1990

3. Pastureland: agricultural land permanently maintained (or recently abandoned) as a pasture area for livestock. Characteristic birds with varying abundance include grasshopper sparrow (*Ammodramus savannarum*), vesper sparrow (*Pooecetes gramineus*), horned lark (*Eremophila alpestris*), and killdeer (*Charadrius vociferus*). A rare bird that breeds in some pastureland is the upland sandpiper (*Bartramia longicauda*).

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 1990

4. Flower/herb garden: residential, commercial, or horticultural land cultivated for the production of ornamental herbs and shrubs. This community includes gardens cultivated for the production of culinary herbs. Characteristic birds with varying abundance include American robin (*Turdus migratorius*), mourning dove (*Zenaida macroura*), and house finch (*Carpodacus mexicanus*).

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 1990

5. Orchard: a stand of cultivated fruit trees (such as apples, cherries, peaches, pears, etc.), often with grasses as a groundcover. An orchard may be

currently under cultivation or recently abandoned. Staghorn sumac (*Rhus typhina*), goldenrods (*Solidago* spp.), and poison ivy (*Toxicodendron radicans*) may be common in abandoned orchards.

Characteristic birds with varying abundance include American robin (*Turdus migratorius*), eastern kingbird (*Tyrannus tyrannus*), mourning dove (*Zenaida macroura*), and in mature orchards with a minimum dbh of 10 in (about 25 cm), yellow-bellied sapsucker (*Sphyrapicus varius*).

Distribution: throughout New York State at low elevations.

Rank: unranked cultural *Revised:* 1990

6. Vineyard: a stand of cultivated vines (such as grapes, or raspberries), often with grasses as a groundcover.

Distribution: throughout New York State at low elevations.

Rank: unranked cultural *Revised:* 1990

7. Hardwood plantation: a stand of commercial hardwood species planted for the cultivation and harvest of timber products. These plantations are usually monocultures: more than 90% of the canopy cover consists of one species. Species typically planted in New York are: black cherry (*Prunus serotina*), red oak (*Quercus rubra*), white oak (*Q. alba*), black walnut (*Juglans nigra*), hybrid poplars (*Populus* spp.), and black locust (*Robinia pseudo-acacia*).

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 1990

8. Pine plantation: a stand of pines planted for the cultivation and harvest of timber products, or to provide wildlife habitat, soil erosion control, windbreaks, or landscaping. These plantations may be monocultures with more than 90% of the canopy cover consisting of one species, or they may be mixed stands with two or more codominant species (in which case more than 50% of the cover consists of one or more species of pine).

Pines that are typically planted in New York include white pine (*Pinus strobus*), red pine (*P. resinosa*), Scotch pine (*P. sylvestris*), pitch pine (*P. rigida*), and jack pine (*P. banksiana*). Groundlayer vegetation is usually sparse, apparently because of the dense accumulation of leaf litter. Speedwell (*Veronica officinalis*) is a characteristic groundlayer plant. More data on this community are needed.

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 1990

9. Spruce/fir plantation: a stand of softwoods planted for the cultivation and harvest of timber products, or to provide wildlife habitat, soil erosion control, windbreaks, or landscaping. These plantations may be monocultures with more than 90% of the canopy cover consisting of one species, or they may be mixed stands with two or more codominant species (in which case more than 50% of the cover consists of one or more species of spruce or fir).

Softwoods that are typically planted in New York include Norway spruce (*Picea abies*), white spruce (*P. glauca*), balsam fir (*Abies balsamea*), and Douglas fir (*Pseudotsuga menziesii*). Groundlayer vegetation is usually sparse, apparently because of the dense accumulation of leaf litter. Speedwell (*Veronica officinalis*) is a characteristic groundlayer plant.

Characteristic birds include golden-crowned kinglet (*Regulus satrapa*), red-breasted nuthatch, yellow-rumped warbler (*Dendroica coronata*), and Blackburnian warbler (*Dendroica fusca*) (P. Novak *pers. comm.*). More data on this community are needed.

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 1990

10. Conifer plantation: a stand of softwoods planted for the cultivation and harvest of timber products, or to provide wildlife habitat, soil erosion control, windbreaks, or landscaping. This is a broadly defined community that excludes stands in which pine, spruce, or fir are dominant, although they may be present at low densities. These plantations may be monocultures, or they may be mixed stands with two or more codominant species.

Softwoods that are typically planted in these plantations include European larch (*Larix decidua*), Japanese larch (*Larix kaempferi*), and northern white cedar (*Thuja occidentalis*). Groundlayer vegetation is usually sparse, apparently because of the dense accumulation of leaf litter. Speedwell (*Veronica officinalis*) is a characteristic groundlayer plant. More data on this community are needed.

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 1990

11. Mowed lawn with trees: residential, recreational, or commercial land in which the groundcover is dominated by clipped grasses and forbs, and it is shaded by at least 30% cover of trees. Ornamental and/or native shrubs may be present, usually with less than 50% cover. The groundcover is maintained by mowing and broadleaf herbicide application.

Characteristic fauna include gray squirrel (*Sciurus carolinensis*), American robin (*Turdus migratorius*), mourning dove (*Zenaida macroura*), and northern mockingbird (*Mimus polyglottos*).

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 1990

12. Mowed lawn: residential, recreational, or commercial land, or unpaved airport runways in which the groundcover is dominated by clipped grasses and there is less than 30% cover of trees. Ornamental and/or native shrubs may be present, usually with less than 50% cover. The groundcover is maintained by mowing and broadleaf herbicide application.

Characteristic birds with varying abundance include American robin (*Turdus migratorius*) and killdeer (*Charadrius vociferus*). A rare bird that breeds in some of the larger mowed lawns, such as airfields, is the upland sandpiper (*Bartramia longicauda*).

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 1990

13. Mowed roadside/pathway: a narrow strip of mowed vegetation along the side of a road, or a mowed pathway through taller vegetation (*e.g.*, meadows, old fields, woodlands, forests), or along utility right-of-way corridors (*e.g.*, power lines, telephone lines, gas pipelines). The vegetation in these mowed strips and paths may be dominated by grasses, sedges, and rushes; or it may be dominated by forbs, vines, and low shrubs that can tolerate infrequent mowing.

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 1990

14. Herbicide-sprayed roadside/pathway: a narrow strip of low-growing vegetation along the side of a road, or along utility right-of-way corridors (*e.g.*, power lines, telephone lines, gas pipelines) that is maintained by spraying herbicides.

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 1990

15. Unpaved road/path: a sparsely vegetated road or pathway of gravel, bare soil, or bedrock outcrop. These roads or pathways are maintained by regular trampling or scraping of the land surface. The substrate consists of the soil or parent material at the site, which may be modified by the addition of local organic material (woodchips, logs, etc.) or sand and gravel. Abandoned railroad beds where tracks have been removed are included here.

One characteristic plant is path rush (*Juncus tenuis*). A characteristic bird is killdeer (*Charadrius vociferus*).

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 2001

16. Railroad: a permanent road having a line of steel rails fixed to wood ties and laid on a gravel roadbed that provides a track for cars or equipment drawn by locomotives or propelled by self-contained motors. There may be sparse vegetation rooted in the gravel substrate along regularly maintained railroads. The railroad right of way may be maintained by mowing or herbicide spraying. Characteristic plants include invasive weeds, such as spotted knappweed (*Centaurea stoebe* ssp. *micranthos*), downy chess (*Bromus tectorum*), coltsfoot (*Tussilago farfara*), Cypress spurge (*Euphorbia cyparissias*), sheep sorrel (*Rumex acetocella*), and crown-vetch (*Coronilla varia*).

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 2005

17. Paved road/path: a road or pathway that is paved with asphalt, concrete, brick, stone, etc. There may be sparse vegetation rooted in cracks in the paved surface.

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 1990

18. Roadcut cliff/slope: a sparsely vegetated cliff or steep slope, along a road, that was created by blasting or digging during road construction.

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 1990

19. Riprap/erosion control roadside: a sparsely vegetated slope along a road that is covered with coarse stones, cobbles, or gabions placed for erosion control.

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 1990

20. Rock quarry: an excavation in bedrock from which building stone (*e.g.,* limestone, sandstone, slate) has been removed. Vegetation may be sparse; plants may be rooted in crevices in the rock surface.

Distribution: throughout upstate New York, north of the Coastal Lowlands ecozone.

Rank: unranked cultural *Revised:* 1990

21. Gravel mine: an excavation in a gravel deposit from which gravel has been removed. Often these are dug into glacial deposits such as eskers or kames. Vegetation may be sparse if the mine is active; there may be substantial vegetative cover if the mine has been inactive for several years. Near-vertical slopes are used by bank swallows (*Riparia riparia*) and belted kingfisher (*Ceryle alcyon*), for nesting sites if the substrate is loose enough to excavate.
.
Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 1990

22. Sand mine: an excavation in a sand deposit or sand dune from which sand has been removed. Vegetation is usually sparse.

A characteristic bird is bank swallow (*Riparia riparia*) and belted kingfisher (*Ceryle alcyon*).

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 1990

23. Brushy cleared land: a former forest, woodland, or shrubland that has been clearcut or cleared by brush-hog. The cut stumps of trees and shrubs are evident and usually common. There may be a lot of woody debris such as branches and slashings from trees that were logged. Vegetation is patchy, with scattered herbs, shrubs, and tree saplings. The amount of vegetative cover probably depends on soil fertility and the length of time since the land was cleared.

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 2001

24. Artificial beach: a sand beach constructed on a lake or river shore by depositing sand from outside the site onto the natural substrate; a sandy beach neither created nor maintained by natural lake shore or river processes.

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 1990

25. Riprap/artificial shore: a lake/pond shore, or stream/river shore that is covered with coarse stones, cobbles, concrete slabs, gabions, etc. placed for erosion control. The vegetation is usually sparse.

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 2005

26. Dredge spoil lake shore: a lake shore or pond shore that is composed of dredge spoils. The vegetation may be sparse.

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 1990

27. Construction/road maintenance spoils: a site where soil from construction work and/or road maintenance materials have been recently deposited. There is little, if any, vegetation.

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 1990

28. Dredge spoils: an upland site where dredge spoils have been recently deposited. On sandy dredge spoils along the Hudson River, characteristic species of early successional deposits include winged pigweed (*Cycloloma atriplicifolium*), lovegrass (*Eragrostis pectinacea*), purple sandgrass (*Triplasis purpurea*), tall crabgrass (*Digitaria sanguinalis*), and field sandbur (*Cenchrus longispinus*); cottonwood (*Populus deltoides*) and black locust (*Robinia pseudo-acacia*) can form "dredge spoil forests" along the Husdon River (B. Carr *pers. comm*). European common reed (*Phragmites australis*) may be present in areas with moister soil, but should be compared to dredge spoil wetlands, a Palustrine Cultural community.

Maritime dredge spoil islands along the seacoast of Long Island provide nesting habitat for herring gull (*Larus argentatus*), least tern (*Sterna antillarum*), and piping plover (*Charadrius melodus*).

Distribution: throughout New York State, especially near large rivers, lakes, or the ocean.

Rank: unranked cultural *Revised:* 2005

Sources: Carr and Baumgartner 2000.

29. Mine spoils: a site where mine spoils have been deposited. These sites may be extensive. Mine spoils may include tailings, crushed rock, and overburden deposits.

Distribution: throughout upstate New York, north of the Coastal Lowlands ecozone.

Rank: unranked cultural *Revised:* 1990

30. Landfill/dump: a site that has been cleared or excavated, where garbage is disposed. The bulk of the material in a landfill or dump is usually paper and other organic biodegradable waste (*e.g.*, food waste, yard waste, and wood). Examples of inorganic materials in landfills include construction waste and items made of plastic, glass, and metal. Characteristic animals include Norway rat (*Rattus norvegicus*) and gulls.

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 2002

31. Junkyard: a site that has been cleared for disposal or storage of primarily inorganic refuse, including discarded automobiles, large appliances, mechanical parts, etc. Small pockets of water that collect within the junk piles and in discarded tires provide abundant breeding sites for mosquitoes.
Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 2002

32. Urban vacant lot: an open site in a developed, urban area that has been cleared either for construction or following the demolition of a building. Vegetation may be sparse, with large areas of exposed soil, and often with rubble or other debris.

Characteristic trees are often naturalized non-native species such as Norway maple (*Acer platanoides*), white mulberry (*Morus alba*), and tree of heaven (*Ailanthus altissima*), a species native to northern China and introduced as an ornamental. Tree of heaven is fast growing and tolerant of the harsh urban environment; it can dominate a vacant lot and form dense stands.

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 1990

33. Urban structure exterior: the exterior surfaces of metal, wood, or concrete structures (such as commercial buildings, apartment buildings, houses, bridges) or any structural surface composed of inorganic materials (glass, plastics, etc.) in an urban or densely populated suburban area. These sites may be sparsely vegetated with lichens, mosses, and terrestrial algae; occasionally vascular plants may grow in cracks. Nooks and crannies may provide nesting habitat for birds and insects, and roosting sites for bats.

Characteristic birds with varying abundance include common nighthawk (*Chordeiles minor*) on rooftops, American robin (*Turdus migratorius*) on porches or under shelter, and non-native birds such as rock dove (*Columba livia*), house sparrow (*Passer domesticus*), and European starling (*Sturnus vulgaris*).

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 1990

34. Rural structure exterior: the exterior surfaces of metal, wood, or concrete structures (such as commercial buildings, barns, houses, bridges) or any structural surface composed of inorganic materials (glass, plastics, etc.) in a rural or sparsely populated suburban area. These sites may be sparsely vegetated with lichens, mosses, and terrestrial algae;

occasionally vascular plants may grow in cracks. Nooks and crannies may provide nesting habitat for birds and insects, and roosting sites for bats.

Characteristic birds include American robin (*Turdus migratorius*) and eastern phoebe (*Sayornis phoebe*) on porches or under shelter, barn swallow (*Hirundo rustica*) under shelter, and non-native birds such as rock dove (*Columba livia*), house sparrow (*Passer domesticus*), and European starling (*Sturnus vulgaris*).

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 1990

35. Interior of barn/agricultural building: the interior spaces of a barn or other agricultural building which provides shelter for livestock or storage space for agricultural products (hay, straw, silage, etc.).

Characteristic fauna besides the livestock are small rodents, bats, cats, native and non-native birds such as barn swallow (*Hirundo rustica*), eastern phoebe (*Sayornis phoebe*), and rock dove (*Columba livia*).

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 1990

36. Interior of non-agricultural building: the interior spaces of a house, garage, commercial building, or industrial building that is used primarily by people for living space, work space, or storage space.

A characteristic bird is chimney swift (*Chaetura pelagica*) which nests in chimneys and inner walls of buildings.

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 1990

E. TERRESTRIAL REFERENCES

Adams, K. B. and D. A. Franzi. 1994. The pine barrens of Clinton County (New York). Wildflower 10(2):30-33.

Andrle, R. F. and J. R. Carroll, eds. 1988. The Atlas of Breeding Birds in New York State. Cornell Univ. Press, Ithaca, NY.

Art, H. W. 1976. Ecological studies of the Sunken Forest, Fire Island National Seashore, New York. US National Park Service, Scientific Monograph Series, No. 7.

Bernard, J. M. and F. K. Seischab. 1995. Pitch pine (Pinus rigida Mill.) communities in northeastern New York State. Am. Midl. Nat. 134:294-306.

Bonanno, S. E., D. J. Leopold, and L. R. St. Hiliaire. 1998. Vegetation of a freshwater dune barrier under high and low recreational uses. Journal of the Torrey Botanical Society. 125(1):40-50.

Bonanno, S. E. 1992. Vegetation of a Lake Ontario dune barrier, Oswego and Jefferson Counties, NY, under high and low recreation pressure. Masters Thesis. State University of New York, College of Environmental Science and Forestry, Syracuse, NY. 80 PP.

Braun, E. L. 1950. Deciduous forests of Eastern North America. MacMillan Publ. Co. Inc., New York, NY.

Bray, W. L. 1915. The development of the vegetation of New York State. New York State Coll. of Forestry, Tech. Publ. No. 3, Syracuse, NY.

Bray, W. L. 1921. History of forest development on an undrained sand plain in the Adirondacks. New York State Coll. of Forestry, Tech. Publ. No. 13, Syracuse, NY.

Brodo, I. M. 1968. The lichens of Long Island, New York: a vegetational and floristic analysis. New York State Mus. and Science Service Bull. No. 410, Albany, NY.

Brooks, R. R. 1987. Serpentine and its vegetation: a multidisciplinary approach. Dioscorides Press, Portland, OR.

Cain, S. A. 1936. The composition and structure of an oak woods, Cold Spring Harbor, Long Island, with special attention to sampling methods. Am. Midl. Nat. 19: 390-416.

Cain, S. A., M. Nelson, and W. McLean. 1937. Andropogonetum Hempsteadi: a Long Island grassland vegetation type. Am. Midl. Nat. 18: 334-350.

Carr, B. P. and C. A. Baumartner. 2000. A flora of Schodack Island State Park. New York Flora Association Newsletter 11(2): 1-2.

Catling, P. M., J. E. Cruise, K. L. McIntosh, and S. M. McKay. 1975. Alvar vegetation in southern Ontario. Ontario Field Biol. 29: 1-23.

Charney, J. D. Hemlock-hardwood community relationships in the Highlands of southeastern New York. Bulletin of the Torrey Botanical Club 107(2): 249-257.

Clark, J. S. 1986. Coastal forest tree populations in a changing environment, southeastern Long Island, New York. Ecol. Monogr. 56(3): 259-277.

Cleavitt, N. L., S. A. Williams, and N. G. Slack. 2005. Rare moss list: Interim report to the Biodiversity Research Institute. 23 pp.

Cleavitt, N. L., S. A. Williams, and N. G. Slack. 2006. Updating the rare moss list for New York State: ecological communities and species-centered approaches. Final report for the Biodiversity Research Institute. NY State Museum, Albany, NY. 46 pp.

Cleavitt, N. L., S. A. Williams, and N. G. Slack. 2009. Relationship of bryophyte occurrence to rock type in upstate New York and coastal Maine. Northeast. Nat. 16(1): 67-84.

Collins, B. R. and K. H. Anderson. 1994. Plant communities of New Jersey: A study in landscape diversity. Rutgers University Press, New Brunswick, NJ.

Conard, H. S. 1935. The plant associations of central Long Island. Am. Midl. Nat. 16: 433-515.

Core, E. L. 1968. The botany of ice mountain, West Virginia. Castanea 33: 345-348.

Cryan, J. F. and J. L. Turner. 1981. A landscape imperiled: the Long Island oak brush plains. The Heath Hen 1: 2-34.

Curran, R. P. 1974. Vegetational development of the plains of the Oswegatchie. M. S. thesis, State University College of Environmental Science and Forestry, Syracuse, NY.

DiNunzio, M. G. 1972. A vegetational survey of the alpine zone of the Adirondack Mountains, New York. M. S. thesis, State University College of Forestry, Syracuse, NY.

Drennen, S. R. 1981. Where to find birds in New York State: the top 500 sites. Syracuse University Press, Syracuse, NY.

Dunwiddie, P. W., R. E. Zaremba, and K. A. Harper. 1996. A classification of coastal heathlands and sandplain grasslands in Massachusetts. Rhodora 98:117-145.

Eaton, S. W. and E. F. Schrot. 1987. A flora of the vascular plants of Cattaraugus County, New York. Bull. Buffalo Soc. Nat. Sci. 31: 1-235.

Edinger, G.J. 2003. Nellie Hill: A calcareous red cedar barrens. Assessment and classification of the red cedar communities at Nellie Hill, Dutchess County, NY. A report prepared for the Eastern New York Chapter of The Nature Conservancy. New York Natural Heritage Program, New York State Department of Environmental Conservation. Albany, NY. 40 pp. plus appendices.

Eyre, F. H., ed. 1980. Forest cover types of the United States and Canada. Society of American Foresters, Washington, DC

Faber-Langendoen, D., J. P. Gibbs, and W. Porter. 2000. Ecological assessment of Niagara Mohawk Power Corporation lands: Moose River Site. Final Report. College of Environmental Science and Forestry, State University of New York, Syracuse, NY.

Forman, R. T. T., ed. 1979. Pine Barrens: ecosystems and landscape. Academic Press, NY.

Franzi, D. A. and K. B. Adams. 1999. The origin and fate of the sandstone pavement barrens in northeastern New York. *In* Wright, S. F. (Ed.), New England Intercollegiate Geologic Conference Guidebook No. 91. pp. 201-212.

Germaine, S. S., S. H. Vessey, and D. E. Capen. 1997. Effects of small forest openings on the breeding bird community in a Vermont hardwood forest. The Condor 99: 708-718.

Gifford, N. 1994. Habitat selection by birds in two adjacent forested ecosystems. M. A. Thesis. State University of New York at Plattsburgh, Plattsburgh, NY.

Gilman, B. 1998. Alvars of NewYork: a site summary. Finger Lakes Community College. Canadaigua, NY.

Good, R. E., and N. F. Good. 1970. Vegetation of the sea cliffs and adjacent uplands on the north shore of Long Island, New York. Bulletin of the Torrey Botanical Club 97:204-208.

Gordon, R. B. 1937. The primeval forest types of southwestern New York. New York State Mus. Bull. No. 321, Albany, NY.

Greller, A. M. 1977. A classification of mature forests on Long Island, New York. Bulletin of the Torrey Botanical Club 104:376-382.

Greller, A. M., R. E. Calhoon, and J. M. Mansky. 1978. Grace Forest: a mixed mesophytic stand on Long Island, New York. Botanical Gazette 139:482-489.

Greller, A. M., J. M. Mansky, and R. E. Calhoon. 1982. An oak, hickory-dogwood forest on central Long Island, New York. Bulletin of the Torrey Botanical Club 109(2): 219-225.

Grossman, D. H., K. L. Goodin, and C. L. Reuss, editors. 1994. Rare plant communities of the conterminousUnited States: an initial survey. The Nature Conservancy, Arlington, VA.

Hancock, T. E. 1995. Ecology of the threatened species seabeach amaranth (*Amaranthus pumilus* Rafinesque). Masters Thesis. Department of Biological Sciences, University of North Carolina, Wilmington, NC.

Harper, R. M. 1911. The Hempstead Plains: a natural prairie on Long Island. Bull. Amer. Geol. Soc. 43:351-360.

Harper, R. M. 1912. The Hempstead Plains of Long Island. Torreya 12:277-287.

Harper, R. M. 1917. The natural vegetation of western Long Island south of the terminal moreaine. Torreya 17:1-13.

Hawver, C. A. 1993. Stand structure in a Jack Pine chronosequence: role of fire in the preservation of biodiversity. M. A. Thesis. State University of New York at Plattsburgh, Plattsburgh, NY.

Heimburger, C. C. 1934. Forest-type studies in the Adirondack Region. Cornell Univ. Exp. Sta. Memoir 165, Ithaca, NY.

Holmes, R. T., T. W. Sherry, and F. W. Sturges. 1986. Bird community dynamics in a temperate deciduous forest: along-term trends at Hubbard Brook. Ecol. Monogr. 56:201-220.

Holway, J. G. and J. T. Scott, eds. 1969. Vegetation-environmental relations at Whiteface Mountain in the Adirondacks. Atmospheric Sciences Research Center, State Univ. of New York at Albany, Report 92.

Hotchkiss, N. 1932. A botanical survey of the Tug Hill plateau. New York State Mus. Bull. No. 287, Albany, NY.

Howard, T. 2009. Vegetation communities of the Adirondack alpine zone. Unpublished manuscript. New York Natural Heritage Program, Albany, NY.

Irland, L. C. 1993. A virgin red spruce and northern hardwoods stand, Maine 1902: its forest management implications. Maine Naturalist 1(4):181-192.

Johnson, A. F. 1981. Plant communities of the Napeague dunes. Bulletin of the Torrey Botanical Club 108:76-84.

Johnson, A. F. 1985. A guide to the plant communities of the Napeague Dunes. Publ. by the author, Southampton, NY.

Jordan, M. 1998. Ecological effect of a large and sever summer wildfire in the Long Island dwarf pine barrens. Unpublished report. The Nature Conservancy, Long Island Chapter, Cold Spring Harbor, NY.

Kendeigh, S. C. 1946. Breeding birds of the beech-maple-hemlock community. Ecology 27(3): 226-245.

Kerlinger, P. and C. Doremus. 1981. The breeding birds of three pine barrens in New York State. Kingbird 31: 126-135.

Lamont, E. 1997. The maritime oak-basswood forest on Long Island's north fork. Long Island Botanical Society Newsletter. 7(5):27-28.

Lamont, E. 1998. The Grandifolia Sandhills: one of Long Island's great natural wonders. Long Island Botanical Society Newsletter. 8(3):13-19.

Larson, D.W., U. Matthes, and P.E. Kelly. 2000. Cliff Ecology: Pattern and Process in Cliff Ecosystems. Cambridge University Press, New York, New York.

Latham, R. 1935. Flora of the State Park, Orient, Long Island, NY. Torreya 34:139-149.

Leatherman, S. P. 1979. Barrier Island Handbook. National Park Service Cooperative Research Unit. University of Massachusetts, Amherst, MA.

LeBlanc, DC 1981. Ecological studies on the alpine vegetation of the Adirondack Mountains of New York. M. A. thesis, SUNY College of Arts and Science, Plattsburgh, NY.

Leopold, D. J., C. Reschke, and D. Smith. 1988. Old-growth forests of Adirondack Park, New York. Natural Areas Journal 8(3): 166-189.

Levine, E. L. ed. 1998. Bull's Birds of New York State. Comstock Publishing, Ithaca, NY.

Lougee, J. 2000. Sam's Point Dwarf Pine Ridge Preserv cliff community survey. Unpublished report. The Nature Conservancy, Eastern New York Chapter, Troy, NY.

Marchand, P. J., F. L. Goulet, and T. C. Harrington. 1986. Death by attrition: a hypothesis for wave mortality in subalpine balsam fir forests. Canadian Journal of Forest Research 16:591-596.

McIntosh, R. P. 1972. Forests of the Catskill Mountains, New York. Ecol. Monogr. 42: 143-161.

McIntosh, R. P. and R. T. Hurley, 1964. The spruce-fir forest of the Catskill Mountains. Ecology 45: 314-326.

McLaughlin, S. B., D. J. Downing, T. J. Blasing, E. R. Cook, and H. S. Adams. 1987. An analysis of climate and competition as contributors to decline of red spruce in high elevation forests of the eastern United States. Oecologia 72: 487-501.

McVaugh, R. 1958. Flora of the Columbia County area, New York. New York State Mus. and Sci. Service, Bull. No. 360, Albany, NY.

Mellinger, M. V. and S. J. McNaughton. 1975. Structure and function of successional vascular plant communities in central New York. Ecol. Monogr. 45: 161-182.

Mellor, D. 1995. Climbing in the Adirondacks: A guide to rock and ice routes in the Adirondack Park. The Adirondack Mountain Club, Lake George, NY.

Nicholson, S. 1965. Altitudinal and exposure variations of the spruce-fir forest on Whiteface Mountain. M. S. thesis, State Univ. of New York at Albany.

Office of Parks, Recreation and Historic Preservation. 1988. Park program analysis for Chimney Bluffs State Park. Unpublished report. Office of Parks, Recreation and Historic Preservation. Finger Lakes State Park Region. Trumansburg, NY.

Olsvig, L. S. 1979. Pattern and diversity analysis of the irradiated oak-pine forest, Brookhaven, New York. Vegetatio 40(2): 65-78.

Olsvig, L. S. 1980. A comparative study of northeastern pine barrens vegetation. PhD thesis, Cornell University, Ithaca, NY.

Olsvig, L. S., J. F. Cryan, and R. H. Whittaker. 1979. Vegetational gradients of the pine plains and barrens of Long Island, New York. pg. 265-282 *In:* Forman, R. T. Pine Barrens: Ecosystem and Landscape. Academic Press, New York.

Probst, John R. 1979. Oak forest bird communities. In: DeGraaf, Richard M.; Evans, Keith E., compilers. Management of north central and northeastern forests for nongame birds: Proceedings of the workshop; 1979 January 23-25; Minneapolis, MN. Gen. Tech. Rep. NC-51. St. Paul, MN: US Department of Agriculture, Forest Service, North Central Forest Experiment Station: 80-88.

Reed, C. F. 1986. Floras of the serpentinite formations of Eastern North America, with descriptions of geomorphology and mineralogy of the formations. Contributions of the Reed Herbarium No. XXX, Baltimore, Maryland.

Reiners, W. A. 1967. Relationships between vegetational strata in the pine barrens of central Long Island, New York. Bulletin of the Torrey Botanical Club 94(2):87-99.

Reschke, C., R. Reid, J. Jones, T. Feeney, and H. Potter. 1999. Conserving Great Lakes Alvars: final technical report of the International Alvar Conservation Initiative. The Nature Conservancy, Great Lakes Program, Chicago, IL.

Reschke, C. and B. Gilman. 1988. Vegetation of the limestone pavements in Jefferson County, New York. Poster presented at the 15th Annual Natural Areas Conference, Syracuse, NY.

Rimmer, C.C., K.P. Mcfarland, W.G. Ellison, and J.E. Goetz. 2001. Bicknell's Thrush (*Catharus bicknelli*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/592

Robichaud-Collins, B. and K. H. Anderson. 1994. Plant Communities of New Jersey: A study in landscape diversity. Rutgers University Press, New Brunswick, NJ.

Roman, J. R. 1980. Vegetation-environment relationships in virgin, middle elevation forests in the Adirondack Mountains, New York. PhD thesis, SUNY College of Environmental Science and Forestry, Syracuse, NY.

Ross, P. 1958. Microclimatic and vegetational studies in a cold-wet deciduous forest. Black Rock Forest Papers No. 24, Harvard Black Rock Forest, Cornwall-on-the-Hudson, NY.

Ross, R. M., L. A. Redell, R. M. Bennett, and J. A. Young. 2004. Mesohabitat use of threatened hemlock forests by breeding birds of the Delaware River Basin in the northeastern United States. Natural Areas Journal 24(4):307-315.

Rosza, R. and K. Metzler. 1982. Plant communities of Mashomack. In: The Mashomack Preserve Study. Vol. 2: Biological Resources. S. Englebright, ed. The Nature Conservancy, East Hampton, NY.

Sabo, S. R. 1980. Niche and habitat relations in subalpine bird communities of the White Mountains of New Hampshire. Ecol. Monogr. 50:241-259.

Seischab, F. K, and J. M. Bernard. 1996. Pitch pine (Pinus rigida Mill.) communities in Hudson Valley region of New York. Am. Midl. Nat. 136:42-56.

Seyfert, W. G. 1973. A study of the Hempstead Plains, Long Island, New York, and its vascular flora. M. S. thesis, C. W. Post College, Long Island University, Greenvale, NY.

Shanks, R. E. 1966. An ecological survey of the vegetation of Monroe County, New York. Proc. Rochester Acad. Sci. 11: 108-252.

Silvertown, J. 1996. Are sub-alpine firs evolving towards semeparity? Evolutionary Ecology 10:77-80.

Slack, N. G. 1977. Species diversity and community structure in bryophytes: New York State studies. New York State Museum Bulletin No. 428, Albany, NY.

Slack, N. G. and A. W. Bell. 1993. 85 Acres: a field guide to the Adirondack alpine summits. Adirondack Mountain Club, Lake George, NY.

Slack, N. G. and A. W. Bell. 1995. Field guide to the New England alpine summits. Appalachian Mountain Club, Boston, MA.

Slack, N. G., C. Reschke, and B. Gilman. 1988. *Scorpidium turgescens* rediscovered in New York State. Bryologist 91: 217-218.

Sneddon, L., M. Anderson, and J. Lundgren, eds. 1998. International classification of ecological communities: terrestrial vegetation of the Northeastern United States (July 1998 working draft). Unpublished report. The Nature Conservancy, Eastern Conservation Science and Natural Heritage Programs of the northeastern US, Boston, MA.

Sperduto, D. D. 2000. A classification of wetland natural communities in New Hampshire. New Hamphire Natural Heritage Inventory. Concord, NH.

Sperduto, D. D. and C. V. Cogbill. 1999. Alpine and subalpine vegetation of the White Mountains, New Hampshire. New Hampshire Natural Heritage Inventory, Concord, NH.

Sprugel, D. G. 1976. Dynamic structure of wave-regenerated *Abies balsamea* forests in the northeastern United States. Journal of Ecology 64: 889-911.

Sprugel, D. G. 1984. Density, biomass, productivity, and nutrient-cycling changes during stand development in wave-regenerated balsam fir forests. EcologicalMonographs 54:165-186.

Stanton, E. J. 1997. Inventory of the macrolepidoptera on alvars of Jefferson County, New York. Submitted to The Nature Conservancy, Central and Western New York Chapter, Rochester, NY and New York Natural Heritage Program, Latham, NY.

Sturgas, R. L. and Adams, K. B. 1989. Jack pine barrens in northeastern New York: postfire macronutrient concentrations, heat content, and understory biomass. Can. J. For. Res. 19:904-910.

Taylor, N. 1923. The vegetation of Long Island. Part I. The vegetation of Montauk: a study of grassland and forest. Brooklyn Botanical Garden Memoirs 2: 1-107.

Thompson, J. 1996. Vegetation survey of the Northern Shawangunk Mountains, Ulster County, New York. Unpublished report. The Nature Conservancy, Eastern New York Chapter, Troy, NY.

Thompson, J. E. 1997. Ecological communities of the Montauk Peninsula, Suffolk County, New York. Unpublished report. The Nature Conservancy. Long Island Chapter, Cols Spring Harbor, NY.

Yorks, T. E. and K. B. Adams. 2003. Restoration cutting as a management tool for regenerating Pinus banksiana after ice storm damage. Forest Ecology and Management 177:85-94.

Zaremba, R. E. 1990. A comparison of maritime heathlands of Holocene deposits to related communities in Massachusetts and New York. In press: Proceedings of the first lowland heath conference, May 5, 1988, Nantucket, MA.

Zenkert, C. A. 1934. Flora of the Niagara frontier region. Bull. Buffalo Soc. Nat. Sci., Vol. 16, Buffalo, NY.

Zon, R. 1914. Balsam fir. Bull US Dept. Agriculture No. 55: 1-68.

VII. SUBTERRANEAN SYSTEM

The subterranean system consists of both aquatic and non-aquatic habitats beneath the earth's surface, including air-filled cavities with openings to the surface (caves), water-filled cavities and aquifers, and interstitial habitats in small crevices within an inorganic matrix. Different subterranean communities are distinguished by hydrology and substrate characteristics. The communities are described in terms of three to four light intensity zones. The entrance zone has about 50 to 100% of the light intensity of the subterranean/terrestrial interface and is well lit by direct natural light. This zone often supports a characteristic suite of species including craneflies, microlepidoptera, geometrids, spiders, flies, mosquitoes, and endogeans (soil organisms). Bryophytes and lichens may be common in this zone. The twilight zone (or threshold zone), a partially lit area of reflected light, may be divided into two parts: a moderately well-lit outer twilight zone, which has about 10 to 50% of the light intensity of the subterranean/terrestrial interface, and a dim inner twilight zone, which has up to about 10% of the light intensity of the subterranean/terrestrial interface. The dark zone (or deep zone) is an area of complete darkness. This zone contains organisms referred to as troglobites, trogloxes, and troglophiles which often include spiders and beetles. Fungi (predominantly mushrooms, molds, and mildews) may be common in this zone. There are apparently only few obligate cave species in New York, unlike the diversity found in caves of the Interior Lowlands of the eastern US and the caves of the southwest US

Characteristic species have been derived from a combination of comments from the staff of DEC's Endangered Species Unit, based upon their knowledge of bat hibernacula and caves in New York, other subterranean scientists, literature review, and NYNHP field surveys. To date, NY Natural Heritage has conducted preliminary inventory work on caves including several plots. Although NY Natural Heritage has conducted cursory cave community inventories; we do not currently have in our files sufficient field data for confidently undertaking any major restructuring of the Rschke (1990) subterranean classification. However, field work has suggested that this classification works well for representing the coarsest scale distinctions between both biotic and abiotic features of subterranean community types.

Further refinement of the classification, especially to distinguish potential regional variants, will likely be based on additional field surveys and analysis of data collected by various subterranean scientists and agencies statewide. Regional variation in some cave types is evident, but we do not currently have in our files enough information or have undertaken analyses to confidently split these common and widespread types into specific regional variants. A finer scale classification that distinguishes types according to ecoregion is being evaluated. Preliminary conclusions suggest that mammal, reptile and insect assemblages may be strongly correlated with ecoregion boundaries.

A. NATURAL CAVES

This subsystem includes caves and cavities in which the structure and hydrology have not been substantially modified by human activities, and the native biota is dominant.

1. Aquatic cave community: the aquatic community of a subterranean stream or pond. These caves vary in their water chemistry and substrate type. Well-developed examples contain all four light intensity zones. Habitat features may include riffles, runs and pools. These caves often occur in close association with non-aquatic cave types. Preliminary studies suggest that there are sufficient differences in the biota of subterranean streams and ponds, and a split of this community into riverine cave community (or subterranean stream) and lacustrine cave community (or subterranean pond) is being evaluated.

The fauna of aquatic caves is poorly known; characteristic species may include individuals from adjacent connected above-ground aquatic communities such as crayfish (*e.g., Cambarus robustus*), mayflies (Ephemeroptera) and amphipods (Amphipoda) in subterranean streams and fish in subterranean lakes. Characteristic terrestrial species associated with subterranean streams may include ground beetles (Carabidae).

Four ecoregional variants (Northern Appalachian, Great Lakes, Lower New England, and Allegheny Plateau types) are suspected to differ in biota, substrate type, water chemistry and water temperature. Major watershed may be a secondary factor in distinguishing caves based on biota. More data on this community are needed.

Distribution: throughout upstate New York, north of the Coastal Lowlands ecozone.

Rank: G4 S2S3 *Revised:* 2001

Examples: Burroughs Cave (in part), Essex County; Valcour Island, Clinton County; McFails Cave (in part), Schoharie County; Black River Bay, Jefferson County; Clarksville Cave, Albany County.

Source: NYNHP field surveys.

2. Terrestrial cave community: the terrestrial community of a cave with bedrock walls, including the biota of both solution caves (in limestone) and tectonic caves. Typical examples contain all four light intensity zones. Temperatures are stable in deep caves. Small or shallow caves may have a temperature gradient ranging from cold (below freezing) to cool (up to 50^{o} F or 10^{o} C). Although many caves have ice on the cave floor in winter, the ceiling is warm enough for a bat hibernaculum. Habitat features may include bare rock, floors of pebble, gravel or soil, piles of terrestrial plant debris, carpets of bat guano, and piles of mammal scat. The latter three substrates often promote growth of fungal colonies.

Characteristic bats that hibernate in caves include little brown bat (*Myotis lucifugus*), big brown bat (*Eptesicus fuscus*), and eastern pipistrelle (*Pipistrellus subflavus*). Additional characteristic hibernating bats may include northern long-eared bat (*Myotis septentrionalis*). Characteristic and dominant invertebrates may include ground beetles (Carabidae), microlepidoptera, crickets, and a diverse array of spiders.

Four to five ecoregional variants (including Northern Appalachian, Great Lakes, Lower New England, and Allegheny Plateau types) are suspected. More data on regional variants are needed.

Distribution: throughout upstate New York, north of the Coastal Lowlands ecozone.

Rank: G4 S2S3 *Revised:* 2001

Examples: Norton Range Cave, Franklin County; Burroughs Cave (in part), Essex County; McFails Cave (in part), Schoharie County; Pompeys Cave, Ulster County; Mystery Cave, Sullivan County; Clarksville Cave, Albany County.

Source: NYNHP field surveys.

3. Talus cave community: the community that occurs in small crevices and caves with walls of boulders or cobbles, typically in a talus slope at the base of a cliff. This includes talus slopes that are cool enough to allow winter ice to remain within the talus through all or part of the summer; these are known as ice caves. Most examples are shallow and predominated by twilight zone. They may have small areas of dark zone.

Animals that may use this community as denning habitat, include bobcat (*Lynx rufus*), porcupine (*Erethizon dorsatum*), and small mammals such as rock vole *(Microtus chrotorrhinus*). A rare reptile of some talus cave communities is the timber rattlesnake (*Crotalus horridus*). Bats may be present in larger examples, but at low abundance. Characteristic and dominant invertebrates may include craneflies (Tipulidae) and a diverse array of spiders.

Bryophytes, lichens and fungi may be abundant in these caves.

Three to five ecoregional variants (including Northern Appalachian, Lower New England, and Allegheny Plateau types) are suspected to differ in characteristic and dominant mammals, reptiles, insects, lichens, bryophytes and fungi. More data on invertebrates, bryophytes and fungi, as well as regional variants, are needed.

Distribution: throughout upstate New York, north of the Coastal Lowlands ecozone, usually at high elevations.

Rank: G4 S2S3 *Revised:* 2001

Examples: Indian Pass, Essex County; Wilmington Notch, Essex County; Moss Lake Mountain, Hamilton County; Slide Mountain, Rensselaer County; Shawangunk Mountains, Ulster County.

Source: NYNHP field surveys.

B. SUBTERRANEAN CULTURAL

This subsystem includes communities that are either created and maintained by human activities, or are modified by human influence to such a degree that the physical conformation of the substrate, or the biological composition of the resident community is substantially different from the character of the substrate or community as it existed prior to human influence.

1. Mine/artificial cave community: the biota of an abandoned mine or artificial underground excavation. Abandoned mines that are deep enough to maintain stable winter temperatures are important bat hibernacula. Mines, like natural caves, may be terrestrial or aquatic. Wells are also included here. Characteristic bats include little brown bat (*Myotis lucifugus*), northern long-eared bat (*Myotis septentrionalis*), big brown bat (*Eptesicus fuscus*), and eastern pipistrelle (*Pipistrellus subflavus*). A rare mammal of some mines is Indiana bat (*Myotis sodalis*) (US Fish and Wildlife Service 2007).

Distribution: throughout upstate New York, north of the Coastal Lowlands ecozone.

Rank: unranked cultural *Revised:* 2001

Example: Barton Hill Mine, Essex County; Barton Garnet Mine, Warren County.

Source: US Fish and Wildlife Service 2007.

2. Sewer: the biota of a subterranean conduit constructed to carry off sewage and sometimes runoff from an urban or developed area. A characteristic rodent is the Norway rat (*Rattus norvegicus*).

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 1990

3. Tunnel: the biota of a subterranean passageway constructed to allow transportation routes to pass through rock or earth obstructions or underground, including tunnels for roads, footpaths, highways, railroads, and subways. Water-filled tunnels, such as aqueducts, and culverts are tentatively included here.

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 1990

4. Basement/building foundation: the biota of an underground structure that was built primarily as a support structure for a house, commercial building, or industrial building. This includes foundations of abandoned structures, as well as those that are actively used. Characteristic fauna include a wide variety of insects, spiders, and small vertebrates.

Distribution: throughout New York State.

Rank: unranked cultural *Revised:* 1990

C. SUBTERRANEAN REFERENCES

Boga, S. 1997. Caving. Stackpole Books, Mechanicsburg, PA

Cullen, J. J., J. Mylroie, and A. N. Palmer. 1979. Karst hydrology and geomorphology of eastern New York. Unpublished guidebook. National Speleogical Society Annual Convention, Pittsfield, MA.

Engel, T. 1997. What is a cave? Northeastern Caver. March 1997.

Evans, J., P. Quick, and B. Sloane. 1979 An introduction to caves of the northeast: guidebook for the 1979 National Speleogical Society Annual Convention, Pittsfield MA.

Ford, DC and P. W. Williams. 1989. Karst geomorphology and hydrology. Unwin Hyman Ltd. Winchester, MA.

Halliday, W. R. 1993. How (and why) to inventory cave wilderness values. National Speleogical Society News. December 1993 :328-329.

Hamilton-Smith, E. 1971. The classification of cavernicoles. The National Speleogical Society Bulletin. 33(1):63-66.

Kastning, E. H. and S. M. Cohen. 1988. Caverns of the Shawangunk and its environs, southesastern New York. Northeastern Regional Organization Publication 20. National Speleogical Society.

Moore, G. W. and N. Sullivan. 1997. Speleology: Caves and the cave environment. Cave Books, St. Louis, MO.

Mylroie, J. E. 1977. Speleogenesis and karst geomorphology of the Helderberg Plateau, Schoharie County, New York. Bulletin 2. New York Cave Survey. Ph. D. Thesis. Rensselaer Polytechnic Institute, Troy, NY.

Nardacci, M. 1991. Guide to the caves and karst of the northeast. National Speleogical Society, Huntsville, AL.

National Speleological Society. 1958. Caves of Watertown, New York State. N. R. O. Publication.

Perry, C. 1966. Underground empire: Wonders and tales of New York caves. I. J. Friedman, Inc., Port Washington, NY.

US Fish and Wildlife Service. 2007. Indiana Bat (*Myotis sodalis*) Draft Recovery Plan: First Revision. US Fish and Wildlife Service, Fort Snelling, MN. 258 pp.

Vandel, A. 1965. Biospeleology: the biology of cavernicolous animals. Pergamon Press. New York, NY.

GENERAL REFERENCES

COMMUNITY CLASSIFICATION

Anderson, M., P. Bourgeron, M. T. Bryer, R. Crawford, L. Engelking, D. Faber-Langendoen, M. Gallyoun, K. Goodin, D. H. Grossman, S. Landaal, K. Metzler, K. D. Patterson, M. Pyne, M. Reid, L. Sneddon, and A. S. Weakley. 1998. International classification of ecological communities: terrestrial vegetation of the United States. Volume II. The National Vegetation Classification System: list of types. The Nature Conservancy, Arlington, VA.

Anonymous. 1986? Vegetative cover and land use classification. Unpubl. report, City of New York, Dept. of Parks and Recreation.

Braun, L. 1950. Deciduous forests of Eastern North America. MacMillan Publ. Co. Inc., New York, NY.

Breden, T. F. 1989. A preliminary natural community classifcation for New Jersey. Natural Heritage Program, New Jersey Department of Environmental Protection, Division of Parks and Forestry, Office of Natural Lands Management, Trenton, NJ.

Breden, T.F., Y. Alger, K. Strakosch Walz, and A.G. Windisch. 2001. Classification of Vegetation Communities of New Jersey: Second Iteration. Association for Biodiversity Information and New Jersey Natural Heritage Program, Office of Natural Lands Management, Division of Parks and Forestry, NJ Department of Environmental Protection. Trenton, NJ.

Chambers, B. A., B. J. Naylor, J. Nieppola, B. Merchant, and P. Uhlig. 1997. Ontario Ministry of Natural Resources, Southcentral Science Section, North Bay, Ontario, Canada.

Chapman, K. A. 1985. Draft descriptions of palustrine and terrestrial natural community classification units in Michigan. Unpubl. report, Michigan Natural Features Inventory, Lansing, MI.

Collins, B. R. and K. H. Anderson. 1994. Plant communities of New Jersey: A study in landscape diversity. Rutgers University Press, New Brunswick, NJ.

Driscoll, R. S., D. L. Merkel, D. L. Radloff, D. E. Snyder, and J. S. Hagihara. 1984. An ecological land classification framework for the United States. Miscellaneous Publ. 1439, US Dept. of Agriculture, Washington DC

Enser, R. 1995. Natural communities of Rhode Island. Rhode Island Natural Heritage Program, Providence, RI.

Faber-Langendoen, D., editor. 2001. Plant communities of the Midwest: Classification in an ecological context. Association for Biodiversity Information, Arlington, VA.

Fike, J. 1999. Terrestrial & palustrine plant communities of Pennsylvania. Pensylvania Natural Diversity Inventory. Pennsylvania Department of Conservation and Natural Resources, Bureau of Forestry, Harrisburg, PA.

Gawler, S. C., and A. Cutko. 2010. Natural landscapes of Maine: A classification of vegetated natural communities and ecosystems. Maine Natural Areas Program, Department of Conservation, Augusta.

Grossman, D. H., D. Faber-Langendoen, A. S. Weakley, M. Anderson, P. Bourgeron, R. Crawford, K. Goodin, S. Landaal, K. Metzler, K. D. Patterson, M. Pyne, M. Reid, and L. Sneddon. 1998. International classification of ecological communities: terrestrial vegetation of the United States. Volume I. The National Vegetation Classification System: development, status, and applications. The Nature Conservancy, Arlington, VA.

Harris, A. G., S. C. McMurray, P. W. C Uhlig, J. K. Jeglum, R. F. Foster, and G. D. Racey. 1996. Field gui de to the wetland ecosystem classification for northwestern Ontario. Ontario Ministry of Natural Resources, Northwest Science &Technology. Thunder Bay, Ontario, Canada. Field Guide FG-01.

Jackson, M. T. 1978? A classification of Indiana plant communities. Proc. Indiana Acad. Sci. 89: 159-171.

Metzler, K., and J. Barrett. 2006. The vegetation of Connecticut: A preliminary classification. State Geological and Natural History Survey, Report of Investigations No. 12. Connecticut Natural Diversity Database, Hartford.

Ozard, J. 1981. Significant habitat covertypes - codes and definitions. Pamphlet, Significant Habitat Unit, NYS Dept. of Environmental Conservation, Delmar, NY.

Penfound, W. T. 1967. A physiognomic classification of vegetation in conterminous United States. Bot. Rev. 33: 289-326.

Poiani, K.A., B.D. Richter, M.G. Anderson, and H.E. Richter. 2000. Biodiversity conservation at multiple scales: functional sites, landscapes, and networks. BioScience 50(2):133-146.

Rawinski, T. J. 1984. New England natural community classification. Unpubl. report, The Nature Conservancy, Eastern Regional Office, Boston, MA.

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

Robichaud-Collins, Beryl and Karl H. Anderson. 1994. Plant Communities of New Jersey: A study in landscape diversity. Rutgers University Press, New Brunswick, NJ.

Sneddon, L., M. Anderson, and J. Lundgren. 1998. International Classification of Ecological Communities: Terrestrial Vegetation of the Northeastern United States. July 1998 Working Draft. Unpublished Report. The Nature Conservancy, Eastern Conservation Science and Natural Heritage Programs of the Northeastern United States, Boston, MA.

Sneddon, L., M. Anderson, and J. Lundgren. 2000. Lower New England–Northern Piedmont Ecoregion Classification Shrub and Herbaceous Types Review Draft. Unpublished Report. The Nature Conservancy, Eastern Conservation Science and Natural Heritage Programs of the Northeastern United States, Boston, MA. February 2000.

Smith, T. 1985. Natural communities of Pennsylvania. Unpublished report, Pennsylvania Natural Diversity Inventory, Harrisburg, PA.

Sperduto, D. D. 2000. A classification of wetland natural communities in New Hampshire. New Hamphire Natural Heritage Inventory. Concord, NH.

Sperduto, D. D., and W. F. Nichols. 2004. Natural communities of New Hampshire: A guide and classification. New Hampshire Natural Heritage Inventory, DRED Division of Forests and Lands, Concord. 242 pp.

Swain, P. C., and J. B. Kearsley. 2001. Classification of natural communities of Massachusetts. September 2001 draft. Natural Heritage and Endangered Species Program, Massachusetts Division of Fisheries and Wildlife. Westborough, MA

The Association for Biodiversity Information. 2000. International Classification of Ecological Communities: Terrestrial Vegetation. Natural Heritage Central Databases. The Association for Biodiversity Information, Arlington, VA.

Thompson, E. H. and E. R. Sorensen. 2000. Wetland, woodland, wildland: A guide to the natural communities of Vermont. Vermont Department of Fish and Wildlife and The Nature Conservancy. University Press of New England, Hanover, NH.

Warner, B. G. and C. D. A. Rubec (eds.) 1997. The Canadian Wetland Classification. Second Edition. Wetlands Research Centre, University of Waterloo, Waterloo, Ontario, Canada.

GEOLOGY AND SOILS

Buol, S. W., F. D. Hole, and R. J. McCracken. 1973. Soil genesis and classification. Iowa State Univ. Press, Ames, IO.

Broughton, J. G., D. W. Fisher, Y. W. Isachsen, and L. V. Rickard. 1966. Geology of New York: a short account. Educational leaflet No. 20, New York State Museum and Science Service, Albany, NY.

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.

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, NY.

New York State Museum and Science Service. 1970. Geologic Map of New York, Map and Chart Series No. 15. The University of the State of New York, The State Education Department, Albany, NY.

New York State Museum and Science Service. 1970. Surficial Geologic Map of New York, Map and Chart Series No. 15. The University of the State of New York, The State Education Department, Albany, NY.

PLANTS

Fungi

Bessette, A. E., A. R. Bessette, and D. W. Fischer. 1997. Mushrooms of Northeastern North America. Syracuse University Press, Syracuse, NY.

Binion, D. E., S. L. Stephenson, W. C. Roody, H. H. Burdsall, Jr., L. N. Vasilyeva, and O. K. Miller, Jr. 2008. Macrofungi Associated with Oaks of Eastern North America. West Virginia University Press, Morgantown, WV.

Lincoff, G. H. 1981. The Audubon Society Field Guide to North American Mushrooms. Chanticleer Press, Inc., New York, NY.

Phillips, R. 2005. Mushrooms and Other Fungi of North America. Firefly Books, Inc., Buffalo, NY.

Lichens

Brodo, I. M. 1968. The lichens of Long Island, New York: a vegetational and floristic analysis. NYS Mus. and Science Service Bull. No. 410, Albany, NY.

Brodo, I. M., S. D. Sharnoff, and S. Sharnoff. 2001. Lichens of North America. Yale University Press, New Haven, CT.

Dirig, R. 1994. Lichens of pine barrens, dwarf pine plains, and "ice cave" habitats in the Shawangunk Mountains, New York. Mycotaxon 52:523-558.

Egan, R. S. 1987. A fifth checklist of the lichen-forming, lichenicolous, and allied fungi of the continental United States and Canada. The Bryologist 90:77-173.

Esslinger, T. L. 2009. A cumulative checklist for the lichen-forming, lichenicolous and allied fungi of the continental United States and Canada. North Dakota State University: http://www.ndsu.nodak.edu/instruct/esslinge/chcklst/chcklst7.htm (First Posted 1 December 1997, Most Recent Version (#15) 27 August 2009), Fargo, North Dakota.

Hale, M. E. 1979. How to know the lichens. 2nd ed. William C. Brown Co., Dubuque, IO.

Hinds, J. W. and P. L. Hinds. 2007. The macrolichens of New England. Memoirs of the New York Botanical Garden, Volume 96. The New York Botanical Garden Press, Bronx, NY.

Mosses and Liverworts

Andrus, R. E. 1980. Sphagnaceae (peat moss family) of New York State. Contributions to a Flora of New York State III. New York State Museum Bulletin No. 422. Albany, NY.

Cleavitt, N. L., S. A. Williams, and N. G. Slack. 2006. Updating the rare moss list for New York State: ecological communities and species-centered approaches. Final report for the Biodiversity Research Institute. NY State Museum, Albany, NY. 46 pp.

Conard, H. S. and P. L. Redfearn, Jr. 1979. How to know the mosses and liverworts. 2nd ed. William C. Brown, Dubuque, IO.

Crum, Howard A. 1983. Mosses of the Great Lakes Forest. The University of Michigan Herbarium, Ann Arbor, MI.

Crum, H. A. and L. E. Anderson. 1981. Mosses of Eastern North America. Volume 1-2. Columbia University Press. New York, NY.

Flora of North America Editorial Committee. 2010. Bryophyte Flora of North America (FNA Vols 27, 28, 29). Oxford University Press, New York, NY. (http://www.mobot.org/plantscience/bfna/bfnamenu.htm)

Ketchledge, E. H. 1980. Revised checklist of the mosses of New York State. New York State Museum, Bull. No. 440, Albany, NY.

Ley, L. M. and J. M. Crowe. 1999. An enthusiasts guide to the liverworts and hornworts of Ontario. Lakehead University, Thunder Bay, Ontario, Canada.

McQueen, C. B. 1990. Field Guide to the Peat Mosses of Boreal of North America. University Press of New England, Hanover, NH.

Missouri Botanical Garden. 2010. Tropicos. St. Louis, MO.

Slack, N. G. 1977. Species diversity and community structure in bryophytes: New York State studies. NYS Museum, Bull. No. 428, Albany, NY.

Vascular Plants

Brown, L. 1979. Grasses. An Identification Guide. Houghton Mifflin Co., Boston, MA.

Chapman, W. K. 1997. Orchids of the Northeast. Syracuse University Press, Syracuse, NY.

Chapman, W. K. and Alan E. Bessette. 1990. Trees and Shrubs of the Adirondacks. North Country Books, Utica, NY.

Chapman, W. K., Valerie Chapman, Alan Bessette, Arleen Raines Bessette, Douglas Pens. 1998. Wildflowers of New York in Color. Syracuse University Press, Syracuse, NY.

Crow, G. E. and C. B. Hellquist. 2000. Aquatic and Wetland Plants of Northeastern North America. Two volumes. The University of Wisconsin Press, Madison, WI.

Elias, T. S. 1980. Trees of North America. Crown publishers, New York, NY.

Fernald, M. L. 1950. Grays Manual of Botany. Eighth Edition. Dioscorides Press, Portland, OR.

Gleason, H. A. and A. Cronquist. 1991. Manual of Vascular Plants of Northeastern United States And Adjacent Canada. The New York Botanical Garden, Bronx, NY.

Hitchcock, A. S. 1950. Manual of the Grasses of United States. Volumes I and II. Dover Publications, New York, NY.

Holmgren, N. H. 1998. Illustrated Companion To Gleason and Cronquist's Manual. New York Botanical Garden, Bronx, NY.

Lellinger, D. 1985. A Field manual of the Ferns and Fern Allies of the United States and Canada. Smithsonian Institution Press, Washington, DC

McGrath, A. 1981. Wildflowers of the Adirondacks. North Country Books, Utica, NY

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

Mitchell, R. S. ed. 1983-1993. Contributions to a Flora of New York State. Volumes 1-11. The New York State Museum, Albany, NY.

Newcomb, L. 1977. Newcomb's Wildflower Guide. Little, Brown and Company, Boston, MA.

Niering, W. A. and N. Olmstead. 1979. Audubon society field guide to North American wildflowers. Eastern region. A. E. Knopf, New York, NY.

Petrides, G. A. 1972. A Field Guide to Trees and Shrubs. A Peterson field guide series. Houghton Mifflin Co., Boston, MA.

Petrides, G. A. and J. Wehr. 1998. A Field Guide to Eastern Trees. A Peterson Field Guide Series. Houghton Mifflin Co., Boston, MA.

Peterson, R. T. and M. McKenny. 1968. The field guide to wildflowers of Northeastern and North Central North America. A Peterson Field Guide Series. Houghton Mifflin Co., Boston, MA.

Rhoads, A. F., and T. A. Block. 2000. The plants of Pennsylvania: An illustrated manual. Univ. Pennsylvania Press, Philadelphia.

Slack, N. and A. W. Bell. 1993. 85 Acres. A Field Guide to the Adirondack Alpine Summits. Adirondack Mountain Club.

Soper, J. and M. Heimburger. 1982. Shrubs of Ontario. The Royal Ontario Museum, Toronto, Canada.

Symonds, G. W. D. 1963. The Shrub Identification book. George McLeod Limited, Toronto, Canada.

Symonds, G. W. D. 1958. The Tree Identification Book. George McLeod Limited, Toronto, Canada.

Voss, E. G. 1972. Michigan flora. Part I. Gymnosperms and monocots. Cranbrook Institute of Science and Univ. Michigan Herbarium. Ann Arbor.

Voss, E. G. 1985. Michigan flora. Part II. Dicots (Saururaceae-Cornaceae). Cranbrook Institute of Science and Univ. Michigan Herbarium. Ann Arbor.

Voss, E. G. 1996. Michigan Flora. Part III. Dicots (Pyrolaceae-Compositae). Cranbrook Institute of Science and Univ. Michigan Herbarium. Ann Arbor.

Weldy, Troy and David Werier. 2010 New York Flora Atlas. [S. M. Landry and K. N. Campbell (original application development), Florida Center for Community Design and Research. University of South Florida]. New York Flora Association, Albany, New York.

INVERTEBRATES

Insects

Borror, D. J. and R. E. White. 1970. A field guide to the insects of America north of Mexico. Houghton Mifflin Co., Boston, MA.

Covell, C. V., Jr. 1984. A field guide to the moths of eastern North America. Houghton Mifflin Co., Boston, MA.

Glassberg, J. 1999. Butterflies through the Binoculars: The East. Oxford University Press, New York. 242 p.

Hodges, R. W., T. Dominick, D. R. Davis, DC Ferguson, J. G. Franclemont, E. G. Munroe, J. A. Powell (editors). 1983. Check List of the Lepidoptera of America North of Mexico (Including Greenland). E. W. Classey Ltd. and The Wedge Entomological Research Foundation, London. 284 pp.

Miller, L D. and F. M. Brown. 1981. A catalogue/checklist of the butterflies of America north of Mexico. The Lepidopterists' Society Memoir No. 2.

Milne, L. J. 1980. The Audubon Society field guide to North American insects and spiders. A. E. Knopf, New York, NY.

Opler, P. A. and G. O. Krizek. 1984. Butterflies east of the Great Plains: An illustrated natural History. John Hopkins University Press, Baltimore, MD.

Pyle, R. M. 1981. The Audubon Society field guide to North American butterflies. A. E. Knopf, New York, NY.

Mollusks

Jokinen, E. H. 1992. The freshwater snails of New York State. New York State New York State Museum, Bull. No. 482, Albany, NY.

Strayer, D. L., and K. J. Jirka. 1997. The pearly mussels of New York state. Memoirs of the New York State Museum 26:1-113.

Turgeon, D. D., A. E. Bogan, E. V. Coan, W. K. Emerson, W. G. Lyons, W. L. Pratt, C. F. E. Roper, A. Scheltema, F. G. Thompson, and J. D. Williams. 1988. Common and scientific names of aquatic invertebrates from the United States and Canada: mollusks. American Fisheries Society Special Publication 16. American Fisheries Society, Bethesda, MD.

VERTEBRATES

Fishes

American Fisheries Society Committee on Names of Fishes. 1980. A list of common and scientific names of fishes from the United States and Canada. 4th ed. American Fisheries Society Special Publication No. 12.

Boschung, H. T. Jr., J. D. Williams, D. W. Gotshall, D. K. Caldwell, and M. C. Caldwell. 1983. The Audubon Society field guide to North American fishes, whales, and dolphins. A. E. Knopf, New York, NY.

Decker, D. J., R. A. Howard, W. H. Everhart, and J. W. Kelley. 1980. Guide to the freshwater fishes of New York. Cornell University, Ithaca, NY.

Eddy, S. and J. C. Underhill. 1978. How to know the freshwater fishes. 3rd ed. William C. Brown, Dubuque, IO.

Greeley, J. R. 1929. Fishes of the Erie-Niagara watershed. pp. 150-179 In: A biological survey of the Erie-Niagara system. Suppl. to the 18th Ann. Rep., 1928. NYS Conserv. Dept., Albany, NY.

Greeley, J. R. 1940. Fishes of the Lake Ontario watershed with annotated list. In: A biological survey of the Lake Ontario watershed. Suppl. to the 29th annual report, 1939. NYS Conservation Dept., Albany, NY.

Haynes, J. M. and N. J. Frisch. 1993. Illustrated guide to Hudson River fishes. SUNY College at Brockport, Brockport, NY.

McClane, A. J. 1974. Field guide to freshwater fishes of North America. Holt Reinhart and Winston, New York, NY.

Page, L. M. an B. M. Burr. 1991. Freshwater fishes. Houghton Mifflin Co., Boston, MA.

Robins, C. R., R. M. Bailey, C. E. Bond, J. R. Brooker, E. A. Lachner, R. N. Lea, and W. B. Scott. 1991. Common and scientific names of fishes from the United States and Canada. Fifth Edition. American Fisheries Society Special Publication 20. American Fisheries Society, Bethesda, MD.

Robins, C. R. and G. C. Ray. 1986. A field guide to Atlantic Coast fishes of North America. Houghton Mifflin Co., Boston, MA.

Smith, C. L. 1985. The inland fishes of New York State. New York State Department of Environmental Conservation, Albany, NY.

Werner, R. G. 1980. Freshater fishes of New York State. Syracuse University Press, Syracuse, NY.

Reptiles and Amphibians

Behler, J. L. and F. W. King. 1979. The Audubon Society field guide to North American reptile and amphibians. A. E. Knopf, New York, NY.

Bishop, S. C. 1941. Salamanders of New York. New York State New York State Museum, Bull. No. 324, Albany, NY.

Bishop, Handbook of salamanders. Comstock Publishing Company, Inc., Ithaca, NY.

Collins, J. T., R. Conant, E. Huheey, J. L. Knight, E. M. Rundquist, and H. M. Smith. 1982. Standard common and current scientific names for North American amphibians and reptiles. 2nd ed. Society for the Study of Amphibians and Reptiles, Miami University, Oxford, OH.

Conant, R. and J. T. Collins. 1991. A field guide to reptiles and amphibians; Eastern and central North America. 3rd ed. Houghton Mifflin Co., Boston, MA.

DeGraaf, R. M. and D. D. Rudis. 1981. Forest habitat for reptiles & amphibians of the Northeast. Forest Service, US Department of Agriculture. Northeastern Forest Experiment Station, Amherst, MA.

Ernst, C. H., R. W. Barbour, and J. E. Lovich. 1994. Turtles of the United States and Canada. Smithsonian Institution Press, Washington, DC

Frost, D. R. 1985. Amphibian species of the world: a taxonomic and geographic reference. Allen Press, Inc. and The Association of Systematics Collections, Lawrence, KS.

New York State Department of Environmental Conservation. 1985. Checklist of the amphibians, reptiles, birds and mammals of New York State, including their protective status. Nongame Section, Div. of Fish and Wildlife, NYS Department of Environmental Conservation, Delmar, NY.

Petranka, J. W. 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington, DC

Birds

American Ornithologists' Union. 1983. Check-list of North American birds. Sixth Edition. Allen Press, Inc., Lawrence, KS.

Bull, J. 1974. Birds of New York State. Doubleday/Natural History Press, Garden City, NY

Bull, J. and J. Farrand, Jr. 1977. The Audubon Society field guide to North American birds: Eastern region. A. E. Knopf, New York, NY.

Farrand, J., Jr. 1983. The Audubon Society master guide to birding 3 vols. A. E. Knopf, New York, NY.

Holmes, R. T., T. W. Sherry, and F. W. Sturges. 1986. Bird community dynamics in a temperate deciduous forest: long-term trends at Hubbard Brook. Ecol. Monogr. 56: 201-220.

Levine, E. L. ed. 1998. Bull's Birds of New York State. Comstock Publishing, Ithaca, NY.

Peterson, R. T. 1980. A field guide to the birds of Eastern and Central North America. 4th ed. Houghton Mifflin Co., Boston, MA.

Robbins, C. S., B. Bruun, and H. S. Zim. 1983. A guide to field identification: Birds of North America. Golden Press, New York, NY.

Sabo, S. R. 1980. Niche and habitat relations in subalpine bird communities of the White Mountains of New Hampshire. Ecol. Monogr. 50: 241-259.

Scott, S. L., ed. 1999. Field guide to the birds of North America. National Geographic Society. Washington, DC

Mammals

Burt, W. H. and R. P. Grossenheider. 1980. A field guide to the mammals. 3rd ed. Houghton Mifflin Co., Boston, MA.

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

Honacki, J. H., K. E. Kinman, and J. W. Koeppl, eds. 1982. Mammal species of the world. Assoc. of Systematic Collections and Allen Press, Lawrence, KS.
Jones, J. K., Jr., DC Carter, H. H. Genoways, R. S. Hoffmann, D W. Rice, and C. Jones. 1986. Revised checklist of North American mammals north of Mexico, 1986. Occas. Papers Mus., Texas Tech. Univ. 107:1-22.

Leatherwood, S., D. K. Caldwell, and H. E. Winn. 1976. Whales, dolphins, and porpoises of the western North Atlantic. N. O. A. A. Tech. Rep., National Marine Fisheries Service CIRC-396.

Matthews, M. J. 1981. Urban wildlife habitat inventory map overlay user information. Pamphlet, Urban Wildlife Unit, NYS Dept. of Environmental Conservation, Delmar, NY.

Merrit, J. F. 1987. Guide to the mammals of Pennsylvania. University of Pittsburgh Press, Pittsburgh, PA.

REGIONAL STUDIES

Adams, C. C., R. B. Gordon, F. W. Emerson, L. A. Kenoyer, L. E. Hicks, and A. A. Saunders. 1937. Vegetational survey of Allegany State Park. NYS Mus. Handbook 17, Albany, NY.

Batcher, M. S. 1998. The comparative effect of environmental gradients, fire and fragmentation of the composition and structure of natural communities in the Northern Shawangunk Mountains. Unpublished report. The Shawangunk Ridge Biodiversity Partnership, Ulster County, NY.

Curran, R. P. 1974. Vegetational development of the plains of the Oswegatchie. M. S. thesis, State University College of Environmental Science and Forestry, Syracuse, NY. 186 pp.

Curtis, J. T. 1959. The vegetation of Wisconsin. An ordination of plant communities. University of Wisconsin Press, Madison.

DeGraaf, R. M. and D. D. Rudis. 1986. New England Wildlife: habitat, natural history, and distribution. USDA. Forest Service, Northeastern Forest Experiment Station. Gen. Tech. Report NE-108.

Dickinson, N. R. 1979. A division of southern and western New York State into ecological zones. Unpubl. report for NYS Dept. of Environmental Conservation, Wildlife Resources Center, Delmar, NY.

Faigenbaum, H. M. 1937. Chemical investigation of the lower Hudson area. In: A biological survey of the lower Hudson watershed. Suppl. to the 26th Ann. Rep., 1936. NYS Conserv. Dept., Albany, NY.

Faigenbaum, H. M. 1939. Chemical investigation of the fresh waters of Long Island. In: A biological survey of the fresh waters of Long Island. Suppl. to the 28th Ann. Rep., 1938. NYS Conserv. Dept., Albany, NY.

Faigenbaum, H. M. 1939. Chemical investigation of the south shore and eastern bay areas of Long Island. In: A biological survey of the salt waters of Long Island, 1938. Suppl. to the 28th Annual Report, 1938. A joint survey with the US Bureau of Fisheries. NYS Conservation Dept., Albany, NY.

Fassett, N. C. 1928. The vegetation of the estuaries of northeastern North America. Proc. Boston Sox. Nat. Hist. 39: 73-130.

Giles, R. H., ed. 1969. Wildlife Management techniques. The Wildlife Society, Washington, DC

Hubbs, K. 1995. Fire History of the Northern Shawangunks. Unpublished report. The Nature Conservancy, Troy, NY
Johnson, A. H. and S. B. McLaughlin. 1986. The nature and timing of the deterioration of red spruce in the northern Appalachian Mountains. In: Acid deposition long-term trends, pp. 200-230, National Academy Press.

Jordan, M. 1999. Conceptual ecological models for the Long Island Pine Barrens. Unpublished report. The Nature Conservancy, Long Island Chapter, Cold Spring Harbor, NY.

Laing, C. 1994. Vegetation and fire history of the dwarf pine ridges, Shawangunk Mts., New York. Unpublished report. The Nature Conservancy, Eastern New York Chapter, Troy, NY.

Mohler, C. L. and P. L. Marks. 1983. Vegetation - environment relations in the central Finger Lakes region of New York. Draft manuscript. Section of Ecology and Systematics, Cornell Univ., Ithaca, NY.

Niering, W. A. 1953. The past and present vegetation of High Point State Park, New Jersey. Ecol. Monogr. 23: 127-148.

Russell, E. W. B. 2001. Three centuries of vegetational change in the Shawangunk Mountains. Unpublished report. The Nature Conservancy, Eastern New York Chapter, Troy, NY.

Scott, J. T., T. G. Siccama, A. H. Johnson, and A. R. Breisch. 1984. Decline of red spruce in the Adirondacks, New York. Bull. Torrey Bot. Club 111: 438-444.

Shelford, V. E. 1963. The Ecology of North America. University of Illinois Press, Urbana, Illinois.

Thompson, J. E. 1997. Ecological communities of the Montauk Peninsula, Suffolk County, New York. Unpublished report. The Nature Conservancy. Long Island Chapter, Cold Spring Harbor, NY.

Weiss, M. J., L. K. McCreary, I. Millers, M. Miller-Weeks, and J. T. O'Brien. 1985. Cooperative survey of red spruce and balsam fir decline and mortality in New York, Vermont, and New Hampshire 1984. USDA. Forest Service Northeastern Area, NA-TP-11, Broomall, Pa.

Wiegand, K. M. and A. J. Eames. 1926. The flora of the Cayuga Lake basin, New York. Cornell Univ. Ag. Exp. Sta. Memoir 92.

Will, G. B., R. D. Stumvoll, R. F. Gotie, and R. S. Smith. 1979. The ecological zones of northern New York. Unpubl. report for NYS Dept. of Environmental Conservation, Albany, NY.

APPENDIX A: HERITAGE PROGRAM ELEMENT RANKS

Explanation of ranks and codes used in Natural Heritage database reports.
Each element has a global and state rank as determined by NY Natural Heritage. These ranks carry no legal weight but are believed to accurately reflect the relative rarity given of the element. The global rank reflects the rarity of the element throughout the world and the state rank reflects the rarity within New York State. The global rank for communities is estimate of the rarity of the state type throughout its range. Infraspecific taxa are also assigned a taxon rank to reflect the infraspecific taxon's rank throughout the world. For species, the Taxon or T-ranks (T1 - T5) are defined like the global ranks (G1 - G5), but the T-rank *only* refers to the rarity of the subspecific taxon of the species.

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 and/or ecology.
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 = Typically 5 or fewer occurrences, very few remaining individuals (for species), acres, or miles of stream, or some factor of its biology and/or ecology making it especially vulnerable in New York State.
S2 = Typically 6 to 20 occurrences, few remaining individuals (for species), acres, or miles of stream, or factors demonstrably making it very vulnerable in New York State.
S3 = Typically 21 to 100 occurrences, limited acreage, or miles of stream in New York State.
S4 = Apparently secure in New York State.
S5 = Demonstrably secure in New York State.
SH = Historically known from New York State, but not seen in the past 20 years.
SX = Apparently extirpated from New York State.
SE = Non-native species, not native to New York State.
SR = State report only, no verified specimens (for species) known from New York State.
SU = Status unknown.

TAXON RANK (for species)

T1 - T5 = indicates a rank assigned to a subspecies following the 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.

APPENDIX B: GLOSSARY

abundance: term referring to the the number of individuals of a single species present in a community.

abundant: a species with a relatively high number of individuals in a communty.

acidic: describes water or soil with a pH less than 5.5.

algific: producing cold; as in ice cave talus community.

alkaline: describes water or soil with a pH greater than 7.4.

allochthonous: sources of carbon or energy (photosynthesis) in aquatic systems occurs on land near the waterbody; most of the carbon is derived from dead plant material or detritus that enter the waterbody from the surrounding forest.

alluvium: unconsolidated material deposited by running water, including gravel, sand, silt, clay, and various mixtures of these.

alpine: characteristic of any lofty mountain or mountain system; implies high elevation, near or above tree line, and a cold, windy climate.

alvar: a Swedish term to describe barrens and grassland vegetation that grows on thin soils over level outcrops of limestone or dolomite bedrock.

aquatic bed: a wetland or deepwater habitat dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years.

aquatic macrophyte: an aquatic plant that is large enough to be visible without magnification by a microscope or handlens.

assemblage: a non-committal term for a group of organisms that live together and can be studied; does not imply any particular scale.

associate: any species that commonly occurs in the same community or assemblage with one particular species, is an associate of that species.

autochthonous: sources of carbon or energy (photosynthesis) in aquatic systems occurs within the waterbody itself; in larger aquatic systems, most of the carbon is produced by resident algae, diatoms, cyanobacteria, dinoflagellates and aquatic plants via photosynthesis.

bar: an elongated landform generated by waves and currents and usually running parallel to the shore, composed predominantly of unconsolidated sand, gravel, cobbles, or stones, and with water on two sides.

barrens: a depauperate community with either a low canopy coverage or with stunted individuals of species which elsewhere reach considerable size; this term is applied to both savannas and woodlands.

barrier beach: a narrow, elongate sand ridge rising slightly above the high-tide level and extending generally parallel with the shore, but separated from it by a lagoon or marsh; it is rarely more than a few miles (or several kilometers) long.

base level: the theoretical limit or lowest level toward which erosion of the earth's surface constantly progresses; especially the level below which a stream cannot erode its bed.

bedrock: the solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

benthic/benthos: organisms living in or on the bottom of an aquatic system such as a lake or a river.

biota: the complete flora and fauna of an area from the taxonomic point of view.

bog: a nutrient-poor, acidic peatland that receives water primarily from direct rainfall, with little or no influence of groundwater or runoff; vegetation consists primarily of peat mosses (*Sphagnum* spp.) and ericaceous shrubs.

boreal: describes the circumpolar forest region in the northern hemisphere that is generally dominated by conifer tree species; the boreal forest extends north to the treeless tundra and south to the mixed conifer/deciduous forests or temperate grasslands.

brackish: describes marine and estuarine waters with moderate salinity, in the range of 0.5 to 18.0 ppt dissolved salts.

bryophyte: a collective term referring to mosses and liverworts.

calcareous: formed of calcium carbonate or magnesium carbonate by biological deposition or inorganic precipitation in sufficient quantities to effervesce carbon dioxide visibly when treated with cold 0.1 normal hydrochloric acid.

canopy: the aerial branches of terrestrial plants (usually trees or shrubs), and their complement of leaves, that form the uppermost layers of vegetation in a community; a canopy is said to be complete (or have 100% cover) when the ground is completely hidden by the leaves when viewed from above the canopy.

carr: a wetland dominated by *Alnus* and/or *Salix* adjoining water courses, where periodic flooding precludes peat accumulation (Andrus 1980).

channel: the bed of a single or braided watercourse that commonly is barren of vegetation and is formed of modern alluvium.

characteristic species: a species that commonly occurs in a particular community, although it is not necessarily

abundant; it may not occur in all examples of that community, but it may be expected to occur in at least half the examples.

circumneutral: describes water or soil with a pH of 5.5 to 7.4.

clay: soil composed of very fine particles (with particle sizes less than 0.002 mm).

closed canopy: a forest canopy that has a high percent cover; where the ground is completely or almost completey shaded by the canopy.

coarse woody debris: describes the dead woody material in a forested community, such as standing dead trees, dead branches and twigs, logs, and stumps.

coastal plain: any plain of unconsolidated fluvial or marine sediment which had its margin on the shore of a large body of water, particularly the ocean.

cobble: rock fragments 3 to 10 inches (7.6 to 25.4 cm) in diameter.

codominant: a species with relatively high abundance or percent cover in a community; two or more species providing roughly equal cover, abundance, or influence in a community, and which in combination control the environment of the community.

community: an assemblage of plants and animals interacting with one another, occupying a habitat, and often modifying the habitat; a variable assemblage of plant and animal populations sharing a common environment and occurring repeatedly in the landscape.

composition: a term that refers to all the species that comprise a community and their relative abundances.

conifer: a cone-bearing tree of the pine family (*Pinaceae*), usually evergreen.

copropel: in aquatic communities denotes a mixture of humus material, fine plant fragments, algal remains, grains of quartz and mica, diatom frustules, exoskeleton fragments from aquatic arthropods, and spore and pollen relics.

cover: the amount of ground surface that is covered or shaded by the leaves and stems of a plant species or a group of species in a community.

cultivated: planted and maintained by people.

cyanobacteria: organisms once known as "bluegreen algae."

dbh: abbreviation for "diameter at breast height," which describes the diameter of a tree at a height of 4.5 ft (about 1.4 meters) above the ground; this measurement is used to estimate basal area (cross-sectional area of a tree at the same height), which is a measure of dominance in forests.

density: term to indicate the number of individuals per unit area.

deposition: the laying down of potential rock-forming or soil-forming materials; sedimentation.

desiccation: the process of becoming completely dry.

dimictic: describes a lake that has two periods of mixing or turnover each year (spring and fall); these lakes are thermally stratified in summer (warmest water at the surface), and they freeze over and become inversely stratified in winter (coldest water at the surface).

discharge: total volume of water per unit time flowing through a channel.

disturbance regime: describes a repeating pattern of natural disturbance in a community, such as seasonal flooding, daily tidal flooding, periodic fires, windthrow, erosion, and ice scouring.

dominant: a species with the greatest abundance or percent cover in a community; a species with so much cover, abundance, or influence in a community that it controls the environment of the community; a species of great importance in a community through size, number, or other characters which enable it to receive the brunt of external environmental forces and modify them before they affect the other members of the community; for example, the dominant tree in a forest receives the most sunlight and produces the most shade, thus modifying the environment of the forest.

drumlin: a low oval mound or small hill, typically one of a group, consisting of compacted boulder clay molded by past glacial action.

dwarf: a stunted growth form; for example, dwarf trees are less than 4.9 m (16 ft) tall.

dystrophic: describes lake water with a high content of organic matter; brown-water lakes. Having brownish acidic waters, a high concentration of humic matter, and a small plant population.

ecosystem: living organisms and their environment functioning as an interacting unit.

ecotone: the edge or transition between two different communities or ecosystems.

edaphic: of or relating to soil, especially as it affects living organisms; influenced by the soil rather than by the climate.

effluent: liquid outflow from sewage works, factories, farms, etc.

embayment: a bay or a formation resembling a bay.

emergent: upright, rooted, herbaceous plants that may be temporarily to permanently flooded at the base while the upper portions of the plant grow erect above the water surface; these plants do not tolerate prolonged inundation of the entire plant; for example, cattail (*Typha latifolia*).

ephemeral: something temporary; used to describe intermittently wet areas; see also: spring ephemeral.

epilimnion: the upper, warm, circulating layer of water in a stratified lake.

epilithic: growing on stone; *e.g.*, "epilithic mosses"

epiphytic: describes organisms (especially plants) that live on the surface of a plant; for example, an alga living on an aquatic plant, or a moss living on the bark of a tree.

ericaceous: describes plants belonging to the heath family, the *Ericaceae*.

erosion: the wearing away of the land surface by running water, waves, moving ice and wind, or by other geological processes.

eskers: a winding, narrow ridge of sand or gravel deposited by a stream flowing in or under glacial ice.

eutrophic: relatively rich in nutrients; generally referring to a habitat more nutrient rich than oligotrophic or mesotrophic habitats; especially used for an aquatic system that has a high concentration of plant nutrients such as nitrogen and phosphorus, and supports high plant productivity.

exemplary: an excellent example.

non-native: an introduced species that is not native to New York State.

fauna: all of the animal species that live in a particular site or area.

feather mosses: term for large mosses that are pinnately branched and look like feathers or miniature ferns.

fen: an open peatland, sometimes with scattered trees, ocurring on minerotrophic sites that receive groundwater which has been in contact with soil or bedrock, and is richer in mineral-nutrient elements than rainwater; a peatland that is richer in nutrients and less acidic than a bog; vegetation consists primarily of sedges, grasses, mosses and shrubs.

flarks: in patterned peatlands strings and flarks occur as narrow or broad bands of vegetation that extend perpendicular to the direction of water flow across the slope of the peatland. The flarks, or hollows (low, relatively wet areas) are more minerotrophic than stings.

flat: a nearly level landform composed of unconsolidated sediments such as mud or sand, or nearly level expanses of sedimentary rock.

floating plant: a plant that floats freely in the water or on the water surface and is not anchored in the substrate; for example, duckweed (*Lemna minor*).

floating-leaved aquatic: an herbaceous plant that is rooted in the substrate with some leaves floating on the water suface; for example, white water lily (*Nymphaea odorata*). Plants such as common yellow pond-lily (*Nuphar variegata*) that sometimes have leaves raised above the water surface are considered either floating-leaved or emergent, depending on their growth habit in a particular site or community.

flora: all of the plant species that grow spontaneously in a particular area; a taxonomic list of species; the size of a flora is determined by the number of species and is not influenced by the number of individuals of each species.

forb: an herbaceous plant that is not grass-like, especially used for broad-leaved herbaceous plants, and may include ferns and fern-allies.

foredune: low, very active dune that is parallel to the beach; named for its position as the first (fore) dune inland from the beach; also known as primary dune.

forest: communities formed by trees with a canopy cover of at least 61 percent or more at maturity, with tree crowns usually interlocked.

frequency: a measure of the commonness and widespread distribution of plant or animal individuals in a single example of a community.

fresh: describes water with salinity less than 0.5 ppt dissolved salts.

gradient: a gradually changing factor; especially used for environmental variables, for example, a gradient from wet to dry soils.

graminoid: general term for any grass-like plant; including grasses (Poaceae), sedges (Cyperaceae), rushes (Juncaceae), and cattails (Typhaceae), as well as some plants in other families.

grass: a plant in the grass family (Poaceae).

grassland: an open canopy community dominated by graminoids; forbs may be common, but there are relatively few shrubs and less than one tree per acre.

grass-savanna: an upland community with a sparse canopy of trees (from 25 to 60% cover), and a groundlayer dominated by graminoids and forbs (with less than 50% cover of shrubs).

gravel: a mixture composed primarily of small rock fragments 0.1 to 3 inches (2 mm to 7.6 cm) in diameter.

grikes: fissures, cracks, and crevices in limestone pavement bedrock created by the dissolution of limestone, especially in alvar communities.

groundlayer: the herbs, shrubs, and woody vines found beneath the trees in a forest; or the lowest layer of vegetation in an open-canopy community.

groundwater: water found underground in porous rock strata and soils.

halophyte, halophytic: a plant that thrives in saline soil; a plant adapted to living in a saline environment.

hardwood: deciduous trees that are not conifers.

headward erosion: erosion moving towards the headwaters or source of a stream.

heath shrub: a shrub in the heath family (Ericaceae); an ericaceous shrub.

heath-like shrub: shrubs that are similar in habit and growth form to heath shrubs but not in the heath family (Ericaceae); broad-leaved, often evergreen shrubs with leathery leaves and a compact growth form.

heathland: a low shrubland dominated by heath or heath-like shrubs.

herb: a plant with no persistent woody stem above ground, as distinct from shrubs and trees; includes graminoids and forbs.

herbaceous layer: the layer or stratum of vegetation in a community in which herbs are common or dominant; usually the groundlayer.

high-enery waves: rough waves; waves that have enough energy to move large objects or modify landforms.

hollow: a microtopographic depression in a peatland; these can be of various sizes, and intermittently with standing water.

hummock: a moss-covered mound in a peatland, usually less than 40 cm high, and varying from less than 1 to more than 10 square meters in area; vegetation usually includes some dwarf shrubs, and sometimes includes tall shrubs or trees.

hydric: term describing areas with wet soils.

hydrology: describes the way water is distributed in the landscape, moves on the ground surface and underground, and cycles by evaporation, precipitation, and flow.

hydrophyte, hydrophytic: describes any plant adapted to growing in water or on a very wet substrate (one that is at least periodically deficient in oxygen as a result of excessive water content).

hypolimnion: the deep, cold, lower layer of water in a stratified lake.

impoundment: a pond caused by a dam across a stream and used for purposes such as water supply or water power.

infauna: aquatic animals that live in the substrate of a body of water, especially in a soft sea bottom.

introduced: describes an non-native species that became established in New York State by human activities, either intentionally (such as many cultivated plants) or accidentally; not native.

levee: and artificial or natural embankment built along the margin of a watercourse or an arm of the sea, to protect land from inundation, or an embankment that confines streamflow to its channel.

liana: a woody-stemmed vine. Lianas are rooted in the substrate and use trees or shrubs as support; often their leaves and flowers reach the canopy of layer of the vegetation. Used in this classification to describe vines that are in the tree canopy vs. vines that form a groundcover.

limnetic zone: the open water area of lakes.

litter layer: the uppermost layer of soil; it usually consists of fresh or partly decomposed organic debris such as fallen leave, twigs, fruits, etc.

littoral zone: the shallow water zone at the interface between the drainage basin land surrounding a lake and the open water of the lake.

macrophyte: a plant (especially an aquatic plant) large enough to be visible without magnification by a handlens or microscope.

madicolous habitat: refers to the thin surface film of water on rocks, or thin layer of water flowing over a substrate (*e.g.*, springs, wet cliffs, wet shoreline outcrops).

maritime: describes sites or communities near the ocean and influenced by coastal processes.

marl: an earthy, unconsolidated deposit consisting chiefly of calcium carbonate mixed with clay in approximately equal proportions (35 to 65% of each); formed primarily under freshwater lacustrine conditions, but also deposited by decomposing algae in very alkaline wetlands.

marsh: a wet area, periodically inundated with standing or slow-moving water, that has a grassy or herbaceous vegetation and often little peat accumulation.

meadow: an open canopy community with forbs, graminoids and shrubs codominant; meadows may have scattered trees, but there is less than 25% canopy cover of trees.

mean high tide: the average height of the high tide water over 19 years.

meander: one of a series of sinuous loops, with sine-wave form, in the course of a stream channel.

meromictic: describes a lake that has no annual periods of mixing and remains chemically stratified throughout the year.

mesic: term describing areas with moist, well-drained soils; intermediate between xeric (dry) soils and hydric (wet) soils.

mesophytic: term describing vegetation characteristic of moist, well- drained soils.

mesotrophic: having moderate levels of nutrients; referring to a habitat intermediate in richness between eutrophic and oligotrophic.

microlepidoptera: an artificial grouping of moth families, commonly known as the “smaller moths” with wingspans

generally under 20 mm.

microtopography: the fine scale topography of a site.

mineral soil: soil with less than 20% organic matter if the mineral fraction contains no clay; or less than 30% organic matter if the mineral fraction contains 50% or more clay. For more information see Appendix D in: Cowardin *et al.* (1979).

minerotrophic: groundwater-fed; areas influenced by water that has been in contact with soil or bedrock, and is richer in mineral-nutrient elements than rainwater.

monomictic: describes a lake that has one period of mixing or turnover each year.

morphometry: describes morphological features of a lake or stream and its included water mass; includes water depth, surface area, lenth of shore line, water volume, and slope and topography of the basin.

mosaic: in a landscape, a complex pattern composed of different types of communities or assemblages that are intermingled.

muck: highly decomposed organic material in which the original plant parts are not recognizable; contains more mineral matter and is usually darker in color than peat.

mudflats: a level landform associated with shores that is composed of unconsolidated mud sediments; mudflats may be irregularly shaped or elongate and continuous with the shore.

native: describes species that naturally occur in New York State, and were not introduced by human activities; indigenous.

naturalized: describes species that were introduced into New York State by human activities, and are successfully established and reproducing naturally without cultivation.
nutrient-poor: providing low levels of plant nutrients.

nutrient-rich: providing high levels of plant nutrients.

oligotrophic: poor to extremely poor in nutrients; referring to a habitat less nutrient-rich than eutrophic or mesotrophic.

ombrotrophic: rain-fed; used especially to indicate peatlands or portions of peatlands which receive water only from precipitation.

open canopy: with very sparse cover of canopy trees; with less than 25% canopy cover.

organic matter: material derived from the decay of living organisms.

organic soil: soil with at least 20% organic matter if the mineral fraction contains no clay, or with at least 30% organic matter if the mineral fraction contains 50% or more clay. For more details see Appendix D: Cowardin *et al.* (1979).

outcrop: that part of a geologic formation or structure that appears at the surface of the earth.

oxbow: a closely looping stream meander having an extreme curvature such that only a neck of land is left between the two parts of the stream.

pack ice: ice formed from ice floes that were washed onto the shore of a river or lake.

panne: a low area within a salt marsh (usually in high salt marsh) that is permanently saturated or includes a small pond hole that is permanently filled with water.

peat: the partially-decayed remains of plant material accumulating on wet sites because of water-logging; unconsolidated soil material consisting of accumulated, undecomposed (or only slightly decomposed) organic matter.

peat moss: any moss in the genus *Sphagnum*.

peatland: a wet area in which peat has accumulated; in this classification, wetlands with marl substrates are included in peatlands.

pelagic: 1. of, relating to, or living in open oceans or seas rather than waters adjacent to land or inland waters; *e.g.*, "pelagic birds." 2. in aquatic communities, the zone that includes free-floating organisms (*e.g.*, plankton and fish), also called the "limnetic" zone.

perched water table: a water table held above the regional level by an impermeable or slowly permeable layer.

periphytic: describes organisms living on the surfaces of submerged plants.

pH: symbol for units in the measurement of acidity or alkalinity of soil, water, or other substrates.

podzolized: describes a type of soil in which organic matter, iron, aluminum, a small amount of phosphorus, and sometimes clay, have been translocated from the upper part of the mineral soil layers to the lower part.

polychaetes: a class of segmented marine worms including bristleworms, tube-worms, and fan-worms.

pond hole: a deep panne or low area within a salt marsh that is permanently filled with water; pond holes have nearly vertical walls of salt marsh turf.

pool: in a stream, a portion of the stream that is deep and has a slow current (relative to shallower portions of the stream); the water surface is calm unless disturbed by wind.

poor: describes a nutrient-poor environment; can also be used to describe communities with low species diversity.

ppt: abbreviation for "parts per thousand."

primary dune: the dune closest to the water (shore) that is the largest and takes the brunt of wave and wind action; also known as foredune.

profundal zone: the deep, central area of a lake.

prominent: describes a species with a relatively high percent cover or abundance in a community.

quiet water: calm water, not subject to violent wave action.

relic: a disjunct community, separated by other communities from its main geographical range.

relict: pertaining to surface landscape features that have never been buried and are products of past environments no longer operative in a given area.

remnant: a portion or fragment of a pre-settlement ecological community remaining after the destruction of the bulk of the community by human activities such as agricultural, residential, or commercial development.

rich: describes an environment that is relatively high in plant nutrients (*e.g.,* minerals such as calcium); describes plants indicative of these environments (*e.g.,* mineral-rich indicator herbs); can also be used to describe communities with high species diversity; some communities can be mineral rich and species rich (*e.g.,* rich graminoid fen).

riffle: a portion of a stream that is shallow and has a fast current (relative to adjacent deeper portions of the stream). The water surface is disturbed by the current and may form standing waves.

rosette-leaved aquatic: a low-growing aquatic plant with leaves arranged in a circular cluster.

rubble: an accumulation of loose angular rock fragments, commonly overlying a rock outcrop.

run: a portion of a stream that has a moderate to fast current; the water is deep enough that the water surface is smooth and unbroken by the water current (although it may be disturbed by wind).

saline: general term for waters containing various dissolved salts.

salinity: the total amount of solid material in grams contained in 1 kg of water when all the carbonate has been converted to oxide, the bromine and iodine replaced by chlorine, and all the organic matter completely oxidized; here expressed in parts per thousand (ppt) dissolved salts.

sand: composed primarily of coarse-grained mineral sediments with diameters larger than 0.074 mm and smaller than 2 mm.

sandspit: a small point or narrow embankment of land, consisting of sand deposited by longshore drifting and having one end attached to the mainland and the other terminating in open water, usually the sea; a fingerlike extension of the beach.

Secchi disk depth: a measure of the transparency of a body of water determined by lowering a round, white or black-and-white disk into the water until it is not visible from above the water.

secondary dune: the dunes that form on the leeward or landward side of the primary dunes. The conditions are less severe (not so windy or salty) and the elevation is usually lower in secondary dunes.

sedge: a grasslike herbaceous plant in the family Cyperaceae, especially a species of the genus *Carex*.

seepage: lateral water flow through the soil; it represents an important source of minerotrophic water to a peatland.

semidiurnal tides: tides that occur about every twelve hours, or twice in each tidal day.

shallows: a relatively shallow place in an estuary or other body of water.

shoal: a relatively shallow place in a stream, lake, sea, or other body of water; a shallows.

shrub: a perennial, woody plant that differs from a tree by its low growth form and presence of multiple stems or several branches starting at or near the ground; a shrub is usually less than 16 feet (5 meters) tall at maturity, and usually has several erect, spreading, or prostrate stems and a more or less bushy appearance.

shrubland: a community dominated by woody perennial shrubs, with more than 50% canopy cover of shrubs, and less than 25% canopy cover of trees.

shrub layer: the layer of vegetation in a community that is dominated by shrubs.

shrub-savanna: an upland community with a sparse canopy of trees (from 25 to 60% cover), and a groundlayer that is predominantly shrubby (at least 50% cover of shrubs).

silt: soil composed of fine-grained mineral sediments; particles are intermediate in size between sand and clay (particle sizes between 0.074 and 0.002 mm), and they were carried or laid down as sediment by moving water.

site: a place or location; not used here in the special sence employed by foresters.

slough: a swamp or marsh that is part of an inlet or backwater.

species diversity: the number of species that occur in an area or in a community; species richness; not used in this classification to describe species equitability or the relative abundances of species.

spring ephemeral: spring-flowering plants that emerge and flower in a forest before the leaves of canopy trees are fully grown, and then wither after the canopy leaves shade the forest floor.

spring tide: tides occurring near the time of full or new moon, when the range of tides is greater than the mean range; the highest high and lowest low tides during the

lunar month.

stand: a particular example of a community.

stochastic: being or having a random variable; *e.g.*, "a stochastic event," "stochastic processes," such as fire, flood, or wind blow down.

stone: rock fragments larger than 10 inches (25.4 cm) but less than 24 inches (60.4 cm).

strand forests: or maritime forests are linear forests that develop on relatively narrow peninsulas and barrier islands.

stratified: a term that describes the condition of many temperate lakes during summer and winter when layers of water within a lake have different temperatures and different circulation patterns; for example, a summer-stratified lake has an upper, circulating layer of warm water that overlays a lower, cold layer; these layers are separated by a relatively thin transition zone or thermocline.

strings: in patterned peatlands strings and flarks occur as narrow or broad bands of vegetation that extend perpendicular to the direction of water flow across the slope of the peatland. The strings, or hummocks (high, relatively dry areas) are ususally ombrotrohic or weakly minerotrophic.

structure: the spatial arrangement of vegetation layers within a community.

subcanopy: in a forest community, the tops and braches of small trees and tall shrubs that form a distinct layer beneath the tree canopy and above the shrub layer.

sublittoral: the portion of a lake bottom that is intermediate between the peripheral shallows or littoral zone and the deep, cold, dark profundal zone.

submerged aquatic: an aquatic plant, either rooted or non-rooted, which grows entirely beneath the surface of the water, except for the flowering parts in some species; for example, tapegrass or wild celery (*Vallisneria americana*).

substrate: the base material (soil or rocks) in which plants are rooted and from which they obtain nutrients.

subtidal: in tidal wetlands, the permanently flooded area below the lowest tide.

successional: describes communities that are changing relatively quickly as new species, usually more shade-tolerant species, replace the more sun-loving species that initially become established after a site is disturbed.

swamp: a wooded wetland; an area intermittently or permanently covered with water, that has shrubs and/or trees.

talus: rock fragments of any size or shape (usually coarse and angular) derived from and lying at the base of a cliff or very steep, rock slope; the accumulated mass of this loose broken rock formed chiefly by falling, rolling, or sliding.

thermocline: the region of rapid temperature transition in a stratified lake.

topography: configuration of the land surface.

tree: a woody perennial plant, usually having one principal stem or trunk, that has a definite crown of branches and leaves, and characteristically reaches a mature height of at least 5 m (16 ft); some species of oak (*Quercus*), juniper (*Juniperus*), willow (*Salix*) and other plants may grow as either trees or shrubs.

tree line: the upper limit of tree growth at high latitudes or at high elevations in mountains; timberline.

trophic: of, or involving, the feeding habits or food relationship of different organisms in a food chain.

upland: sites with well-drained soils that are dry to mesic, but never hydric.

understory: the lower layers of vegetation in a community; in a forest community, all the vegetation layers beneath the tree canopy and subcanopy.

vascular plant: plants with a vascular system, including trees, shrubs, and herbs, but not including mosses, lichens, or algae.

vernal: occurring in the spring.

vine: any woody or herbaceous plant which trails, climbs, or creeps as contrasted to those which stand without support.

washover: a deposit of sand caused by storms; washovers occur in low areas along the coast where a barrier usually protects the area from the full force of ocean waves and where storms occasionally cause masses of sand to be carried over the barrier and onto the protected area (such as a marsh, interdunal swale, or lagoon).

watershed: the area drained by a river or river system.

woodland: communities composed of trees with a canopy cover of 26 to 60 percent at maturity. A herbaceous and/or shrub understory is usually present.

xeric: term describing areas with dry, well-drained soils.

APPENDIX C: KEY TO SYSTEMS AND SUBSYSTEMS

The following key is a tool for identification of communities described in this book. This key is designed to help you find the appropriate system and subsystem in the classification for an unknown community. The key is arranged as a series of pairs of choices, and each pair is identified by a letter. Starting with the first pair (A and AA), read both choices of the pair, and select the description that most closely fits the community in question. At the end of each choice is the letter that identifies the next pair of choices to consider, or the name of the subsystem. Continue selecting from each subsequent pair of choices until you reach a subsystem.

After you have identified the system and subsystem using this key, read the community descriptions in the main text following the subsystem and select the description that most closely fits the community in question. Keep in mind that there are continuous ecological gradients in the landscape. If an unknown community does not fit well within any one community type described in this classification, it might be best described as intermediate between two community types.

A. Underground communities that are never exposed to sunlight (SUBTERRANEAN SYSTEM) ..... **B**

AA. Above-ground communities that are usually exposed to some sunlight ..... **C**

B. Natural caves and cavities in which the structure and hydrology have not been substantially modified by human activities and native species are dominant ..... NATURAL CAVES

BB. Artificial underground structures or cavities that are either created and maintained by human activities, or are modified by human influence to such a degree that the physical structure, hydrology, and species composition are substantially different from the structure, hydrology, and species composition of the site as it existed prior to human influence ..... SUBTERRANEAN CULTURAL

C. Aquatic or wetland communities: communities that are in water all year; or have wet soils all year; or are regularly flooded every day (such as flooded by tidal waters); or are regularly flooded at one or more seasons of the year (such as flooded in spring) and have predominantly hydrophytic vegetation and hydric soils ..... **D**

CC. Upland communities: communities on soils that are well-drained and never regularly flooded; or on soils that are usually well-drained and not hydric, lack predominantly hydrophytic vegetation, but may be regularly flooded for a short time each year (TERRESTRIAL SYSTEM) ..... **R**

D. Tidal aquatic or wetland communities (salt and freshwater) with some direct hydrological connection to the open ocean, and with regular, daily water level fluctuations caused by ocean tides ..... **E**

DD. Non-tidal aquatic or wetland communities that are not directly connected to the open ocean, or if directly connected, then upstream from the influence of regular, daily water level fluctuations caused by ocean tides..... **J**

E. Marine communities: aquatic or wetland communities of the open ocean overlying the continental shelf, its associated high-energy coastline, and shallow coastal indentations or bays lacking significant inflow of fresh water, with water salinity exceeding 18.0 parts per thousand (ppt) ocean-derived salts (MARINE SYSTEM) ..... **F**

EE. Estuarine communities: aquatic or wetland communities of deepwater tidal habitats and adjacent tidal wetlands that are usually semi-enclosed but have open, partly obstructed, or sporadic access to open ocean or tidal fresh waters, with water salinity usually less than 18.0 ppt ocean-derived salts (ESTUARINE SYSTEM)..... **H**

F. Natural marine communities in which the substrate, hydrology, and species composition have not been substantially modified by human activities, or where native species are dominant..... **G**

FF. Disturbed or artificial marine communities that are either created and maintained by human activities, or are modified by human influence to such a degree that the physical structure, hydrology, and species composition are substantially different from the structure, hydrology, and species composition of the site as it existed prior to human influence ..... MARINE CULTURAL

G. Aquatic marine communities of the subtidal zone, which is permanently flooded with tidal ocean waters, and occurs in the area below the lowest tide where the substrate is continuously submerged by ocean waters ..... MARINE SUBTIDAL

GG. Marine communities of the intertidal zone, which is located between the highest tide level and the lowest tide level where the substrate is periodically exposed and flooded by semidiurnal tides (two high tides and two low tides per tidal day) ..... MARINE INTERTIDAL

H. Natural estuarine communities in which the substrate, hydrology, and species composition have not been substantially modified by human activities, or where native species are dominant..... **I**

HH. Disturbed or artificial estuarine communities that are either created and maintained by human activities, or are modified by human influence to such a degree that the physical structure, hydrology, and species composition are substantially different from the structure, hydrology, and species composition of the site as it existed prior to human influence ..... ESTUARINE CULTURAL

I. Aquatic estuarine communities of the subtidal zone, which is permanently flooded with tidal waters, and occurs in the area below the lowest tide where the substrate is continuously submerged by tidal waters ..... ESTUARINE SUBTIDAL

II. Estuarine communities of the intertidal zone, which is located between the highest tide level and the lowest tide level where the substrate is periodically exposed and flooded by semidiurnal tides (two high tides and two low tides per tidal day) ..... ESTUARINE INTERTIDAL

J. Aquatic communities of streams, lakes, or ponds, in those portions of the streams, lakes, or ponds that are characterized by lack of persistent emergent vegetation, although they may have submerged or floating-leaved aquatic vegetation..... **K**

JJ. Wetland communities that are characterized by persistent emergent vegetation, including wetlands that are permanently saturated by seepage, permanently flooded wetlands, and wetlands that are seasonally or intermittently flooded (these may be seasonally dry) if the vegetative cover is predominantly hydrophytic and soils are hydric (PALUSTRINE SYSTEM) ..... **N**

K. Aquatic communities of a flowing, non-tidal stream, in portions of the stream that lack persistent emergent vegetation, but may include areas with submerged or floating-leaved aquatic vegetation (RIVERINE SYSTEM) ..... **L**

KK. Aquatic communities of a lake or pond in a topographic depression or dammed river channel, in portions of the lake or pond that lack persistent emergent vegetation, but may include areas with submerged or floating-leaved aquatic vegetation (LACUSTRINE SYSTEM) ..... **M**

L. Aquatic communities of streams in which the stream flow, morphometry, and water chemistry have not been substantially modified by human activities, or native species are dominant ..... NATURAL STREAMS

LL. Aquatic communities of disturbed streams or artificial channels that are either created and maintained by human activities, or are modified by human influence to such a degree that the stream flow, morphometry, and water chemistry are substantially different from the flow, morphometry, and chemistry of the site as it existed prior to human influence ..... RIVERINE CULTURAL

M. Aquatic communities of lakes and ponds in which the trophic state, morphometry, and water chemistry have not been substantially modified by human activities, or native species are dominant ..... NATURAL LAKES AND PONDS

MM. Aquatic communities of disturbed or artificial lakes and ponds that are either created and maintained by human activities, or are modified by human influence to such a degree that the trophic state, morphometry, and water chemistry are substantially different from the trophic state, morphometry, and chemistry of the site as it existed prior to human influence..... LACUSTRINE CULTURAL

N. Natural wetland communities in which the physical structure of the substrate, hydrology, or species composition is not substantially modified by human activities, or wetlands where native species are dominant..... **O**

NN. Disturbed or artificial wetland communities that are either created and maintained by human activities, or are modified by human influence to such a degree that the physical structure of the substrate, hydrology, and species composition are substantially different from the substrate, hydrology, and composition of the site as it existed prior to human influence; non-native species may be dominant..... PALUSTRINE CULTURAL

O. Peatlands: wetlands in which the substrate primarily consists of accumulated peat (partly decomposed plant material such as mosses, sedges, and shrubs) or marl (organically derived or chemically precipitated calcium carbonate deposits), with little or no mineral soil; characterized by continuous saturation of the peat (despite water table fluctuations) caused by either capillary action of the peat or constant water seepage; continuous saturation allows little aeration of the substrate, slowing decomposition of plant litter, and resulting in accumulation of peat or a mixture of peat and marl **P**

OO. Wetlands in which the substrate primarily consists of mineral soil, bedrock, or fine-grained organic soils (muck or well-decomposed peat); fluctuating water levels allow enough aeration of the substrate to allow plant litter to decompose, so there is little or no accumulation of peat ..... **Q**

P. Peatlands with less than 50% canopy cover of trees (defined as a woody plant usually having one principal stem or trunk, a definite crown shape, and characteristically reaching a mature height of at least 5 m (16 ft); the dominant vegetation may include shrubs, herbs, or mosses ..... OPEN PEATLANDS

PP. Peatlands with at least 50% canopy cover of trees; the understory may include shrubs, herbs, and mosses ..... FORESTED PEATLANDS

Q. Wetlands with less than 50% canopy cover of trees; the dominant vegetation may include shrubs or herbs; substrates range from mineral soils or bedrock, to well-decomposed organic muck .....OPEN MINERAL SOIL WETLANDS

QQ. Wetlands with at least 50% canopy cover of trees; the understory may include shrubs, herbs, and mosses; substrates range from mineral soils or bedrock, to well-decomposed organic muck ....FORESTED MINERAL SOIL WETLANDS

R. Natural upland communities in which the physical structure of the substrate, or species composition have not been substantially modified by human activities, or where native species are dominant..... ...**S**

RR. Disturbed or artificial upland communities that are either created and maintained by human activities, or are modified by human influence to such a degree that the physical structure of the substrate, or species composition are substantially different from the substrate and composition of the site as it existed prior to human influence; non-native species may be dominant ..... TERRESTRIAL CULTURAL

S. Open communities with less than 25% canopy cover of trees; the dominant species are shrubs, herbs, or cryptogammic plants (mosses, lichens, etc.).....OPEN UPLANDS

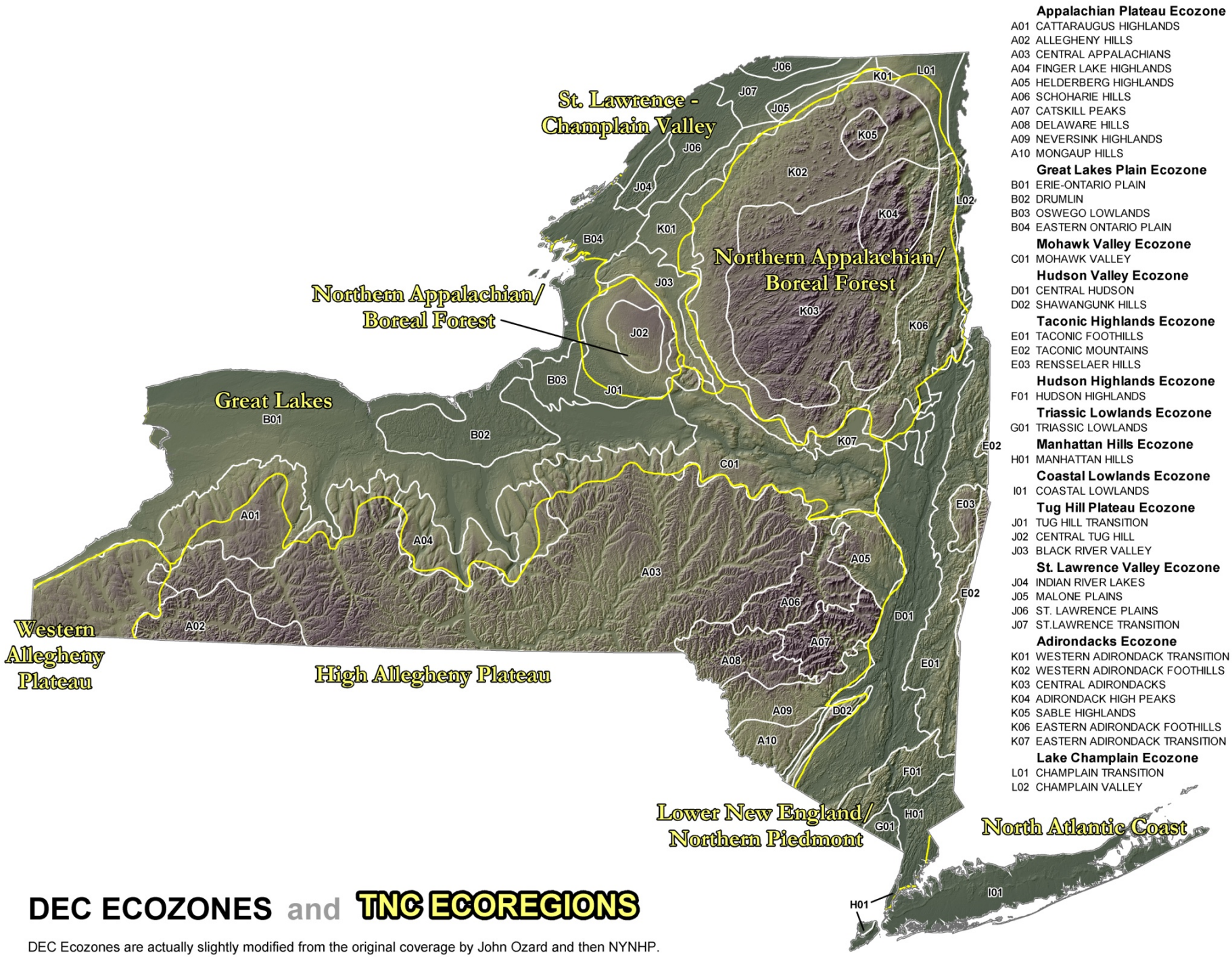
SS. Wooded communities, with at least 25% canopy cover of trees ....**T**

T. Forests: communities with more than 60% canopy cover of trees; substrates are deep to shallow soils that include less than 50% rock outcrop or very shallow soil over bedrock..... FORESTED UPLANDS

TT. Wooded upland communities that are structurally intermediate between forested uplands and open canopy uplands; includes communities with a sparse canopy of trees (25 to 60% cover) and a groundlayer that is predominantly either grassy or shrubby; wooded communities dominated by stunted or dwarf trees (less than 4.9 m or 16 ft tall); and wooded communities with soils that include at least 50% rock outcrop or very shallow soil over bedrock..... BARRENS AND WOODLANDS

Italics = former Rescke (1990) community name.


CLINTON
FRANKLIN
ST LAWRENCE
ESSEX
JEFFERSON
LEWIS
HAMILTON
WARREN
WASHINGTON
OSWEGO
ONEIDA
NIAGARA
ORLEANS
MONROE
WAYNE
FULTON
SARATOGA
GENESEE
ONONDAGA
HERKIMER
MADISON
MONTGOMERY
ONTARIO
SCHENECTADY
ERIE
WYOMING
LIVINGSTON
SENECA
CAYUGA
RENSSELAER
YATES
OTSEGO
ALBANY
CORTLAND
SCHOHARIE
CHENANGO
TOMPKINS
SCHUYLER
GREENE
COLUMBIA
CHAUTAUQUA
CATTARAUGUS
ALLEGANY
STEUBEN
DELAWARE
CHEMUNG
TIOGA
BROOME
ULSTER
SULLIVAN
DUTCHESS
ORANGE
PUTNAM
ROCKLAND
WESTCHESTER
BRONX
NEW YORK
SUFFOLK
NASSAU
QUEENS
KINGS
RICHMOND



Appalachian Plateau Ecozone
A01 CATTARAUGUS HIGHLANDS
A02 ALLEGHENY HILLS
A03 CENTRAL APPALACHIANS
A04 FINGER LAKE HIGHLANDS
A05 HELDERBERG HIGHLANDS
A06 SCHOHARIE HILLS
A07 CATSKILL PEAKS
A08 DELAWARE HILLS
A09 NEVERSINK HIGHLANDS
A10 MONGAUP HILLS

Great Lakes Plain Ecozone
B01 ERIE-ONTARIO PLAIN
B02 DRUMLIN
B03 OSWEGO LOWLANDS
B04 EASTERN ONTARIO PLAIN

Mohawk Valley Ecozone
C01 MOHAWK VALLEY

Hudson Valley Ecozone
D01 CENTRAL HUDSON
D02 SHAWANGUNK HILLS

Taconic Highlands Ecozone
E01 TACONIC FOOTHILLS
E02 TACONIC MOUNTAINS
E03 RENSSELAER HILLS

Hudson Highlands Ecozone
F01 HUDSON HIGHLANDS

Triassic Lowlands Ecozone
G01 TRIASSIC LOWLANDS

Manhattan Hills Ecozone
H01 MANHATTAN HILLS

Coastal Lowlands Ecozone
I01 COASTAL LOWLANDS

Tug Hill Plateau Ecozone
J01 TUG HILL TRANSITION
J02 CENTRAL TUG HILL
J03 BLACK RIVER VALLEY

St. Lawrence Valley Ecozone
J04 INDIAN RIVER LAKES
J05 MALONE PLAINS
J06 ST. LAWRENCE PLAINS
J07 ST.LAWRENCE TRANSITION

Adirondacks Ecozone
K01 WESTERN ADIRONDACK TRANSITION
K02 WESTERN ADIRONDACK FOOTHILLS
K03 CENTRAL ADIRONDACKS
K04 ADIRONDACK HIGH PEAKS
K05 SABLE HIGHLANDS
K06 EASTERN ADIRONDACK FOOTHILLS
K07 EASTERN ADIRONDACK TRANSITION

Lake Champlain Ecozone
L01 CHAMPLAIN TRANSITION
L02 CHAMPLAIN VALLEY

DEC ECOZONES and TNC ECOREGIONS

DEC Ecozones are actually slightly modified from the original coverage by John Ozard and then NYNHP.